"An investigation involving multiple systematic reviews and a consensus study of the effects and definition of squatting position in childbirth".

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A thesis submitted for the degree of
Doctor of Philosophy in Evidence-Based Health Care

Kellogg College, Department of Continuing Education
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Abstract

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Abstract

The primary purpose of this Doctoral research programme is to establish an evidence-based understanding of the squatting position in childbirth. The aim to achieve this is through a systematic approach that enhances the design and reporting of future randomised controlled trials. The overarching objective of the thesis is to compile a comprehensive body of evidence on the squatting position in childbirth by conducting multiple secondary analyses of existing studies and conducting primary research using consensus development methods. The thesis is composed of eight chapters. Chapter 1 introduces the field of analysis, defines the research topic's context, and outlines specific aims, objectives, and the structure of the thesis. Chapter 2 conducted an overview of Cochrane systematic reviews as a foundation to generate hypotheses for subsequent chapters. Chapter 3 focuses on biomechanical characteristics and consequences of the squatting position in childbirth. Chapter 4 investigates the effectiveness of the squatting position compared to other positions during childbirth, using RCTs and non-randomised studies of interventions and examining maternal and neonatal birth outcomes. Chapter 5 explores the factors that influence the use of the squatting position in childbirth. Chapter 6 analyses pre-specified and post hoc subgroup data derived from RCTs. Chapter 7 describes a

Delphi e-survey and nominal group technique discussions to establish a consensus and expert opinion on the precise definition of the squatting position. Chapter 8 serves as the discussion and conclusion chapter, summarizing the evidence-based framework on the squatting position in childbirth and highlighting its implications for clinical practice and future research.

Acknowledgements

This thesis is dedicated to my delightful family and supervisors. I was able to persevere through challenging times during my DPhil submission thanks to the unwavering support of my family and supervisors. Despite moments when my faith wavered during this DPhil journey, I would like to express my deep gratitude to God for His guidance and providence that sustained me until the completion of this degree.

I feel tremendously privileged to have incredibly supportive supervisors: Professor Mike Clarke, Dr Stephanie Tierney, and Dr Igho Onakpoya, who exemplify professional excellence and compassion. Their persistent guidance commitment, and competent supervision made the completion of this doctoral thesis possible. Their discreet expertise in the field of evidence-based healthcare significantly contributed to my understanding of research and its application in clinical practice, and I am truly appreciative. I have learned invaluable lessons from their perceptive methods of academic supervision. I would be remiss if I did not extend my heartfelt gratitude to my supervisor, Professor Mike Clarke, for his tireless and unwavering support, which began at the outset of my course in 2012 and continued as he guided me through the valleys, slopes, and mountains to its conclusion.

Furthermore, I extend my gratitude to the Centre for Evidence-Based Medicine (CEBM), fellow students, and administrators within Kellogg College, the Department of Continuing Education, and the Department of Primary Care Health Sciences at the University of Oxford. Their collective efforts have made this DPhil journey possible. I wish to acknowledge Professor Carl Heneghan, Dr Jamie Hartmann-Boyce, Dr Alison Ward, Professor Amanda Burls, and Professor Valerie Smith for their instructions, guidance, and insights that significantly enhanced the quality of this thesis. I am also thankful to the postnatal women, midwives,

practitioners, researchers, obstetricians, and other healthcare professionals who generously volunteered their time to contribute to the inquiry of this study.

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Personal Statement

My journey with the Centre for Evidence-Based Medicine (CEBM) at Oxford began in September 2001. At that time, I was a qualified practising midwife in one of the National Health Service Maternity Services in Basildon. The motivation behind my decision to pursue the evidence-based healthcare course was to elevate my role in delivering exceptional midwifery care. This thesis represents the culmination of my prior Master of Science in Evidence-Based Health Care (EBHC) at the University of Oxford in 2006. The practical and theoretical knowledge I have acquired throughout this thesis holds immense value for me.

I humbly believe that my efforts have had a positive impact on the well-being of women and babies by promoting the application of evidence-based practice, not only in squatting but also in various positions during childbirth. The rational, cognitive, and analytical skills I have developed through this DPhil program are intended to contribute to the advancement of midwifery education, research, procedures, and practices.

Statement Of Contributions

I confirm that the doctoral thesis presented here is independent, and I am the original sole author except where otherwise indicated. Academic supervisors Professor Mike Clarke, Dr Stephanie Tierney, and Dr Igho Onakpoya contributed their expertise in guiding the overall research strategy, protocol, design, conduct, analyses, and presentation of results.

Additional contributions from various individuals are as follows:

Valerie Smith (VS): Midwifery Professor at the School of Nursing and Midwifery, Trinity College Dublin, reviewed and provided advice on the research methods outlined in the study protocol, and co-signed the ethical application of the Consensus Development Study in Chapter 7.

Rafael Perera-Salazar (RPS): Statistician Professor at the University of Oxford, guided on the statistical methods required to complete the Consensus Development Methods and offered advice on sample size considerations, as detailed in Chapter 7.

Mike Kerr (MK): Information Specialist at the Medical Library, East Kent Hospitals University NHS Foundation Trust, assisted in developing the search strategy for the multiple systematic reviews in Chapters 2, 3, 4, and 5.

Art Atiomu (AA): Trust Research and Development Manager at East Kent Hospitals University NHS Foundation Trust, facilitated and co-signed the ethical application to the East of Scotland Research Ethics Service (EoSRES) REC 1, Ninewells Hospital & Medical School, George Pine Way, Dundee, as described in Chapter 7.

Jane Butler (JB): Manager at Southeast Health Education Kent, Surrey, and Sussex Organization, approved funding toward my salary and tuition fees for the DPhil program.

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List of Abbreviations

Abbreviation	Meaning
AoP	Intra-partum angle of progression
AP	Dr Amy Price
AWHONN	Association of Women's Health, Obstetrics and Neonatal Nurses
BMI	Body Mass Index
CAN	Ass Prof. Constance Adron Nsibambi
CASP	Critical Appraisal Skills Programme
CDMs	Consensus Development Methods
CDSR	Cochrane Database of Systematic Reviews
CENTRAL	Cochrane Central Register of Controlled Trials
Chi^2	Chi-Square
CIs	Confidence Intervals
CSRs	Cochrane Systematic Review(s)
CTG	Cardiotocography
DARE	Database of Abstracts of Reviews of Effectives
DPhil	Doctor of Philosophy
DVT	Deep Vein Thrombosis
e.g.	For Example,
EMBASE	Excerpta Media Database
ENTEREQ	Enhancing Transparency in Reporting the Synthesis of Qualitative Research
EPOC	Cochrane Effective Practice and Organisation of Care Group
EoSRES	The East of Scotland Research Ethics Service
Etc	Etcetra
e-Survey	Email Survey
FHR	Foetal Heart Rate
GRADE	Grading of Recommendation, Assessment, Development and Evaluation
I^2	I-Square
i.e.	That is
IO	Dr Igho Onakpoya
IRAS	Integrated Research Application System
MC	Prof. Mike Clarke
MECIR	Methodological Expectations of Cochrane Intervention Reviews

MEDLINE	Medical Literature Analysis and Retrieval System Online
MeSH	Medical Subject Heading
MD	Mean Difference
MK	Mark Kerr
MK	Marion Kibuka
MIDIRS	Midwifery Information Database and Resource Service
MLU	Midwifery-Led Unit
MRC	Medical Research Council
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
NICU	Neonatal Intensive Care Unit
OLU	Obstetric-Led Unit
OSOP	One Sheet of Paper Analysis
OVIDSP	Ovid Database
PICOS	Population, Intervention, Control, Outcome, Study
PRISMA	The Preferred Reporting Items for Systematic Reviews and Meta-Analysis
PPH	Post-Partum Haemorrhage
PROSPERO	International database of prospective register of systematic reviews
PsycINFO	Psychological Information Database
P-value	Probability value
R-AMSTAR	Revised Assessment of Multiple Systematic Reviews
RANZCOG	The Royal Australian and New Zealand College of Obstetricians & Gynaecology
RCM	Royal College of Midwives
RCOG	Royal College of Obstetrics and Gynaecology
RCTs	Randomised Controlled Trials
REC	Research Ethics Committee
Rev-Man 5	Review Manager Software 5.3
RR	Risk Ratio
NGT	Nominal Group Technique
NHS	National Health Service
SD	Standard Deviation
SPIDER	Sample, Phenomenon of Interest, Design, Evaluation and Research Type
SR(s)	Systematic Review(s)

ST	Dr Stephanie Tierney
SVB	Spontaneous Vaginal Birth
Tau^2	Tau-Square
TBA	Traditional Birth Attendants
TIDieR	The Template for Intervention Description and Replication
UK	United Kingdom
WHO	World Health Organisation
1^{st} Stage Labour	First Stage of Labour
2^{nd} Stage Labour	Second Stage of Labour
3^{rd} Stage Labour	Third Stage of Labour
4^{th} Stage Labour	Fourth Stage of Labour
$\geq$	Equal to or Greater Than
$\leq$	Equal to or Less Than

CHAPTER 1

Introduction

1.0 Introduction

1.1 Overview of Thesis

The World Health Organisation (WHO) clinical guidelines [1] and other international guidelines [2-7] recommend using upright positions, including squatting, kneeling, standing and all fours, during the first and second stages of labour. [8] A review of 115 primitive cultures found that in 91 of these cultures (79%), women chose upright delivery postures. [9] For example, Shipral and Puah (circa 1560 Before Christ.), the Egyptian midwives to the Israelites, used squatting stools for delivery (Dr Leak cited by Read [10]). At that time, the squatting posture was common and the woman could squat holding onto a robe, furniture or a birth stool [11] (illustrated in Rosselyn's Rosengarien) [10]. Birthing chairs date back to the Babylonian culture of 2000 (B.C). [12] . In Soranus of Ephesus (circa 110 After Death (A.D.) and Hippocrates (in 460-377 B.C.), the woman used the chair during the first stage of labour and squatted over the chair during the pushing stage before the baby was crowned. [13]

However, there is continuing uncertainty about whether women should, or should not squat in childbirth despite this, and more recent, historical evidence. In 1748, the value of getting the woman out of bed in early labour was mentioned by William Smellie. [14] More than 150 years later, in 1903, J Whitridge Williams argued that '*during childbirth, the patient usually prefers to move about her room, and frequently is more comfortable when occupying a sitting position. During this period, therefore, she should not be compelled to take to her bed unless she feels so inclined*'. [15] Likewise, Leak stated: *'My investigations around the world show that the large majority of peoples of the world of all colours employ for delivery the squatting attitude,* [12] this is still valid today.

1.2 Significance of the DPhil Research

Squatting is one of the upright [16] birthing positions which is fundamental to this Doctor of Philosophy (DPhil) research study. It is mainly observed during the second stage of labour, which has two phases: the passive stage of labour when the cervix is fully dilated in the absence of involuntary expulsive contractions, to allow the presenting part to descend to the pelvic floor [2, 17], and the expulsive stage, which is the onset of the active phase when the expulsive contractions allow the descending part to pass through the pelvic floor until the birth of the baby. [2, 17]

Research suggests that squatting positions have some benefits including the effects of gravity, [18, 19] a better alignment of the foetus in the birth canal, [20, 21] an increase of the pelvic outlet diameter, [20, 22, 23] greater uterine contractions intensity and efficiency, [9] and relieving lower back pain, [24, 25] consequently resulting into increased rates of spontaneous normal vaginal birth. [24, 25] A spontaneous normal birth has been defined as one which starts naturally, progresses without any medical, pharmacological or technological intervention and ends with the natural birth of the baby. [26-28] It is referred to as a positive indicator of birth outcome [26], is used as a measure of the quality of women's health [27] and reduces maternal and foetal morbidities. [25-27]. However, the evidence base for the effectiveness of maternal positions for low-risk women during the second stage of labour is fragmented. [29-31] Despite being a long-proven safe and effective procedure, the use of upright positions in childbirth [18, 32, 33] has declined steadily globally, with a concurrent increase in the rates of supine positions (i.e., when the woman's lumber spine is horizontal) ranging from 49% to 99%. [34-38] Evidence suggests that the dominancy of supine positions during childbirth is associated with a lack of providers' education and training, traditions and routines in clinical practice. [36, 39-43]. This is because most vaginal births observed and undertaken by students during their training occur when the woman is supine. [9, 31, 40, 41, 44, 45]

A Cochrane systematic review (CSR) found a reduction in the duration of the second stage and a reduction in interventions (instrumental delivery and episiotomy) when using squatting on a birthing cushion and stool but an increase in blood loss when squatting on a birthing chair. [18] This indicates that squatting procedures can affect the delivery during labour and birth because it is acceptable practice for healthcare providers to support women to assume any positions during a spontaneous vaginal birth without formal education, training or assessment of technique skills. [25, 42, 46]

Evidence-based practice is a well-established principle in contemporary maternity care. It is increasingly challenging to existing practices and seeks to provide care or interventions based on their effectiveness. [47] It is also important that the conduct of research is evidence-based and studies investigating the effects of maternal position in childbirth should include a measure of the skill, confidence and attitudes of the midwives taking part in the trial. [18, 32]

The basic descriptions of the obstetrical mechanisms (i.e., cause to effect) for one squatting position over another or compared with other positions in optimising the duration of labour and medical interventions require investigating. CSRs and international professional bodies have called for well-designed studies to provide high-quality evidence-based knowledge to enable women to use more options and better support them during the second stage of labour. [32, 34, 48, 49] The programme of research for this DPhil used a multi-method approach to provide extensive, synthesised evidence that clearly describes the squatting position and its effects on birth outcomes, using the best available evidence and appropriate theory.

1.3 Purpose of the thesis

The primary purpose of this DPhil thesis was to develop an evidence base by systematically compiling available qualitative and quantitative evidence to generate hypotheses and

guidance to improve the design, analysis and reporting of future trials for evaluating the effects of squatting vaginal birth.

1.4 Research methodology.

The research uses a multi-method approach, involving multiple systematic reviews (SRs) and a modified Delphi email survey (e-survey) to evaluate the effects and explore the factors that influence the use and definition of squatting positions in childbirth.

1.5 Research objectives:

1.5.1 Chapter 2: Overview of CSRs

To systematically evaluate evidence from CSRs of randomised trials (RCTs) and quasi-RCTs (which are collectively referred to as RCTs in this thesis) on the benefits and harms of assuming upright (i.e., all fours, kneeling, standing, and squatting) compared with horizontal positions during the first (1^{st}) and second (2^{nd}) stages of labour on maternal, foetal, and neonatal outcomes.

To identify knowledge gaps and limitations in the current evidence and to provide the foundation for the subsequent research elements in this thesis.

1.5.2 Chapter 3: Biomechanical Analysis

To investigate whether the biomechanical effects of the squatting position on pelvic dimensions and intra-uterine pressure influence birth outcomes.

1.5.3 Chapter 4: SR and Meta-analysis

To systematically evaluate and summarise evidence from both RCTs, and non-randomised studies of interventions (NRSIs) on the benefits and harms of assuming a squatting position compared with other positions during birth on the duration of the 2^{nd} stage of labour, mode of birth, postpartum haemorrhage (PPH) of ≥500mls or more, and perineal integrity birth outcomes.

1.5.4 Chapter 5: Qualitative Evidence Synthesis

To explore the views and experiences of women, their partners and healthcare providers regarding the factors influencing the use or implementation of upright/squatting positions in childbirth.

1.5.5 Chapter 6: Subgroup Analysis

To identify sources of variable effect sizes between different RCTs and explore the relationship between different characteristics of squatting positions during the 2nd stage of labour on maternal or foetal morbidity.

To compare the effect sizes from RCTs that addressed and did not address the implications for interventions that were derived from the analytical themes of the qualitative synthesis to generate testable hypotheses of how squatting positions might impact the birth outcomes.

1.5.6 Chapter 7: Consensus Development Methods

To generate ideas on the terminologies and definition of squatting positions during childbirth using the Nominal Group Technique (NGT) nested in a Delphi e-survey involving women, midwives, obstetricians, and other health professionals.

1.6 Structure of the thesis

This thesis is composed of nine chapters. The thesis scope, structure and research methods of this thesis are presented in Table 1. Chapter 1 sets out the field of analysis and defines the context and landscape of the research topic with specific reference to the period until the 06th of October 2023.

Chapter 2 identifies and critically appraises results from CSRs. This uses a framework, [50] in which population (P), intervention (I), comparison (C), outcomes (O) and studies (S) (PICOS) are considered, to systematically identify knowledge gaps to determine appropriate research methods, identify the most appropriate maternal position for the thesis, provide

relevant details on the comparisons, conditions and outcomes and the population that might benefit from this intervention. This chapter presents an overview of CSRs to show what is known about the effectiveness of the upright compared with horizontal positions during 1st and 2nd stages of labour, with or without epidural analgesia. This overview of CSRs provided the foundation for the subsequent research elements in this thesis.

Chapter 3 reports the biomechanical factors which act as 'active ingredients' that might contribute to the effectiveness of squatting, as compared to other positions. Biomechanics refers to a description of movement in the squatting position and how physiological forces might facilitate the mechanism of labour to culminate in normal vaginal birth. The chapter investigates the biomechanical characteristics that can impact the squatting position in association with pelvic dimensions and intra-uterine pressure, contractions, perineal integrity and pelvic floor muscles, optimal foetal positioning, and progression through the pelvic birth canal to facilitate various birth outcomes.

The heterogeneous results in the overview of CSRs (Chapter 2) informed the systematic review of quantitative studies to assess the effects of adopting squatting compared to other positions during the 2nd stage of labour on maternal and foetal birth outcomes in Chapter 4. The primary outcomes included duration of labour, operative birth, perineal trauma requiring suturing, and PPH ≥500mls or more. RCTs and NRSIs were eligible for the review. The quality of the evidence was assessed using the Grading of Recommendations, Assessment, Development and Evaluation system (GRADE) approach and data on the quality of descriptions of squatting and other positions from each included study were coded and qualitatively analysed using the Template for Intervention Description and Replication (TIDieR) tool.

Chapter 5 is a thematic qualitative evidence synthesis addressing people's views and experiences about the barriers to and facilitators of using upright/squatting positions in

childbirth to complement the evidence from the reviews of effectiveness. The qualitative study designs considered (but were not limited to) ethnography, phenomenology, grounded theory, action research, case study, narrative inquiry, appreciative inquiry, discourse analysis, and qualitative process evaluation, as outlined by Ring, *et al*. [12] Following the Cochrane Effective Practice and Organisation of Care (EPOC) guidance, [51] mixed methods studies were eligible if the qualitative component was easily distinguishable from the quantitative part. Data were brought together using thematic synthesis.

The results of Chapters 4 and 5 guided the subsequent Chapter 6 by highlighting modifying variables that were explored using subgroup analyses. This Chapter investigates pre-specified and post hoc subgroup analyses of RCTs on squatting position during birth. The purpose was to identify moderator variables interacting with squatting during birth with the potential to impact different outcomes. The interaction of subgroup effects was investigated between squatting during birth with secondary interventions and squatting by type on five birth outcomes. The investigation addressed whether the secondary interventions (i.e., not randomised) that addressed implications for interventions in Chapter 5, modified the results by producing larger effect sizes when interacting with squatting positions (randomised) during birth compared with those that did not. A total of nine subgroup analyses derived from five hypotheses were conducted from 37 RCTs that were included in the effectiveness review (i.e., Chapter 4).

The aim of Chapter 7 was to generate expert consensus statements on the terminologies and parameters defining squatting vaginal birth using the NGT nested into a Delphi e-survey. The secondary objective was to generate agreement on the influencing factors considered most important or important when assuming squatting positions during pregnancy and childbirth by an expert panel. Consensus methods were used to generate expert opinion and

move towards the identification, differentiation and codification of squatting features [52] that might influence the birth outcomes.

Chapter 8 summarises the thesis and its contribution to knowledge in the field of maternity care research on squatting vaginal birth. It provides an overview of findings from all chapters, aligning with the overall thesis objective to systematically compile qualitative and quantitative evidence into a cohesive document and generate hypotheses for enhancing the design, analysis and reporting of future research on the effects of squatting vaginal birth.

The evidence suggests that conducting a feasibility cluster of RCTs integrated with a pilot study is crucial before embarking on a confirmatory cluster RCT to evaluate the effects of squatting vaginal birth on spontaneous normal vaginal birth. This recommendation follows the United Kingdom (UK) Medical Research Council framework (MRC) [53] for complex intervention. Moreover, a qualitative evaluation of the key components of the implementation of squatting compared with semi-recumbent positions is deemed essential. This evaluation aims to explore whether these interventions are implemented as planned or scheduled. Additionally, investigating the barriers and facilitators influencing the delivery of the intervention and women's health-related quality of life is imperative. In conclusion, the thesis contributes cumulative evidence highlighting the clinical significance of research on squatting vaginal birth.

Table 1: Presenting the scope, structure, and research methods of the DPhil thesis.

<table>
<tr><th colspan="7">Scope of DPhil</th></tr>
<tr><td rowspan="6">Multiple Research Strategies</td><td colspan="6">Discrete steps to develop ‘scientific knowledge’ of squatting position in childbirth</td></tr>
<tr><td colspan="6">Identification, Description and Explanation Generation</td></tr>
<tr><td colspan="5">Synthesising of Evidence
A combination of aggregative methods (meta-analysis/sub-group analyses) with configurative methods (narrative & thematic syntheses)</td><td>Consensus-Based Methods</td></tr>
<tr><td colspan="5">Secondary Research</td><td>Primary Research</td></tr>
<tr><td><u>Chapter 2</u>
Overview of CSRs</td><td><u>Chapter 3</u>
SR of Biomechanical effect of squatting positions</td><td><u>Chapter 4</u>
RCTs and NRSIs of Interventions: SR and Meta-analysis</td><td><u>Chapter 5</u>
Qualitative Evidence Synthesis (QES): Thematic synthesis</td><td><u>Chapter 6</u>
Investigating pre-specified and post hoc subgroup analyses.</td><td><u>Chapter 7</u>
NGT nested in Delphi e-survey.</td></tr>
</table>

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CHAPTER 2

Overview of Cochrane Reviews

2.0 Overview of CSRs

The protocol for this overview was registered with the International Prospective Register of Systematic reviews (PROSPERO) and can be found at https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42014014255. This was first published on 14 October 2014 and updated on 26 February 2020.

The findings of this chapter have been published:

Kibuka M, Price A, Onakpoya I, Tierney S, Clarke M. Evaluating the effects of maternal positions in childbirth: An overview of Cochrane Systematic Reviews. European Journal of Midwifery. 2021 Dec 21;5:57. doi: 10.18332/ejm/142781. PMID: 35005482; PMCID: PMC8678923. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8678923/

2.1 Background

This chapter presents an overview of CSRs to compile existing evidence for relevant research questions that have been addressed by more than one SR and identify areas for future research. Overviews of CSRs use standardised methodological approaches to generate useful and practical knowledge through the integration of empirical findings. Campbell and colleagues[1] stated that an overview of the existing evidence evaluating interventions should be a starting point for defining the extent of the clinical problem, assessing the benefits and harms of the intervention, identifying gaps in research and informing the developmental planning stage for a new intervention. This view is supported by other authors. [2-4] The overview used the PICOS framework, [5] in which population, intervention, comparison, outcomes and studies are examined, to identify knowledge gaps systematically. As this DPhil seeks to improve understanding of the effects on maternal and foetal outcomes of different positions that may be taken up by women during childbirth, this first element addresses the question: *what is already known about the effects of maternal positions during*

childbirth?

2.1.1 Aim

The overview of CSRs aimed to inform research questions to be answered in this thesis, identify specific types of intervention that were not sufficiently included in the evidence base, provide relevant details on the comparisons, conditions and relevant outcomes, and identify the population that might benefit from this intervention.

2.1.2 Objectives

To summarise evidence from CSRs of RCTs on the potential benefits and harms of upright versus horizontal positions during the first and second stages of labour, for maternal and foetal outcomes.

To identify knowledge gaps and limitations in the current evidence, and to provide the foundation for the subsequent research elements in this DPhil research.

2.2 Research Methodology

Criteria for considering CSRs for this overview.

2.2.1 Types of CSR

The overview included only CSRs that had evaluated RCTs. Cochrane uses a rigorous approach to combine research using strict analytical methodological approaches and reporting standards and CSRs be of higher quality than non-CSRs.[6] CSRs are considered to be robust in minimising bias, maximising transparency, and improving the accuracy of summarised data. [6, 7] They are highly trusted by clinicians. [8] Reviews were eligible for this overview if they had been published and had evaluated the effects of upright compared with horizontal positions during labour and childbirth using randomised trials.

2.2.2 Condition or Domain being Studied.

CSRs were included if they had reported on the first and second stages of labour. The 1st stage of labour or labour has two distinct phases: the 'latent' and the active phase onset stages. [2, 3] The 2nd stage of labour or birth is defined according to two distinct phases: the 'passive or latent' phase and the 'active' phase. CSRs that had evaluated the effects of maternal positions in the third stage of labour were not eligible for the overview.[2, 3]

2.2.3 Types of Participants

The eligible population were pregnant women of any parity (i.e. primigravidae, multigravida or mixed) who had experienced spontaneous or induced labour at the full term of their pregnancies (> 37 weeks gestational age), using any type of analgesia.

2.2.4 Types of Interventions

Reviews that had examined the effects of any upright positions during the 1st and 2nd stages of labour were eligible. Upright positions included the use of one or more of the following: squatting, kneeling, all fours, sitting and standing (as defined by the authors).

2.2.5 Types of Comparisons

The comparison group included women who assumed one or more horizontal positions, including supine, lithotomic, semi-recumbent or recumbent, lateral, dorsal and Trendelenburg's positions.

2.2.6 Types of Outcome Measure

2.2.6.1 Primary Outcomes

A shorter duration of labour and birth is desirable for the well-being of mother and baby, because this reduces the likelihood of morbidity or mortality associated with operative birth, perineal trauma that requires suturing, and other birth outcomes. [4-6] Three primary outcomes measure commonly quoted in research studies evaluating the effects of maternal

positions in childbirth were considered:

- Duration of labour (i.e., 1st stage of labour)
- Duration of birth period (i.e., 2nd stage of labour)
- Mode of birth (operative birth, defined as a sum of caesarean sections and assisted birth or subgroup of each of these)

2.2.6.2 Secondary Maternal Outcomes

- Perineal trauma requiring suturing (a sum of 2nd, third (3rd), fourth (4th) and episiotomy) as reported by authors.
- Estimated PPH $\geq$ 500ml, as reported by authors.
- Need for analgesia/anaesthesia.

2.2.6.3 Foetal/Neonatal Outcomes were:

- Abnormal foetal heart rate (FHR) patterns
- Need for admission to neonatal intensive care unit (NICU). See table 2.1 below presenting definitions of all these outcomes considered.

Table 2 provides a brief definition of the above outcomes.

Table 2: present brief definitions of the above outcome measurements

Birth Outcomes	Definitions
Duration of 1st & 2nd stages of labour	See section 2.2.2
Mode of birth	Caesarean section is an alternative to a vaginal birth for women
	Assisted vaginal births
	Spontaneous or a normal vaginal birth
Classifications of Perineal trauma requiring suturing	**2nd degree tear:** Injury to the perineum involving perineal muscles but not involving the anal sphincter. **3rd degree tear:** Injury to the perineum involving the anal sphincter complex: Grade 3a tear: Less than 50% of the external anal sphincter (EAS) thickness torn. Grade 3b tear: More than 50% of EAS thickness torn. Grade 3c tear: Both EAS and internal anal sphincter (IAS) torn. **4th degree tear:** Injury to the perineum involving the anal sphincter complex (EAS and IAS) and anorectal mucosa
Classifications of Estimated PPH ≥ 500mls	The traditional definition of primary PPH is the loss of 500 ml or more of blood from the genital tract within 24 hours of the birth of a baby. PPH can be classified as: Minor (500–1000 ml) Major or moderate (more than 1000 – 2000 ml). Severe (more than 2000)
Analgesia and anaesthesia	**Analgesia** refers to the relief of pain without the loss of consciousness. Referring to non-pharmacological (e.g., TENs

	machine and pharmacological (e.g., parenteral narcotics) methods. **General anaesthesia** was once the primary anaesthetic technique used in obstetrics, both for vaginal deliveries and Caesarean section (CS), (e.g., epidural analgesia).
Abnormal FHR patterns	An abnormal FHR pattern during childbirth refers to any deviation from the normal rhythmic pattern of FH, ranging from the baseline of 110 bpm to 160 bpm during labour and delivery. The abnormal FHR patterns are classified as below 110 bpm or above 180 bpm, indicating various issues, such as foetal distress, oxygen deprivation, or other complications.
NICU	NICU is a very specialized unit where critically ill neonates cared to reduce neonatal morbidity and mortality

2.2.7 Literature search

The Cochrane Database of Systematic Reviews (CDSR) and Archie (the Cochrane information management system) were searched on 4 March 2020 for relevant reviews. No restrictions on language, date of publication or geography were imposed, but Cochrane reviews are published in English.

A sensitive search strategy was developed through the combination of index terms and text keywords. Free text keywords included: *(upright OR position OR supine) and (first OR second OR stage OR labour).* The search was limited to the title, abstract and keywords of the reviews.

The lead overview author, Marion Kibuka (MK), developed the search strategy, performed the search and screened the results. Decisions about eligibility were checked and verified independently by Amy Price (AP). Disagreements were resolved through discussion.

2.2.8 Data extraction (selection and coding)

MK extracted data into predefined worksheets. AP and a third reviewer (Constance A. Nsibambi, [CAN]) checked the extracted data for accuracy and completeness. Key information extracted from each review included:

- general information (e.g. first author's name, contact details)
- number of included studies
- search strategies.
- inclusion and exclusion criteria
- methods to assess methodological quality.
- participant information
- interventions
- outcome measures
- results.

Disagreements were resolved through discussion.

2.2.9 Quality of included reviews and overall body of evidence

It was intended to assess two aspects of quality for the included reviews: quality of evidence within the reviews (i.e., their included studies) and quality of the reviews. The ‘revised assessment of multiple systematic reviews’ (R-AMSTAR) tool was used. This contains 11 questions for assessing the methodological quality of reviews. A score of 1 to 4, based on predefined criteria for each item (yes = clearly done, or no = clearly not done; cannot answer or not applicable) was assigned to each domain of the R-AMSTAR tool. The sum of total scores, which can range from 11 to 44, was used to grade the overall methodological quality of each review. For this overview, high-quality reviews scored 40 or higher 'yes' answers, moderate-quality reviews scored between 30 and 39 ‘yes’ answers and low-quality reviews

scored 29 or fewer 'yes' answers. [7, 8] The GRADE ratings were extracted from each included review and the overall quality of evidence was reported as presented in each review.

The overall quality of the body of evidence reported for each relevant outcome in each CSR is presented as reported by the review. The GRADE tool[16] was applied to the included reviews to provide an overall quality of evidence for specified outcomes. This tool examines the domains of study design, risk of bias, inconsistency, indirectness, imprecision and publication bias.[17-22] If any included review did not report the quality of evidence across the included trials or for a specific outcome, these outcomes were not assessed.

The lead reviewer MK completed the quality assessments of each review using R-AMSTAR parameters and extracted data on the overall body of evidence using GRADE, which was verified by the co-authors AP, Igho Onakpoya [IO]; Stephanie Tierney [ST], Mike Clarke [MC]. Discrepancies were resolved by discussion when needed.

2.2.10 Data Analysis: Timing and Effect Measures

The characteristics of included reviews were summarised in tables showing relative measures of effect (risk ratio [RR]) with a 95% confidence interval (CI) for dichotomous outcomes or mean difference (MD) with 95% CI for continuous outcomes.

2.3 Results

2.3.1 Management of the overview of CSRs data

The literature search identified 173 non-duplicate citations, of which eight CSRs were assessed in full. Three CSRs met the eligibility criteria (Table 3). Three CSRs were excluded because they were not relevant to the topic and two were Cochrane clinical answers (see Appendices 1 and 2). Figure 1 shows the process for including reviews.

Only one CSR (25 trials with 5,218 women) reported on birth outcomes during the 1st stage

of labour with or without epidural analgesia. [9] This CSR conducted two discrete but related meta-analyses. Eighteen trials included 3,337 women who did not have epidural analgesia, and seven trials included 1,881 women who used epidural analgesia. All studies were conducted in hospital settings. The authors of this CSR did not assess the quality of evidence of birth outcomes because it was conducted in 2013, before the GRADE tool. [9]

Another included CSR (32 trials with 9,201 women) assessed the effect of upright versus horizontal positions during the 2nd stage of labour among women who did not use epidural analgesia.[23] The trials were conducted in low-, middle- and high-income countries. The overall quality of evidence was reported as low to moderate using GRADE. [10]

The third included CSR (8 trials with 4,464 women) assessed the effect of upright versus horizontal positions during the 2nd stage of labour with women who used epidural analgesia. [24] The trials were conducted in three high-income European countries. The overall quality of the evidence was graded as low to high. [11]

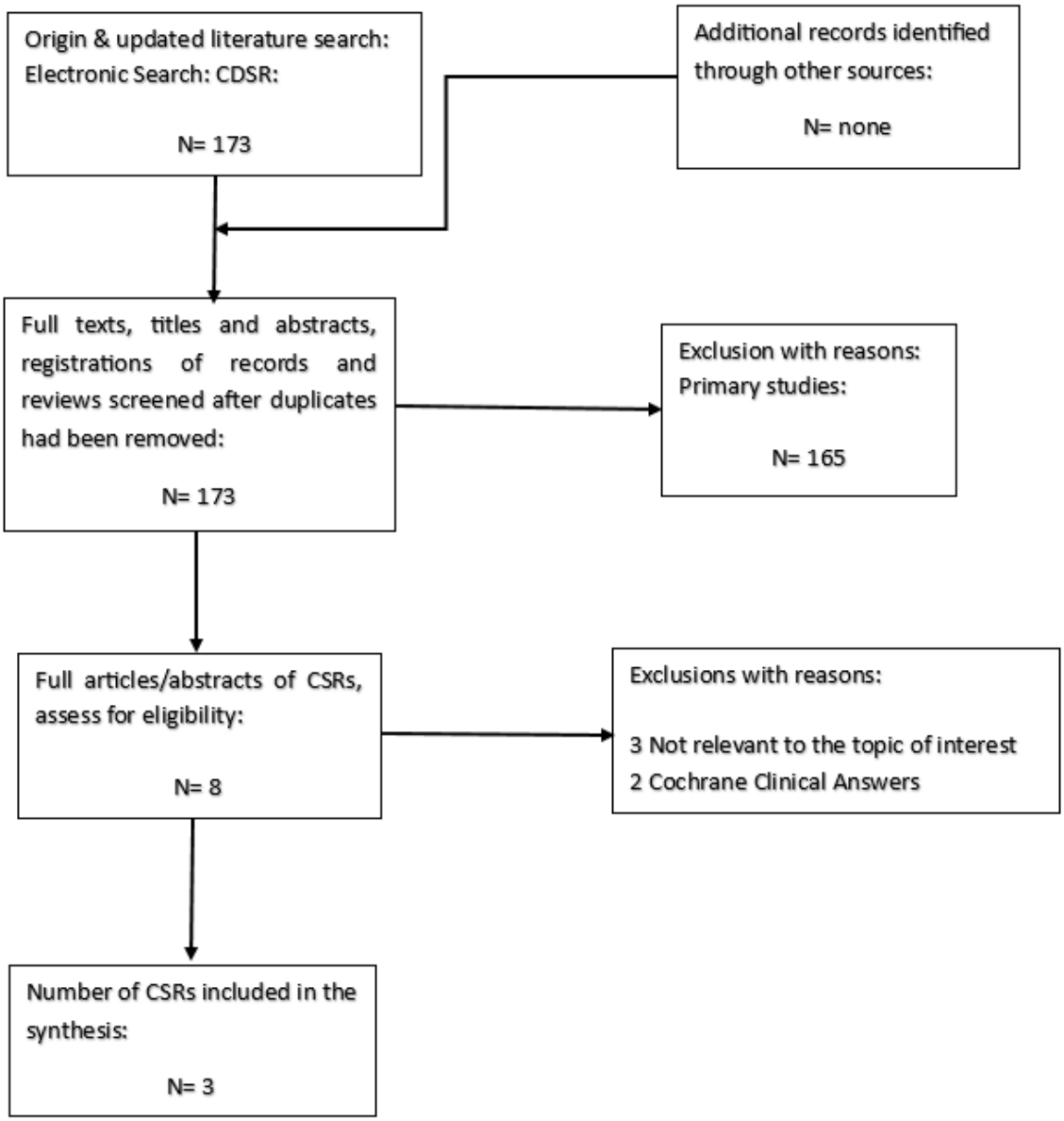


Figure 1: Flowchart for Overview of Cochrane SRs

2.3.2 Type of Included CRSs.

The three CSRs in the overview included a total of 65 randomised trials of which 50 [77%] used a parallel group design, The other 15 trials [23%] were quasi-randomised studies. No cluster-randomised studies were included in the CSRs (Table 3).

Table 3: Characteristics of included CSRs

Review ID	**Date of last search. Date of latest publication. Evaluation of whether it is up to date**	**No of trials and women included.**	**Countries of origin of included studies**	**Inclusion and exclusion criteria**	**Intervention and comparison**	**Outcome measurements**	**Obstetric condition**	**R-AMSTAR & (GRADE quality of the evidence)**
Lawrence et al.[9]	Search: 13 January 2013 Published in June 2013 Out of date	25 trials, 5,218 women	**13 countries** Australia, Brazil, Finland, France, Hong Kong, Iran, Japan, Sweden,	Studies: RCTs and quasi-RCTs. Population: any parity *receiving or NOT receiving* epidural analgesia. Condition: 1st stage of labour.	**<u>Interventions</u>** Sitting Standing Walking Kneeling Squatting All fours (hands and knees) **<u>Comparisons</u>**	**<u>Primary outcomes</u>** <u>Maternal outcomes</u> Duration of first stage Mode of birth (Spontaneous vaginal birth, operative and caesarean births) Maternal satisfactory <u>Foetal outcomes</u>	1st stage of labour with and without epidural analgesia	43 (GRADE Not reported)

	Taiwan, Thailand, United Kingdom, United States of America.	Timescale: No publication trial limit.	Semi-recumbent Lateral Supine Dorsal Bed care	Foetal distress Need for ventilation. **<u>Secondary outcomes</u>** <u>Maternal outcomes</u> Pain Use of analgesics Duration of second stage Augmentation of labour Artificial rupture of membranes Hypotension Blood loss ≥ 500ml Perineal trauma <u>Foetal/neonatal outcomes</u> Apgar scores Admission to NICU Perinatal death

Gupta et al.[10]	Search: 30 November 2016. Published in 2017 Up to date	32 trials, 9,015 women	**17 countries** Brazil, China, Finland, France, Hong Kong, India, Iran, New Zealand, Canada, Pakistan, Palestine, Iran, South Africa, Sweden, Thailand, Turkey,	Studies: RCTs and quasi-RCTs. Population: any parity *NOT* epidural analgesia. Condition: second stage of labour. Outcomes: any outcome reported in the study. Timescale: No publication trial limit.	**<u>Interventions</u>** Sitting (obstetric chair/stool) Kneeling (all fours) Squatting (unaided or using squatting bars) Squatting (aided with birth cushion) **<u>Comparisons</u>** Lateral (Sim's) position Dorsal Semi-recumbent (trunk tilted forwards up to 30º to the horizontal) Lithotomy position Trendelenburg's position	**<u>Primary outcome</u>** <u>Maternal outcome</u> Duration of 2nd of labour **Secondary outcomes** <u>Maternal outcomes</u> Pain Use of any analgesia or anaesthesia Assisted birth Caesarean birth Episiotomy 2nd-degree tears 3rd- and 4th-degree tears PPH ≥ 500ml Need for blood transfusion Manual removal of placenta Shoulder dystocia	2nd stage of labour without epidural analgesia	44 (moderated to very low)

			United Kingdom.			Urinary incontinence Faecal incontinence <u>Foetal outcome</u> Abnormal FHR patterns <u>Neonatal outcomes</u> Admission to NICU Perinatal death		
Walker et al.[11]	Search: June 2018 Published in 2018 Up to date	8 trials, 4,464 women	**3 Countries** France (1 trial) United Kingdom (5 trials) Spain (2 trials)	Studies: RCTs and quasi-RCTs. Population: any parity *receiving* epidural analgesia. Condition: second stage of labour. Timescale: No	**<u>Interventions</u>** Sitting (on a bed) Sitting Squatting (unaided or using squatting bars) Squatting (aided with birth cushion) Semi-recumbent (we classed this as an upright position if the main axis of the body [chest and	**<u>Primary outcomes</u>** <u>Maternal outcomes</u> Operative birth Duration of 2nd stage of labour **<u>Secondary outcomes</u>** <u>Maternal outcomes</u> Caesarean birth	2nd stage of labour with epidural analgesia	43 (High to very low)

publication limit.	trial	abdomen] was 45° or more from the horizontal) Kneeling Walking **<u>Comparisons</u>** Lithotomy position Lateral position Trendelenburg's position Knee-elbow (all fours) position Semi-recumbent (we classed this as a recumbent position if the main axis of the body [chest and abdomen] was less than 45° from the horizontal).	Assisted birth. Trauma to birth canal Blood loss > 500ml Prolonged 2nd stage of labour > 60 minutes Maternal experience <u>Baby outcomes</u> Abnormal FHR patterns Apgar scores < 7 at 5 mins Low cord pH less than 7.1 Admission to NICU Need for ventilation. Perinatal death

Table 4: Summary of participants included in the overview of CSRs.

Systematic review	**Lawrence et al.[25]**	**Gupta et al.[23]**	**Walker et al.[24]**
Number of individual RCTs	20	22	8
Number of individual quasi-RCTs	5	10	0
Number of clusters-RCTs	0	0	0
Total number of included studies	25	32	8
Total number of participants	5,218 (3,337 without epidural and 1,881 with epidural)	9,015	4,464

2.3.3 Clinical maternal conditions

All three CSRs contained effect estimates that were incorporated into at least six overview outcomes. [9-11] Since each CSR had considered different stages and use of epidural analgesia in childbirth (see Table 3), it was predicted that the effect estimates would vary across the CSRs and results were not compared across the CSRs. However, it was important to compare clinical descriptions of interventions, comparisons and outcomes reported across the CSRs.

2.3.4 Description of Participants

A total of 18,697 women were included in the three CSRs.[9-11] Sample sizes for their included studies ranged from 66 to 3,236 participants. Of the 65 RCTs in the reviews, 30 considered

only primiparous women, four investigated only multiparous women and 31 studied women of mixed parity. All trials included women who were either experiencing singleton pregnancies at term (>37 weeks of gestation) or who were at >34 weeks of gestation. Table 4 presents a summary of participants included in the overview of CSRs.

2.3.5 Geographical Settings and Dates

The studies included in the CSRs were conducted in 23 countries (Figure 2). They involved women from low-, middle- and high-income countries, mainly in hospital settings, and were published between 1963 and 2016.

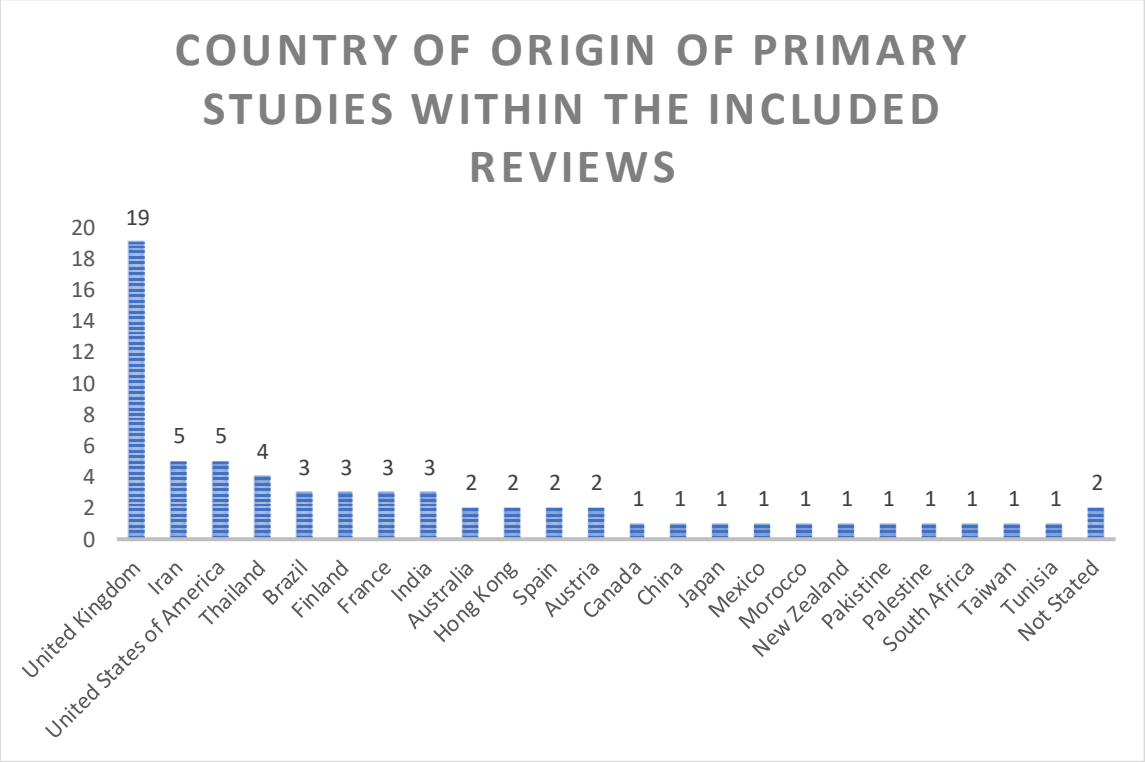


Figure 2: Countries of Origin & Number of RCTs Conducted in each Geographical Setting

2.3.6 Types of Intervention and Controls

A broad range of classifications of upright and horizontal positions was used in the CSRs. One defined the upright position as requiring the angle of the spine to be > 30°,[10] while another cited a 45° angle[24] and the third provided no information on the angle of the spine. [9]

Furthermore, there were discrepancies in the descriptions of different positions (e.g. all fours position was considered an upright position in two CSRs,[9, 10] but it was considered horizontal in the other CSR). [11]

Two CSRs reported the direction and magnitude of the effect in subgroup analysis by position type, which included sitting, walking, squatting, kneeling, all fours and squatting on a cushion, chair or stool compared with horizontal. [10]

2.3.7 Quality of the RCTs in the included CRSs

All three CSRs used the Cochrane risk of bias tool to assess their included studies. The specific details of the assessments of risk of bias that they reported are summarised in Table 5. In all included studies, it was not possible to blind the participants, healthcare personnel or outcome assessors to the allocated intervention. Also, all three CSRs noted poor reporting of random sequence generation, allocation concealment and other parameters for risk of bias in included studies. Therefore, the quality of evidence from the studies included in the CSRs was variable.

Table 5: Summary of Risk of Bias (RoB) in the included CSRs.

	Gupta et al.[10] **No. of trials = 32**			**Walker et al.[11]** **No. of trials = 8**			**Lawrence et al.[9]** **No. of trials = 25**		
RoB	**LRB**	**URB**	**HRB**	**LRB**	**URB**	**HRB**	**LRB**	**URB**	**HRB**
Random sequence generation	8	15	9	6	2	0	5	14	6
Allocation concealment	1	22	9	2	6	0	8	12	5
Performance bias	0	1	31	0	0	8	0	1	24
Detection bias	0	28	4	0	0	8	0	1	24

Attrition bias	21	3	8	4	2	2	16	4	5
Reporting bias	23	1	8	1	5	2	0	19	6
Other bias	32	0	0	1	4	5	—	—	—

LRB: low risk of bias, HRB: high risk of bias, URB: unclear risk of bias, No.: number

2.3.8 Quality Assessment of the Included CSRs using the AMSTAR tool

Based on the R-AMSTAR criteria, the three included reviews were rated high quality (i.e. R-AMSTAR score of ≥ 40).[9-11] (Table 3). The authors of one CSR did not assess for publication bias because it included only eight trials. [26-28] All CSRs contained tables that showed information regarding included and excluded studies.

2.3.9 Quality of the Evidence in the Included CSRs

Two CSRs [10, 11] used the GRADE approach to assess study quality, although one of these did not present sufficient information. [9] The GRADE assessments in the summary of findings tables for the two CSRs [10, 11] varied widely. The overall quality of evidence for outcomes in the CSRs ranged from moderate to very low.

2.3.10 Summary of the results of the overview of CSRs

The summary of findings table (SoF) below (Table 6) shows the main outcomes from the three included CSRs. The tables show the numbers of trials and women in the meta-analysis, the RR with 95% CI, the I^2 statistic, which was used for heterogeneity with Tau^2 and p-values, and the quality rating of the most important outcomes. The SoF table is presented in the following format using abbreviations for each comparison:

Comparison 1 is called CL1, in which C stands for comparison and L for Lawrence and presents the analyses by Lawrence et al., [9] who evaluated maternal positions in the first stage of labour when epidural analgesia was not used. [9] Comparison 2 is CL2 which presents the analyses by Lawrence et al., who evaluated maternal positions in the first stage of labour when mothers

used epidural analgesia. [9] Comparison 3 is CG3, which presents analyses reported by Gupta et al.,[10] who evaluated maternal positions in the second stage of labour without epidural analgesia. Comparison 4 is CW4, which presents analyses reported by Walker et al.,[11] who evaluated maternal positions during the second stage of labour when epidural analgesia was used.

Table 6: Summary of findings for the main comparisons of maternal positions during childbirth. [9–11]

	Any upright compared to supine position for the 1st and 2nd stages of labour for women with and without epidural anaesthesia					
	Condition: 1st and 2nd stages of labour Patient or population: Women of any parity with or without epidural analgesia Setting: hospital settings Intervention: any upright position Comparison: supine position					
	Outcomes	**Anticipated absolute effects* (95% CI)**		**Relative effects of upright vs supine (RR or MD with 95% CI) and measure of heterogeneity**	**No. of participants (studies)**	**Quality of the evidence (GRADE)**	**Comments**
		Risk with supine position	**Risk with any upright position**				
Duration of 1st stage of labour							
CL1: 1.1	**Duration of 1st stage of labour without epidural analgesia**			The mean duration of 1st stage of labour was 1.22 hours shorter in the upright position (2.13 to 0.31 hours shorter) *I^2 = 93%; Tau^2 = 3.42; P < 0.00001*	2,502 (15 RCTs)	Not reported	Including primigravida and multigravida women Favours upright

CL2: 1.2	**Duration of 1st stage of labour with epidural analgesia**			No significant difference in the mean duration of 1st stage between the two groups average MD = −3.71 hours (−9.37, 1.94) MD = 2.35 minutes higher (−15.22 lower to 19.91 higher) *I^2 = 0%; Tau^2 = 0.00; P = 0.44*	204 (2 RCTs)	Not reported	No significant difference
Duration of 2nd stage of labour							
CL1: 2.1	**Duration of second stage of labour without epidural analgesia**			No significant difference in the mean duration of 2nd stage between the two groups MD = −3.71 hours (−9.37 lower, 1.94 higher) *I^2 = 73%; Tau^2 = 51.97; P = 0.00026*	2,077 (9 RCTs)	Not reported	
CG3: 2.2	**Duration of 2nd stage of labour without epidural**			The mean duration of 2nd stage of labour was 6.16 minutes shorter in the upright position (9.74 minutes	5,811 (19 RCTs)	⊕⊖⊖⊖ VERY LOW	Including multigravida and primigravida

	analgesia			shorter to 2.59 minutes shorter) I^2 = *98%; Tau² = 1404.42; P < 0.00001*			women Favours upright
CW4: 2.3	**Duration of 2nd stage of labour with epidural analgesia**			The mean duration of 2nd stage labour across control groups ranged from 52.06 minutes to 124.3 minutes. MD = 6.00 minutes higher (37.46 lower to 49.46 higher) *I^2 = 91%; Tau² = 56.35; P < 0.00001*	456 (3 RCTs)	⊕⊖⊖⊖ VERY LOW	No significant difference
CW4 **2.4**	**Duration of pushing phase > 60 minutes**			MD = −16.37 (−24.55, −8.19)	199 (1 RCT)	Not reported	Favours upright
Mode of birth: operative birth (caesarean section or assisted vaginal birth)							
CW4: 3.1	**Operative birth with epidural analgesia**	554 per 1000	476 per 1000 (382 to 592)	RR 0.86 (0.70 to 1.07) *I^2 = 49%; Tau² = 0.00; P = 0.16*	4,316 (8 RCTs)	⊕⊕⊖⊖ LOW	No significant difference
Mode of birth: assisted birth							
CL1: 4.1	**Assisted birth without epidural analgesia**			RR 0.91 (0.73 to 1.14) *I^2 = 21%; Tau² = 0.00; P = 0.40*	2,519 (13 RCTs)	Not reported	No significant difference

CL2: 4.2	**Assisted birth with epidural analgesia**			RR 1.06 (0.90 to 1.25) *I^2 = 0%; Tau^2 = 0.00; P = 0.58*	1,568 (6 RCTs)	Not reported	No significant difference
CG3: 4.3	**Assisted birth without epidural analgesia**			RR 0.75 (0.66 to 0.86) *I^2 = 29%; Tau^2 = 0.00; P = 0.11*	6,481 (21 RCTs)	⊕⊕⊕⊖ MODERATE	Favours upright
		128 per 1000	96 per 1000 (84 to 110)				
CW4: 4.3	**Assisted birth with epidural analgesia**	468 per 1000	421 per 1000 (337 to 524)	RR 0.90 (0.72 to 1.12) *I^2 = 69%; Tau^2 = 0.00; P = 0.002*	4,316 (8 RCTs)	⊕⊖⊖⊖ VERY LOW	No significant difference
Mode of birth: caesarean section							
CL1: 5.1	**Caesarean section without epidural analgesia**			RR 0.71 (0.54 to 0.94) *I^2 = 42%; Tau^2 = 1.47; P = 0.19*	2,682 (14 RCTs)	Not reported	Favours upright
CL2: 5.2	**Caesarean section with epidural analgesia**			RR 1.05 (0.83 to 1.32) *I^2 = 17%; Tau^2 = 0.00; P = 0.31*	1,566 (6 RCTs)	Not reported	No significant difference
CG3: 5.3	**Caesarean section without epidural**			RR 1.22 (0.81 to 1.81) *I^2 = 0%; Tau^2 = 0.00; P = 0.49*	5,439 (16 RCTs)	⊕⊕⊖⊖	No significant difference

	analgesia	14 per 1000	18 per 1000 (12 to 26)			LOW	
CW4: 5.4	**Caesarean section with epidural analgesia**	86 per 1000	81 per 1000 (52 to 125)	RR 0.94 (0.61 to 1.46) *I^2 = 69%; Tau^2 = 0.13; P = 0.07*	4,316 (8 RCTs)	⊕⊖⊖⊖ VERY LOW	No significant difference
	*** The risk in the intervention group (and its 95% CI) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).** **CI: confidence interval; RR: risk ratio; MD: mean difference**						

2.3.11 Primary maternal outcomes.

2.3.11.1 Duration of the 1st stage of labour.

The duration of the 1st stage of labour was reported in one review. [11] Fifteen RCTs that included women who did not use epidural analgesia found that the period of the 1st stage was 82 minutes shorter for the upright group than for those in recumbence. This difference was statistically significant (MD −1.36 hours, 95% CI −2.22 to 0.51, I^2 = 93%, Tau^2 = 2.39, P < 0.0017, 2503 women; quality of evidence not reported). This outcome was not reported for the women using epidural analgesia.

2.3.11.2 Duration of the 2nd stage of labour.

The duration of the 2nd stage of labour was reported in all three reviews. [9–11] In one CSR [9] nine trials reported no significant difference in the mean duration of the 2nd stage of labour between upright and horizontal groups of women when these positions were maintained during the 1st stage of labour without epidural analgesia (MD −3.71, 95% CI −9.37 to 1.94, I^2 = 73%, Tau^2 = 51.97, P = 0.20, 2077 women; certainty of evidence not reported). [9] Similarly, two trials found no significant difference in the mean duration of the 2nd stage of labour for women using epidural analgesia in the 1st stage of labour (MD 2.35, 95% CI −15.22 to 19.91, I^2 = 0%, Tau^2 = 0.0, P = 0.44, 204 women; certainty of evidence not reported). [9] The other two CSRs investigated the effect of upright versus horizontal positions during the 2nd stage of labour only. They included no criteria for how the women had experienced the 1st stage of labour. [10, 11] In one CSR,[10] 19 RCTs reported a significantly shorter duration of the 2nd stage of labour, by six minutes and 16 seconds, in the upright group compared with the horizontal among those who did not use epidural analgesia (MD −6.16, 95% CI −9.74 to −2.59, I^2 = 91%, Tau^2 = 56.35, P =0.00072, 1, 5811 women; very low certainty of evidence). [10]

Among women who used epidural analgesia,[11] three RCTs found no significant difference in the duration of the 2nd stage between women who assumed upright versus horizontal positions (MD 6.00 minutes, 95% CI −37.46 to 49.46, I^2 = 96%, Tau^2 = 1404.42, P = 0.79, 456 women; very low-quality certainty of evidence), but one RCT showed a significant reduction in the duration of the prolonged 2nd stage of labour (pushing for more than 60 minutes) for women who used upright positions compared with those who lay horizontally (MD −16.37, 95% CI −24.55 to −8.19, I^2, Tau^2 and P not measurable, 199 women; certainty of evidence not reported).[11]

Mode of birth.

2.3.11.3 Operative birth (caesarean section or assisted vaginal birth).

The sum of operative births (caesarean sections plus assisted vaginal births) was reported in one CSR. [11] Eight RCTs found no significant difference in the rates of operative births between the upright and horizontal positions in the 2nd stage of labour among women who used epidural analgesia (RR 0.86, 95% CI 0.70 to 1.07, I^2 = 78%, Tau^2 = 0.06, P = 0.18, 4316 women; low certainty of evidence of effect). [11]

2.3.11.4 Assisted vaginal birth.

Assisted vaginal birth outcomes were reported in all three CSRs.[9–11] There was no significant difference between the rates of assisted vaginal birth in the comparison groups during the 1st stage of labour without epidural anaesthesia in thirteen trials (RR 0.91, 95% CI 0.73 to 1.14, I^2 = 21%, P =0.40, 2519 women; certainty of evidence not reported) or in three RCTs with epidural analgesia (RR 1.02, 95% CI 0.86 to 1.20, I^2 = 0.0%, Tau^2 = 0.00, P = 0.45; certainty of evidence not reported).[9] However, in the 2nd stage of labour among women who did not use epidurals, meta-analyses of 21 RCTs showed significantly lower rates of assisted vaginal birth in the upright compared with the horizontal group (RR 0.75, 95% CI 0.66 to 0.86 I^2 = 29%,

Tau^2 = 0.00, P = 0.000047, 6481 women, moderate certainty of evidence).[10] In contrast, during the 2nd stage of labour with epidural analgesia, eight RCTs found no significant difference in the rates of assisted vaginal birth (RR 0.90, 95% CI 0.72 to 1.12, I^2 = 69%, Tau^2 = 0.00, P = 0.002, very low certainty of evidence). [11]

2.3.11.5 Caesarean section.

Overall, among women who did not use epidurals, the meta-analysis of 14 RCTs found a significant reduction in caesarean section rates among those who chose the upright compared with the horizontal position during the 1st stage of labour (RR 0.71, 95% CI 0.54 to 0.94, I^2 = 42%, Tau^2 = 1.47, P < 0.018, 2682 women; certainty of evidence not reported). Six RCTs found no significant difference for women using epidural analgesia (RR 1.05, 95% CI 0.83 to 1.32, I^2 = 17%, Tau^2 = 0.00, P = 0.31, 1566 women; certainty of evidence not reported). [9]

Among women without epidural analgesia during the 2nd stage of labour, there was no significant difference between upright and horizontal groups in the rates of caesarean section in the meta-analysis of 16 RCTs (RR 1.22, 95% CI 0.81 to 1.81, I^2 = 0%, Tau^2 = 0.0, P = 0.34; 5439 women; certainty of evidence not reported). [10] Again, for those who used epidurals during the 2nd stage, the meta-analysis of eight RCTs revealed no significant difference in caesarean section rates between upright and horizontal groups (RR 0.94, 95% CI 0.61 to 1.46, I^2 = 69%, Tau^2 = 0.13, P = 0.07; 4316 women; very low certainty evidence). [11]

Secondary outcomes: maternal, foetal, and neonatal outcomes.

Maternal outcomes.

2.3.11.6 Need for analgesia/anaesthesia.

The need for analgesia/anaesthesia was reported in two CSRs. [9, 10] Nine RCTs found a significant reduction in the rates of women needing analgesia/anaesthesia between upright

positions and horizontal during the 1st stage of labour (RR 0.81, 95% CI 0.66 to 0.99, I^2 = 0%, Tau^2 = 0.0, P = 0.73; 2107 women; certainty of evidence not reported). (9) Seven RCTs showed no significant difference in the rates of needing analgesia/anaesthesia during the 2nd stage of labour (RR 0.97, 95% CI 0.93 to 1.02, I^2 = 30%, Tau^2 = 0.0, P = 0.19; 3093 women; certainty of evidence not reported). (10)

2.3.11.7 Trauma to birth canal, requiring suturing (defined as 2nd-, 3rd- and 4th-degree tears and episiotomy).

Perineal trauma to the birth canal requiring suturing was in two CSRs.(9, 11) Three RCTs found no significant difference in the rates of perineal trauma requiring suturing for women in the 1st stage of labour without epidural analgesia (RR 0.92, 95% CI 0.82 to 1.04, I^2 = 0%, Tau^2 = 0.0, P = 0.43; 1374 women; certainty of evidence not reported)(9). The same was found in three RCTs during the 2nd stage of labour with epidural analgesia (RR 1.00, 95% CI 0.89 to 1.13, I^2 = 46%, Tau^2 = 0.01, P = 0.16; 3266 women; certainty of evidence not reported). (11) This outcome was not reported for women in the 1st stage of labour with epidural or 2nd stage of labour without epidural.

2.3.11.8.1 Subgroup analysis: episiotomy.

Perineal trauma requiring suturing was reported in one review. (23) Seventeen RCTs found a significant reduction in rates of episiotomy in the upright compared with the horizontal group during the 2nd stage of labour without epidural analgesia (RR 0.75, 95% CI 0.61 to 0.92, I^2 = 88%, Tau^2 = 0.13, P = 0.0049; 6148 women; certainty of evidence not reported).

2.3.11.8.2 Subgroup analysis: 2nd-degree tears.

In one CSR, the meta-analysis of 18 RCTs found no significant difference in the rates of 2nd-degree perineal tears (RR 1.20, 95% CI 1.00 to 1.44, I^2 = 43%, Tau^2 = 0.05, P = 0.46; 6715

women; moderate certainty evidence) without epidural analgesia. [10]

2.3.11.8.3 Subgroup analysis: 3rd- and 4th-degree tears.

One CSR reported this outcome. [10] Overall, there was no significant difference in the number of 3rd- or 4th-degree perineal tears between women in upright and supine positions (RR 0.72, 95% CI 0.32 to 1.65, I^2 = 0%, Tau^2 = 0.0, P = 0.44; 1840 women; high certainty evidence).

2.3.11.9PPH ≥ 500ml.

Estimated PPH ≥ 500ml was reported in two CSRs. [9, 10] Two RCTs found no significant difference between the two comparison groups during the 1st stage of labour without epidural anaesthesia (RR 0.71, 95% CI 0.14 to 3.55, I^2 = 0%, Tau^2 = 0.00, P = 0.56; 240 women; certainty of evidence not reported). [9] However, 15 RCTs found a significant increase in PPH ≥ 500ml in any upright group compared with the horizontal group during the 2nd stage of labour without epidural (RR 1.48, 95% CI 1.10 to 1.98, I^2 = 33%, Tau^2 = 0.10, P = 0.0090; 5615 women; certainty of evidence not reported). [10] This CSR found no significant difference in rates of PPH requiring blood transfusion for women in upright (RR1.66, 95% CI 0.70 to 3.94, I^2 = 0%, Tau^2 = 0.0, P = 0.25; 1747 women; certainty of evidence not reported) compared with horizontal positions during the 2nd stage of labour without epidural. [10] Similarly, one large RCT found no significant difference in rates of PPH requiring blood transfusion between the two groups during the 2nd stage of labour with epidural analgesia (RR 1.20, 95% CI 0.83 to 1.72, I^2, Tau^2 and P not measurable; 3093 women, moderate certainty evidence). [11]

Foetal outcomes

2.3.11.10 Abnormal foetal heart rate (FHR) patterns

The meta-analysis of six RCTs found a non-significant difference in the rates of abnormal FHR patterns in the 1st stage of labour without epidural (RR 0.69, 95% CI 0.35 to 1.33, I^2 = 8%,

Tau^2 = 0.0, P = 0.36; 1757 women; certainty of evidence not reported) [9] and during the 2nd stage of labour with epidural analgesia (RR 1.69, 95% CI 0.32 to 8.84, I^2, Tau^2 and P not measurable; 200 women; certainty of evidence not reported).[11] In contrast, the meta-analysis of two RCTs found a significant reduction in the rates of abnormal FHR patterns in upright (RR 0.46, 95% CI 0.22 to 0.93, I^2 = 15%, Tau^2 = 0.0, P = 0.030; 617 women; certainty of evidence not reported) compared to horizontal during the 2nd stage of labour without epidural. [10]

Neonatal outcomes.

2.3.11.11Need for admission to NICU.

One RCT found a significant reduction in the admission rates to the NICU in the upright group during the 1st stage of labour without epidural analgesia compared with the horizontal group (RR 0.20, 95% CI 0.04 to 0.89, I^2, Tau^2, and P not measurable; 200 women; certainty of evidence not reported). [9] However, the meta-analysis of four RCTs found no statistically significant difference in the rates of babies admitted to NICU care in the upright compared with the horizontal group during the 2nd stage of labour without epidural (RR 0.79, 95% CI 0.51 to 1.21, I^2 = 0%, Tau^2 = 0.0, P = 0.27 certainty of evidence not reported) [10] and one RCT found similar with epidural (RR 0.54, 95% CI 0.02 to 12.73, I^2, Tau^2 and P not measurable; 66 women; certainty of evidence not reported). [11]

2.3.11.12Position type.

Two CSRs analysed data according to position type. [9, 10] One [9] reported varying results on caesarean section, operative birth and duration of labour between different upright positions compared with horizontal during the 1st stage of labour without epidural analgesia. The other CSR [10] found contradicting results between squatting using a cushion, chair and stool compared with horizontal on the duration of birth, assisted vaginal birth, episiotomy, 2nd-degree

tears and estimated PPH ≥ 500ml during the 2nd stage of labour (see Appendix 2.3).

2.4 Discussion

2.4.1 Main findings

The three CSRs [9-11] included in this overview, with a total of 18,697 women, reported a variety of definitions and classifications of upright and horizontal positions, type of outcome measures and the quality of RCTs. Women in the upright position with no epidural analgesia were more likely to experience a significantly shorter duration of the 1st stage of labour and a significantly shorter duration of the 2nd stage of labour.

During the 1st stage of labour without epidural analgesia, women in upright positions showed a significant reduction in rates of caesarean section, need for epidural analgesia and admission to neonatal intensive care units. However, there were no significant differences in the duration of the 2nd stage of labour, assisted vaginal birth and perineal trauma requiring suturing. This review found no difference between assuming an upright position compared with horizontal on the duration of the 1st stage of labour, assisted vaginal birth and caesarean section among women using epidural analgesia. [25]

During the 2nd stage of labour without epidural analgesia, women in an upright position showed significant reductions in rates of assisted vaginal births, need for episiotomies, and abnormal foetal heart rate patterns. [10] However, there were significantly increased rates of estimated PPH of ≥ 500ml in the upright compared with the horizontal group. No significant differences were found between the two groups on rates of caesarean section, perineal trauma requiring suturing or the need for admission to neonatal intensive care. The overall quality of the studies included in the review was variable. Most had design limitations (inadequate randomisation, allocation concealment, attrition bias), with high heterogeneity and imprecision of effect.

During the 2nd stage of labour with epidural analgesia, there were no significant differences in the overall effect for operative birth, duration of the 2nd stage of labour, PPH ≥ 500mls requiring blood transfusion, perineal trauma requiring suturing, abnormal FHR patterns requiring intervention and admission to NICU. [11] For most of these outcomes, the quality of the evidence was rated very low to moderate using GRADE. The overall quality of the RCTs included in the review was variable as most had design limitations (inadequate randomisation, allocation concealment, exposure, and attrition biases) with high heterogeneity and imprecision of effect. Consequently, the true effect is likely to be substantially different from the estimate of the effect on the primary outcome (duration of labour or birth) and may be substantially different from the estimate of the effect on all other birth outcomes.

2.4.2 Limitations in this overview of CSRs

All three included CSRs found large differences in the direction and magnitude of effect in individual studies on the duration of labour and birth, assisted vaginal birth and caesarean section. This may be due to biases including lack of blinding, incomplete data, selective reporting, and other biases. Two of the CSRs rated this as very low-quality evidence.[10, 11]

Confidence in the effect estimate is limited by inconsistencies in the results of subgroup analyses by position type, mainly on the three types of squatting positions (cushion, chair and stool) during birth (see Appendix 3). The procedures for delivering these positions were not described which may influence the results. This highlights the need to evaluate the effectiveness of different squatting positions versus other positions during the 2nd stage of labour, which has not yet been investigated.

Considering the effectiveness of different maternal positions on the duration of the 1st and 2nd stages of labour are important for clinical management and decision-making is crucial. However, defining the duration of these stages of labour is a complex task due to several

limitations and the inherent heterogeneity of outcomes. The variability and subjective nature of defining labour duration is influenced by factors such as healthcare provider subjectivity, physiological differences among women, the use of medical interventions and variable clinical practice guidelines.

As suggested above, these two stages of labour are particularly challenging to define due to subjective determinations of cervical dilation and individual physiological variations. For example, determining the exact time from complete cervical dilation to the birth of the baby can be subjective and prone to interobserver variability in healthcare. In addition, factors such as pelvic shape and size, maternal positioning, and foetal position can influence the duration of these stages of labour. Thus, physiological variability makes it challenging to establish a universal standard for the duration of childbirth.

Furthermore, medical interventions like epidural anaesthesia and oxytocin augmentation can affect labour duration, balancing the need for timely delivery with maternal and foetal safety. While clinical guidelines often provide recommendations for the duration of these stages of labour, which vary between different professional organisations and may not always reflect individual patient circumstances or preferences.

Moreover, outcomes within the 1st and 2nd stages of labour can vary widely, with some women experiencing minimal complications while others face prolonged labour that might lead to operative deliveries with its associated complications e.g., severe perineal trauma, PPH ≥ 500mls and other postpartum complications. [39] Psychological factors, cultural norms, and access to healthcare resources also influence labour management. These variable factors make it challenging to establish a universal standard for the duration of 1st and 2nd stages of labour. In designing RCTs, the application of components such as individualised care, maternal preferences, and vigilant monitoring of maternal and foetal well-being are essential. These

variables may be helpful to broaden the understanding of the continuous labour process (duration) since RCTs are challenging to perform within childbirth. Future studies need to carefully evaluate how 1st or 2nd stage duration and mode of delivery should be properly accounted for in studies investigating labour duration and associated birth outcomes.

The included CSRs used statistical techniques such as the random-effect model, subgroup analysis and sensitivity analysis to aid in understanding the high statistical heterogeneity. However, these measurements have limitations such that any associations may be spurious (e.g. subgroup comparisons are observational by nature). [29, 30] Several authors have noted that the synthesis of qualitative evidence can help explain the findings of effectiveness research by identifying contextual factors that can influence the use of interventions in health care. [1, 29, 31-35]

The precise definitions of each maternal position and their biomechanical characteristics were not assessed systematically in the included CSRs. There is inadequate detail on the optimal procedure, material, intensity, interval and duration, and frequency of the description of maternal position to make the findings generalisable across research and clinical practice. Consequently, there is uncertainty over the specific components that are responsible for the effects of one position relative to another on outcomes during childbirth. In addition, uncertainty remains over whether effectiveness in randomised trials can be replicated in clinical practice.

This overview illustrates the need for consensus on a core set of outcomes, due to the wide variation in the reporting of birth outcomes across published reviews and the studies they include (see Table 3). Standardised measurement instruments for outcome data are needed, to include maternal pain, control and satisfaction, to reduce imprecision and selective reporting of results. The Lawrence *et al*.[9] CSRs authors support this view. However, it is beyond the scope of this DPhil research to develop a core outcome set for studies of maternal positions in

childbirth, due to time and resource constraints.

2.4.3 Quality of the evidence from the included reviews

The reviews in this overview were classified as high quality (all scored >40 on the R-AMSTAR tool) but the quality of the 65 trials they included was variable: only 19 used adequate methods of randomisation, 11 reported adequate allocation concealment, 40 had a low risk of attrition bias and 24 had a low risk of reporting bias. Moreover, the trials that were designated low-quality tended to report larger effects than the high-quality trials,[36, 37] which undermines the overall evidence of the overview.

2.4.4 Overall completeness and applicability of evidence.

This overview summarises only published CSRs of RCT and quasi-RCTs of maternal position in the two stages of childbirth. There was a wide variation in interventions, control protocols, outcome measurement tools and definitions of outcomes. The effect on birth outcomes of maternal positions during childbirth is a dynamic and complex process that involves many physiological, organisational, cultural and social variables. The multiple interactive activities include maternal physiological variables, variable skills among the professionals providing health care, confidence and attitudes among health care providers, and organisational clinical protocols.

Moreover, empirical studies argue that the biomechanical consequences and the 'active components' of upright and horizontal positions related to poor or good birth outcomes are not directly identifiable in the current evidence. [38-40] All reviews included in the overview included a study population with any type of upright and horizontal positions, broadly described across the included trials, which makes comparisons of positions in childbirth very imprecise.

One included CSR can be judged to be out of date because it only included evidence published before January 2013,[9] meaning that evidence from more recent trials may have been missed. The two other CSRs included evidence up to June 2018[11] and November 2016,[10] by which time the literature search date had already exceeded two years. Thus, current evidence may be missing from all CSRs in this overview.

All the CSRs included in this overview provide an average estimate of the effect of various upright positions compared with horizontal on various outcomes. This may obscure the effect of specific positions (such as squatting, kneeling or all fours), which may be more effective or harmful than other positions. In such situations, a meta-analysis on a single position or a large, pragmatic RCT is needed to provide a balanced and objective summary of the research evidence on the topic. [41]

2.4.5 Comparison of the Findings of Included CSRs with Existing Guidelines

The three CSRs in this overview have been used in the development of several international guidelines for the management of intrapartum care for healthy women and babies. These guidelines are provided by the WHO,[29] the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG), [30] the National Institute for Health and Care Excellence (NICE),[31] and the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN)[32] This overview is consistent with these international guidelines, which specify that women in labour should be discouraged from lying supine or semi-supine during birth and should be encouraged to adopt any other position that they find comfortable. [10]

2.4.6 Compliance with the Protocol

This overview deviated from its protocol by excluding non-CSRs. However, empirical evidence suggests that CSRs provide more rigorous evidence than non-CSRs.[44, 45] Several

authors of overviews of reviews have found it relevant to include only CSRs because they are judged to be at low risk of bias. [14, 46-49]

2.5 Conclusion

This overview of CSRs suggests that there is more benefit than harm if women assume an upright position in childbirth. However, the included CSRs reported wide variability in the results between pooled RCTs and there was little or no information on the precise definitions and optimal positioning during childbirth. Furthermore, there is uncertainty about the mechanism of action for upright positions or the components responsible for the effects on birth outcomes and whether effectiveness in randomised trials can be replicated in clinical practice.

2.5.1 Implications for Clinical Practice

Uncertainty remains on the effects of upright compared with horizontal positions on the duration of labour and birth, and operative births. The variability in the effects of upright compared to horizontal positions necessitates accurate definitions of each position and investigation of their maternal biomechanical consequences to enable the safe replication of these methods. Hence, until the influence of each birth position on birth outcomes is better understood through high-quality studies, women should be encouraged to give birth in whatever position they find comfortable.

2.5.2 Implications for Research

In 2013, a draft research proposal for this study was developed by the lead researcher (MK). In the same year, the research topic, choice of questions, and design were addressed to various groups comprising representatives from UK NHS organizations, the Academic Division, student representatives, healthcare researchers, and lecturers. Over 45 individuals, including

health professionals, commissioners (Health Education of KSS), opinion leaders (from East Kent University & Medway NHS hospitals: obstetric consultants, midwifery managers, and consultants), academic professors, healthcare researchers (Kent University, University College Dublin, University of Brighton), midwives (East Kent NHS), and students (University of Oxford), were involved. Different methods were utilized to involve stakeholders in this study, including seminars, presentations, face-to-face group or one-to-one discussions, and email contacts between the researcher and stakeholders. Recommendations on the relevance of the topic (squatting), study designs (systematic reviews and consensus development methods), and problem-solving (developing a definition of squatting position) were made.

Implications for Research Developed with Stakeholder Group Beyond Supervisors of the DPhil:

The involvement of a broad stakeholder group beyond the DPhil supervisors had significant implications for the research. Engaging with diverse representatives from healthcare organizations, academic institutions, and student bodies ensured that the research was grounded in practical and academic relevance. This collaborative approach facilitated a comprehensive understanding of the research topic from multiple perspectives, enhancing the robustness and applicability of the study.

1- **Enhanced relevance and impact:** The input from stakeholders such as healthcare professionals and opinion leaders ensured that the research addressed practical concerns and needs within the NHS and broader healthcare community. This relevance is crucial for the successful implementation and impact of the research findings in real-world settings.

2- **Methodological rigour:** Involving stakeholders in the discussion of study designs, including systematic reviews and consensus development methods, contributed to a more rigorous and well-rounded research methodology. The diversity of expertise

among stakeholders helped identify and address potential methodological challenges, ensuring a more robust and credible research process.

3- **Innovative solutions:** The collaborative problem-solving approach, particularly in developing a training package, benefited from the practical insights and experience of midwives, healthcare researchers, and educators. This collective input likely led to more innovative and effective solutions tailored to the needs of the target audience.
4- **Broad ownership and support:** Engaging a wide range of stakeholders early in the research process fostered a sense of ownership and support for the project. This buy-in is essential for the successful dissemination and adoption of research findings, as stakeholders are more likely to champion and implement outcomes they helped shape.

This thesis aims to be a compilation and summary, in one document of the evidence base on squatting positions and their use in childbirth. This is intended for use in improving the design and reporting of squatting positions in future research. The overall question that arises from this overview in this chapter in this thesis is: *how can we improve the evidence base on squatting and its complexity in implementation in childbirth?* From this question, five research questions emerge, which are discussed in subsequent chapters.

RQ 2: What is already known about the biomechanical activities of squatting positions during childbirth? (Chapter 3)

RQ 3: What are the potential benefits and harms of squatting compared with other positions in the second stage of labour for low-risk women? (Chapter 4)

RQ 4: What are the perspectives of women, their partners and health care providers regarding the barriers to and facilitators of using upright/squatting positions in childbirth? (Chapter 5)

RQ 5: Do various types of squatting positions and secondary factors (such as co-interventions or effect moderators) modify treatment effects (results) on birth outcomes or explain heterogeneous effects observed between quantified quantitative studies? (Chapter 6)

RQ 6: What are the important key components of the terminologies and parameters of squatting positions in childbirth among women and healthcare professionals? (Chapter 7).

The next chapter provides a narrative systematic review summarising studies that examined the biomechanical characteristics of squatting positions in childbirth. It aims to identify biomechanical or physiological features of how the squatting position might be responsible for creating effects on maternal and foetal-related outcomes, thereby determining the relevance of evaluating the effectiveness of the squatting position compared with other positions from a scientific, evidence-based perspective.

2.6 Chapter 2 References

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CHAPTER 3

Biomechanical Analysis

3.0 Biomechanical Characteristics Analysis

The protocol of systematic reviews including this review was registered with the PROSPERO and can be found at https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42014014255 . This was first published on 14 October 2014.

The findings of this chapter have been published:
Kibuka M, Nsibambi CA. A systematic review of the physiological and biomechanical mechanisms of squatting interventions in childbirth. Midwifery Information Database and Resource Service (MIDIRS), Midwifery Digest, 2020; 30(3): 349-353.

3.1 Background

Biomechanics about labour and birth refers to a description of the flexible or non-flexible sacrum (pelvic movement) and how physiological forces might affect the mechanism of labour and birth. It has been found that upright positions, including squatting, are associated with perineal integrity, with a higher incidence of second-degree tears, but reduced rates of episiotomies compared with horizontal positions. [(1)] Moreover, research has shown that measurement of the size of a woman's pelvis (pelvimetry) can vary with different maternal positions. [(1-4),] Additionally, Caldeyro-Barcia *et al.*, [(5)] found that position in labour influences uterine activity, whereby being upright during childbirth is associated with increased intensity of contractions. [(5)] According to Desseauve *et al.* [(4)] measurement of the effect of one position compared to another requires precise definitions of each position, their maternal biomechanical consequences and safe measurement methods. This view is supported by other authors. [(4, 6, 7)] In this chapter, the discussion of biomechanics characteristics in childbirth incorporates a detailed analysis of the squatting position [(8)] and their influence on pelvic dimensions, intra-

uterine pressure, stress and strain of pelvic floor muscles and foetal moulding or descent during childbirth. This chapter addresses the question: *'What is already known about the biomechanical activities of squatting positions during childbirth?'*

3.1.1 Aim

This chapter presents an SR of published research studies of the biomechanical activities of the squatting position compared with other positions and their effects in childbirth.

3.1.2 Objective

To investigate and identify how various biomechanical characteristics of squatting positions might influence the pelvic dimensions, intra-uterine pressure, contractions, perineal integrity, and pelvic floor muscles, optimal foetal positioning, and progression in terms of descent through the pelvic birth canal.

3.2 Methodology

Selection Criteria

3.2.1 Types of studies

This chapter considers both experimental and epidemiological study designs including (1) RCTs (including quasi-RCTs) and (2) NRSIs (which include all quantitative studies, including before and after studies, prospective and retrospective cohort studies, case-control studies, and analytical cross-sectional studies). The studies included in this review sought to understand the potential biomechanical or underlying physiological effects of squatting in the context of improving birth outcomes during childbirth. The search was for studies published in English up to 30 September 2020. Participants were women of any parity (primigravidae and multiparous).

3.2.2 Types of squatting positions

A range of squatting positions were established in a literature review, mainly from the two most recent CSRs. [9, 10] All studies included in this systematic review examined one or more of any of the following:

Full squatting - crouching, deep, full, or unsupported squatting [8]

Modified or supported squatting – birthing on a chair/ball/stool/cushion/bed [10]

Partial squatting - flexing one leg, squat-kneeling [11].

Partial squatting - McRoberts manoeuvre [12] (squat-supine)

Studies comparing at least two squatting positions were eligible for the comparison of the biomechanical difference between squatting positions.

3.2.3 Types of Biomechanical Outcomes

Any biomechanical or physiological characteristics associated with squatting position on maternal or foetal or neonatal wellbeing during childbirth were eligible. Outcome effects such as changes in pelvic dimension, changes of intra-uterine pressure about expulsive force and efficiency of contractions, pelvic floor muscles, foetal descent and other outcomes related to those reported by authors were also considered. These are the biomechanical factors that affect the progress of labour. [4, 13]

3.2.4 Exclusion Criteria

Studies that discussed the physiological aspects of maternal positions other than the squatting position were excluded. Research protocols, qualitative studies, surveys, and clinical case reports were excluded. Appendix 4: provides a list of excluded studies.

Literature search

3.2.5 Electronic literature search

The search terms were developed by MK using the PICOS framework. A systematic search employed free-text terms: (squatting OR crouching OR sitting) AND (pelvic OR dimension OR floor OR intrauterine OR intra-abdominal OR contraction OR pressure). A systematic search strategy was devised with the aid of an experienced research librarian (Mark Kerr) at a local NHS hospital's postgraduate library and included eight electronic databases: Medical Literature Analysis and Retrieval System Online (MEDLINE), Excerpta Media Database (EMBASE), MIDIRS, Cochrane Database of Systematic Reviews (CDSR), Database of Abstracts of Reviews of Effectives (DARE), Cochrane Central Register of Controlled Trials (CENTRAL), PsycINFO and ProQuest Dissertations and Theses.

3.2.6 Other literature searches

Reference lists and bibliographies of the articles identified through the database search were scrutinised for additional relevant articles. Full copies of potentially eligible articles were obtained for data synthesis. Where appropriate, the corresponding authors were contacted for additional information. Searches were not restricted by date or publication type. The search was last updated in September 2020, retrieving four more studies eligible for inclusion.

3.2.7 Data selection, extraction

The lead reviewer (MK) assessed studies for inclusion, extracted data and assessed the methodological quality of each included study. A standardised form was designed to extract the necessary data including demographic information, study and participant characteristics, biomechanical elements, experimental and control, outcome measurements and results. When any of this information was unclear, authors of the original reports were contacted for further details.

3.2.8 Assessment of risk of bias in included studies.

One reviewer (MK) independently assessed the risks of bias for each non-randomised study, using the criteria outlined in Cochrane's ROBINS-1 tool. [14] Each included study was assessed for risk of bias in ten domains: sequence generation, allocation concealment, comparability of baseline characteristics and outcome measurements, blinding of participants, representativeness of the exposed and non-exposed cohort, blinding of outcome assessment, incomplete outcome data, selective outcome reporting, outcome measures reliable and other sources of bias. Each domain was assessed as low; unclear; or high risk of bias.

3.2.9 Data collection and analysis

A meta-analysis was not attempted because of differences in study designs and outcome measurement instruments across the studies. Thus, the results were synthesised and descriptively presented, with a narrative synthesis presented for each included study. The included studies were analysed for their characteristics of squatting components and comparative results as reported on the primary outcome measures.

3.3 Results

Six studies were excluded at the full-text stage due to the wrong population, not squatting position and squatting position assessed not in childbirth. [15-20] Fourteen NRSIs with 504 women were included, with the sample size per study ranging from five to 143 participants. All included studies investigated the biomechanics associated with squatting position compared to standing, semi-recumbent, supine, and lithotomy. All included studies were published between 1969 and 2019. Figure 3 outlines the selection process and Table 7 presents the characteristics of included studies.

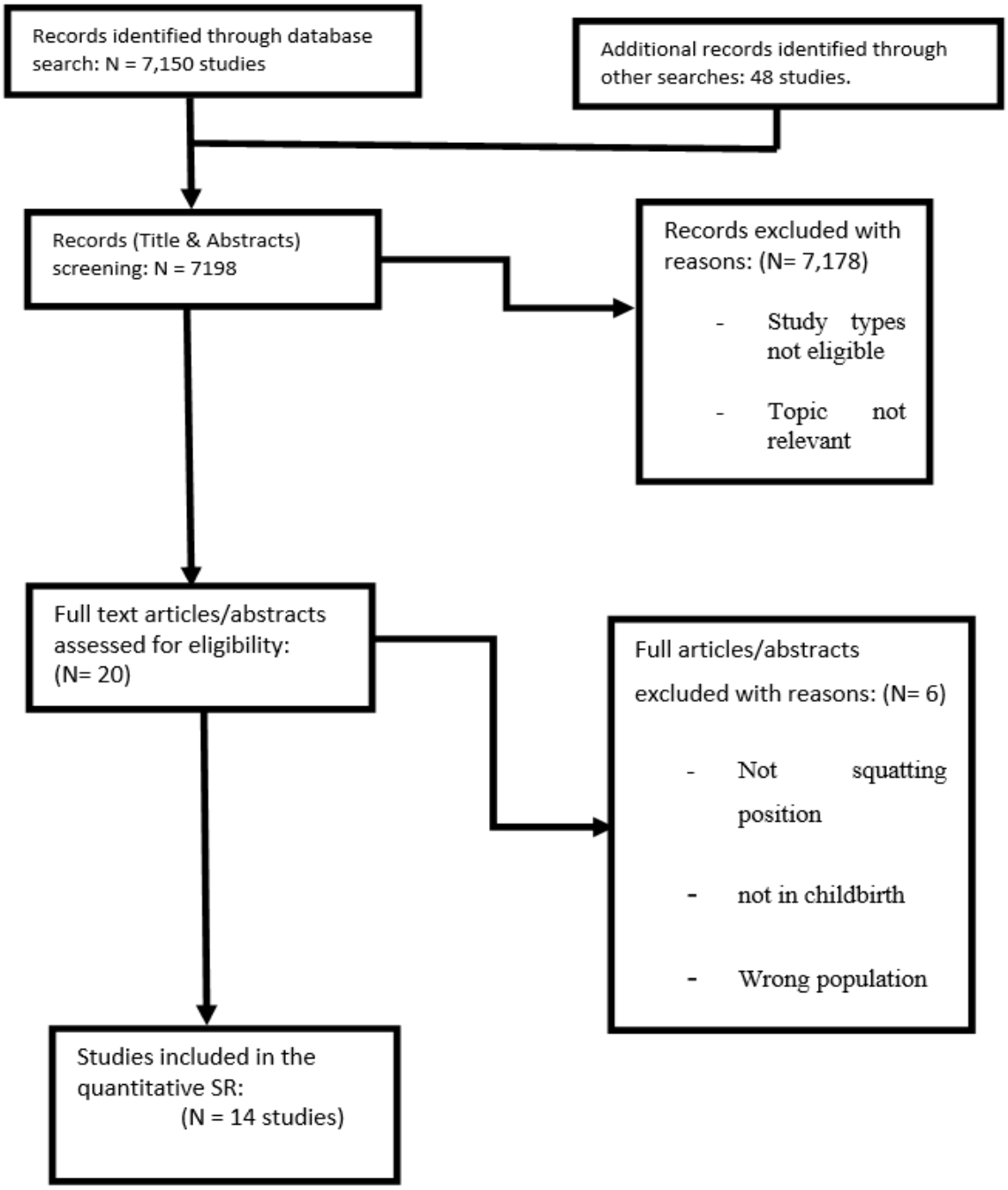


Figure 3: Flowchart of Literature Review

3.3.1 Study Design and Settings.

The 14 included NRSIs comprised eight prospective comparative cross-over studies whereby each participant acted as her control [2, 3, 21-26] and six prospective cohort studies. [7, 27-31] The literature search did not identify any RCTs on this topic. Three of the included NRSIs were set

in America [21, 25, 27], three in Canada [7, 28, 29], three in the United Kingdom [2, 23, 24], two in France[26, 31], one in Switzerland, one in Germany[11] and one in Israel. [30]

3.3.2 Biomechanical Characteristics of Squatting

Biomechanical characteristics for the impact of squatting position on birth outcomes were identified in nine NRSIs [2, 3, 7, 21, 23, 25-27, 30]. A brief definition of squatting position is illustrated as: 'crouching with abduction as well as flexing the thighs on the abdomen [24] or 'hyper flexing of the hips up to 45 [29] to 135. [32] It was found that 4.35 degrees of hip flexion led to 1 degree of flexion of the pelvic inlet plane. [31] The two major modes of squatting position are 'full or deep'[7, 23] and 'modified or supported squatting'. [2, 23]

3.3.3 Key Attributes of Participants and Providers

Information on the pregnant women who can and who cannot assume squatting position during childbirth were described in the included NRSIs. (Table 7) The key attributes of being eligible to use the squatting positions in childbirth were reported in five NRSIs.[3, 21, 26, 27, 30] The inclusion criteria were: the use of epidural analgesia, foetal head presentation, gestation age from thirty-three weeks, age from eighteen, any parity, women during pregnancy, in labour and birth. Women with morbidities associated with specific rapid movement of the lower limbs and hips were excluded from squatting positions. These included obese women with Body Mass Index (BMI) >40kg/m^2, lower-limb and pelvic fractures, spinal cord injuries, neuromuscular disorders, osteoarthritis, rheumatoid arthritis or any other medical conditions or severe degenerative joint disorders with contraindication of maternal hip hyperflexion. In addition, exclusion included any obstetric history of disorders such as placental abnormalities, malpresentation of the foetus, women with bleeding, hypertension, and other illnesses.

Two NRSIs provided information on the providers, with disciplinary backgrounds and specialists in obstetrics [27] and physiotherapy. [2] There was unclear evidence of physical or

information materials used for participants and providers, but photographs were provided in three NRSIs. [2, 3, 22]

3.3.4 Duration and Timing of Exposure

Only one NRSI provided information on the duration of intervention during the examination, which did not exceed 10 minutes. [22] This reported that participants found the full squatting position difficult to maintain for longer than 10 minutes. Three NRSIs included labouring women during the second stage of labour [21, 25, 30]; one NRSI included both antenatal and postnatal women [2]; three NRSIs included only pregnant women during antenatal period [3, 26, 27]; four NRSIs included pregnant women during antenatal period and non-pregnant women [7, 22, 28, 29], one NRSI included women during birth [30] and two NRSIs included only postnatal women after a caesarean section. [23, 24]

3.3.5 Types of Outcome Measurements

Three biomechanical outcome effects were measured for association with squatting position compared with other positions: pelvic dimension, intra-uterine pressure, and intrapartum foetal angle of progression during the 2nd stage of labour (See Table 7 for a summary of characteristics of included articles). All 14 NRSIs investigated the physiology of the mechanism of labour about maintaining a squatting position compared to standing, semi-recumbent, supine, and lithotomy. Eleven NRSIs focused on variables related to squatting positions and the measurements of pelvic dimensions [2, 3, 7, 22-24, 27-29], one NRSI measured dimensions of hip flexion and abduction and lumbar curve [31] and one NRSI compared the alteration of biomechanical metrics when squatting on a tiptoe changing to feet flat on the ground. [26] Three NRSIs concentrated on the effects of squatting position on intra-uterine pressure with its effect on the efficiency of the contractions [21, 25], and one on the intrapartum angle of foetal head progression during the second stage of labour measurements. [30]

Findings from pelvic dimension and intra-uterine pressure analyses varied depending on the measurement instrument used, collection and reporting of outcomes and what factors are included in the investigation.

3.3.6 Risk of bias

All included NRSIs were assessed as 'serious' risk of bias in the confounding domain, participant selection, intervention classification, and selection of reported results but were deemed to be at a 'low' risk of bias across the other domains (deviations from intervention, missing data, outcome measurement). Appendices: 5 Table of Risk of Bias; 6 Table of Assessing the Risk of Bias.

Table 7: Characteristics of the included studies

Study (including country of origin) *	Interventions and number of subjects	Inclusion & exclusion criteria	Study design and length of follow-up	Outcomes and outcome instruments used
1. Buhimschi et al [21] (USA).	McRoberts vs dorsal lithotomy. 22 women in active labour	Inclusion criteria: women in labour with epidural analgesia and cephalic presentation Exclusion criteria: high risk women	Cross-over – patients acted as own control.	Measure of intrauterine pressure. Outcome instrument: A sensor-tip catheter connected to a recording system.
2. Desseauve et al [26] (France).	Squatting: with feet flat on the floor with tiptoe on the floor 11 out of 13 pregnant women not in labour.	Inclusion criteria: 18 years old 32week gestation Exclusions: BMI > 40, without inflammatory joint diseases or joint hypermobility syndrome, Marfan's syndrome	Prospective comparative – patients acted as own control.	Angle of flexion on the spine of the plane of the pelvis external conjugate, hip flexion and abduction and lumbar curve. Outcome instrument: Optoelectronic motion capture system consisting, and a biomechanical model adapted from the conventional gait model and a measuring system of the lumbar curve.
3. Desseauve et al [31]	Hip flexion.	18 years old and above	Cohort Prospective	Flexion and abduction), the pelvis

(France)	Hip abductions. 20 convenient sample of pregnant women (2 lost to follow up)	Antenatal period in the 1st, 2nd and 3rd trimester; BMI under 40Kg, m^2; Exclusion: no current or previous history of inflammatory joint disease or joint hypermobility syndrome		external conjugate, and lumber curve position, joint laxity and maternal characteristics. Outcome instrument: Optoelectronic motion capture lumbar curve with Epionics Spine system Joint laxity was measured with modified Jobbin's extensometer
4. Gherman et al [27] (USA).	Squatting Lithotomy. (36 women in labour)	Inclusions: 36 Women at least >36 weeks gestation, in labour or delivery. Exclusions: active labour and high risk pregnancy	Cohort. Prospective. .	Pelvic dimensions: pelvic inlet; mid-pelvis; pelvic outlet; all measurement of antero-posterior and transverse; symphyseal separation, obstetric conjugate, true conjugate, diagonal conjugate; measure between symphysis pubis & top of L5. Outcome instrument: X-ray - Colcher-Sussman technique Radiographic magnification with a metallic ruler

5. Gupta et al [23] (UK).	Full squatting Semi-recumbent. (63 postnatal women)	5th or 6th post-natal day after caesarean section	Cross-section. Prospective – patients acted as own control.	Pelvic dimensions: pelvic inlet & outlet Outcome instrument: Radiographic x-ray
6. Hemmerich et al [29] (Canada).	Kneeling-squat. Supine. 5 none-pregnant women	Non-pregnant women	Cohort. Prospective.	Pelvic dimensions: anteroposterior and pelvic outlet and transverse diameters. Outcome instrument: Obstetric Magnetic Resonance Imaging (MRI) scan
7. Hemmerich et al [28] (Canada).	Squatting. All-fours. McRoberts. 2 pregnant and 3 non- pregnant	Pregnant women (3rd trimester); non-pregnant	Cohort. Prospective.	Pelvic movement: hip and sagittal plane lumbosacral joint. Outcome instrument: Ten optical motion capture cameras and synchronised with ground reaction force.
8. Hemmerich et al [7] (Canada).	Full squatting (50 pregnant and non-pregnant women)	Pregnant women Non pregnant women	Cohort. Prospective.	Pelvic dimensions: anatomical landmarks on the innominate bones, sacrum and coccyx. Anteroposterior and transverse diameters. Pubic symphysis width and angle.

				Angle of pelvis areas at the inlet, mid-plane, and outlet. Measure of ligament laxity
9. Lilford et al [24] (UK).	Squatting. Standing. (43 postnatal women).	Postnatal women 1 week after caesarean section	Cross-sectional study – patients acted as own control. Prospective.	Pelvic dimensions: pelvic in-let; pelvic outlet and bi-spinous diameter Outcome instrument: Radiographic x-ray
10. Michel et al [3] (Switzerland).	Squatting: Hands & knees: Supine. 10 multiparous and 25 nulliparous.	Inclusion criteria: any parity; age >18 years; breech presentation; gestation age (range 35 to 39 gestation weeks) Exclusion criteria: women with metal prosthesis; contra-indication for vaginal breech birth.	Cross-sectional study – patients acted as own control. Prospective.	Pelvic dimensions: obstetric conjugate, sagittal outlet, interspinous diameter, inter-tuberous diameter, transverse diameter. Outcome instrument: Obstetric MRI scan
11. Reitter et al [22] (Germany).	Kneeling-squat: Supine-dorsal. 100 women (50 pregnant & 50	Pregnant & non-pregnant women	Cross-sectional study – patients acted as own control. Prospective.	Pelvic dimensions: anatomic conjugate; obstetric conjugate; diagonal conjugate; anteroposterior diameter of mid-plane;

	non-pregnant)			lower antero-posterior diameter of mid-plane; anterior-posterior outlet. Outcome instrument: Obstetric (MRI) scan
12. Roberts and Hanson [25] (USA). (cited from Mengent & Murphy (1933)	Squatting, sitting on stool or chair, standing, lateral prone, knee elbow, recumbent and semi-recumbent. (5 pregnant women).	Inclusion: women in the second stage of labour	Cross-sectional study – patients acted as own control.	Measuring intra-uterine pressure. Outcome instrument: Vaginal balloon
13. Russell [2] (UK).	Squatting: Supine. (96 pregnant and 47 postnatal women of any parity).	Pregnant women in their third trimester and six weeks postnatal women	Cross-sectional study – patients acted as own control. Prospective.	Pelvis dimensions : bi-spinous diamètres, sagittal ourlet. Outcome instrument: Radiographic x-ray
14. Zimerman *et al* [30] Israel	Squatting: Supine (50 nulliparous women during the second stage of labour)	Inclusion: Nulliparous women; full cervical dilation; Foetal occipital-anterior position Exclusion criteria: multiple pregnancy, non-vertex or non-	Prospective cohort study Study follow up not stated	Intrapartum angle of progression (AoP) measurements (i.e., assessment of foetal head descent in the second stage of labour) Outcome instrument:

3.3.7 Comparison of Pelvic Dimensions

Ten NRSIs (407 women) reported on maternal pelvic dimensions. [2, 3, 7, 22-24, 26-29, 31] Eight of these found a significant increase in the size of the pelvic outlet when squatting; ranging approximately from 1-3cm compared with standing, supine and semi-recumbent. [9,13,16,19-22, 31] Two NRSIs found no significant difference between the squatting positions compared with semi-recumbent and supine on the pelvic outlet. [23, 27]. Seven NRSIs found a significant increase in the pelvic transverse diameter when squatting, compared with other positions. [9,13,16,19-21,22] Three NRSIs found no significant difference between the squatting position and other positions on the pelvic transverse diameter. [3, 23, 27]. Three NRSIs did not report the outcome of the pelvic dimension of squatting positions in pregnancy and childbirth. [21, 25 ,30]

Three NRSIs showed a significant decrease in the pelvic inlet dimensions (true conjugate) when women moved from standing or supine positions to a hyper-flexed position with the abduction of the thighs and the knees onto the abdomen (squatting). [22, 23 27] It has been hypothesised that a reduction of the true conjugate facilitates flexion and rotation of the presenting part of the baby. [22]

One NRSI assessed the impact of foot position on biomechanical parameters in the obstetrical biomechanics of squatting position between tiptoe and flat feet. The angle of hip flexion on the spine of the plane of the pelvis external conjugate, hip flexion and abduction, and lumbar curve was significantly increased on a flat foot compared with tiptoe. It was concluded that the biomechanical effects of different squatting positions may vary, whereby squatting on flat feet on the ground is closer to optimal birth conditions than squatting on tiptoe.

3.3.8 Association of Pelvis orientation, lumbar curve, and thigh postures

One NRSI [31] assessed the effects of hip flexion and abduction on the position of the pelvic inlet plane and the lumbar curve in the gynaecological position according to the individual characteristics of 20 pregnant women during the first, second and third trimesters. Among 18 participants in this NRSI, hip flexion and abduction when squatting were significantly associated with the angle between the external conjugate and spine facilitated by joint laxity as the pregnancy progressed. However, the association of the flexion of the thighs in squatting positions and the estimation of pelvic dimension was significantly higher compared with hip abduction. It was found that 4.35 degrees of hip flexion led to 1 degree of flexion of the pelvic inlet plane. In the lumber curve analysis, the association was significantly higher for hip flexion than for hip abduction. [31]

3.3.9 Comparison of Intra-uterine pressure

Three NRSIs (63 women) [21, 25, 27] found that intra-uterine pressure was significantly increased when assuming the squatting position compared with other positions. A significant increase in intrauterine pressure was associated with effective expulsive forces produced by intensive and efficient contractions with hyper-flexion of the thighs to the abdomen resulting in adequate progression of labour compared with lateral, semi-recumbent, and supine positions. [21] The squatting position converts involuntary maternal expulsive effort, dependent on or independent of uterine contractions, into a significant increase in intrauterine pressure. In the squatting position, the efficiency of intra-uterine pressure (squatting 143mmHg; sitting on a stool or chair 154mmHg) was found when converting voluntary maternal expulsive force to enhance uterine pressure independent of contractions. This intra-uterine pressure was similar with standing 145mmHg compared to other positions (lateral – 118mmHg; supine – 127mmHg; knee elbow 134mmHg and semi-recumbent – 135mmHg). [25]

3.3.10 Comparison of the Intrapartum Angle of Progression

One NRSI (50 women) [30] reported the intrapartum angle of foetal head progression measurements at four femoral-pelvic angle stations: hip extension at -10^0; lying flat at 0^0 (standard obstetric bed with stirrups); knees flexed at 45^0; and hip hyper flexed at 135^0 (McRoberts' manoeuvre). A significant increase in the intrapartum angle of foetal head progression values with maternal hip flexion with 135^0 in the second stage of labour facilitating a normal vaginal birth was also reported.

When a median intrapartum angle of foetal head progression was measured in the different stations, a significant median increase in measured intrapartum angle of foetal head progression values from extended hip (45^0) to hyperflexion in the McRoberts manoeuvre (135^0) was observed. A small intrapartum angle of foetal head progression values was found from lying flat (0^0) to flexed knees (45^0).

3.3.11 Comparison of the Pelvic Floor Muscles

The effects of squatting compared with other positions on the pelvic floor perineal muscles were not reported in any of the included studies.

3.4 Discussion

3.4.1 Summary of Findings

The available evidence regarding the biomechanical effects of squatting position in childbirth is of very low quality for pregnant, non-pregnant, and postnatal women. The evidence in this chapter shows that squatting during childbirth is associated with five biomechanical effects, listed as the following: Firstly, it increases the transverse and anteroposterior dimensions in the mid-pelvic plane and the pelvic outlet as pregnancy progresses, likely due to joint laxity. Secondly, the angle of hip flexion, abduction, and lumbar curve is significantly increased when squatting on a flat foot compared to tiptoe. Thirdly, squatting significantly enhances the

efficiency of expulsive force, increasing intra-uterine pressure independently of contractions. Fourthly, it also increases the efficiency of intra-uterine pressure with contractions alone, independent of maternal effort. Lastly. squatting increases the intrapartum angle of foetal progression during the second stage of labour.

3.4.2 Agreements and disagreements with other literature

The effect of squatting highlighted in magnetic resonance imaging (MRI) NRSIs showed that the sacral promontory is flattened in the squatting position, leading to a decrease in the inlet anteroposterior compared with standing and supine positions. [3, 22] This has been supported by several authors. [32-36] Verralls [36] hypothesised that, in the squatting position, the iliac crests move inwards, as though the ilium is being squeezed, and the promontory of the sacrum moves downwards and forwards, reducing the true conjugate whereby the outlet is enlarged as the anteroposterior and transverse diameters are increased. Reitter et al [22] add that a reduction of the true conjugate does not hinder the progress of labour, but facilitates a more foetal flexion and optimal rotation of the presenting part of the foetus; thus, transforming the foetus into a cylindrical shape with the smallest possible cross-section passing through the pelvic canal. [15]

The NRSIs included in this review suggest that the fundamental biomechanical characteristic of squatting position in childbirth is the abduction as well as hyperflexion of the thighs to the abdomen or chest with a vertical or horizontal spine. [2, 21, 22, 37] The thighs are anatomically connected to the pelvis by a ligamentous complex. [31] Movement of the thighs that involves the hip flexion causes a significant movement of the pelvis relative to joint laxity during pregnancy and the maternal weight off the pelvis. [7, 31] Several studies have found an increase in peripheral ligament laxity as pregnancy progresses,[38-40] reaching the maximum during the second trimester of pregnancy. [41] According to Deseauve *et al.*, [31] the correlation analysis of these parameters shows a linear relation of 4.35 degrees hip flexion to 1-degree pelvic flexion in the third trimester of pregnancy.

The findings of two NRSIs showed that during birth the coccyx rotates outwards in the sagittal plane when unencumbered. This is believed to be due to the gravitational force of the foetus opening the pelvic outlet whereby the sacrum and coccyx move freely by pulling the sacrum outwards[2, 7] facilitating an even and direct application of the foetal head to the introitus. [1, 42] This is supported by Verralls [36], who states that the pubic angle is widened because the ischial tuberosities move further apart; the coccyx moves upward and backwards while the outlet is enlarged as the anteroposterior and transverse diameters increase.

Another finding is that hyper-flexing of the thighs when the spine is vertical or horizontal increases pressure. This is caused by the uterus when the thighs are brought closer to the diaphragm, doubling the intra-uterine pressure of up to 154mm generated by contractions only without maternal effort. [21, 25] With an increase in intra-uterine pressure, it is essential that during birth minimum or no expulsive muscular effort is used to promote a physiological slow descent of the vertex (head of the foetus) allowing optimum relaxation of the perineum. However, the effect of the increased pelvic dimensions, intra-uterine pressure, improvement in the efficiency of contractions and expulsive efforts and their relation to the protection of the pelvic floor muscles is uncertain.

This SR suggests that there is a linear correlation between hip position (flexion and abduction) and pelvic mobilisation. The squatting positions can allow the optimal foetal body progression under the best conditions through the birth canal as shown by Zimerman *et al.*,[30] The optimal conditions could be obtained if hyperflexion of the thighs occurs together with ligament laxity in pregnancy and labour. [21, 25, 30, 31] Several studies have hypothesised that the biomechanical effect of the squatting position significantly decreases the pelvic inlet, a feature that allows a more direct line of entry for the foetal head into the pelvic canal that facilitates the progression of the second stage of labour. [7, 22, 29, 30]

It has been hypothesised that foetal engagement starts best when the approach of the foetal head is at a right angle to the pelvic inlet. [43, 44] This is supported by the findings of this review, whereby optimal foetal head positioning about optimal positioning of the thighs, pelvis and lumbar spine is relevant for potential foetal progression in the pelvis ideally following the pelvic axis, to facilitate physiological birth. [4, 30, 45]

3.4.3 Quality of evidence

The quality of the evidence supporting the findings of this review is limited due to the small number of participants in the individual studies and inconsistencies in the outcome measures. The main source of bias is the methodological limitations in that blinding was not possible then it is important to blind the outcome assessors.

RCTs in pregnancy, particularly for complex interventions, can be challenging due to ethical considerations, logistical constraints, and the preferences of the women involved. When women have clear preferences and choices in their birth plans, it's essential to respect their autonomy and consider alternative research methods.

In cases where randomized trials might not be feasible or ethically acceptable, developing high-quality observational evidence can be a valuable approach. Observational studies can provide insights into the real-world effectiveness of interventions while respecting individual preferences and choices. These studies can utilize various designs, such as cohort studies or case-control studies, to examine outcomes in pregnant women based on the interventions they choose.

However, it's crucial to acknowledge the limitations of observational evidence, such as potential confounding variables and biases. Therefore, researchers should strive to minimize these limitations through careful study design, robust data collection methods, and appropriate statistical analysis.

Ultimately, the choice between RCTs and observational evidence depends on various factors, including the nature of the intervention, ethical considerations, feasibility, and the preferences of the women involved. Collaboration between researchers, healthcare professionals, and expectant mothers is essential to ensure that research methods align with ethical principles and address the needs and preferences of pregnant women.

3.4.4 Overall completeness and applicability of evidence

A biomechanical analysis of the squatting positions during pregnancy, labour and birth was conducted with the best available current evidence. Clinical practice and future protocols on the squatting position can be informed by the characteristics summarised in Table 3.1 and should involve the elements of different types of squatting illustrated in the review, i.e., full, and modified squatting techniques. Specific biomechanical characteristics of these techniques to be considered in clinical practice are discussed in section 3.3.2, where women's thighs are hyper-flexed to at least 45 degrees. Additional biomechanical approaches to squatting position could necessitate the precise positioning of the pelvis and spine, which might influence the rotation of the foetal head to the occiput anterior position. [4, 31] The duration of assuming a full squatting position could not exceed 10 minutes per session [22] and modified squatting using equipment to support the women's weight was considered appropriate for women's comfort. [23]

The assessment of the squatting position of the lumbar spine, the pelvis and the spine were conducted using various measurement tools, mainly X-ray radiological, MRI and ultrasound (see Table 3.1). The use of X-rays during physiological pregnancies to improve knowledge of these obstetrical biomechanics raises ethical concerns due to the use of radiation. [4] The use of MRI during labour is constraining and prevents women from assuming comfortable positions. [22, 46] Ultrasound alone appeared to be a safe and suitable method for investigating the biomechanics of women's positions during childbirth but is limited to measuring pelvis

dimensions alone. [4] Other safe methods include optoelectronic motion capture systems and the Conventional Gait Model which have been used successfully to measure the movements of the hips, joints, and pelvis of pregnant women. [4, 26, 47, 48] Future protocols might measure intra-uterine pressure using a sensor-tip catheter connected to a recording system or vaginal balloon [18, 21] as well as intrapartum angle of progression using radiographic ultrasound[30] and joint laxity using Jobbin's extensometer. [31]

Some key attributes for participants to consider when examining maternal positioning of the pelvis, lumber spine and thighs are listed in Table 3.1. These include women from 33 gestation weeks of any parity, aged 18 years and above, cephalic presentation, using or not using epidural analgesia and excluding those with inflammatory joint disease or joint hypermobility syndrome.

This review of the biomechanical effects of squatting position compared with other positions found a large degree of variation in interventions, outcome measurement tools, control protocols, and types of women. This heterogeneity meant it was not possible to pool data in meta-analyses. The included studies also used a variety of squatting positions with different levels of hyper-flexing and vertical or horizontal spine. There was insufficient detail to enable replication of the techniques of squatting (e.g., settings, type, intensity, and optimal timing). Additionally, information demonstrating the acceptability of the implementation of the included methods and the key attributes that are essential for the health caregiver are unclear and active components of the control group compared to squatting are not recognisable. Therefore, the overall evidence assessing the biomechanical effects of squatting compared with other positions, and the external validity of the findings, should be interpreted cautiously.

3.4.5 Reflections on the literature search

The initial search for this review was conducted in May 2013 and guided the research direction of this thesis. Since then, the literature search was updated and reassessed annually, with a final search date of 31 January 2020. A broad search strategy with selected key terms was developed to represent issues prevalent in childbirth with limited specificity to a squatting position. The main search included the four most comprehensive databases [49] (CENTRAL, MEDLINE, PubMed, and EMBASE) and two specialist databases (CINAHL, MIDIRS) to increase the probability of identifying relevant studies.

There are no other known published reviews on this topic. The 14 included NRSIs provided data on the biomechanical characteristics of squatting position. Seven of these were published after the start of this DPhil study in 2012: one NRSI was published in 2014 [22], three NRSIs in 2018, [28-30]; and three NRSIs in 2019 [7, 26, 31]. The gradual increase in the number of publications evaluating the biomechanical characteristics of squatting positions in childbirth illustrates the necessity of a new approach required for assessing the effectiveness of birth positions in childbirth. [4, 6] This should explore the biomechanical effects on the hip joint angles (hyperflexion, abduction, and adduction) and their impact on the pelvis, lumbar curve, optimal foetal positioning, and progression in labour. [4, 6, 22, 26] It has been argued that such studies will not only enhance a better understanding of the benefits or harms of different birth positions but also the ability to reproduce them. [31]

3.4.6 Strengths of the study

The major strength of this SR is that it addresses the evidence base that correlates different squatting positions with the mechanisms of labour. It included 14 NRSIs of biomechanical parameters including joint laxity, showing the relationship of squatting position with pelvic dimensions, intra-uterine pressure, and intrapartum angle of foetal progression of squatting position. The overall biomechanical effects of squatting position on some elements of the

mechanism of labour have been highlighted and gaps in current evidence have been identified.

The SR also showed how different techniques of squatting positions may impact on biomechanical parameters of the pelvic measurements that may result in different birth outcomes. The review improves the evidence base for biomechanical mechanisms associated with squatting position in childbirth, which might explain heterogeneous or homogeneous results of the effects of different positions on maternal and child outcomes.

Eight included NRSIs [2, 3, 21-26] used a study design in which each woman acted as her control alternating between squatting and other positions. This enabled a better comparison of biomechanical features between positions without introducing confounding due to individual or obstetrical care differences between women. A strong internal validity of this design is that error variance is reduced and a smaller sample size would lead to statistically valid conclusions. [18]

3.4.7 Limitation of the study

The published and unpublished in languages other than English were not included and the included NRSIs were conducted in high-income countries, limiting the generalisability to a wider context. Moreover, there is a possibility of publication bias with only two studies reporting negative results for overall assessment of pelvic dimensions.

Wide variations attributed to different instruments used to measure outcomes, populations, diversity of experimental and control groups, outcome measurements and observer biases prevented meaningful meta-analysis and led to difficulties in comparing and contrasting results. This makes drawing solid conclusions about squatting positions difficult, and the overall results should be taken with caution. Further studies with improved methodology are required to provide a better and more consistent comparison of positions during childbirth.

Furthermore, the search did not retrieve any study of the physiological relationship between squatting position and perineal integrity (pelvic floor muscles) during vaginal birth. This outcome is important to women and their families. [50-53] as it helps reduce severe perineal injury related to long-term maternal complications such as pain, urinary retention, urinary and faecal incontinence, and sexual dysfunction which significantly affect the quality of life. [50-53].

More robust studies are needed to evaluate the effect of squatting on pelvic dimension, intra-uterine pressure, and intrapartum angle of progression. There is limited evidence to support an ideal squatting position during the second stage of labour. In addition, differences between the numerous squatting positions are not apparent. For example, the position of the pelvis relative to the lumber spine and the flexion of the thighs must be examined. Furthermore, high-quality studies with larger sample sizes ($n \geq 100$) are essential.

3.4.8 Implication of the review for clinical practice

Although there is growing evidence to suggest how squatting positions might work to improve maternal and neonatal birth-related outcomes, this evidence is of low quality. Healthcare providers involved in childbirth should have a good understanding of the biomechanical aspects related to the squatting position. This includes knowledge of how the squatting position affects foetal head descent through the pelvis, pelvis movements, the efficiency of contractions, and the role of pelvic floor muscles during pregnancy and childbirth. This knowledge can help in making informed decisions about when and how to implement the squatting position during pregnancy and childbirth. However, there is insufficient information on the key attributes of the care providers that are needed for the application of squatting position.

3.4.9 Implication of the review for future research

RCTs are often considered the gold standard for evaluating the effectiveness of interventions because they can minimize bias and provide robust evidence of causality. However, conducting

RCTs in pregnancy for complex interventions can present challenges, particularly when women have clear preferences and choices in their birth plans.

The following five factors should be put into consideration when deciding appropriate study designs:

1) **Feasibility:** Conducting RCTs in pregnancy can be challenging due to ethical considerations, logistical issues, and the need for large sample sizes to detect clinically meaningful differences. Additionally, recruiting and retaining participants in RCTs during pregnancy can be difficult due to the emotional and physical demands of pregnancy and childbirth.

2) **Preferences and Choices:** Women's preferences and choices in their birth plans may impact the feasibility and acceptability of RCTs. If women strongly prefer a particular intervention or approach to childbirth, it may be challenging to randomize them to different treatment groups. This can lead to issues with adherence and attrition, which may compromise the validity of the trial results. However, some RCTs have considered women with no preferences to resolve attrition, while promoting choice.

3) **Ethical Considerations:** Ethical considerations are paramount in conducting RCTs during pregnancy. Researchers must ensure that the trial design respects women's autonomy, minimizes potential harm, and adheres to ethical guidelines for research involving pregnant women and fetuses.

4) **Alternative Study Design:** In cases where RCTs are not feasible or acceptable, alternative study designs, such as observational studies, may be used to evaluate complex interventions in pregnancy. Observational studies, including cohort studies and case-control studies, can provide valuable insights into the effectiveness and safety of interventions while allowing participants to make their own choices regarding their care.

5) **Combining Evidence:** In some cases, a mixed-methods approach that combines both RCTs and observational studies may be beneficial. This approach can provide a more comprehensive understanding of the effectiveness, safety, and acceptability of complex interventions in pregnancy.

Ultimately, the choice between conducting RCTs or developing high-quality observational evidence will depend on the specific research question, ethical considerations, feasibility constraints, and the preferences and choices of pregnant women. Collaboration between researchers, healthcare providers, and pregnant women is essential to designing studies that address these considerations while providing meaningful evidence to inform clinical practice.

3.5 Conclusion

The need for a better understanding of squatting positions in childbirth for investigation in clinical trials is essential. This chapter has synthesised evidence which suggests an increase in pelvic dimensions, intra-uterine pressure, and a faster descent of the foetus in the second stage of labour when assuming a squatting position compared with other positions and one assumption justifying these results is the biomechanical characteristics of squatting which are abduction and flexing of the thighs. This review also reveals the variants of squatting positions and techniques used in childbirth and that not all squatting positions are equal. This implies that variations in squatting techniques could result in different birth outcomes. Further validation of the evidence from the observational studies included in this review and an evaluation of the effects of squatting positions will improve our understanding of its use in childbirth and a research question for the next chapter is: W*hat are the potential benefits and harms of squatting compared with other positions in the second stage of labour for low-risk women?*

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CHAPTER 4

A Systematic Review and Meta-analysis

4.0 A Systematic Review and Meta-analysis

4.1 Background

Chapter 3 showed that intra-abdominal pressure can be increased in the squatting position [1-3] and noted radiological reports of an increased sagittal diameter of the pelvic outlet in the squatting position [4-7] which can improve birth outcomes. [8-12] However, the overview in Chapter 2 illustrated that the overall evidence from CSRs of the effects of different maternal positions during childbirth is fragmented.

In this chapter, the two previous chapters are advanced by focusing on quantitative studies comparing the effects of squatting positions with other positions during the 2nd stage of labour, on maternal, foetal and neonatal birth outcomes. This is to synthesise the most current evidence, updating and enabling a more objective appraisal of the evidence on the effects of maternal positions in childbirth. In addition, it helps to identify areas where the available evidence is controversial and where further good-quality trials are required. [13] This chapter focuses on answering the question: *what are the potential benefits and harms of squatting compared with other positions in the second stage of labour for low-risk women?*

4.1.1 Research Objectives.

The primary objective is to systematically evaluate evidence from quantitative studies to summarise the benefits and harms of assuming a squatting position compared with other positions during the second stage of labour.

The primary outcome measures are the duration of the 2nd stage of labour, mode of birth, postpartum haemorrhage, perineal integrity, and other secondary maternal, foetal and neonatal outcomes.

4.2 Methodology

The *Cochrane Handbook of SRs of Interventions* [1] methods were adopted to identify, appraise,

and synthesise relevant studies. This review was first registered on PROSPERO (CRD42014014255) on 15 October 2014. After careful consideration and gaining insight both into the review topic and methodological issues, an update of the protocol was essential (see updated protocol: PROSPERO: CRD42020166032, registered on 26 February 2020).

Criteria for considering studies for this review.

4.2.1 Types of Studies

The quantitative component of the review considered both RCTs and NRSIs [14], as has been recommended within the evidence-based frameworks. [15-17] It was anticipated that well-designed NRSIs may provide sound evidence comparable to that of RCTs and might address some interventions, outcomes and adverse events that were missed in the RCTs. [18] However, caution is needed when combining data from these two types of studies because NRSIs may be more likely to overestimate any potential benefits, as they lack randomisation. [19, 20]

4.2.2 Types of Population

Pregnant women of any parity (primigravidae and multi-gravidae), in the 1st or 2nd stages of induced or spontaneous labour, with or without epidural analgesia, were eligible. Women recruited in any stage of labour and classified as being of low-risk pregnancy, uncomplicated and planned or anticipated vaginal birth were eligible. Women with all other high-risk pregnancies were excluded. Women giving birth in any setting (i.e. a hospital, home births, standalone birth centres, midwifery-led care units or health community centres) were eligible.

4.2.3 Type of Childbirth Condition

Women using squatting positions compared with other positions during the 2nd stage of labour or birth were eligible. There are three potential time phases of birth in which the effects of different positions can be studied. [21] These distinct phases of the 2nd stage of labour are the

latent phase, the active phase, and both. The passive phase occurs when the cervix is fully dilated but there is an absence of involuntary expulsive contractions, facilitating descent of the presenting part to the pelvic floor. [22] The active phase is from the onset of expulsive contractions that facilitate the progressive descent of the foetus through the pelvic floor until the birth of the baby. [22] Studies of the effects of a squatting position during the 1st stage and third (3rd stage) stages of labour were excluded but studies were included where women assumed a squatting position during the 1st stage of labour but continued with this position into the passive and/or active 2nd stage of labour. Case reports or individual reports of the benefits and adverse events, surveys and qualitative studies were excluded.

4.2.4 Types of Interventions

The experimental intervention in this SR was the use of any squatting position (as listed in Chapter 3 section 3.2.2) and those defined by the authors of the included studies. In this SR, squatting is defined as vertical, [23-26] or upright [27] deep or crouching, or unsupported squatting [28] and supported sitting [29] or modified squatting. [30-32] Studies evaluating the association of the sitting position without defining the position adequately were excluded. This SR included only studies which evaluated squatting other than multi-upright positions (e.g., all fours, kneeling). This restriction allowed a more specific evaluation of one position to ensure greater similarity in aspects of some detailed and comparable description to have been included in the report of the RCTs (e.g. who delivered the intervention).

4.2.5 Type of Comparisons

The control group included upright positions other than squatting and horizontal. Any upright position other than squatting as listed in Chapter 2 Section 2.4.4 and Section 2.4.5 for horizontal positions.

4.2.6 Main Outcomes

Primary outcomes included duration of birth, mode of birth and adverse events associated with upright positions commonly reported in research on this topic. [12, 21, 33, 34] The maternal and infant outcomes were informed by the overview of reviews in Chapter 2. These are:

4.2.6.1 Maternal Primary Outcomes

Short-term (immediate up to 24 hours) primary outcomes:

- Duration of birth (second stage of labour) in minutes
- Operative birth (caesarean section or assisted vaginal birth)
- Maternal primary outcomes – adverse events:
- PPH ≥ 500ml requiring intervention – need for blood transfusion.
- Estimated PPH moderate > 1000ml and severe > 1500ml.
- Perineal trauma that required suturing involved the sum of 2nd, 3rd or 4th degree tears and episiotomy.

4.2.6.2 Maternal Secondary Outcomes

- Need for analgesia/anaesthesia.

4.2.6.3 Foetal or Neonate

- Abnormal foetal heart rate patterns
- Need for neonatal intensive care unit (NICU)

4.2.7 Search Strategy.

A systematic literature search was undertaken to reduce selection bias and therefore assist with achieving reliable estimates of effects. [35-37] The search strategy included MEDLINE, EMBASE and CENTRAL, as recommended by Methodological Expectations of Cochrane Intervention Reviews (MECIR), [38] together with six additional databases and a search of the grey literature using online websites. [39] The reference lists and bibliographies of the eligible

studies retrieved were scrutinised for further studies. [40] Table 8 describes the different methods used to retrieve eligible studies.

Table 8: Literature Search Strategy

Type of search engine	Databases and other methods
Electronic databases	MEDLINE (1966–April 2020) EMBASE (January 1947–December 1979 and January 1980–November 2020) Midwives Information Resource Service (MIDIRS) (1985–Nov 2020) Cochrane Database of Systematic Reviews (CDSR) Database of Abstracts of Reviews of Effectives (DARE) Cochrane Central Register of Controlled Trials (CENTRAL) Cumulative Index of Nursing and Allied Health Literature (CINAHL) PsycINFO via OVID (1806–November 2020) ProQuest Dissertations and Theses (1861–November 2020 unpublished dissertations)
Grey literature (websites, conference proceedings)	Open Grey, Social Care Online, Social Science Research Network Library and Google Scholar through April 2020 Trial registers ClinicalTrials.gov The WHO International Clinical Trials Registry Platform (ICTRP)
Other search methods	Reference lists and bibliographies of all eligible articles identified through electronic databases were scrutinised for additional relevant articles.

The search strategy was designed by MK (lead author) to access both published and unpublished articles. Electronic searches were conducted by MK, assisted by an experienced research librarian (Mark Kerr) at a local NHS hospital's postgraduate library. Full copies of potentially eligible articles were obtained. Each database was searched from inception until November 2020. No date or language restriction was imposed, and searches were not restricted by publication type.

4.2.8 Selection of Included Studies

All studies identified as a result of the search strategy were assessed for eligibility. MK selected relevant studies by screening all titles, abstracts and full articles for eligibility using a standardised Cochrane Pregnancy and Childbirth group form. This uses a standardised inclusion criterion for assessment where each study was assessed by type of study, participants, intervention, comparison, and outcome measures. AP checked for accuracy and verified five studies that were deemed eligible. Further discussions were made through MC, IG and ST.

4.2.9 Data Extraction (selection and coding)

Eligible studies identified during the literature review were managed in Endnote. Final records of studies were then imported into the Review Manager 5.3 (Rev-Man) software. [41] Data were extracted using a standardised, piloted, and validated form designed by the Cochrane Pregnancy and Childbirth group. Data were extracted and managed by MK and included three main categories: identifying features of the study (author, publication date, title, source, and country); content of the study (characteristics of participants, details of the intervention and reported outcomes); and data for the meta-analysis.

Furthermore, additional data extracted were to examine the quality of the description of the interventions reported in the included studies. The purpose was to assess its potential for replicability in clinical practice or in subsequent trials (e.g. content, intensity and how delivered) and assessment for generalisability (e.g. setting, recipient and provider). Other items that may provide additional descriptions of the interventions included in the studies are supplementary materials (e.g., for training or clinical guidelines for clinicians). This was essential because the use of squatting and other positions in childbirth may vary in their components and how they are delivered, thus providing a precise description of these positions studied. Therefore, data on the details of the description of the experimental and control groups from each study were

coded and qualitatively analysed using the TIDieR checklist. [17, 42] This checklist has 10 items: brief name, why, what, who, how, where, when and how much, tailoring, modification, and how well.

4.2.10 Assessment of Risk of Bias in Individual Studies

All eligible studies were appraised by MK using standardised critical appraisal instruments using the criteria outlined in Chapters 8 and 9 of the Cochrane Handbook. [43, 44] These tools address both the internal and external validity of each study. A complete 'Risk of Bias' table for RCTs was presented using the modified Cochrane 'Risk of bias' tool. [43] The risk of bias for each NRSI was assessed using an update of the Risk of Bias in NRSIs of – Interventions (ROBINS-I) tool, by Chapter 25 of the Cochrane Handbook. [44] This has five items for randomised trials and seven items for NRSIs. The overall risks of bias for RCTs were ranked into one of three levels: low, high, or unclear. NRSIs were ranked into one of the five levels: low, moderate, serious, critical risk of bias, and no information.

Levels of evidence were assigned on a pre-specified selection of important outcomes to provide an evaluation of the quality of the body of evidence for each outcome. This is considered when interpreting the results of a review. [31, 32] The quality reporting of each outcome was judged on five domains (risk of bias, consistency of effect, imprecision, indirectness, and publication bias) using the GRADE tool. The quality levels of evidence ranged from 1 (high) to 4 (very low).

MK rated the quality of evidence of the seven most important maternal and two foetal outcomes as listed below:

- **Maternal Outcomes:**

Operative birth (defined as a sum of caesarean section and assisted vaginal birth)

Duration of the 2nd stage of labour (in minutes)

Perineal trauma requiring suturing (a sum of 2nd, 3rd and 4th degree tears and episiotomy)

PPH ≥ 1000ml or as defined by the trial authors.

PPH ≥ 500ml requires blood transfusion or other therapy.

Need for analgesia/anaesthesia during birth.

- **Infant Outcomes**

Abnormal foetal heart rate patterns, requiring intervention.

Admission to NICU

A GRADE summary of the main findings table was created to present the intervention effect and a measure of quality for each of the above outcomes by Cochrane guidance by reviews of Ryan *et al*.[45]

Data Analysis

4.2.11 Unit of Analysis Issues: Studies with more than one Intervention Group

For studies with multiple intervention groups, the guidance in Chapter 16.5.4 of the *Cochrane Handbook for SRs of Interventions* was used. [46] In such studies, analysis was performed by following the most appropriate method for dealing with multiple groups. Groups were combined to create a single pairwise comparison, or one pair of interventions was selected but others were excluded, or the 'shared' group was split into two or more groups with smaller sample sizes and including two or more (reasonably independent) comparisons. [47, 48] The overall effect estimates of each outcome measure in this review.

were reported.

4.2.12 Dealing with Missing Data

For missing data, the recommendation from Chapter 16 of the *Cochrane Handbook for SRs of Interventions* was implemented. [49] For included studies where attrition was noted, the authors of the original reports were contacted via email to seek missing details. For all outcomes, analyses were carried out, as far as possible, on an intention-to-treat basis to preserve the integrity of randomisation. [50, 51] The impact of included studies with high levels of missing data in the overall assessment of treatment effect was explored with sensitivity analysis.

4.2.13 Measures of Treatment Effect

A narrative summary of the characteristics of the included studies and a forest plot of the study findings are presented. The RR was used because it provides more consistent and sensitive results for dichotomous data. [52, 53] The 'margin of uncertainty or error' was quantified using CIs. [54, 55] Continuous outcomes were calculated as MDs with 95% CI where outcomes were measured in the same way between studies. The effects of NRSIs were synthesised separately from those of RCTs, to reduce heterogeneity that might arise in meta-analyses of different study designs. [14, 56]

4.2.14 Assessment of Heterogeneity

Statistical heterogeneity was assessed using the I^2 statistic and Tau^2 and Chi statistics were also used. [57] This was to determine the extent to which the results of the studies were consistent with each other to enable appropriate interpretation of meta-analyses. [58] Heterogeneity was regarded as moderate or substantial if I^2 was greater than 30% and either Tau^2 was greater than zero or the P value was <0.10 in the Chi^2 test for heterogeneity. [59]

4.2.15 Assessment of reporting biases

Where there were 10 or more studies for each reported outcome, a funnel plot was used to

investigate small trial biases (such as publication bias). Funnel plot asymmetry was visually examined. If asymmetry was suggested by a visual assessment, exploratory analyses were performed to investigate it. [60]

4.2.16 Selection of Effect Model Analysis

Analyses were performed according to the recommendations in Chapter 9 of the *Cochrane Handbook for SRs of Interventions* and Rev-Man 5.3 was used for analysis. [59] A random-effect model was used to address the source of variation in results because of an assumption that the 'true' effect might differ between studies due to various descriptions of positions or other clinical and methodological diversities.

4.2.17 Subgroup Analysis and Investigation of Heterogeneity

It is important to assess moderator variables that may interact with the interventions and impact on the outcomes. [54, 61, 62] Therefore, differences in subgroups were assessed by interaction tests in Rev-Man 5.3 [41] and subgroup analyses for this review are presented in a separate chapter.

4.2.18 Sensitivity Analysis

Inadequate randomisation, attrition and reporting biases are associated with the exaggeration of treatment effects in RCTs.[63-66] It was therefore essential to test the robustness of the results by conducting pre-planned sensitivity analyses where only the results of high-quality trials with low risk of bias (based on randomisation and allocation concealment) were pooled.

The Preferred Reporting Items for SRs and Meta-Analysis (PRISMA) guidelines[67] were followed to support a rigorous reporting process.

4.3 Results

4.3.1 Study Designs.

The results of the search are summarised in the PRISMA flow diagram (Figure 4). The literature search yielded 7,150 titles in total and a further 48 records were retrieved from additional manual searching of reference lists, for a total of 7,198 available records. From these, 7,032 titles were excluded because their topic was not related to childbirth or the second stage of labour, 166 abstracts were examined, and 71 full-text articles were retrieved and assessed for eligibility. The authors of three articles were contacted for additional data or clarifications and additional data were obtained from two of these authors. Eighteen articles were excluded with reasons (see Figure 4), leaving 37 randomised or quasi-randomised trials and 16 non-randomised studies. See Appendices 7 & 8 for the Characteristics of included studies.

4.3.2 Excluded studies.

Eighteen studies were excluded with reasons, i.e. insufficient data, sitting positions not clearly defined, intervention not squatting, and outcome reported not eligible for this review. No ongoing studies were identified. See Appendices 9 & 10 for the characteristics of excluded studies.

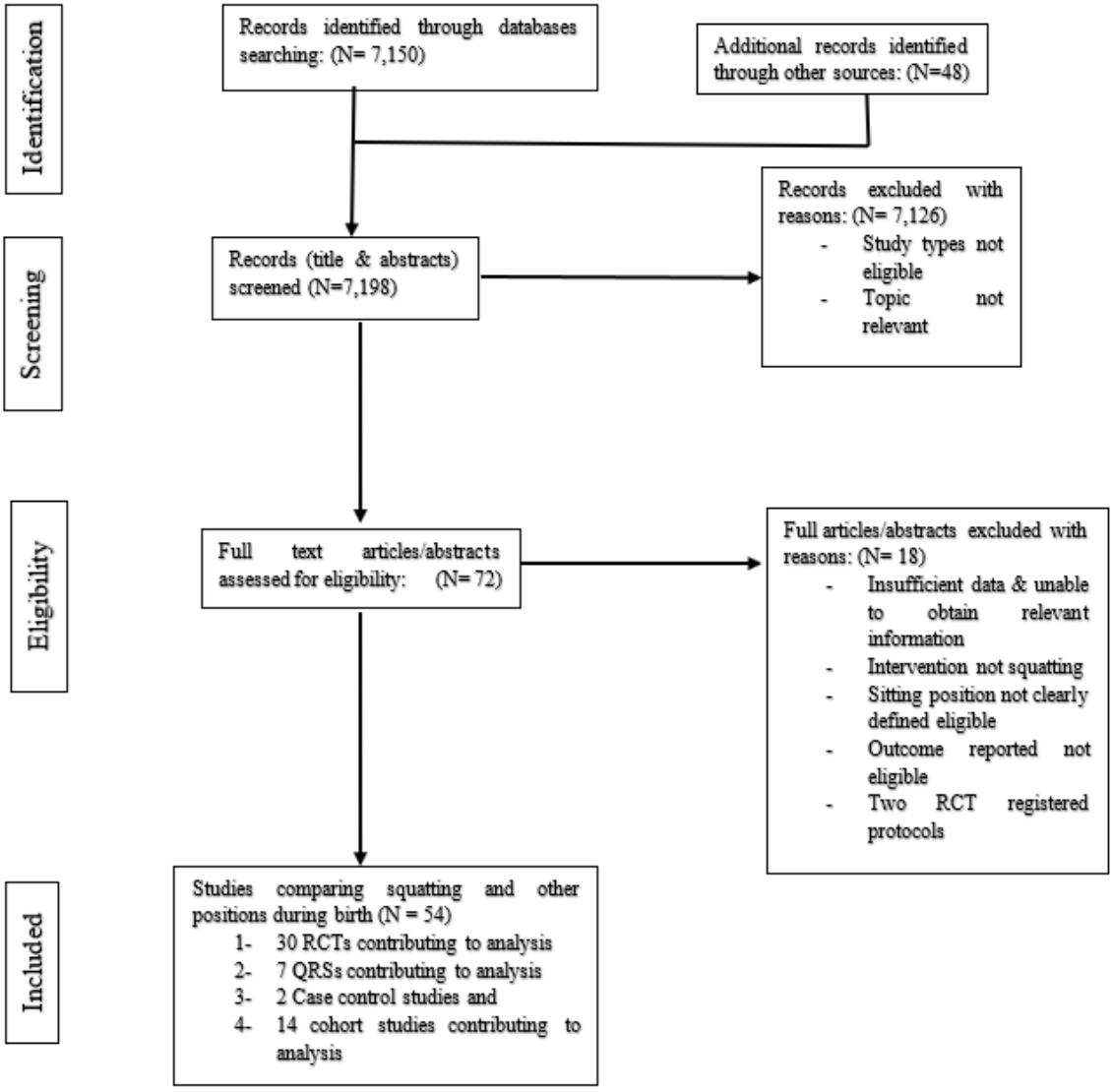


Figure 4: Diagram of the Flowchart for Literature Review

4.3.3 Study population.

This SR included 30 randomised trials, with 11,008 women [8-10, 28, 29, 68-99] and seven quasi-randomised trials. [10, 29, 74, 75, 77, 81, 85] In the RCTs, 5,686 women (51.7%) were randomised into the squatting group, and 5,322 women (48.3%) were placed in the control group. Sixteen studies were NRSIs. [1, 4, 24, 100-113] Two of these were case-control studies[105, 107] and 14 were cohort studies [1, 4, 27, 96–100, 102, 104–109] (eight retrospective and six prospective cohort studies). The NRSIs involved 561,665 women, of whom 15,205 (2.7%) were in the squatting group, and 546,067 (97.3%) were in the control group.

4.3.4 Geographical settings for the included studies

All studies were conducted in hospital settings in 22 countries, including low-, medium- and high-income countries (see Table 9 for RCTs and Table 10 for NRSIs).

Table 9: Summary of the country of origin in the Included RCTs

Number of trials	Study country
7	United Kingdom (UK) [28, 29, 76, 81, 83, 95, 97]
5	India, [68, 73, 78, 80, 89] Iran [70, 71, 85, 94, 98]
3	Sweden [69, 96, 99]
2	Finland, [82, 88] South Africa, [79, 84] Pakistan, [8, 10] Thailand,[90, 91] United States of America (USA)[72, 77]
1	Brazil, [74] China,[87] France,[92] New Zealand, [86] Canada, [93] Taiwan, [75] Turkey. [9]
Study origin by continent:	Europe (n = 18), Asia (n = 7), Middle East (n = 7), North America (n = 3), Africa (n = 1), South America (n = 1)

Table 10: Summary of the country of origin in the Included NRSIs

Number per country	Study country
3	USA,[105, 111, 113] Sweden[24, 103, 107]
2	Italy,[104, 110] The Netherlands,[102, 112] Australia[100, 101]
1	Austria,[100] Brazil,[32] Mexico,[108] Switzerland[106]
Study origin by continent:	North America (n = 3), South America (n = 2), Europe (n = 9), Australia (n = 2)

4.3.5 Types of Participants

Seventeen RCTs involved women of mixed parity (nulliparous and multiparous), [8, 10, 28, 68, 70, 72-74, 78, 79, 82, 83, 88, 92, 95, 97, 99] one RCT included only multiparous women[85] and 19 RCTs included only nulliparous women. [9, 29, 69, 71, 75-77, 80, 81, 84, 86, 87, 89-91, 93, 94, 96, 98] All 16 NRSIs included women of mixed parity (primigravidae and multiparity).

4.3.6 Characteristics of the Description of the Intervention

The summary of characteristics of experimental and control groups according to the 10 items of the TIDieR checklist are provided in Appendices 7 and 8. A summary of the mode of delivery and other components of interventions is provided in the three tables below. Mode of delivery was reported in all included RCTs, which were categorised as either full or modified squatting (Table 11). NRSIs compared one or more squatting positions with different upright and horizontal positions (Table 12). Other descriptions of the intervention according to components and duration were reported in the included studies as follows: brief definition (n = 17); squatting intermittently (n = 5) and continuously (n = 2); the intensity of exposure (n = 3); duration of exposure (n = 12); optimal timing: latent stage (n = 2) and active stage (n = 8); settings: obstetric-led (n = 42) and midwifery-led (n = 8); to whom: inclusion and exclusion criteria (n = 50) and training (n = 2); who: providers' background (n = 38), senior in experience

and skill (n = 9), material and specific training (n = 5); modification (n = 2); tailoring (n = 2); fidelity (n = 6); and strategies to improve adherence (n = 14) (Table 13)

Table 11: Summary of types of interventions reported in the RCTs.

Method of squatting	Type of intervention	Included studies
Full/deep squat vs horizontal	Squatting or crouching on delivery cot/bed/table/floor compared with lithotomy/supine/recumbent/semi-recumbent/dorsal positions.	13 trials [8] [9] [10] [68] [70] [71] [81] [28] [84] [87] [89] [92] [93]
Modified/supported squat vs horizontal	Squatting using birthing chair/ball/bed/stool/cushion/birth-rate seat/E-Z chair/supported sitting, modified squat PSU birth bed with or without holding on squat bar, vs lithotomy/recumbent/semi-recumbent/dorsal/lateral/supine.	23 trials [69] [72] [73] [74] [77] [76] [75] [78] [79] [80] [29] [82] [83, 85] [86, 88, 90] [91] [95] [94] [97] [98] [99]
Modified/supported/semi-squat vs horizontal and upright	Birth-rate seat compared with lithotomy/supine/lateral/kneeling/standing/all fours, standing, supported standing, positions.	1 trial [96]

Table 12: Summary of types of interventions reported in NRSIs.

Method of squatting	Type of intervention	Included studies
Full/deep squat vs other positions (horizontal and other upright)	Squatting compared with semi-recumbent/supine/horizontal/lateral/lithotomy/kneeling/All fours/standing/hands-to-knee/water/bed/sitting legs not flexed	9 studies [101] [105] [24] [28] [108] [32] [114] [110] [111]
Modified/supported squat vs other positions	Squatting on a birthing stool/seat/low chair compared with sitting/lithotomy/supine/dorsal/semi-recumbent/lateral/kneeling/All-fours/standing/hands and knees/usual care	12 studies [1] [4] [101] [24] [106] [107] [108]- [112] [113]

Table 13: Summary of the description of maternal positions using TIDieR tool

Name of item	Description of the item	Number of studies reporting items with (%)
Brief name	Brief definition	n = 17 (32%) [9, 24, 28, 29, 68, 69, 75, 87, 90, 91, 95, 100, 104, 111, 112, 113]
Intervention procedures	Adopting squatting intermittently	n = 5 (9%) [72, 77, 78, 79, 105]
	Adopting squatting continuously	n = 2 (1%) [98, 99]
	Intensity of exposure	n = 3 (6%) [72, 77, 78]
	Duration of exposure (as defined by authors)	n = 12 (23%) [9, 29, 73, 84, 87, 88, 89, 91, 97, 98, 104, 111]
Optimal timing	Latent stage	n = 2 (1%) [104, 111]
	Active stage	n = 8 (15%) [24, 32, 72, 81, 87, 104, 111,112]
Where	Hospital (obstetric led)	n = 42 (79%) [8, 10, 24, 28, 29, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 81, 82, 83, 84, 86, 87, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 103, 105, 206, 107, 108, 110, 111, 114]
	Midwifery-led care	n = 8 (15%) [84, 101, 102, 103, 104, 112, 113, 114]
To whom (women)	Inclusion and exclusion criteria	n = 50 (94%) Only n = 3 NRSIs did not include this data [32, 102, 107]
	Training/exercise	n = 2 (1%) [28, 105]
Who (providers)	Background	n = 38 (72%) [8, 9, 24, 28, 29, 68, 70, 71, 72, 78,79, 81, 82, 83, 84, 86, 87, 90, 91, 92, 93, 94, 96, 97, 99, 100, 101, 102, 103, 104,105, 106, 107,108, 110, 111, 112, 113]
	Expertise in squatting	n = 9 (17%) [24, 75, 79, 81, 82, 100, 104, 105, 111]
	Material/specific training	n = 5 (9%) [28, 75, 87, 96, 105]
Modification		n = 2 (1%) [75, 77]
		n = 2 (1%) [75, 77]
How well	Adherence or fidelity	n = 6 (11%) [28, 29, 84, 87, 96, 105]
	Strategies to improve adherence	n = 14 (26%) [9, 28, 29, 79, 82, 84, 86, 87, 90, 95, 96, 97, 99, 105]

4.3.7 Outcome measures

The included studies measured a total of 26 birth outcomes for women during childbirth without epidural analgesia. Twenty-five outcome measures were reported in the randomised trials and 14 in the NRSIs.

4.3.8 Missing data

Two correspondence authors provided missing information and study data. Thies-Lagergren *et al*. [19] provided details on the definition of the experimental group and childbirth positions employed in the control groups, and Dahlen *et al* [20] provided missing data.

4.3.9 Risk of bias in included studies.

Figure 5 shows the judgements about the risk of bias domains. Owing to the nature of the intervention, it was not possible to blind personnel and participants in all included studies, and they were assessed as having a high risk of performance bias. The risk of bias in the RCTs was variable. Of the 37 trials, 15 were judged as having a low risk of bias in the main aspects of sequence generation and allocation concealment. These 15 RCTs met the criteria for overall high quality for the sensitivity analyses. Figure 6 below presents a summary of the author's judgement about each risk of bias item for each included RCT.

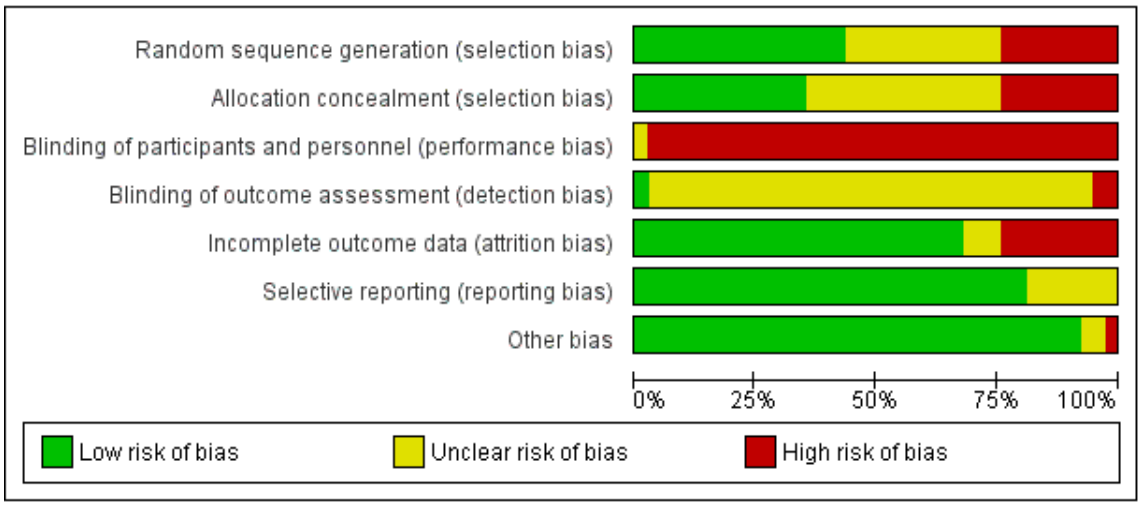
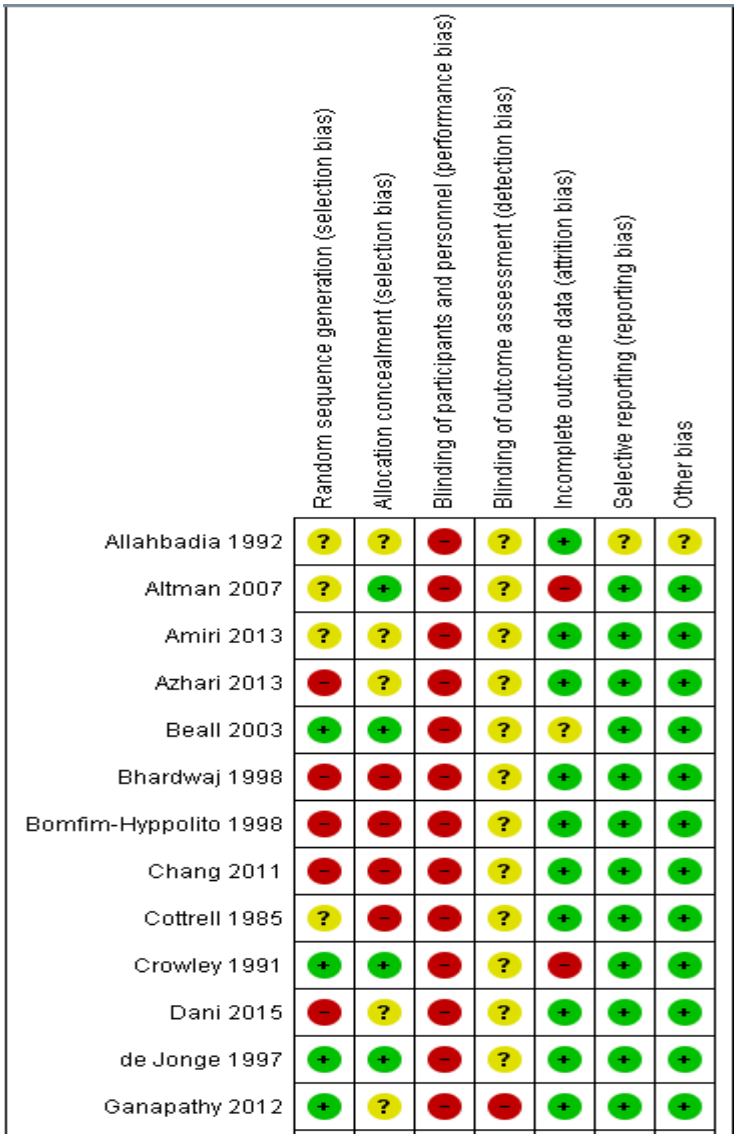


Figure 5: Risk of Bias Graph



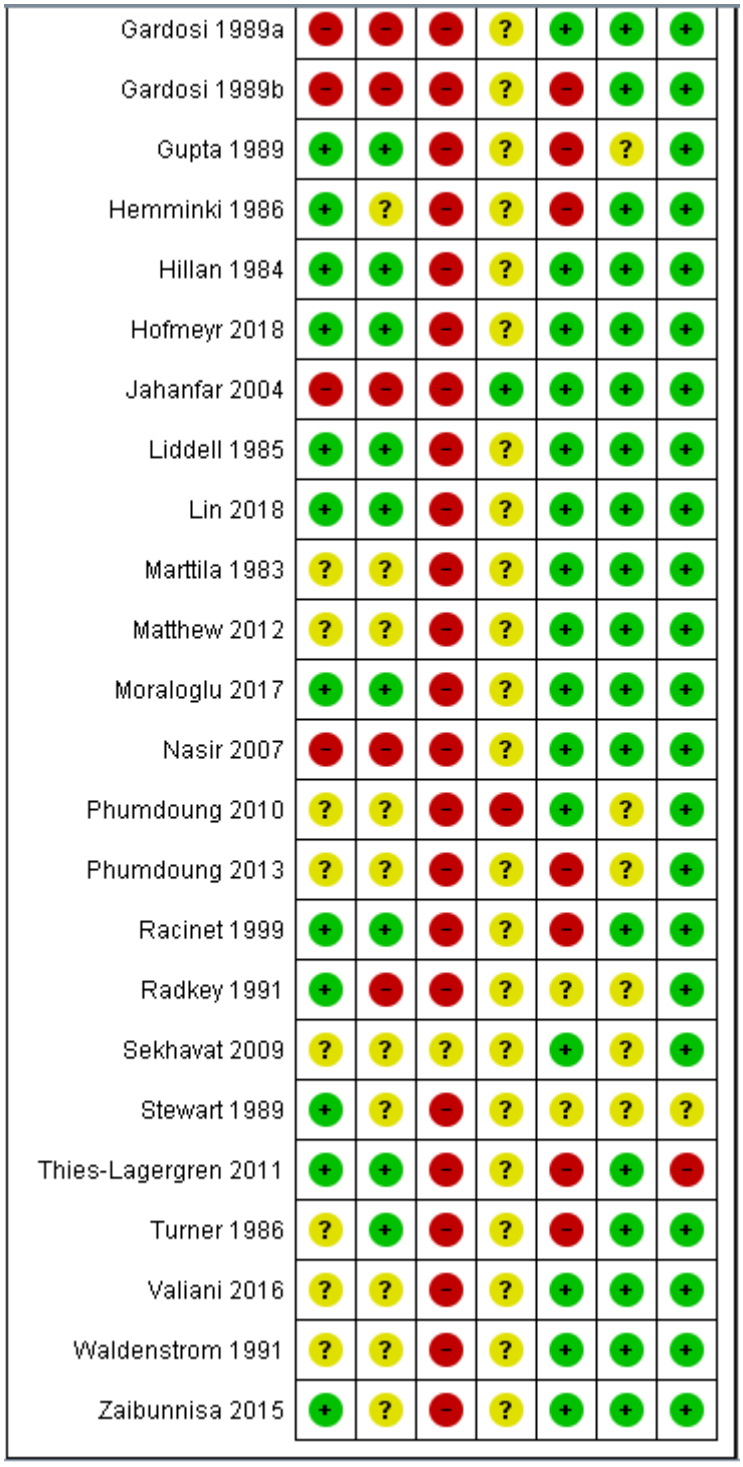


Figure 6: Summary of the Risk of Bias

The 'Risk of bias' criteria for the non-randomised studies are presented in Appendix 11 & 12. For all 16, the overall risk of bias was judged to be high. This was due to a high risk of bias in the selection of participants, measurement of outcomes, systematic differences between experimental and control groups in the care provided and selective reporting of outcomes.

4.3.10 Primary Maternal Outcomes

4.3.10.1 Primary Outcome: Duration of 2nd Stage of Labour

Overall, the 2nd stage of labour was approximately eight minutes and a few seconds shorter in the squatting group compared with other positions (MD −8.48 minutes, 95% CI −13.08 to −3.87 minutes, I^2 = 97%, P = 0.0009, 23 RCTs, 7056 women: very low-quality evidence) (Figure 7). There is some evidence of funnel plot asymmetry from visual examination, although it was difficult to determine if publication bias was present due to the related precision of several RCTs and substantial heterogeneity between the RCTs (Figure 7).

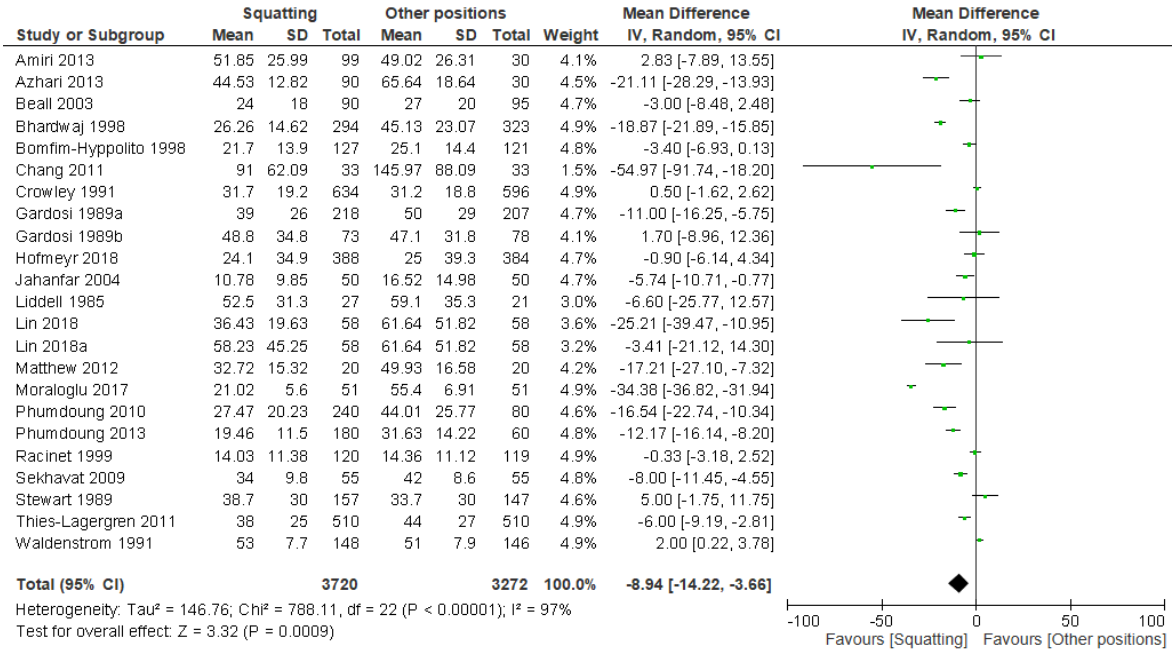


Figure 7: Forest Plot: Duration of 2nd Stage of Labour

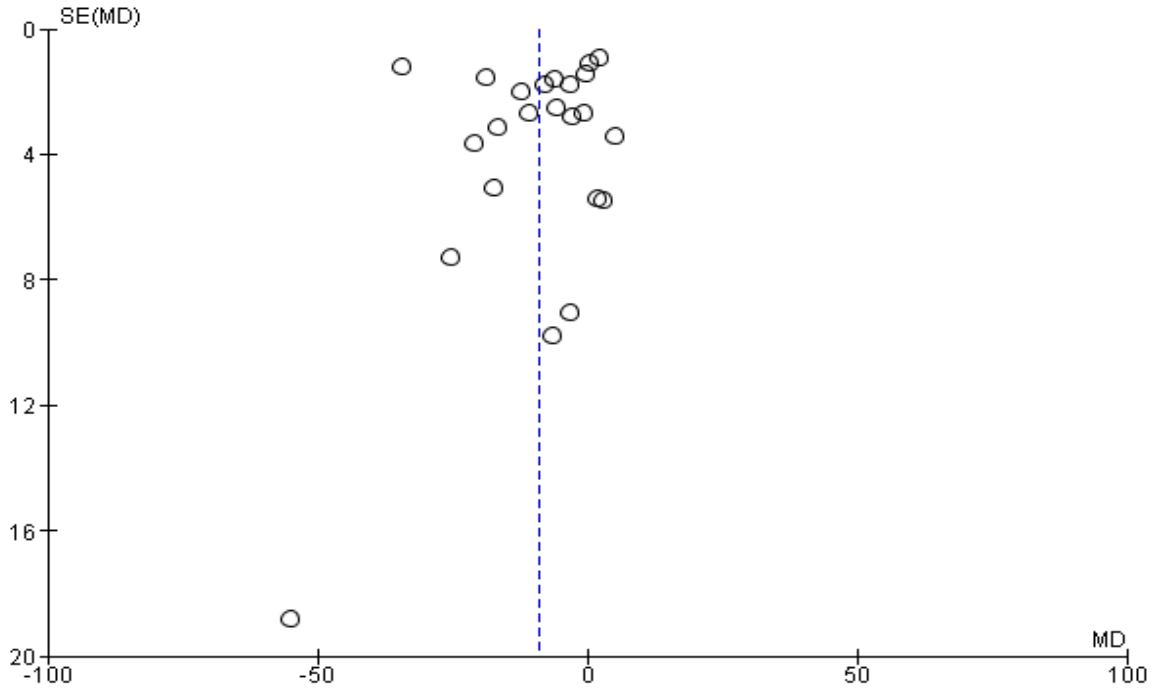


Figure 8: Funnel Plot: Duration of 2nd Stage of Labour

In contrast, sensitivity analysis excluding low-quality RCTs did not show any statistically significant difference between the two groups (MD −7.93, 95% CI, −19.75 to 3.88 minutes, I^2 = 99%, P = 0.19, 8 RCTs, 3899 women) (Figure plot 9).

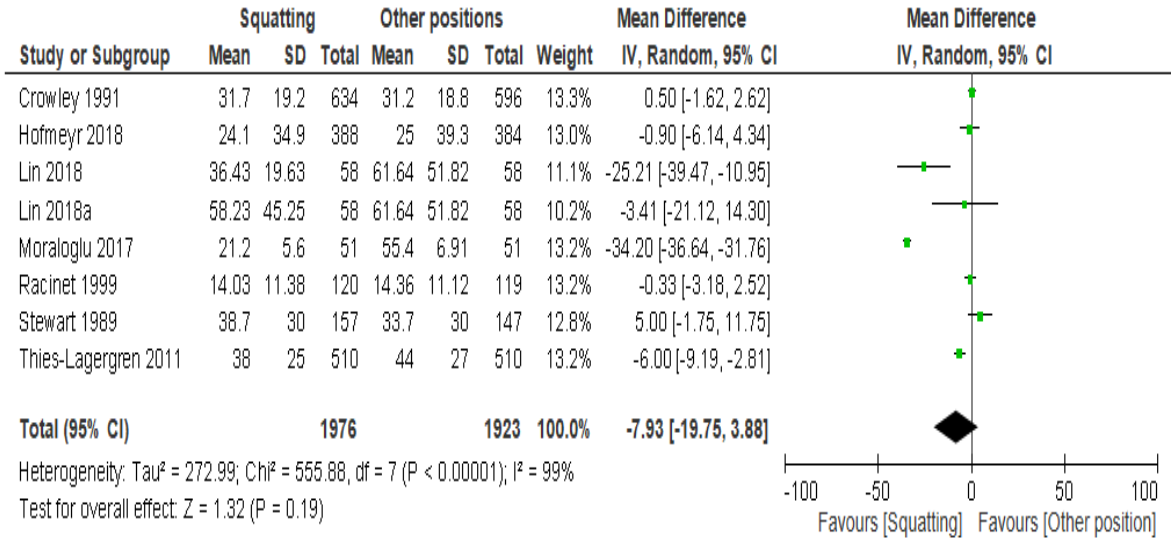


Figure 9: Forest Plot: Sensitivity Analysis: Duration of 2nd Stage of Labour

4.3.10.2 Modes of Birth: Operative Birth (defined as sum of caesarean section and assisted vaginal birth)

There was a significant reduction in operative birth in the squatting group compared to other positions (RR 0.76, 95% CI, 0.63 to 0.91, I^2 = 41%, Tau^2 = 0.06; P = 0.003, 19 RCTs, 7928 women; moderate-quality evidence) (Figure 10). There was some evidence of funnel plot asymmetry from visual examination, suggesting possibility of publication bias (Figure 11).

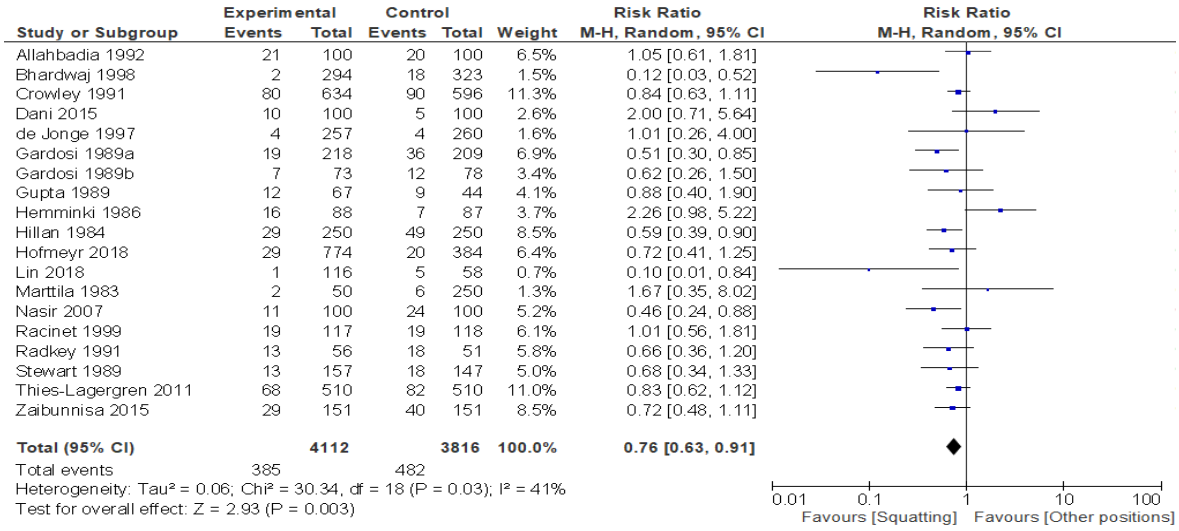


Figure 10: Forest Plot: Operative Birth

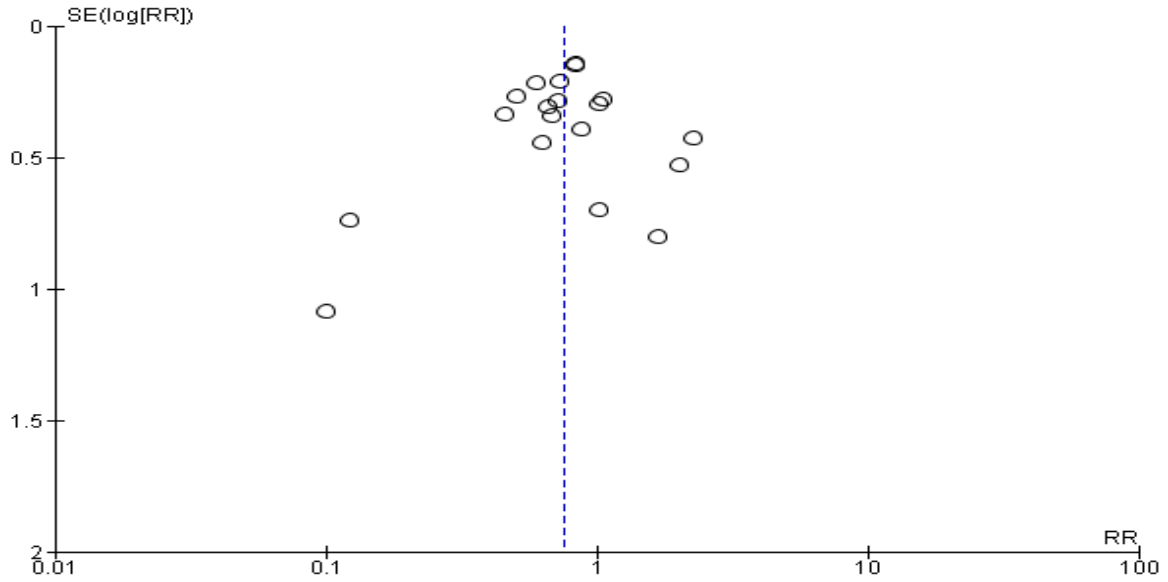


Figure 11: Funnel Plot: Operative Birth

Similarly, the sensitivity analysis of studies with low risk of bias showed a significant reduction rate of operative birth among the squatting group compared with control (RR 0.78, 95% CI, 0.66 to 0.92; absolute effect 3.0% fewer, I^2 = 0%, P = 0.003, 8 RCTs, 4092 women). (Figure 12)

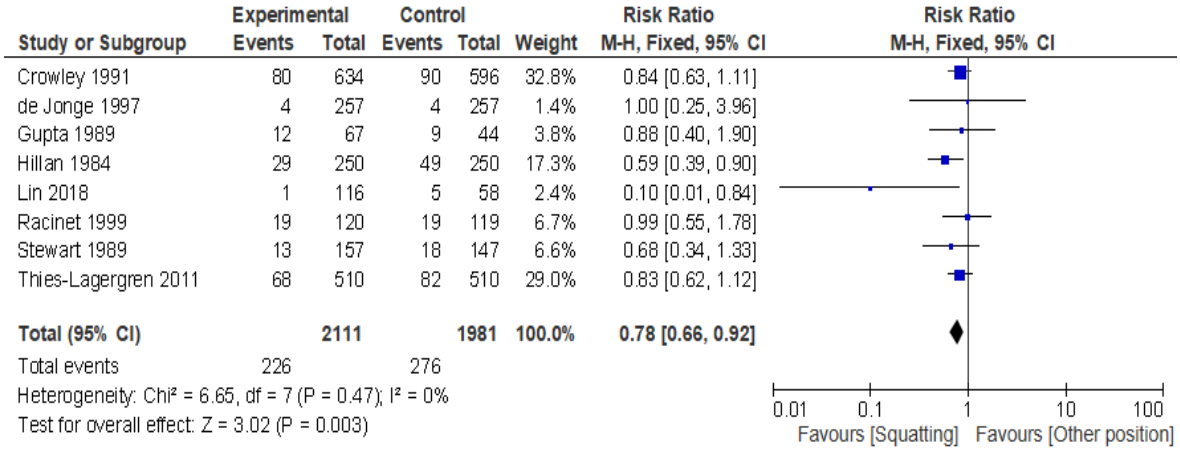


Figure 12: Forest Plot: Sensitivity Analysis

4.3.10.3 Spontaneous Vaginal Birth

There was no significant difference in spontaneous vaginal birth between squatting and other positions (RR 0.97, 95% CI, 0.93 to 1.0, I^2 = 67%, Tau^2 = 0.00; P = 0.30, 10 RCTs, 4462 women). There was little evidence of funnel plot asymmetry from visual examination, but it was difficult to assess if publication bias was present due to the precision of several RCTs, and heterogeneity in the outcomes between different RCTs (Figures 13 and 14).

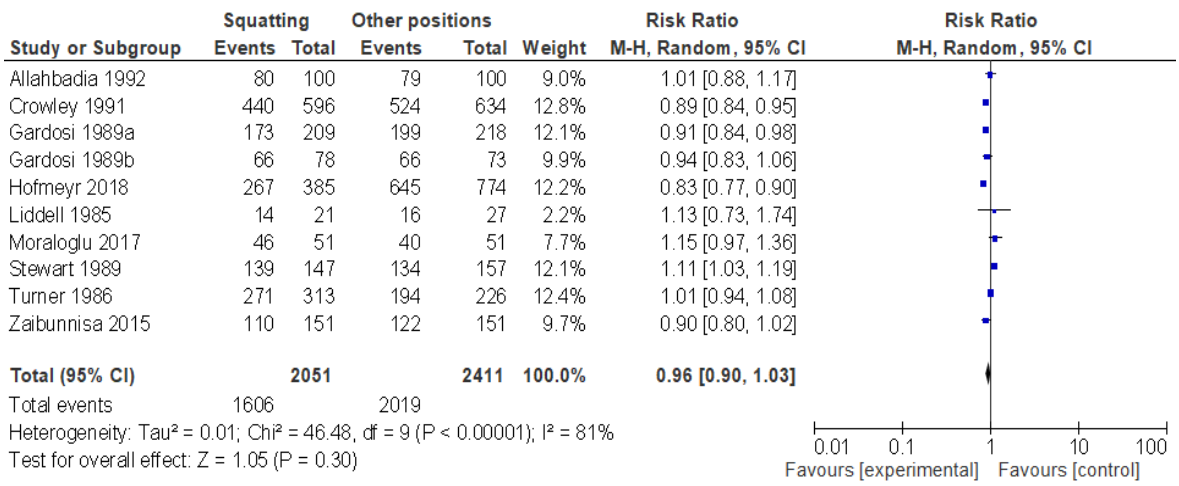


Figure 13: Forest Plot: Spontaneous Vaginal Birth

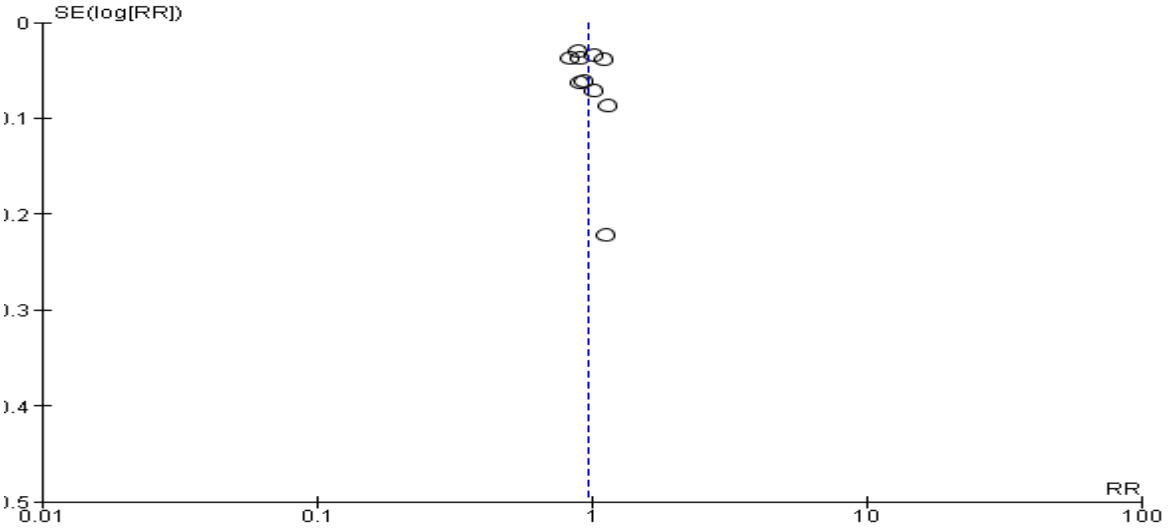


Figure 14: Forest Plot: Spontaneous Vaginal Birth

4.3.10.4 Perineal Trauma Requiring Suturing.

Perineal trauma that required suturing is a primary outcome for this SR. The overall analysis showed that there were significantly less perineal trauma requiring suturing in the squatting group compared with other positions (RR 0.88, 95% CI, 0.82 to 0.95: P = 0.0007, I^2 = 55%, P = 0.0008, 22 trials, 8658 women, low certainty evidence) (Figure 15). There was some evidence of funnel plot asymmetry from visual examination, but it was difficult to determine if publication bias was present due to the precision of several studies and substantial heterogeneity. There was some overlap of CIs between the 22 RCTs which suggests the

presence of heterogeneity, but this cannot be explained by the sensitivity or subgroups analyses (Figures 16).

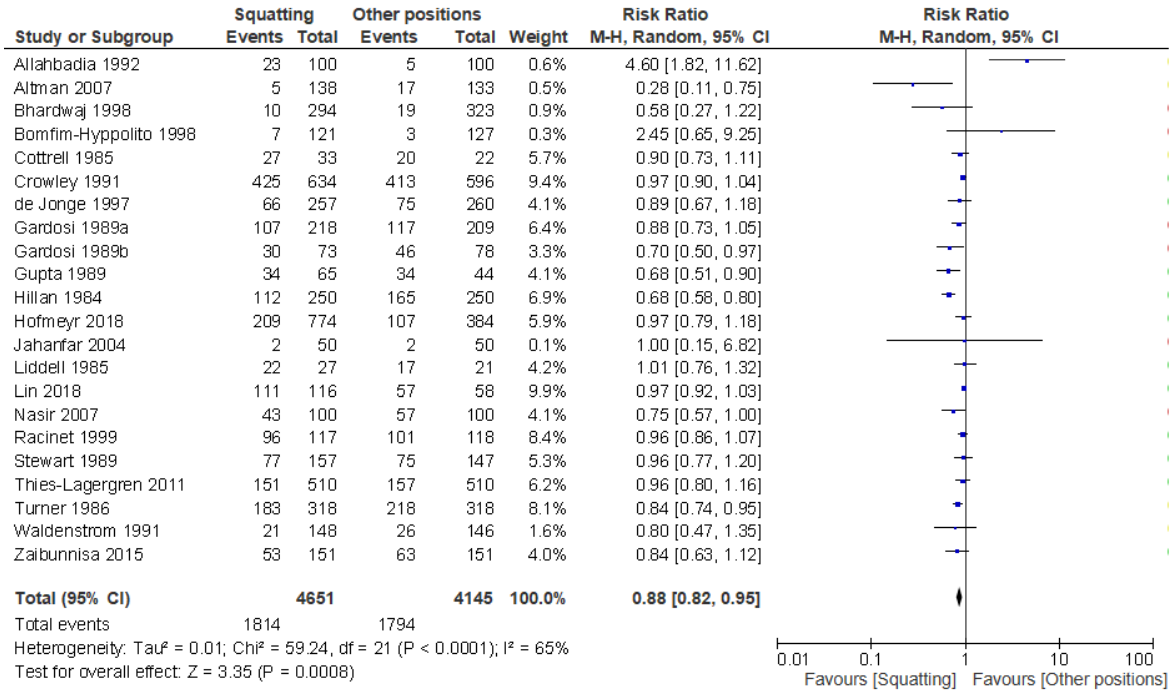


Figure 15: Forest Plot: Perineal Trauma Requiring Suturing

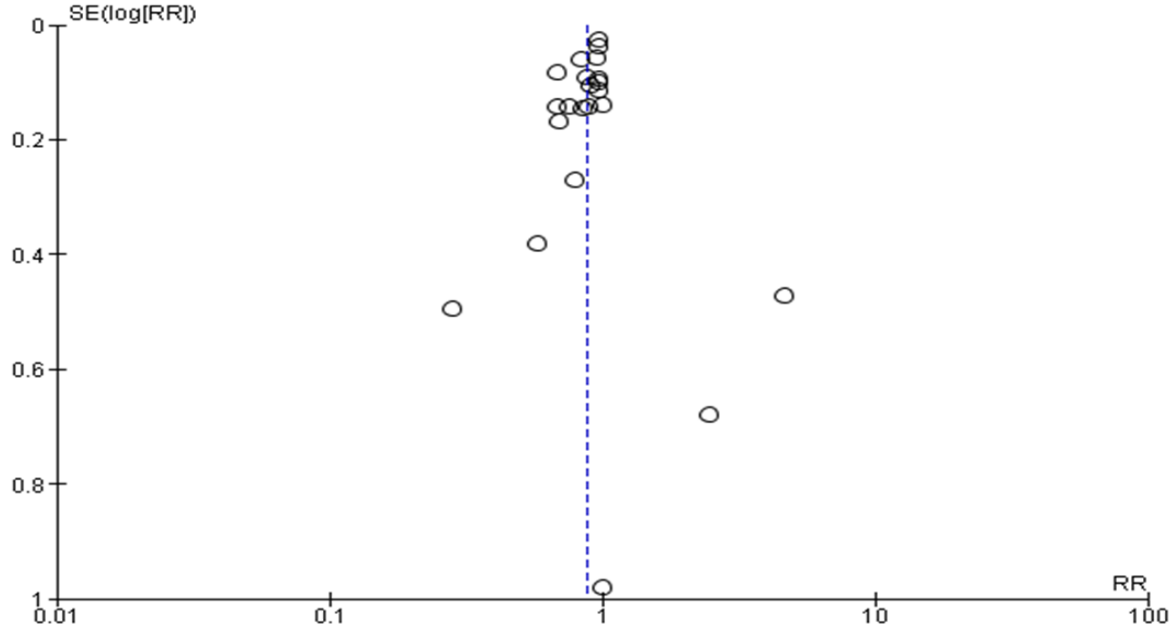


Figure 16: Funnel Plot: Perineal Trauma Requiring Suturing

A sensitivity analysis including eight RCTs of high quality found significantly less perineal trauma requiring suturing when assuming a squatting position compared with other positions (RR 0.90, 95% CI, 0.80 to 0.98: absolute effect 4.3%, I^2 = 63%, P = 0.02, 8 RCTs, 4490 women) (Figure 17).

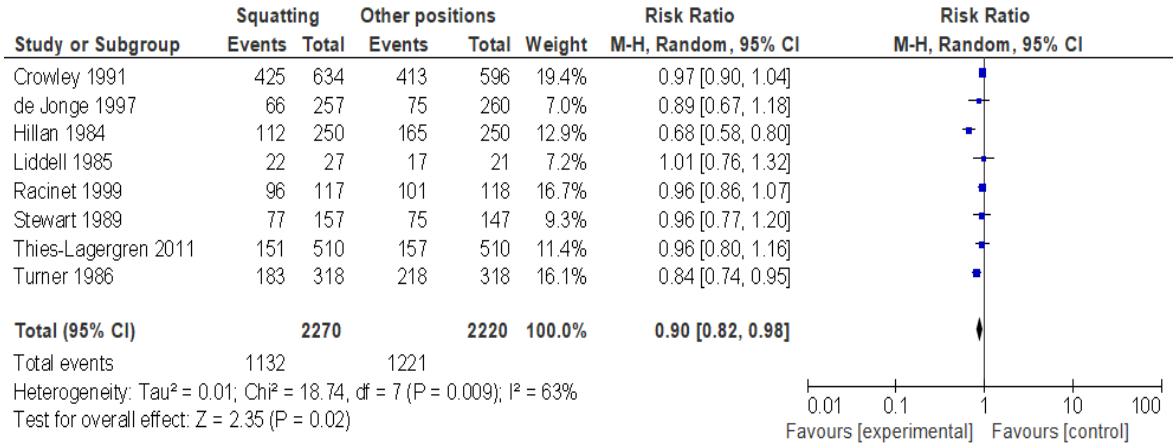


Figure 17: Forest Plot: Sensitivity Analysis: Perineal Trauma Requiring Suturing

4.3.10.5 PPH

There was no significant difference on PPH requiring blood transfusion between squatting and other positions (RR 0.90, 95% CI, 0.60 to 1.35, I^2 = 0%, P = 0.61, 5 RCTs, 4227 women) (Figure 18).

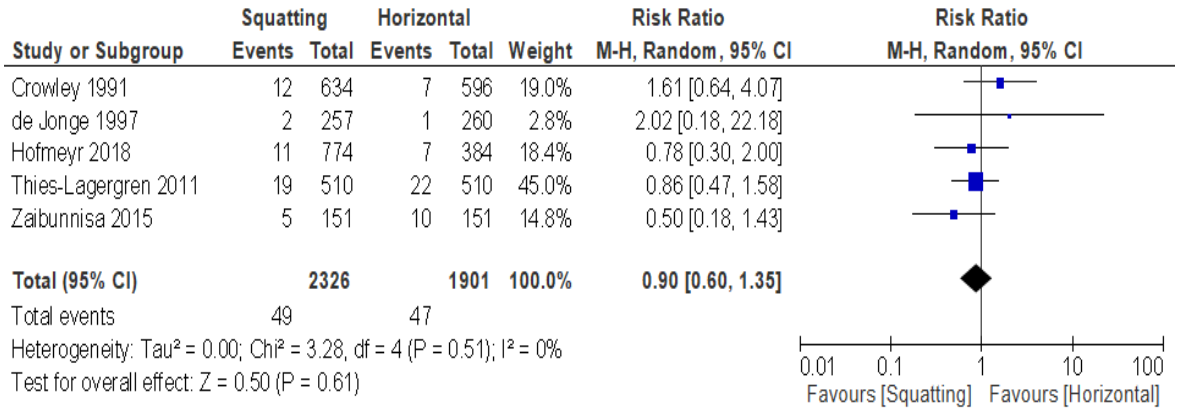


Figure 18: Forest Plot: Post-partum Haemorrhage Requiring Blood Transfusion

Similarly, there was no significant difference in the levels of normal haemoglobin (Hb) ≥ 10mmol after PPH of ≥500ml between squatting and other positions (RR 1.11, 95% CI, 0.95

to 1.29, I^2 = 0%, P = 0.20, 4 RCTs, 2389 women) (Figure 19).

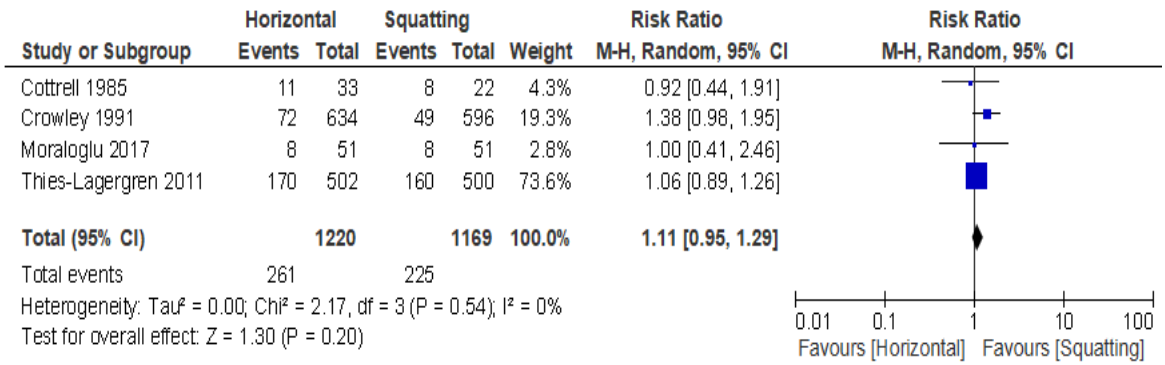


Figure 19: Forest Plot: PPH > 500mls, with normal postnatal haemoglobin.

Likewise, there was no significant difference in the rates of severe PPH > 1000ml between the squatting and other positions (RR 0.94, 95% CI, 0.70 to 1.25, I^2 = 0%, P = 0.66, 2 RCTs, 1291 women) (Figure 20).

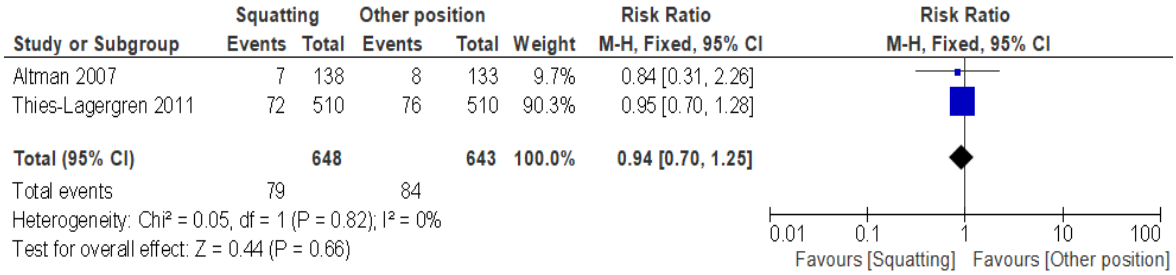


Figure 20: Forest Plot: PPH >1000mls.

4.3.11 Secondary Outcomes

4.3.11.1 Need for Analgesia/Anaesthesia.

There was a significant reduction in the need for analgesia and anaesthesia in favour of women randomised to adopt a squatting position (RR 0.88, 95% CI, 0.80 to 0.98: absolute effect 7.9% fewer, I^2 = 79%, P = 0.02, 9 RCTs, 4161 women) (Figure 21).

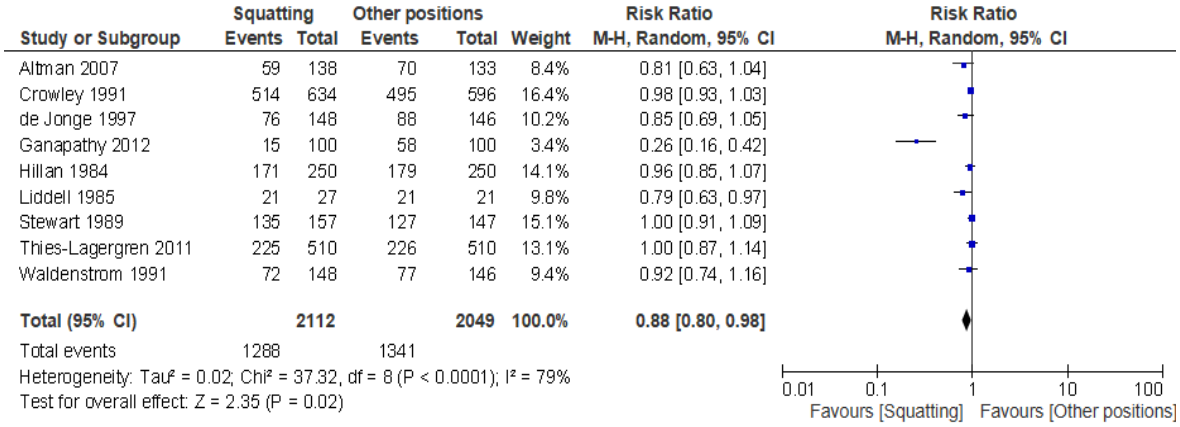


Figure 21: Forest Plot: Need of Analgesia/Anaesthesia.

There was no significant difference in the rates of women needing analgesia or anaesthesia between the squatting group and control when low-quality trials were excluded (RR 0.98, 95% CI, 0.94 to 1.02: I^2 = 0%, P = 0.24, 5 RCTs, 3571 women). (Figure 22)

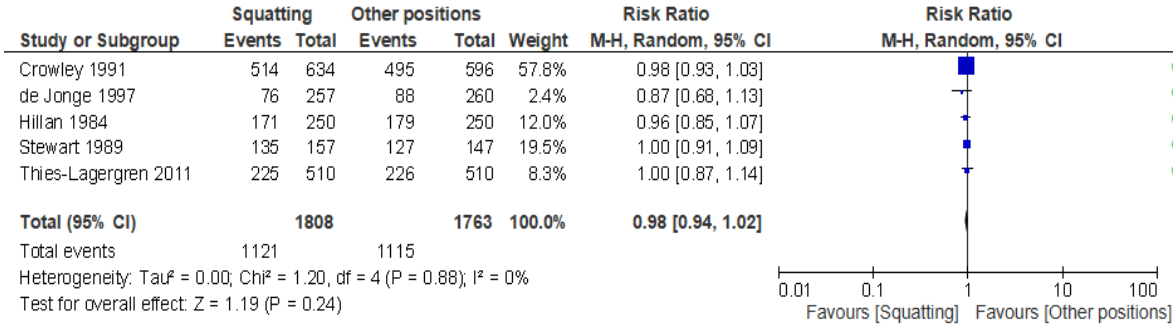


Figure 22: Forest Plot: Sensitivity Analysis – Need of Analgesia/Anaesthesia

Infant Outcomes

4.3.11.2 Abnormal FHR patterns

Abnormal foetal heart rate patterns were significantly reduced in the squatting group compared with controls (RR 0.49, 95% CI, 0.28 to 0.84, absolute effect 4.4% fewer, I^2 = 0%, P = 0.01; 3 trials, 817 women) (Figure 23).

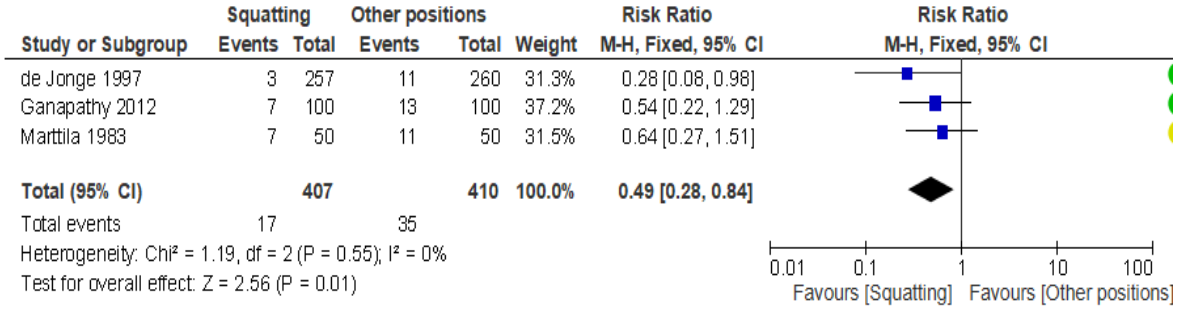


Figure 23: Forest Plot: Abnormal Foetal Heart Rate Pattern

4.3.11.3Need for NICU

There was no significant difference in admissions to the NICU between the squatting and control groups (RR 0.73, 95% CI, 0.32 to 1.01, I^2 = 6%, P = 0.06, 6 trials, 4086 women) (Figure 24).

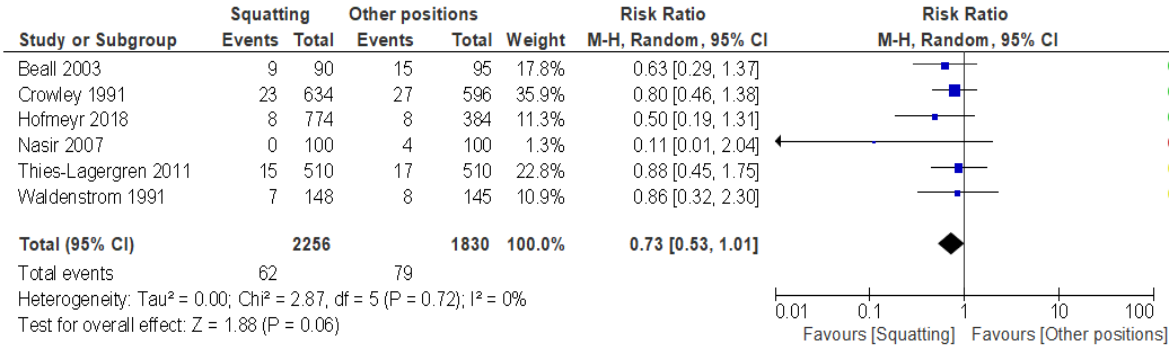


Figure 24: Forest Plot: Need of NICU

Sensitivity analysis of the high-quality trials also showed a non-significant difference between the squatting and other positions (RR 77, 95%CI, 0.52 to 1.13, I^2 = 6%, P = 0.18, 3 trials, 3408 women) (Figure 25).

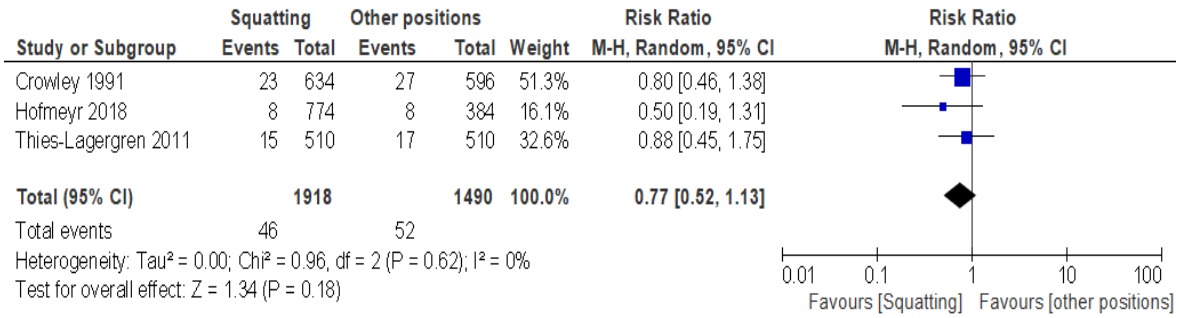


Figure 25: Forest Plot: Sensitivity Analysis – Need of NICU

4.3.12 Analyses of NRSIs

4.3.12.1 Duration of 2nd Stage of Labour

A significantly shorter 2nd stage of labour was found in the squatting position group than for other positions (MD 36.70 minutes, 95% CI, −65.91. to 7.49, I^2 = 99%, P = 0.01, 4 studies, 2779 women) (Figure 26).

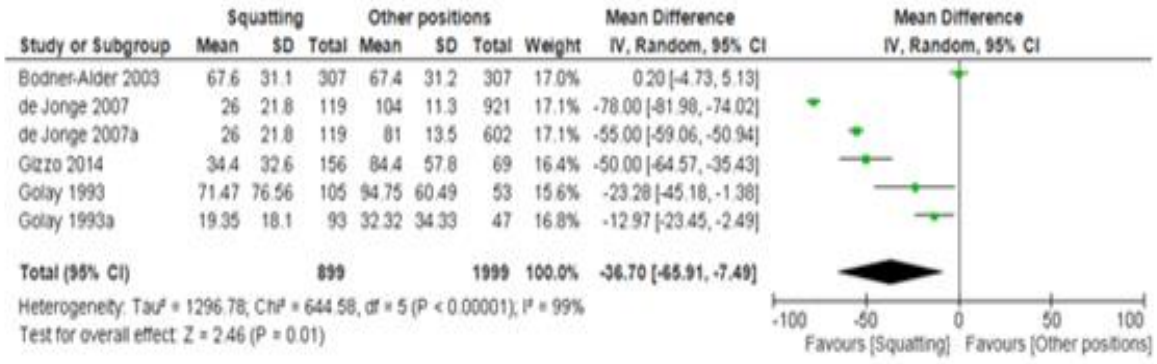


Figure 26: Forest Plot: Duration of 2nd Stage of Labour

4.3.12.2Operative birth

A significant reduction in operative birth was found in the squatting position group compared with other positions (RR 0.29, 95% CI, 0.18 to 0.46, I^2 = 20%, P < 0.00001, 2 studies, 525 women) (Figure 27).

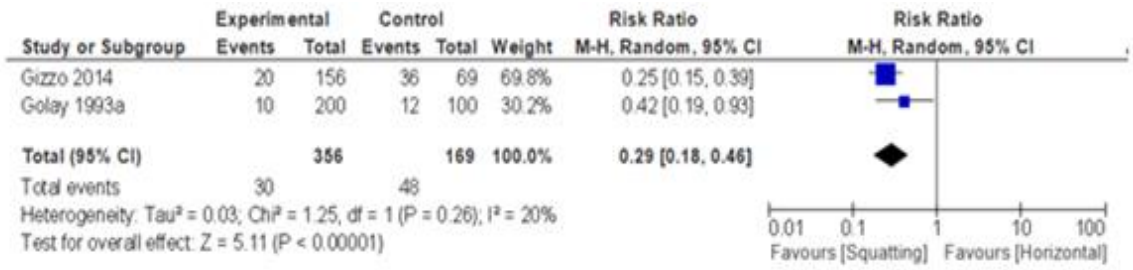


Figure 27: Forest Plot: Operative birth.

4.3.12.4Perineal Trauma Requiring Suturing.

A non-significant difference between squatting and other positions was reported for perineal trauma requiring suturing, with an excessive heterogeneity between the studies (RR 0.98, 95% CI, 0.76 to 1.26, I^2 = 95%, P = 0.89, 13 studies, 36,549 women). There appeared to be some funnel plot asymmetry, which may suggest possible publication bias (Figures 28).

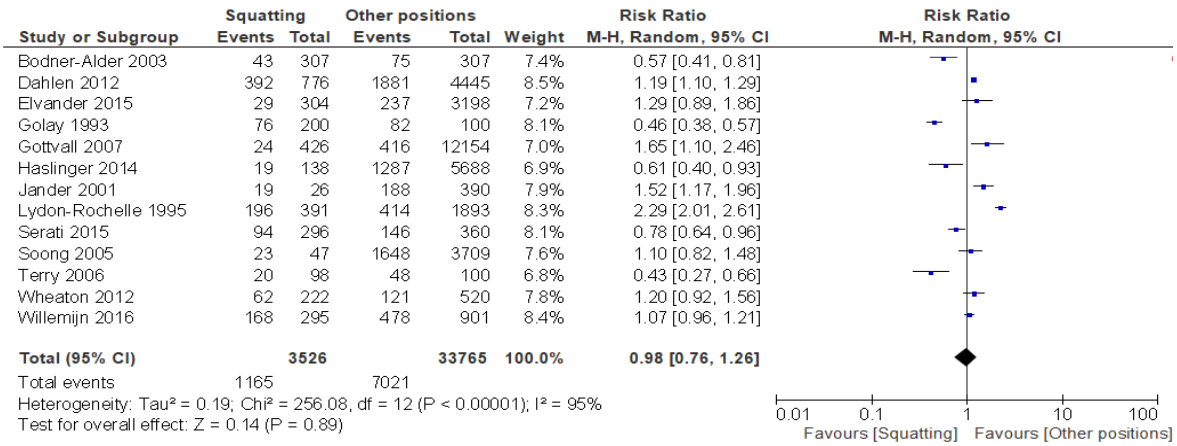


Figure 28: Forest Plot: Perineal Trauma Requiring Suturing

4.3.12.4PPH > 1000ml

A non-significant difference in blood loss > 1000ml was found between squatting and other positions (RR 1.19, 95% CI, 0.66 to 2.13, I^2 = 21%, P = 0.57, 2 studies, 36,549 women) (Figure 29).

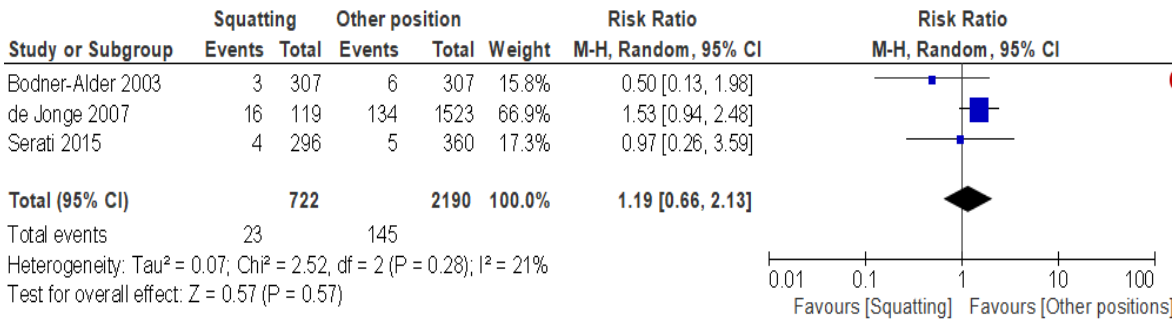


Figure 29: Forest Plot: PPH >1000mls.

4.3.13 Quality of the Evidence using GRADE

The quality of the evidence was assessed using the GRADE approach for the seven pre-specified birth outcomes. There was no outcome with high-quality evidence (Summary of finding [SoF] Table 14).

Table 14: Summary of findings (SoF) table

Outcomes	**Anticipated absolute effects*** (95% CI)		Difference	Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)
	Risk with [comparison]	**Risk with [intervention]**				
Maternal outcomes Duration of second stage of labour	The mean duration of second stage of labour across control groups ranged from 14.36 minutes to 145.97 minutes.	The mean duration of second stage of labour across experimental group ranged from 14.03 minutes to 58.23 minutes.	MD of 8 minutes and 26 seconds lower (13 minutes and 56 seconds lower to 2 minute and 96 seconds lower)	**MD −8.48 (−13.08 to −3.87**	7056 (23 studies)	⨁◯◯◯[a,b] Very low
Perineal trauma requiring suturing	425 per 1,000 42.5%	**370 per 1,000** 37.0% (34.0 to 40.0)	5.5% fewer (8.5% fewer to 2.6 fewer)	**RR 0.88** (0.82 to 0.95)	8832 (22 RCTs)	⨁⨁◯◯[c] Low
Operative birth	126 per 1,000 12.6%	**96 per 1,000** 9.6% (8.4 to 10.9)	3.0% fewer (4.1 fewer to 1.6 fewer)	**RR 0.76** (0.63 to 0.91)	7928 (19 RCTs)	⨁⨁⨁◯[a] Moderate
Blood loss > 1000ml	131 per 1,000 13.1%	**123 per 1,000** 12.3% (9.1 to 16.3)	No significant difference	**RR 0.94** (0.70 to 1.25)	1291 (2 RCTs)	⨁◯◯◯[d,e,f] Very low
Need for blood transfusion (postpartum haemorrhage loss requiring intervention)	21 per 1,000 2.1%	**21 per 1,000** 2.1% (1.4 to 3.3)	No significant difference	**RR 1.01** (0.66 to 1.55)	3925 (4 RCTs)	⨁⨁◯◯[a,d,f] Low

Outcomes	**Anticipated absolute effects*** (95% CI)		Difference	Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)
	Risk with [comparison]	**Risk with [intervention]**				
Need for analgesia/anaesthesia	654 per 1,000 65.4%	**576 per 1,000** 57.6% (52.4 to 64.1)	7.9% fewer (13.1 fewer to 1.3 fewer)	**RR 0.88** (0.80 to 0.98)	4161 (9 RCTs)	⨁⨁◯◯[a,f] Low
Foetal outcomes Abnormal foetal heart rate pattern	85 per 1,000 8.5%	**42 per 1,000** 4.2% (24 to 72)	4.4% fewer (6.1 fewer to 1.4 fewer)	**RR 0.49** (0.28 to 0.84)	817 (3 RCTs)	⨁⨁◯◯[a,d,f] Low
Need for admission to NICU	43 per 1,000 4.3%	**30 per 1,000** 3.0% (2.2 to 4.3)	No significant difference	**RR 0.73** (0.53 to 1.01)	4086 (6 RCTs)	⨁⨁◯◯[a,e,f] Low

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI). **CI:** Confidence interval; **RR:** Risk ratio; **MD:** Mean difference

Outcomes	**Anticipated absolute effects*** (95% CI)		Difference	Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)
	Risk with [comparison]	**Risk with [intervention]**				

GRADE Working Group grades of evidence

High certainty: We are very confident that the true effect lies close to that of the estimate of the effect

Moderate certainty: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different

Low certainty: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect

Very low certainty: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

a) High risk of bias – Methodological limitations mainly inadequate allocation concealment, lack of method of randomisation, incomplete data, publication bias suggesting high likelihood of selection, attrition, reporting bias. Downgraded -1 if studies with serious methodological limitations contribute less than 50% weight analysis – [downgraded by -1].

b) Serious inconsistence – High heterogeneity – I^2 equal to or greater than 70% (P value – 0.05) point estimates and confidence intervals vary considerably. Downgraded -2.

c) High risk of bias – Methodological limitations mainly inadequate allocation concealment, lack of method of randomisation, incomplete data, publication bias suggesting high likelihood of selection, attrition, reporting bias. Downgraded -2 if studies with serious methodological limitations contribute greater than 50% weight analysis.

d) High risk of bias – Under-reported outcome less than 10 out of 36 trials reported on outcome, suggesting selective reporting bias. Downgraded -1.

e) Inconsistency – Moderate to substantial heterogeneity I^2 equal to or greater than 40%. Downgraded -1.

Wide confidence intervals crossing the line of no effect and few events. Downgraded -1.

f) Publication bias: assessment of funnel plot asymmetry not performed due to fewer than 10 studies included for this outcome. Downgraded 1.

4.3.14 Quality of the Evidence for RCTs

A summary of the quality of evidence was performed on six maternal outcomes and two foetal outcomes for the comparison of the squatting position versus other positions using the GRADE approach (see SoF Table: 4.7). Overall, the evidence varied in quality, and the confidence in the effect estimates ranged from moderate to very low certainty. The following ratings of evidence were determined for the different outcomes: operative birth, moderate quality; perineal trauma requiring suturing; need for analgesia/anaesthesia; abnormal FHR pattern; and neonates admitted to NICU, low-quality evidence; duration of the 2nd stage of labour and moderate to severe blood loss > 1000ml, very low-quality evidence.

The main reasons for downgrading the certainty of evidence were design limitations (including lack of blinding), high heterogeneity and wide confidence intervals crossing the line of no difference. The main example is made by visual observation of the forest plot Figure 7.

4.3.15 Quality of Evidence for NRSIs

The risk of bias for each NRSI was assessed using the ROBINS-I tool for the duration of labour, perineal trauma requiring suturing, operative birth, and PPH > 1000ml. All included studies were judged to have a serious risk of bias due to several methodological flaws. The main contributing factors were selection bias, mainly shown in the serious concerns over unmeasurable differences in study groups with extensive unbalanced sample sizes within and across intervention groups (i.e. only 15,205 (2.7%) of 561,665 in the non-randomised studies were in the squatting group), and information bias, which could have affected outcome.

4.4 Discussion

4.4.1 Summary of Main Results

The meta-analysis of 37 randomised trials (11,008 women) shows that assuming squatting positions during the 2nd stage of labour may have some benefits, with no adverse events for

women of low-risk pregnancy and their babies. Overall, squatting positions were associated with a significant reduction rate in the duration of the 2nd stage of labour, need for analgesia/anaesthesia, perineal trauma requiring suturing and operative births and abnormal FHR pattern compared with other positions.

The following outcomes were associated with non-significant differences: spontaneous births; blood loss requiring blood transfusion and levels of normal haemoglobin of > 10mmol; moderate to severe blood loss > 1000ml and neonates admitted to NICU.

When the sensitivity analysis was conducted, limiting the analysis to studies of low risk of bias, the following outcomes showed a significant effect following squatting: operative birth and perineal trauma requiring suturing; and the following outcomes showed no significant difference: duration of the 2nd stage of labour; second-degree tears; need for analgesia/anaesthesia; and neonates needing admission to NICU.

The funnel plots for investigating publication bias showed some asymmetry and suggested publication bias for perineal trauma requiring suturing (analyses 16). Three funnel plot analyses showed no asymmetry in the duration of the 2nd stage of labour, operative birth, and spontaneous birth (analyses 8, 11 & 14).

The meta-analysis of 16 non-randomised studies (561,665 women) found a significant effect associated with squatting on the duration of the 2nd stage of labour and operative birth. There was no significant difference in the rates of perineal trauma requiring suturing and PPH > 1000ml.

4.4.2 Strengths and Limitations of the Review

This review provides summary results on the effects of squatting position during the second stage of labour. The data arose from a comprehensive literature search and the review was

conducted in a coherent and methodologically robust way. It assesses important clinical outcomes and uses a large amount of data from RCTs and NRSIs, thus increasing the statistical power and confidence in the results.

The biomechanical factors demonstrated in Chapter 3 (such as the increase of pelvis dimensions and efficiency of intra-uterine pressure) can be related to the significant reduction of the length of the 2nd stage of labour, reduced rates of operative birth, abnormal FHR patterns and need for analgesia/anaesthesia when assuming a squatting position versus others.

However, any conclusions arising from the results for the different birth outcomes are tentative because none of the studies were without any risk of bias. There was also substantial heterogeneity in the primary outcomes. The review has highlighted the complexity of the intervention itself, whereby some women assumed squatting positions by sitting on chairs and tilting the back of the chair at various angles of 40°,[97] 15–20°, which is almost supine, [95] 60° [24, 69, 80] or 30° to 90° [77, 82, 90] (where the angle is a measure of the recline from vertical). Significant variation in the description of interventions also limited the interpretation of the meta-analysis and made it impossible to analyse the components of the squatting intervention that were effective or ineffective for outcomes.

4.4.3 Agreements and disagreement with existing literature

4.4.3.1 Effects of the Squatting Positions on the Duration of Birth

Eleven RCTs ([9, 69, 72, 75, 77, 78, 84, 87, 89, 96, 98] included in this review were not included in the CSR. Two RCTs were reported as excluded [69, 96] and one was an ongoing study [84] at the time of the publication of the CSR. Squatting position was associated with a significant decrease of 8.48 minutes in the duration of the 2nd stage of labour. Similarly, a Cochrane review found a significantly shorter duration of birth (10.64 minutes) when squatting using a cushion

compared to horizontally. [12] Furthermore, a more recent review found a significant decrease in the 2nd stage of labour (21.12 minutes) when assuming a flexible sacrum position compared to horizontal. [33] A reduction in the length of 2nd stage is important for decreasing the risk of maternal and infant morbidities associated with operative birth, perineal trauma, PPH and neonatal hypoxia. [11, 21] There were extensive levels of heterogeneity in the mean duration between different studies, which was not explained by any of the sensitivity analyses.

4.4.3.2 Effects of the Squatting Positions on Mode of Birth

There was a slight reduction in operative births due to supported and unsupported squatting positions in the 2nd stage of labour without epidural analgesia. These findings were confirmed in sensitivity analysis limited to high-quality trials. A reduced rate of operative birth in the squatting group is attributed mainly to a reduction of assisted vaginal birth rates by the findings of Gupta *et al.* [12]

4.4.3.3 Effect of Squatting Positions on Perineal Trauma Requiring Suturing

There was a significant reduction in the rates of perineal trauma requiring suturing. These results were like the most recent published trials [34, 96] but contrary to some retrospective cohort studies on 3rd- and 4th-degree tears. [24, 103, 106, 107] However, the inconsistencies observed in the NRSIs (i.e., forest plot 28) might indicate influencing factors other than birthing positions reported in the literature that are associated with increased perineal trauma. These include prolonged 2nd stage of labour, foetal malposition, augmentation of labour with oxytocin, nulliparity, inexperienced healthcare providers, maternal age over 30 years, and macrosomia in the baby. [9, 69, 96, 101, 111, 118, 120] It has been argued that retrospective studies should be supported with prospective comparative studies in which it is more certain that 'like is being compared with like' when making causal inferences about the effects of care. [115] Moreover,

evidence from RCTs found no significant difference between squatting and other positions on perineal trauma not requiring suturing.

4.4.3.4 Effects of Squatting Positions on PPH

One of the primary outcomes was blood loss requiring intervention. This was an objective measurement of blood loss in childbirth by recent evidence. [9, 21, 32, 116, 117] A CSR of uterotonic agents for preventing PPH considered clinical or visual estimates of blood loss to be a subjective measurement, judged to have a high risk of performance bias. [116] According to Gallos *et al.*, [116] studies evaluating blood loss in childbirth should do so about its associates, which are outcomes that can be objectively measured. These associates have been reported by several researchers [9, 11, 21, 116, 117] and include the measurement of blood loss using weighing sponges, measurements in drapes or volumetric assessment or blood loss requiring intervention. [9, 116, 117] These methods have been judged by recent trials and reviews to have a low risk of bias. [8, 9, 21, 116]

4.4.3.5 Description of the intervention

The review aimed to scrutinise whether the experimental and control positions in the included studies were adequately described for researchers to replicate or validate the findings. Although most included studies clearly described the setting and recipient there was inadequate reporting on the 10 items of the intervention procedures in all included RCTs. In a few studies, several clinical factors that might modify the effect were identified, mainly in the description of the squatting position. These included different models of care, [84, 101] intermittently versus continuous squatting, [84, 96] pushing technique,[82] different support aids, [29, 87] total duration of squatting, [8, 9, 32] type of squatting, with lumber spine and hyper-flexing of the hips at a variety of angles, [32] and selection of providers with adequate skills. [29, 87, 105] These might be the influencing factors that might contribute to how squatting position during childbirth improves

birth outcomes. Overall, this observation emphasises the complexity and variability surrounding the design, conduct and analysis of research studies on childbirth.

4.4.4 Quality of the Evidence

Childbirth involves a coordinated series of complex physiological variables, including the use of maternal positions which results in full dilation of the cervix, progressing to the actual birth of the baby. For the main outcome, the duration of the 2nd stage of labour, there was considerable variation between the included studies. This variation is expressed in terms of hours or minutes, indicating the diverse range of experiences women may have during childbirth. Studies defined and measured the duration of 2nd stage of labour differently. This discrepancy is illustrated by the examples provided: eight RCTs focus on the passive second stage continuing into the active second stage, with women being randomised to different positions during this phase. [9, 28, 29, 75, 81, 87, 90, 91, 96] Seven RCTs, start measuring from the onset of full dilation to the expulsive phase, indicating a different starting point for measurement. [70, 72, 76, 84, 86, 92, 99] Four RCTs record the duration from the 1st stage of labour to the birth of the baby, encompassing a broader timeframe. [71, 89, 94, 95] Three RCTs measured the duration from the 2nd stage to the 3rd stage of labour, marking a different endpoint for measurement. [73, 74, 85] Therefore, it was essential to conduct a post hoc sensitivity analysis to examine the extent to which unmeasured confounding of varying magnitudes could have compromised the results of the meta-analysis.

Figure 7 (i.e., the overall effect estimates of 22 RCTs = I^2 of 97%) and Figure 9 (i.e., sensitivity analysis of seven RCTs with good methodological quality = I^2 of 99%) both revealed statistically significant heterogeneous results when assessing the effects of squatting compared with other positions. It was not clear why the duration of 2nd stage of labour was shorter in the experimental group in some RCTs compared with other RCTs. In this analysis, the CI

surrounding each of the point estimates did not overlap, suggesting that the difference between study variances was not simply a reflection of the play of chance. These findings do not help to guide current care, but they should aggravate more research to explain the divergent findings of different studies and identify the circumstances (if possible) in which assuming squatting is a useful method of care during the 2nd stage of labour.

Such a hypothesis may be related to variations in the characteristics of the study population, in the forms of care compared or in the way that the outcomes of care were assessed. These two findings were considered sufficiently important, and worth exploring further using 'one-out' sensitivity analyses. This approach is where one or more studies that were believed to heavily influence greatly the summary of effect estimates, and between-study variances were excluded at a time in calculations. The impact of removing each study is evaluated on the summary results and between-study heterogeneity, then identify the key variables likely to influence results from the pooled studies.

Visual identification of outlying studies from Figure 7 offered post-hoc hints for performing sensitivity analysis or explaining the reasons for between-study heterogeneity. Three analyses were performed, these are Figure 30 to 32.

The initial pooling of 22 randomized controlled trials (RCTs) revealed a minimal mean difference (MD) effect when comparing squatting with other positions during the second stage of labour (overall summary MD -8.91, 95% CI -14.26 to -3.55, Figure 7). However, a sensitivity analysis of nine studies showed no significant benefit between the two groups (summary MD -0.12, 95% CI -1.63 to 1.42, with 3926 women, Figure 9). Figure 7 displayed a meta-analysis with considerable heterogeneity (I^2 = 97%), which was notably reduced to 37% after excluding nine outlying studies (as shown in Figure 30). Nevertheless, identifying a specific plausible explanation for the modest heterogeneity of 37% was challenging when these

nine studies were combined. Section 4.8.3.5 together with tables 9, 11 and 13 of this chapter demonstrates these variables. Deciding whether any of these factors or other unreported variables, explain the outlier study's results versus the others remains challenging.

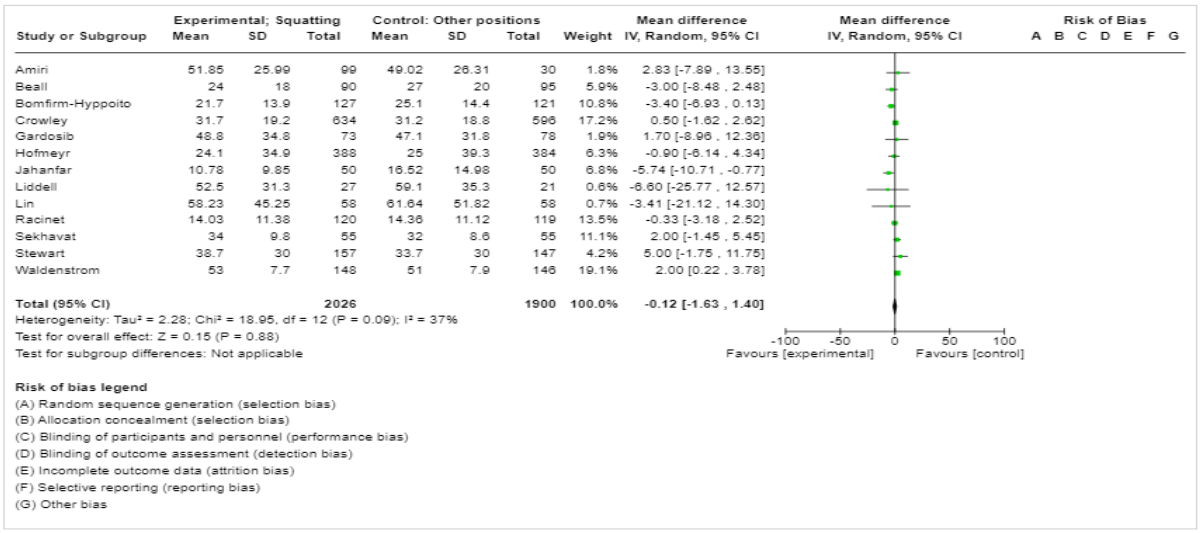


Figure 30: Forest Plot: Duration of 2nd stage: sensitivity analysis.

Another sensitivity analysis of six RCTs decreased significantly the estimated between-study heterogeneity from I^2 = 97% to 60%. While still considerable, this reduction suggests that the variability between the results of the included studies became somewhat more homogeneous after the sensitivity analysis. The direction of MD effects was similar in both analyses with an overall summary MD of -8.91., 95% CI, -14.26 to –3.55, Figure 7 and sensitivity analysis with a summary MD of -15.84., 95% CI, -19.26 to -12.43, Figure 31. The sensitivity analysis was conducted with a larger sample size of 1760 women. The included RCTs were conducted across various countries, including India, [73, 89] Thailand, [90, 91] the UK, [29, 76] and Iran. [71] The variation in countries suggests potential differences in healthcare systems or patient populations, which could contribute to heterogeneity. Despite the reduction in heterogeneity, it was observed that it was more difficult to identify the exact sources of variation or what might have been different or incorrect in reducing the I^2 to 60% with the pooled seven RCTs. This could indicate that while heterogeneity decreased, there may still be underlying factors

contributing to variability among the studies that are challenging to identify or address. In summary, the sensitivity analysis resulted in a notable reduction in between-study heterogeneity and maintained consistency in the direction of effects. However, challenges remain in identifying specific sources of variation, particularly with the inclusion of RCTs conducted in different countries and potential differences in models of care across settings.

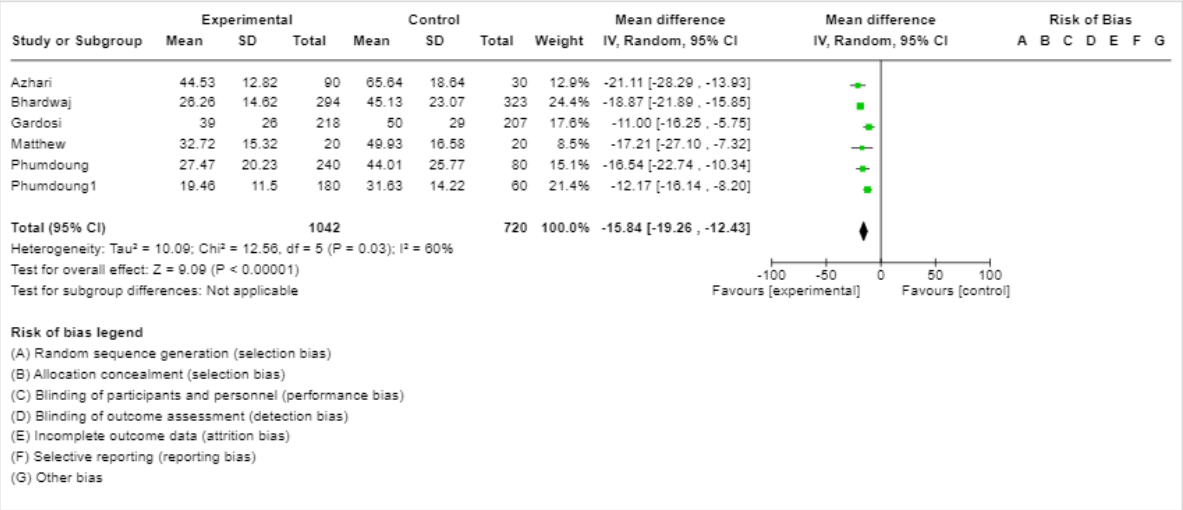


Figure 31: Forest Plot: Duration of 2nd stage: sensitivity analysis.

Another sensitivity analysis of six RCTs decreased significantly the estimated between-study heterogeneity from I^2 = 97% to 28%. This suggests that the variability between the studies' results decreased substantially after conducting the sensitivity analysis. Despite the decrease in heterogeneity, the direction of the mean difference (MD) effects remained similar in both analyses. However, there were differences in magnitude or size between the two analyses. This means that the overall effect of the intervention on the outcome studied was consistent across both the original analysis and the sensitivity analysis (i.e., overall summary MD of -8.91., 95% CI, -14.26 to –3.55, figure 7 and sensitivity analysis a summary MD of -33.29., 95% CI, -40.86 to -25.72, with 284 women, Figure 32), the magnitude of the effect varied. However, the sensitivity analysis was conducted with a smaller sample size of 284 women, as observed. This smaller sample size could potentially impact the statistical power to detect between-study

heterogeneity. It should be noted that while heterogeneity may still exist, it might not be statistically significant due to the limited sample size. In summary, despite the observed differences in effect size across both analyses, the sensitivity analysis led to a notable reduction in between-study heterogeneity while maintaining consistency in the direction of effects. However, caution is warranted due to the smaller sample size in the sensitivity analysis, which could affect the reliability of the findings, particularly regarding the detection of heterogeneity.

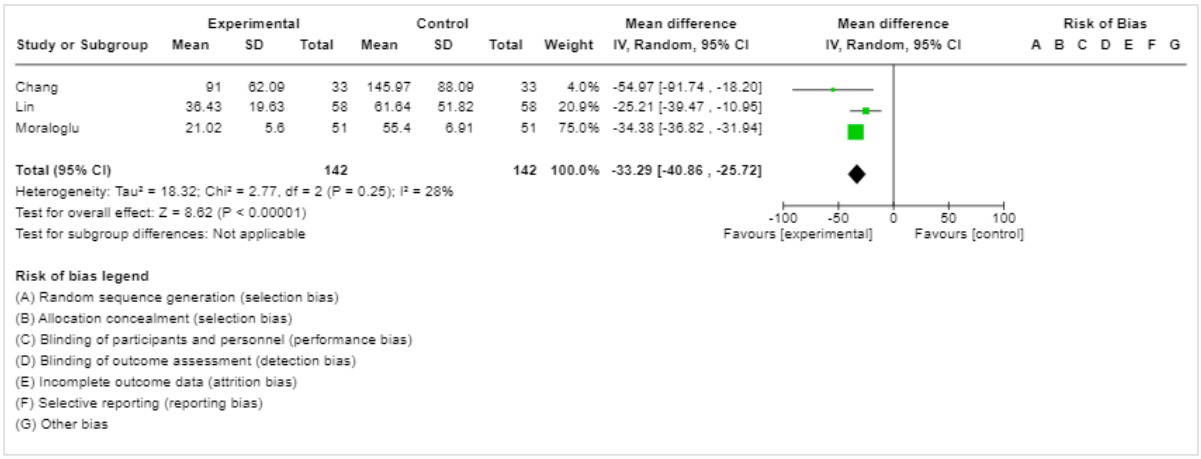


Figure 32: Forest Plot: Duration of 2nd stage: sensitivity analysis.

The effects of squatting during birth are not necessarily the same for every woman. What constitutes the effective application of squatting positions during childbirth is the recognition of women-centredness and various co-interventions that might have impacted birth outcomes. The multifaceted nature of the childbirth-related care processes and management shown in this thesis all comes down to heterogeneity problems. This observation is consistent with previous systematic reviews assessing maternal positions' effects. [11, 12, 118-120] Users may therefore understand evidence-based practice in a more holistic sense by acknowledging the clinically significant effects of squatting position during birth derived from this chapter. This evidence should be combined with optimal clinical judgement based on adequate knowledge and skills of providers and the role of putting a woman at the centre of her care, respecting her needs and expectations. These assumptions maximise the recognition of the effective application of

evidence-based medicine as supported by various authors Dans *et al.*[121]; McAlister *et al.* [122]; Sackett *et al.* [123], which should be incorporated in future studies.

4.4.5 Complementarity other than Disagreement with Existing Literature

One of the main objectives for this review was to complement existing evidence from similar CRSs [12] to enhance the evidence base on the topic. Four other non-CRSs [34, 124–126] were slightly like this review. There were systematic differences, mainly in the eligibility criteria, between the present SR and related SRs, mainly by comparing only one upright position (squatting) with other upright (all fours, kneeling) and horizontal positions. The purpose of this SR was to study comprehensively the various characteristics of squatting, and its potential harms and benefits against other positions assumed in childbirth. This was to produce evidence that might help us to understand the inconsistencies previously reported about squatting positions. [12]

Furthermore, it was essential to investigate the characteristics of the description of squatting positions using the TIDieR framework. This was to identify features of squatting positions that should be replicated in future RCTs and to identify subgroup analyses that might provide insights into moderator variables that may account for variations in the outcomes, thereby assisting researchers in theory development and testing. [127] According to Aguinis *et al.*, [128] the ability to assess moderation effects is a key strength of meta-analyses over narrative reviews and this offers a better understanding of the true relationship between different interventions and their moderation effects.

A later Chapter 6 expands the applicability of the meta-analyses by investigating subgroup analyses or moderation effects in the randomised trials on squatting position during birth. Subgroups defined in accordance to squatting by type with their biomechanical features, [24, 25, 29] and secondary interventions that interact with squatting to influence birth outcomes. Their

main function is to identify how the groups differ in response to the related birth outcome and to answer practical questions about how clinical interventions should be used most effectively. This allows investigation of the stage of the second stage of labour for which squatting is most effective, the optimal duration of squatting for attaining a good birth outcome and the potential harms and benefits of different types of squatting. Answering these questions might identify moderator variables that are interactive during the second stage of labour to significantly benefit women assuming squatting positions.

4.5 Conclusion

4.5.3 Implications for clinical practice

This review shows that squatting positions in the 2nd stage of labour reduces the duration of birth, the risk of operative birth and perineal trauma requiring suturing, but there is uncertainty over whether squatting has any effects on postpartum haemorrhage requiring blood transfusion > 1000ml. The evidence suggests that low-risk women can maintain any squatting position assumed continuously or intermittently at any time during the latent and active second stage of labour without adverse effects on maternal or neonatal outcomes.

However, missing data on the various characteristics of the description of squatting and other positions pose a threat to the validity of the findings. The multiplicity of styles, in both squatting and other positions, requires careful consideration of their characteristic delivery and processes of application. This may lead to a significant standardised description of maternal positions in clinical practice.

4.5.4 Implications for future research

None of the included RCTs reported fully all components of the squatting prescription in the methods or adherence to the prescribed squatting in the results. This implies that current RCTs and NRSIs did not endorse the recommendation of the TIDieR tool, which supersedes the CONSORT extension statement regarding reporting the description of intervention. Tables 11 and 12 revealed a lack of consistency in the classification of squatting during birth which can lead to misclassification at times. The non-standardised means of delivering squatting vaginal birth caused unpredictability of instructions given to pregnant women and care provided by healthcare professionals resulting in irregular birth outcomes.

Likewise, the characteristics of squatting were not well described in the included studies, when they were defined the terminologies used varied across these studies. The terms full or modified squatting positions were highlighted in the included studies, yet there were no clear definitions of what these terms meant. The inconsistencies in the definitions squatting positions limit the contribution of the current body of evidence to science, constrain scientific replication and limit the subsequent use of upright positions. This implies that even though there may be some evidence that squatting positions might work, a clinician may be unclear on how to use these methods as the content of its description remains unclear. A clear classification and defined parameters are needed for delivering squatting and other childbirth positions. Clarity in understanding the components of squatting positions facilitates their implementation and leads to better birth outcomes.

Furthermore, researchers may also be unclear on how to further develop a promising intervention as there is a lack of clear information on all the details of what these methods involve. Awareness raising of the need for a provision of information on key aspects of squatting and other positions to be an integral part of the study development and its analysis.

Poor description of these positions in childbirth is reflected in the inadequate attention to the theoretical and modelling phases of its development. If the definition of these positions cannot be agreed upon, researching whether the rates of adverse events are increasing or decreasing in one position over the other, and deciding appropriate strategies of care that maximise the rates of normal vaginal births remain exceedingly challenging. Any prospective research involving squatting or other positions in childbirth would require all involved to have the same criteria for definition and implementation process to ensure the validity of the result.

The next chapter 5, is to locate, appraise and synthesise qualitative evidence concerning the barriers and facilitators of the use of squatting positions during childbirth. This qualitative synthesis is to produce causal assumptions of the findings of this effectiveness squatting positions review and to suggest the conditions in which squatting positions are most likely to be used.

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CHAPTER 5

A Qualitative Evidence-Synthesis

5.0 Qualitative Evidence Synthesis

5.1 Background

In recent decades, the development of systematic review methodology for synthesising qualitative studies, including within Cochrane, has advanced. [1] QESs can provide an understanding of how people view, experience, interpret and act upon healthcare interventions and what emerges during the interaction between service users and providers. Camp-bell et al. [2] suggest that qualitative synthesis aims 'to achieve greater understanding and attain a level of conceptual or theoretical development beyond any individual empirical study.'

The Cochrane Qualitative and Implementation Methods Group has identified more than 500 qualitative reviews. [3] Although three CSRs have evaluated the effectiveness of maternal positions during childbirth, none of these are considered qualitative research evidence. [4-6] On the other hand, there have been two previous non-Cochrane qualitative reviews related to this topic. Firstly, Green et al. led a qualitative synthesis to explore midwives' influence on childbirth positions. [7] The second review aimed to identify the barriers that midwives face, which hinder them from effectively promoting upright positions during the second stage of labour. [8] Both reviews were limited to high-income country studies and views among midwives only. They were published outside the context of effective reviews (i.e., were not integrated with a quantitative review).

A critical exploration of key stakeholder perceptions on the factors that influence the use of birthing positions can identify core aspects for pregnant women and clinicians that are essential in developing, delivering, and receiving care in childbirth. This fits with national policy in the UK recommending person-centred care in health services. [9] It highlights that people's needs, preferences and experiences about the appropriateness, acceptability and feasibility of practices or interventions should be central to decision-making about their care.

Hence, exploring people's experiences in delivering, developing, and receiving squatting positions is essential. This includes exploring factors that drive or hinder the choice of birthing positions. The systematic qualitative review reported in this chapter was conducted to identify factors influencing implementation success and to understand the perspectives, experiences, behaviours, and interactions of people receiving and delivering upright positions in childbirth. [10, 11] In this type of review, reviewers provide their interpretation of the original authors' interpretation of their participants' views, thereby producing 'third order' constructs (i.e. combining the participants' findings and the author's interpretation to provide new insight). [12] Bringing multiple qualitative studies into a review makes the best use of available evidence on a topic, can be used to increase the transferability of findings, informs the findings of an effective review, and can identify gaps in knowledge and areas for further primary research. Synthesising qualitative evidence can allow for an exploration of similarities and differences across contexts and a better understanding of how upright childbirth positions' structure and components may influence health and well-being outcomes. The qualitative review described in this chapter aimed to address the following overarching question:

What are the perspectives and experiences of women, their partners, and healthcare providers regarding the barriers to and facilitators of using upright or squatting positions in childbirth?

5.1.1 Study objectives.

To identify factors facilitating or hindering the use or implementation of upright positions during childbirth among women, their partners and healthcare providers.

To explore the views and experiences of women, their partners, and healthcare providers regarding factors influencing the choice of upright/squatting positions in childbirth.

5.2 Methodology

This systematic qualitative review was based on the methodology described in Chapter 20 of the Cochrane Handbook [13] and conducted following the Cochrane EPOC Group Qualitative Evidence Syntheses guidance. [14, 15] A research protocol was followed to ensure robustness and transparency. The protocol for this qualitative synthesis was first registered on PROSPERO (CRD42014014255) on 15 October 2014. It was updated on 5 April 2020. (see appendix 13). Reporting of this review followed the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) statement. [16] Table 15 shows the stages of the study process.

Table 15: Stages taken for conducting qualitative evidence synthesis.

Qualitative review stage	Activities
Review protocol	Registered on PROSPERO Formulation of the research question *Criteria for considering studies for this review:* Defining inclusion and exclusion criteria framed by SPIDER [17] (1) **S**ample, (2) **P**henomenon of **I**nterest, (3) **D**esign, (4) **E**valuation, and (5) **R**esearch type Developing a systematic search strategy using conceptual terms formulated by the SPIDER tool
Identification and screening	Search strategy, using search terms informed by the review question, covering electronic databases and other search methods. Screening (exclusion/inclusion criteria and types of studies) Screening by the lead author, who discussed the process with Dr Stephanie Tierney (ST)
Quality appraisal	Critical Appraisal Skills Programme (CASP) for Qualitative Studies Assessment by lead author and discussed with a senior researcher (ST)
Data extraction	Using a standardised form (Appendix 1) Extract study characteristics to map the content of each document

Data synthesis for qualitative evidence	Data synthesis using three staged thematic synthesis methods as described by Thomas and Harden [11] Stage one – Developing initial open coding framework (line by line coding) Stage two – Developing descriptive themes by considering how initial codes go together. Stage three – Generating analytical themes that represent a stage of interpretation whereby the reviewers go beyond the primary studies and generate new interpretive constructs, explanations, or hypotheses
Reporting and implications	Compile findings and reporting of this review following the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) statement

5.2.1 Formulating a research question

Several structures support the formulation of a qualitative review question. While PICOS is fundamental for searching for evidence in an intervention review, alternative components are more applicable to qualitative studies. When developing the scope of the research question for this qualitative review, stakeholders' perspectives, setting, the phenomenon of interest, research design and type were considered essential, in line with the SPIDER framework. [17] This framework defines the review question's critical components, scope, and literature search strategy and guides the review's conduct. [18, 19] This framework informed the inclusion and exclusion criteria for the review as detailed below.

Criteria for inclusion and exclusion

5.2.2 Sample/participants.

Qualitative studies were eligible if they explored key stakeholders' views and experiences. The key stakeholders were those involved in developing (e.g., researchers, clinical specialists or leaders, managers, policymakers, clinical facilitators), receiving or observing (e.g., women and any supporting person such as partners, friends, and family members), and delivering or affected by the intervention in any country (i.e., midwives, doctors, doulas, obstetric nurses, traditional (no formal training) TBA). The review explored differences in the perspectives of various key groups regarding the barriers and facilitators of using upright positions.

5.2.3 Phenomenon of interest

The phenomenon of interest in this review was factors that influence the provision of care on squatting positions supported (with person or equipment) and unsupported (with no aid, equipment, or person) in the first or second stages of labour. The review focused on any immediate, short, or long-term physical, emotional, and social views and experiences of key stakeholders. In the absence of research studies on squatting positions and to provide comprehensive data on the topic, studies exploring participants' perspectives on using other upright positions, including all fours, kneeling, standing, and different positions, were included. This was an a priori decision made at the review's protocol stage.

5.2.4 Types of study design

This review considered studies of qualitative data to complement findings from the systematic review of quantitative evidence (see Chapter 4) [(20).] Designs considered (but not limited to) were ethnography, phenomenology, grounded theory, action research, case study, narrative

inquiry, appreciative inquiry, discourse analysis, and qualitative process evaluation, as outlined by Ring et al. [12] Following the EPOC guidance, [15] mixed methods studies were eligible if the qualitative component was easily distinguished from the quantitative part. Study abstracts that included the study's aim using a qualitative method, including the study population, findings, and recommendations, were eligible for this review. Abstracts were included only if the study added important insights not found in full-text published articles.

5.2.5 Evaluation

Qualitative synthesis seeks to answer questions about how social experience is created and given meaning. This review included qualitative studies that explored views and experiences to identify people's understanding and perceptions of the need, acceptability, appropriateness, and other factors influencing the implementation of upright positions during childbirth. [11] [21] The concepts considered included values, beliefs, preferences, perceptions, attitudes, feelings, perspectives, and opinions. Experiences considered included training, education, knowledge, skills, uptake, research, policy development, and audits.

5.2.6 Research type.

Based on the suggestion by Noyes *et al.* [13], included studies had to have used a qualitative approach for data collection (such as focus groups, semi-structured or unstructured interviews, observation, diaries, fieldwork, reflective journals, and documents). [13] They also had to have used a qualitative approach to analyse data (e.g., content, thematic, framework, narrative, constant comparison, and discourse analysis). [27-30]

Published qualitative studies limited to English were eligible for this review. Qualitative studies were eligible if they were conducted before an effectiveness study, as part of the intervention design process, conducted alongside or within an effectiveness study (e.g., process

evaluations), or conducted after completion of an effectiveness study but with the same groups of participants. [15] These studies have been described as 'trial siblings'.[22] Furthermore, studies were included if they were 'unrelated' (i.e., qualitative research conducted outside the context of an effectiveness study). [22, 23] Questionnaires that had responses to open-ended questions analysed using a qualitative approach (e.g., thematic analysis) were eligible. However, studies were excluded if they used qualitative methods but did not investigate data using qualitative analysis methods (e.g., open-ended survey questions where the response data were analysed using descriptive statistics only).

5.2.7 Literature search

A search strategy was developed at the protocol stage; the SPIDER framework was used to assist in searching and selecting studies (see Figure 5.1). A list of database searches (see below) was developed through discussions between the lead author MK, and an experienced scientific librarian (Mark Kerr). The conversation with the specialist librarian was essential to gather information on which databases and search strategies were best suited to addressing the review question. The search was structured by combining keyword/Medical Subject Heading (MeSH) terms and free text related to the SPIDER framework. Search strategies for each database were not restricted by location or publication date. However, it included studies published in only English. The initial search was conducted on 14 May 2014 and identified no previous qualitative systematic reviews on this topic. The literature search was updated in March 2020. The following databases were searched to reflect the scope and topic of the review.

MEDLINE (PubMed) In-Process & Other Non-Indexed Citations, MEDLINE Daily, and MEDLINE (1946 to 25 February 2022)

EMBASE Classic + EMBASE (1947 to 25 February 2022)

OvidSP (up to 19 March 2020)

MIDIRS (searched from 1985 to 19 March 2020)

PsycINFO (1966 to 19 March 2020)

POPLINE, K4Health (1827 to 19 March 2020)

CINAHL (Cumulative Index to Nursing and Allied Health Literature) (1977 to 25 February 2022),

ProQuest Dissertations and Theses (1861 to 19 March 2020)

Web of Science Conference Proceedings Citation index, ISI Web of Knowledge (1990 to 19 March 2020)

World Health Organization Reproductive Health Library (up to 19 March 2020)

World Health Organization Global Health Library for WHO databases (Regional Indexes) (up to 19 March 2020)

Additional, final searches, on MEDLINE (PubMed), Embase and CINAHL, were undertaken on 25 February 2022, as they are all freely accessible through the Oxford Library Information Platform (OxLip) website.

A MEDLINE search strategy was developed, which was adapted for other databases. Another means of identifying eligible studies was reviewing reference lists of all articles that were retrieved and assessed for eligibility, and b) relevant systematic reviews. In addition, a grey literature search for ongoing and unpublished studies involved searching Grey Literature in Europe, Open SINGLE, Dissertation Abstracts, Grey Literature Network and Networked Digital Library of Theses. Exploring these supplementary strategies was critical to identifying articles not retrieved by databases, and thirteen additional articles were retrieved in this way.

5.2.8 Selection of studies

All citations were exported from the database searches to EndNote software for assessment for relevance and duplicates were removed. Titles and abstracts of retrieved publications were screened by one reviewer (MK) against the inclusion/exclusion criteria. Full-text versions of studies considered possibly appropriate were obtained and again scrutinised for eligibility against the inclusion/exclusion criteria by MK. Papers that did not meet the inclusion criteria were excluded from the review. The eligibility of studies for inclusions and exclusions in the review was discussed with ST (DPhil supervisor and senior qualitative researcher).

5.2.9 Critical appraisal of included studies

The Cochrane Qualitative Methodological Limitations Tool (CAMELOT) maps the various tools available for critical appraisal of qualitative studies and identifies standard criteria across the tools. [24] When critically appraising individual studies, Cochrane advises against scoring each domain to determine an overall quality score, since this assumes that each of the domains is equally important. [25] In addition, it recommends selecting a published and commonly applied tool that assesses the methodological rigour, credibility, and relevance of the papers included in a review. [26]

Studies were critically appraised using the Critical Appraisal Skills Programme (CASP) [26] Qualitative Research Tool. This tool is recommended by the Cochrane EPOC group. [25, 27] It allows for an appraisal of each included study's overall integrity, methodology, design, recruitment, data collection, data analysis, reflexivity, ethical considerations, findings, and research contribution. [28] The need for quality assurance is balanced against the debate about whether and how to appraise qualitative studies. [29] Assessing the quality of included studies provided a detailed understanding of the strengths and weaknesses of each. According to Noyes *et al.* [25], studies assessed as low quality are not necessarily excluded because they can generate

new insights grounded in the data. Still, the assessment allows for transparency about the quality of included papers. Therefore, studies were not excluded on the grounds of quality appraisal.

5.2.10 Data extraction

Several different approaches have been used to extract data within a qualitative synthesis. [29, 30] It has been recommended that data extraction should include information about each study's contextual, methodological, and findings using a standardised extraction form. [31] These elements are relevant to address the review question and to ensure that the context of included primary studies is present during the extraction and synthesis processes. Extracting 'contextual' details such as the number of study participants and their characteristics, the context in which the study occurred, and the type of maternal position studied was vital. Furthermore, MK extracted information on the methodological design and approach, methods for identifying the sample and recruitment, the specific data collection and analysis practices used, reflexivity and ethical approval, and any theoretical models used to interpret or contextualize the findings. The data extracted was discussed with ST. Relevant data from each included study were extracted into Microsoft Excel. This Excel file included information on the contextual details of each study and data to be synthesised from eligible papers, including quotations and authors' interpretations and themes. These were generally found in the narrative of the findings or results section of articles but might also be present in the discussion section or tables. A standardised data extraction form was designed to ensure consistency in extracting data from all included studies. (Appendix 14)

5.2.11 Data synthesis

Several meta-synthesis methods bring together qualitative data. These methods include (but are not limited to) meta-ethnography, meta-study, content analysis, formal grounded theory,

cross-study analysis, and thematic synthesis. [32, 33] Thematic synthesis was relevant to this review for several reasons. First, it is one of the most used qualitative evidence synthesis methods because it can address many topics and questions. This approach draws on the principles of established methods in primary qualitative research, mainly thematic analysis. According to Flemming *et al,* 'Like thematic analysis, thematic synthesis seeks to explore a range of people's views, expectations, opinions, knowledge, experience or values from a set of qualitative data...' [34]

Thematic synthesis methods enable new insights, interpretations, and theories to be developed from primary studies. [35] Like in grounded theory, text is coded line by line, [36] and codes are developed to support the creation of descriptive themes from primary study data. [37] Thematic synthesis also draws on meta-ethnography, moving beyond the content of primary studies to offer novel interpretations by synthesising findings across studies. According to Noyes *et al.* [27], this can allow for a new understanding, including hypotheses for future studies and explanations of results from effectiveness reviews.

Thematic synthesis was appropriate for this review to capture and organize people's in-depth views and experiences related to the review's objectives regarding the subjective interpretation of acceptability, need, appropriateness, and implementation factors. [11] Moreover, it was well suited to the review's objective of combining existing evidence to identify patterns within data. [18] Thematic synthesis can incorporate 'thick' and 'thin' data (e.g., open-ended qualitative survey) to produce descriptive themes and then more in-depth analytic themes through an inductive approach to coding. [11] Thematic synthesis is a suitable method to be used by novice qualitative reviewers. [34]

Thematic synthesis has three broad stages - line-by-line coding, followed by developing descriptive and then analytical themes [11, 12] - as detailed in Table 16. These stages include

labelling the data set, capturing and organising recurring concepts or issues from multiple studies, interpreting and explaining these as themes, and drawing conclusions. [12] Descriptive and analytical themes are concepts that bring together data from individual papers around a shared idea or phenomenon of interest. Each theme (descriptive and then analytical) has a centralising concept that is unique and allows for shared meaning. Descriptive themes involve data reduction – moving from the specific (codes) to the more general (descriptive themes). They are used to develop analytical themes which reflect/relate to the review question. Analytical themes provide new insights by bringing together findings from several studies. The first reviewer (MK) conducted each stage and then discussed it with another researcher (ST).

Table 16: Thematic synthesis stages, description, and specification

Stage	**Description**	**Specification**
Stage 1- Coding	Identify and label each part of the data set	Label the entire data set. Develop a list of initial codes. Consistency checks - going back and forth, re-reading included studies to establish the credibility of the coding
Stage 2 - Developing descriptive themes	Cluster codes into descriptive themes	Themes created from a thorough, inclusive, and comprehensive review of the codes of all papers. Overlaps between codes are identified and collating the remaining codes around centralising ideas. Checking themes against each other and back to the data of the original papers to ensure they are internally coherent, consistent, and distinctive. Descriptive themes are compared and used to develop analytical themes
Stage 3 - Developing analytical themes	Explore relationships between themes and generate analytical themes	Directly address the concerns of the review (barriers and facilitators of upright positions in childbirth) Should 'go beyond' the content of the original primary studies, providing new insights, explanations, or hypotheses

The three stages began by reading each study more than once. Sections of each article pertinent to the review question were highlighted during this familiarisation process (Figure 33).

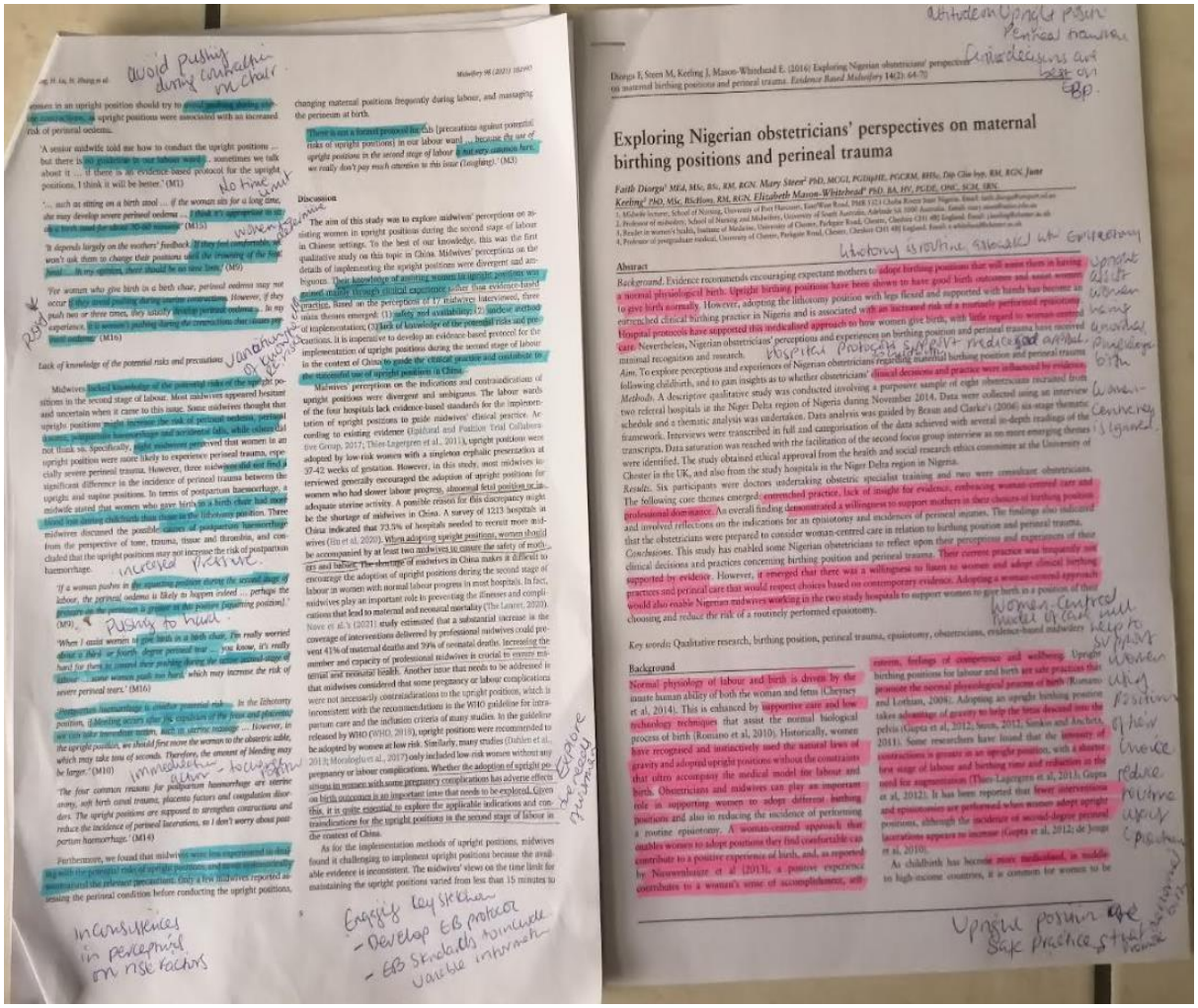
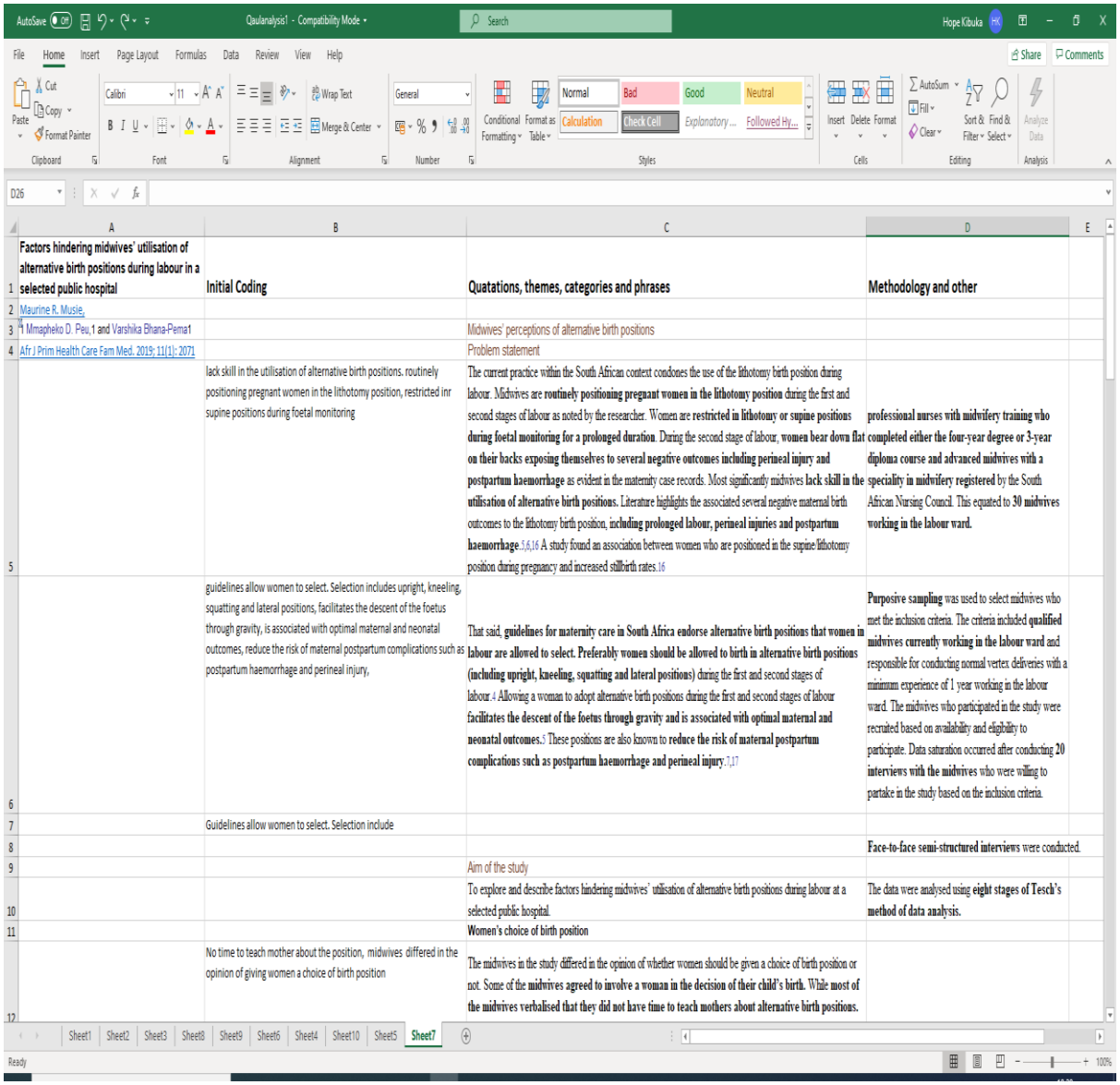


Figure 33: Reading and re-reading of papers, highlighting relevant sections.

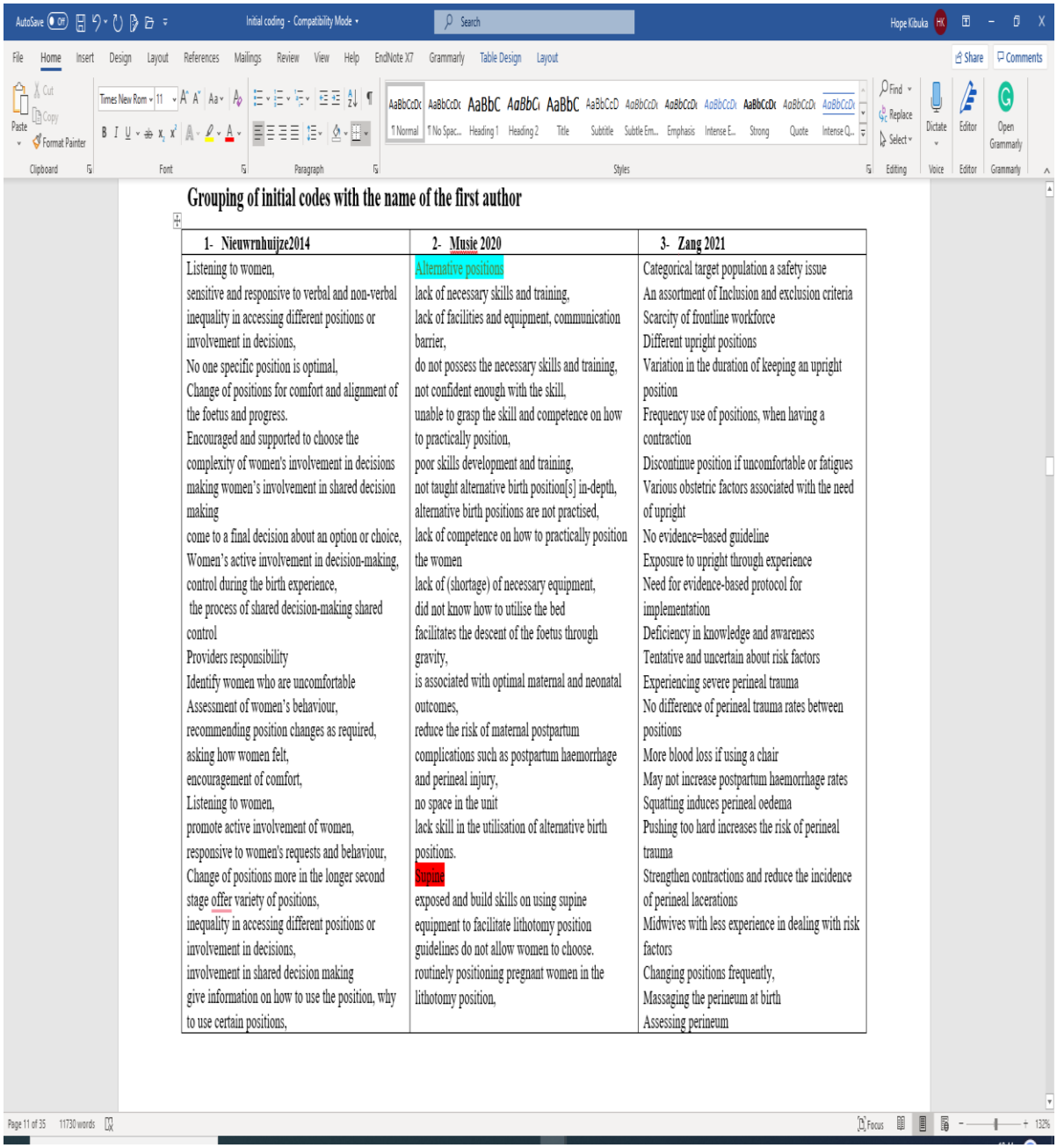
Line-by-line coding allows qualitative reviewers to start the process of translating concepts from one study into another. [38] One reviewer (MK) coded each line of text (see second column Figure 34). The text taken from the included paper is in the third column under quotations, themes, categories, and phrases. Hence, each included study was examined and allocated codes to define relevant sentences or sections. [36]



	A	B	C	D	E
1	Factors hindering midwives' utilisation of alternative birth positions during labour in a selected public hospital	Initial Coding	Quatations, themes, categories and phrases	Methodology and other	
2	Maurine R. Musie,				
3	Mmapheko D. Peu,1 and Varshika Bhana-Pema1		Midwives' perceptions of alternative birth positions		
4	Afr J Prim Health Care Fam Med. 2019; 11(1): 2071		Problem statement		
5		lack skill in the utilisation of alternative birth positions. routinely positioning pregnant women in the lithotomy position, restricted inr supine positions during foetal monitoring	The current practice within the South African context condones the use of the lithotomy birth position during labour. Midwives are **routinely positioning pregnant women in the lithotomy position** during the first and second stages of labour as noted by the researcher. Women are **restricted in lithotomy or supine positions during foetal monitoring for a prolonged duration**. During the second stage of labour, **women bear down flat on their backs exposing themselves to several negative outcomes including perineal injury and postpartum haemorrhage** as evident in the maternity case records. Most significantly midwives **lack skill in the utilisation of alternative birth positions.** Literature highlights the associated several negative maternal birth outcomes to the lithotomy birth position, **including prolonged labour, perineal injuries and postpartum haemorrhage**.5,6,16 A study found an association between women who are positioned in the supine/lithotomy position during pregnancy and increased stillbirth rates.16	**professional nurses with midwifery training who completed either the four-year degree or 3-year diploma course and advanced midwives with a speciality in midwifery registered** by the South African Nursing Council. This equated to **30 midwives working in the labour ward.**	
6		guidelines allow women to select. Selection includes upright, kneeling, squatting and lateral positions, facilitates the descent of the foetus through gravity, is associated with optimal maternal and neonatal outcomes, reduce the risk of maternal postpartum complications such as postpartum haemorrhage and perineal injury,	That said, **guidelines for maternity care in South Africa endorse alternative birth positions that women in labour are allowed to select. Preferably women should be allowed to birth in alternative birth positions (including upright, kneeling, squatting and lateral positions)** during the first and second stages of labour.4 Allowing a woman to adopt alternative birth positions during the first and second stages of labour **facilitates the descent of the foetus through gravity and is associated with optimal maternal and neonatal outcomes.**5 These positions are also known to **reduce the risk of maternal postpartum complications such as postpartum haemorrhage and perineal injury.**7,17	**Purposive sampling** was used to select midwives who met the inclusion criteria. The criteria included **qualified midwives currently working in the labour ward** and responsible for conducting normal vertex deliveries with a minimum experience of 1 year working in the labour ward. The midwives who participated in the study were recruited based on availability and eligibility to participate. Data saturation occurred after conducting **20 interviews with the midwives** who were willing to partake in the study based on the inclusion criteria.	
7		Guidelines allow women to select. Selection include			
8				**Face-to-face semi-structured interviews** were conducted.	
9			Aim of the study		
10			To explore and describe factors hindering midwives' utilisation of alternative birth positions during labour at a selected public hospital.	The data were analysed using **eight stages of Tesch's method of data analysis.**	
11			**Women's choice of birth position**		
12		No time to teach mother about the position, midwives differed in the opinion of giving women a choice of birth position	The midwives in the study differed in the opinion of whether women should be given a choice of birth position or not. Some of the **midwives agreed to involve a woman in the decision of their child's birth.** While **most of the midwives verbalised that they did not have time to teach mothers about alternative birth positions.**		

Figure 34: Initial Line by Line Coding in Microsoft Excel

When all the data had been coded in Microsoft Excel, a list of all codes was transferred into a table in a Word document, ready for the manual grouping and reviewing of codes. All codes were referenced under each study's first name. For example, see figure 35, *Nieuwenhuijze 2014; Musie 2020; Zang 2021*. Labelling codes per study allowed for a continuous review of codes and translation of concepts between studies.



Grouping of initial codes with the name of the first author

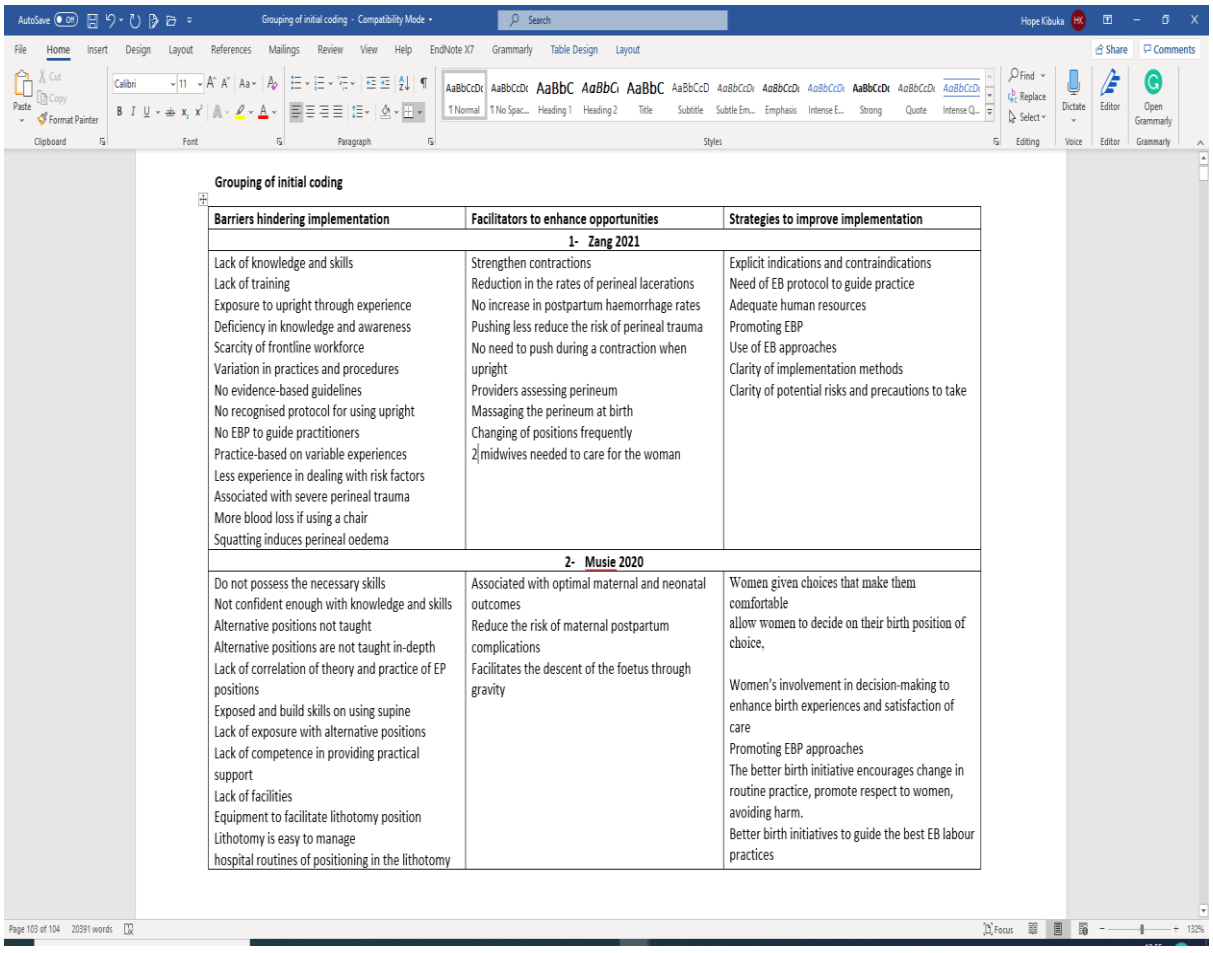
1- Nieuwenhuijze2014	2- Musie 2020	3- Zang 2021
Listening to women, sensitive and responsive to verbal and non-verbal inequality in accessing different positions or involvement in decisions, No one specific position is optimal, Change of positions for comfort and alignment of the foetus and progress. Encouraged and supported to choose the complexity of women's involvement in decisions making women's involvement in shared decision making come to a final decision about an option or choice, Women's active involvement in decision-making, control during the birth experience, the process of shared decision-making shared control Providers responsibility Identify women who are uncomfortable Assessment of women's behaviour, recommending position changes as required, asking how women felt, encouragement of comfort, Listening to women, promote active involvement of women, responsive to women's requests and behaviour, Change of positions more in the longer second stage offer variety of positions, inequality in accessing different positions or involvement in decisions, involvement in shared decision making give information on how to use the position, why to use certain positions,	Alternative positions lack of necessary skills and training, lack of facilities and equipment, communication barrier, do not possess the necessary skills and training, not confident enough with the skill, unable to grasp the skill and competence on how to practically position, poor skills development and training, not taught alternative birth position[s] in-depth, alternative birth positions are not practised, lack of competence on how to practically position the women lack of (shortage) of necessary equipment, did not know how to utilise the bed facilitates the descent of the foetus through gravity, is associated with optimal maternal and neonatal outcomes, reduce the risk of maternal postpartum complications such as postpartum haemorrhage and perineal injury, no space in the unit lack skill in the utilisation of alternative birth positions. Supine exposed and build skills on using supine equipment to facilitate lithotomy position guidelines do not allow women to choose. routinely positioning pregnant women in the lithotomy position,	Categorical target population a safety issue An assortment of Inclusion and exclusion criteria Scarcity of frontline workforce Different upright positions Variation in the duration of keeping an upright position Frequency use of positions, when having a contraction Discontinue position if uncomfortable or fatigues Various obstetric factors associated with the need of upright No evidence=based guideline Exposure to upright through experience Need for evidence-based protocol for implementation Deficiency in knowledge and awareness Tentative and uncertain about risk factors Experiencing severe perineal trauma No difference of perineal trauma rates between positions More blood loss if using a chair May not increase postpartum haemorrhage rates Squatting induces perineal oedema Pushing too hard increases the risk of perineal trauma Strengthen contractions and reduce the incidence of perineal lacerations Midwives with less experience in dealing with risk factors Changing positions frequently, Massaging the perineum at birth Assessing perineum

Figure 35: Grouping of Initial Codes into a Word Document

The next stage was the development of descriptive themes. MK looked for similarities and differences between the codes to start grouping them. Each study code was arranged under three categories:

- Barriers hindering implementation.
- Facilitators to enhance opportunities.
- Strategies to improve performance (see Figure 36)

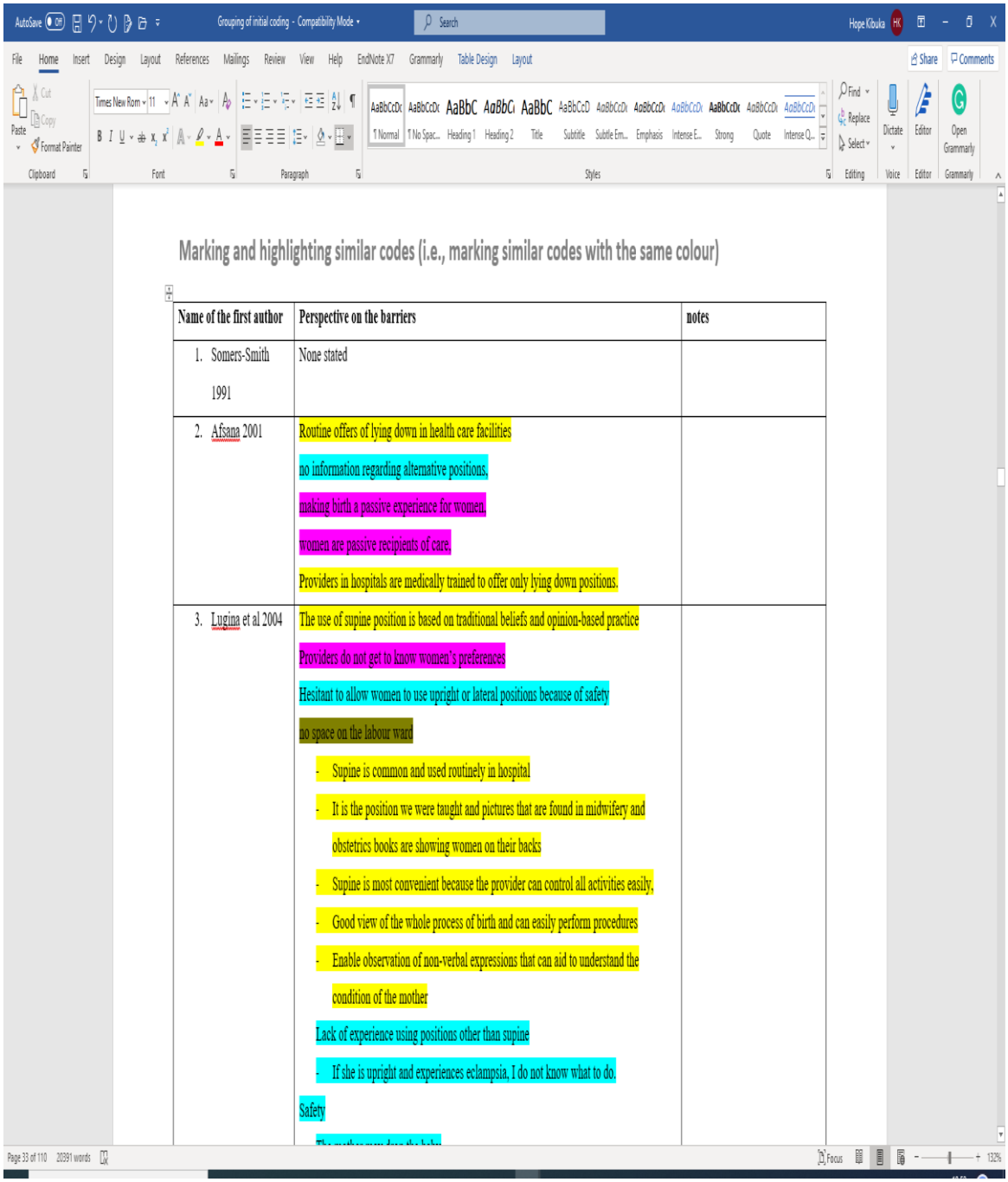
This was followed by highlighting, using the same colour, similar codes across studies (Figure 37). Then, similar codes from different studies were grouped (Figure 38). This task was to assist in translating concepts from one study to another by clustering them together. [39] Similar codes were compared between studies and merged to reduce the number of codes. Afterwards, to develop descriptive themes, each code was handwritten onto post-it notes, condensed, and grouped on One Sheet of Paper (OSOP) analysis, if on a similar issue/topic (Figure 39). A written short narrative (a sentence or two) relating to each descriptive theme was produced to highlight what it was about and clarify how it was distinctive from other themes. The process resulted in a total of sixteen descriptive themes.



Grouping of initial coding

Barriers hindering implementation	Facilitators to enhance opportunities	Strategies to improve implementation
1- Zang 2021		
Lack of knowledge and skills Lack of training Exposure to upright through experience Deficiency in knowledge and awareness Scarcity of frontline workforce Variation in practices and procedures No evidence-based guidelines No recognised protocol for using upright No EBP to guide practitioners Practice-based on variable experiences Less experience in dealing with risk factors Associated with severe perineal trauma More blood loss if using a chair Squatting induces perineal oedema	Strengthen contractions Reduction in the rates of perineal lacerations No increase in postpartum haemorrhage rates Pushing less reduce the risk of perineal trauma No need to push during a contraction when upright Providers assessing perineum Massaging the perineum at birth Changing of positions frequently 2 midwives needed to care for the woman	Explicit indications and contraindications Need of EB protocol to guide practice Adequate human resources Promoting EBP Use of EB approaches Clarity of implementation methods Clarity of potential risks and precautions to take
2- Musie 2020		
Do not possess the necessary skills Not confident enough with knowledge and skills Alternative positions not taught Alternative positions are not taught in-depth Lack of correlation of theory and practice of EP positions Exposed and build skills on using supine Lack of exposure with alternative positions Lack of competence in providing practical support Lack of facilities Equipment to facilitate lithotomy position Lithotomy is easy to manage hospital routines of positioning in the lithotomy	Associated with optimal maternal and neonatal outcomes Reduce the risk of maternal postpartum complications Facilitates the descent of the foetus through gravity	Women given choices that make them comfortable allow women to decide on their birth position of choice, Women's involvement in decision-making to enhance birth experiences and satisfaction of care Promoting EBP approaches The better birth initiative encourages change in routine practice, promote respect to women, avoiding harm. Better birth initiatives to guide the best EB labour practices

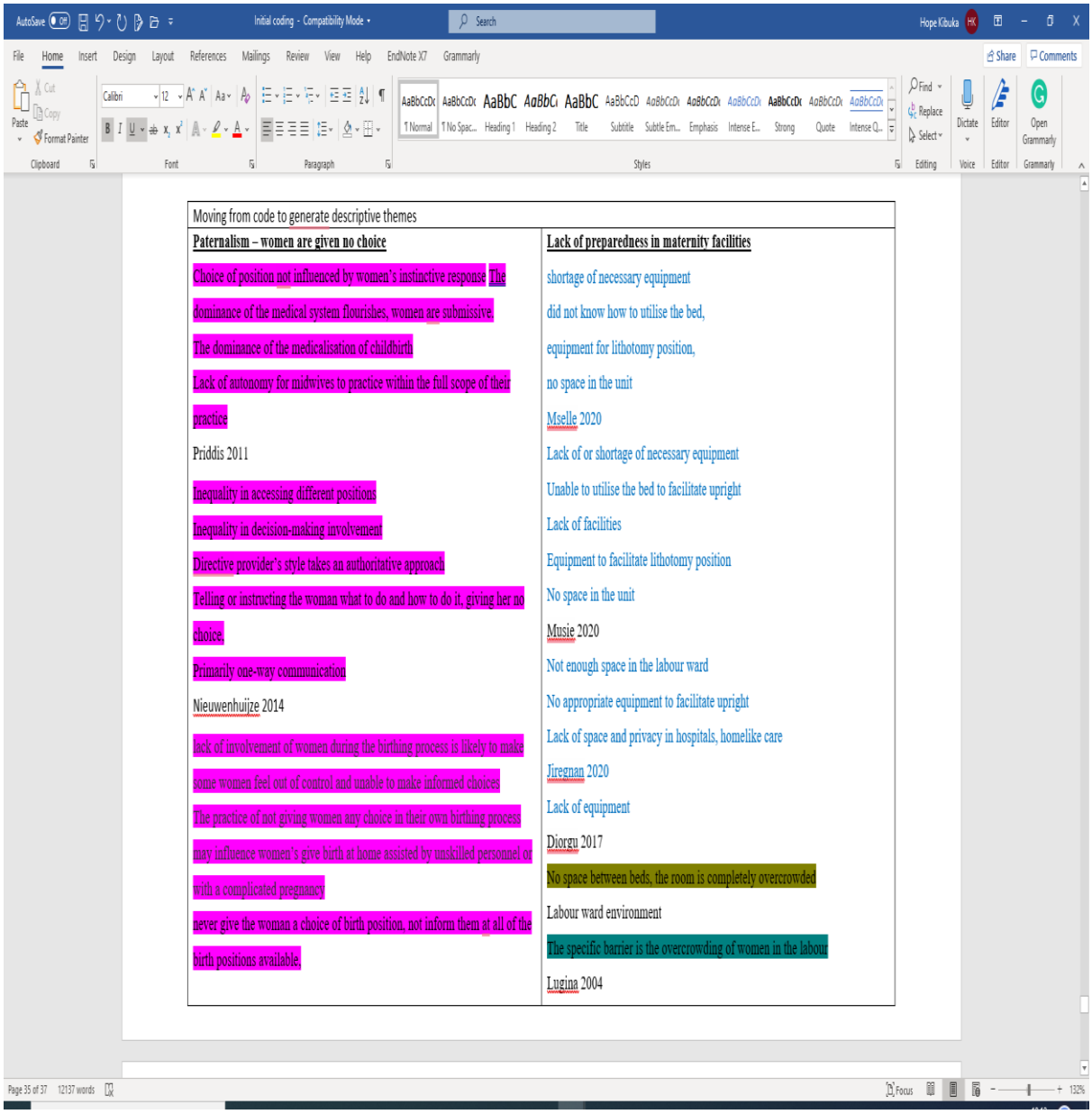
Figure 36: Grouping Codes



Marking and highlighting similar codes (i.e., marking similar codes with the same colour)

Name of the first author	Perspective on the barriers	notes
1. Somers-Smith 1991	None stated	
2. Afsana 2001	Routine offers of lying down in health care facilities no information regarding alternative positions. making birth a passive experience for women. women are passive recipients of care. Providers in hospitals are medically trained to offer only lying down positions.	
3. Lugina et al 2004	The use of supine position is based on traditional beliefs and opinion-based practice Providers do not get to know women's preferences Hesitant to allow women to use upright or lateral positions because of safety no space on the labour ward - Supine is common and used routinely in hospital - It is the position we were taught and pictures that are found in midwifery and obstetrics books are showing women on their backs - Supine is most convenient because the provider can control all activities easily, - Good view of the whole process of birth and can easily perform procedures - Enable observation of non-verbal expressions that can aid to understand the condition of the mother Lack of experience using positions other than supine - If she is upright and experiences eclampsia, I do not know what to do. Safety	

Figure 37: Grouping Codes of Each Study Highlighting Similar Codes



Moving from code to generate descriptive themes	
Paternalism – women are given no choice	**Lack of preparedness in maternity facilities**
Choice of position not influenced by women's instinctive response The dominance of the medical system flourishes, women are submissive.	shortage of necessary equipment
The dominance of the medicalisation of childbirth	did not know how to utilise the bed,
Lack of autonomy for midwives to practice within the full scope of their practice	equipment for lithotomy position,
	no space in the unit
Priddis 2011	Mselle 2020
Inequality in accessing different positions	Lack of or shortage of necessary equipment
Inequality in decision-making involvement	Unable to utilise the bed to facilitate upright
Directive provider's style takes an authoritative approach	Lack of facilities
Telling or instructing the woman what to do and how to do it, giving her no choice.	Equipment to facilitate lithotomy position
	No space in the unit
Primarily one-way communication	Musie 2020
Nieuwenhuijze 2014	Not enough space in the labour ward
lack of involvement of women during the birthing process is likely to make some women feel out of control and unable to make informed choices	No appropriate equipment to facilitate upright
	Lack of space and privacy in hospitals, homelike care
The practice of not giving women any choice in their own birthing process may influence women's give birth at home assisted by unskilled personnel or with a complicated pregnancy	Jiregnan 2020
	Lack of equipment
never give the woman a choice of birth position, not inform them at all of the birth positions available.	Diorgu 2017
	No space between beds, the room is completely overcrowded
	Labour ward environment
	The specific barrier is the overcrowding of women in the labour
	Lugina 2004

Figure 38: Grouping Similar Codes from Different Studies to Produce Descriptive Themes



Figure 39: Arranging of Codes to Generate Descriptive Themes on OSOP

During line-by-line coding and development of descriptive themes, MK inductively analysed data, staying close to the original findings of the included primary studies. Up to this point, it was essential to present the views and experiences of key stakeholders built from the data in the included studies.

The final step in the thematic synthesis is the generation of analytical themes. This entails moving away from simply describing data to determine key messages. The purpose is to develop analytical themes using descriptive themes from the inductive analysis of study findings to answer the review question. [11, 12] A vital element of this stage is a significant degree of interpretive analysis of the data that 'goes beyond' the content of original primary studies. [11, 40] Analytical themes were developed through discussions with ST (study supervisor) and revisions. This entailed going back and forth between initial codes, descriptive themes, and their data from the primary studies in the light of the review question. A repeated cyclical process was crucial until the final analytical themes were sufficiently abstract. This process facilitates the generation of new meaning, understanding, or hypotheses, producing new conceptualisations and explanations related to a review's objectives. [11] Finally, table 17 presents the analytical and descriptive themes, and coding framework with matched quotations obtained from the included studies in the QES.

Table 17: Analytical and descriptive themes and coding framework from included studies

Analytical themes	Descriptive themes	Codes	Indicative quotations from included studies
Recognition of different philosophies of maternity care	Practice shaped by the medicalisation of childbirth	The dominance of medicalisation in childbirth Midwives are not able to practice within their scope. The medical model of care Routine medical interventions No equipment Lack of space Provider attitude Use of supine in hospitals as a standard practice Supine position to control routine clinical activities. Supine is a traditional position. Midwives under medical surveillance Care is regimented and institutionalised.	*"The dominance of the medicalisation of childbirth impedes the ability of midwives to practice within the full scope of their practice." (author)* [41] *"Some clinicians are conformed to a medical model of care in which the supine position is the norm, positions they considered 'natural'" (author).* [42] *"Clinical practice is aligned with the medicalised model of care, use of routine medical interventions of hospital standards hindering women from assuming upright. (author)* [43] *Supine is the best position with CTG, midwife to view and control of the perineum, see and easier to control birth of the head. (midwife) Overcrowding and lack of space in birth rooms prevents women from adopting an upright position (midwife).* [10] *"a small obstetric unit, the bed seems to be the only permanent fixture intended for the woman herself; beanbags, birth balls and the birth stool have to be brought in from a store room. The bedside chair is clearly meant for the woman's partner". (author)* [11]

			On labour room, it was actually a very big room, I felt I was lost in the middle. There was medical type equipment but nothing like birth pool or bean bag or anything comforting like that at all, not anything useful for me but useful to staff obviously. (woman) [10] *"Hospital routines can hinder the use of upright positions, for instance, using an obstetric bed, medical interventions, and professional preferences to use supine position." (author)* [41] *They frighten you into thinking that things are going very badly and restricted, going vaginal examineon and put me on monitor, making me to lying on my back, it was horrible (women). It would be difficult to develop sensible birthing options because of the power, control, and force present in the medical system and industrial domination of technology (author)* [10] *"Routine use of continuous electronic foetal monitoring and vaginal examination were identified as major inhibitors to physiological positioning." (author)* [41]

			"Medical surveillance – midwives are under pressure to undertake unnecessary medical interventions and repeated suggestions for women to consent to epidural analgesia." (author) [41]
	Practice shaped by a midwifery-led model of care	Birth centre. Focus on woman's needs and comfort. Appropriate equipment Home-like environment More space or room	*"One of the roles of midwives is to provide women-centred care that enables women to adopt birth positions they are comfortable with" (author)* [44] *"The birth centre is setting acts as a facilitator for physiological birth positions by providing a buffer from medicalised care." (author)*[41] *"At home, they could move around freely from one room to another and would think of trying other positions more quickly. (author)*[45] *'I was 10 cm and ready to go, and I just climbed up to the bed and squatted on the bed; they lifted the back of the bed up and I was leaning on that.' (woman); 'I felt very homely, instantly reassured..there was a bed for your partner, it was big, it didn't feel clinical.. it felt just really nice (woman)* [11]

			I was supposed to give birth in the birthing centre but ended up on labour ward due to staff shortage at the birthing centre. Loads of equipments were around the place… it was horrible. (woman) [11]
	Autonomous practitioners	Philosophy of a woman-centred care promoted by midwives. Self-directed provider(s) Self-learning in practice	*"Midwives who worked under the philosophy of a woman-centred care, women were more likely to utilise the birth positions of their choice. This could be true because of the one-to-one model of intrapartum care for low-risk women in these maternity units, whereby midwives can utilise alternative positions." (author)* [46] *"Midwifery training on alternative birth position differed for each midwife" (author)* [44]
	Ignoring women's choice	Paternalistic approach Women are not allowed to choose. Disrespectful and abusive approaches Providers' responsiveness to women's request Passive recipient of information and choices	*"We always found the lithotomy being used here in this institution. No is the answer to the question; we never give the woman a choice of birth position. We don't even inform them at all of the birth positions available, because we not going to go with her option we only use birth positions that suit us not the patient" (midwife)* [44]

			"I had tried to use a squatting position by getting off the delivery coach …but the health care providers pushed me to the position they preferred (woman) [46] *"Women relinquished control to the authoritative experts" (author)* [41] *My experience on labour ward was really frightening (emotional crying). The doctors were very intimidating, and they really bully you in there. (woman); The force and control were evident, women who were subjected to providers' control or dominnt force about adopting supine position or medical interventions expressed unhappiness, felt inadequate, became passive (author)* [11] *'We really did have the fight with the doctors to say "no, we don't want this" and then they wanted to use the forceps and I said 'no', so I don't feel I did have a choice and we really did have to argue our case.(woman)* [11] *"Women relinquished control to the authoritative experts" (author)* [41]
Enhancing a positive birth experience	Physiological effects in childbirth	Faster birth Reduces perineal trauma. Facilitâtes foetal descent.	*"Squatting is better for delivering. It is faster. The effort is exerting; it comes out fast, not forced as in the lying down." (woman)* [47]

		Protomes Gravity. Ability to push down. Reduces the need for augmentation. Fewer episiotomy rates Reduces medical interventions. Strong contractions Shortens labour. No stitches	*The physical advantage of the upright position in childbirth is the facilitation of gravity aiding labour progress, optimisation of pelvic by maximising of pelvic outlet, easier to push and good utero-placental perfusion (author)* [(10)] *"Social, natural way of giving birth respecting the physiological birth process associated with increased sagittal outlet and interspinous diameters when upright compared with supine. (author)* [(48)] *"The effects of the upright in childbirth include gravity that helps the foetus descend into the pelvis, reduces the need for augmentation, and fewer episiotomy rates". (author)* [(43)] *"It makes the contractions stronger, making labour shorter, and there will be fewer medical interventions" (doctor)* [(42)] *I found I could almost encourage contractions by being in a certain position, for example if I moved to a deep squat it would bring on an intense one (woman)* [(10)]

	Psychological effects in childbirth	Positive birth experience Postnatal recovery is faster. Shorter hospital stays. Reduces fear, helps psychologically. Feeling more confident Decreases anxiety. Being calm and relaxed Alleviating back pain A way of comfort Easier for mother	*"Postnatal recovery is faster reducing the length of stay in hospital" (midwife)* [42] *"Using a ball introduced an element of fun which decreased their fear and resulted in a more positive labouring experience. (author); Using the ball helps me be calm and relaxed, more in charge of my body." (woman)* [43] *"Eight women felt they had more control over their pushing during birth if they are in upright positions compared to supine." (author); Yes, that went well; actually, I had a feeling that I was able to put more pressure right down like that, giving more pressure from where it should be, actually pushing right down (woman)* [49]
	Acknowledging the role of companionship	Having a companion in childbirth Companion encouraging to mobilise. Physical support	*"Women mentioned their partners could give most support on the birthing stool so that the partner could push against her lower back (author)*[45] *Practical support supports the woman's body in labour, holding the woman, walking, or moving during contractions. (doula)* [50]

			"Women were physically supported to change positions, such as squatting or standing (author); my sister helped me to move around, she held my arm, and we walked together to the bathroom"(woman)"[51] *The woman squats during birth supported by a helper, with a rope overhanging from the ceiling or a squat bar attached to two posts on top of the woman's head, to maintain her balance. (author)* [11] *".. mainly encouragement and support by a midwife, helping to know when you are supposed to push or not to push, and encouragement to move around…and trying different positions. I had two birthing partners my husband and my best friend, I was standing up, leaning on the table with my husband holding on the one arm and my friend holding on the other arm it was perfect. (woman)* [11].
Preserving Safety	Safety in a home environment	Unskilled birth attendants Homebirth is not safe. Risk of litigation claims	*"The practice of not giving women any choice in their birthing process may influence women's give birth at home, with a complicated pregnancy assisted by unskilled personnel." (author)* [48] *"Safe environment, with a feeling of fear that is based on the concept of risk for themselves and their unborn babies."* [39]

			Overcrowding and lack of space in birth rooms to prevent women from adopting an upright position. [(42)] *In view of inadequate manpower, existing midwives will not get ample time to teach mothers about alternative birth positions (midwife)* [(11)] *'The midwife with her expertise and support can also provide the 'safety net' (author)* [(11)]
	Appropriateness of upright positions	Target population Low-risk pregnancy Uncomplicated birth Prolonged labour Used as an intervention	*"if labour is not progressing well, for example, occipital-transverse position, pushing in the supine position for more than an hour without any labour progress, we will help her change to an upright position." (midwife)* [(52)] *'The baby was not coming out as easily as it could, that is why the midwife suggested standing up, let the gravity help. I felt more comforable, obviously you're very tired on your legs but it felt logical. (woman)* [(11)] *"A longer duration of the second stage as described by the providers or woman was a reason to become more active in using different birthing positions; women changed to more upright positions to promote progress". (author)* [(53)]

	Approaches to implementation	Duration of exposure Break between contractions. Duration determined by women. Types of upright/squatting	*"Women assuming an upright position can take a break in a more comfortable position between contractions." (author)*[53] *"I think it is appropriate to sit on a birth stool for about 30-60 minutes (midwife)* [52] *'Most women maintaining squatting position on the birth cushion without effort, usually even stayed in this position until after the 3rd stage was completed… it facilitates maintenance of the posture for longer periods. (author)* [11] *Many assistive birthing devices can be used for assisting birthing women to help in delivering in natural positions such as a birthing stool, birthing ball etc. These are not available or even tried in many labour room settings.(midwife)* [10] *'The crouching position with one knee flexed completely on the ground and the other knee raised to deliver a baby. The rationale for this position is that "if the foetal head is displaced into one of the iliac fossae, it may be forced back over the inlet if the knee on the side of the displacement is raised".' (author)* [10]

			Semi-squatting – this lies between the standing position and the full squat where the woman may rest both hands on her thighs with knees bent for support or when leaning over the bed or chair, with knees bent; also known as suspended squat, normally with hands round partner's neck. (author) [(11)]*; to overcome certain disadvantages of a full squat like fatigue of both the woman and her partner and improve perineal visualisation for the midwife)(author). Birthing stool usually have a big hole cut in the middle, it resolves the problem of support in the squatting position and the sufficient exposure of the perineum (author). The birth cushion was designed to assist the adoption of the squatting position, it is a supported squat.(author)* [(11)] *Sitting upright/semi-squat – weight on buttocks, back elevated greater than 30 or 45 degrees from the horizontal, on or off the bed, with or without the aid of birth cushions, chair, stool or bed* [(10)]
	Potential adverse events	Variable knowledge about postpartum haemorrhage Varying knowledge regarding perineal trauma	*"Two women using birth seats experienced severe vaginal trauma, and another had severe vulva swelling, which led to incontinence and sexual problems. Both women felt that their issues improved within a short period, and they thought that the advantages of a birthing seat outweighed the possible disadvantages." (author)* [(45)]

		No pushing with a contraction on a stool Squat does not push. Prolonged pushing causes severe tears Spontaneous pushing preserves perineal integrity	*"The upright positions are supposed to strengthen contractions and reduce the incidence of perineal lacerations, so I don't worry about postpartum haemorrhage." (midwife)*[52] *"Prolonged pushing on a birthing stool could lead to oedema, suggesting to change to standing for periodically to release pressure (author)*[49]
	Exposure to upright positions	Previous training (of lack of) Exposure through experience Knowledge through discussion with colleagues It varies depending on the setting. Overcrowding of hospital One-to-one provision of care Deficiency in knowledge and awareness Routine use of supine in hospitals reflects providers' previous training. Supine births as routine	*"I had learned at school about alternative birth positions, but I had never seen on the ground (health facility) when women gave birth by their choice of positions and similarly, I as healthcare provider didn't provide information" (midwife)* [46] *"…I usually assist women in the supine position. We never conduct delivery in any other positions. The supine give support to the midwife while conducting the delivery." (Midwife)* [48] *"Most midwives did not grasp the skill and competence to utilise the alternative birth positions during undergraduate studies."* [44]

			"Obstetricians and midwives are educated and trained to facilitate birth using lithotomy" (author) [41] *Number of staff should be adequate to provide one to one care and supervision to women in labour to make them adopt and practice upright positions in labour (midwife).* [11] *"Supine is the position recommended in the textbooks on the mechanism of labour" (Doctor)* [47] *"Supine is the position we are taught, and pictures that are found in midwifery and obstetrics books show women on their backs" (midwife)* [42] *"It was suggested that in obstetric units, the labour wards are overcrowded with the care of high-risk labour women, which is a challenge for providers to support upright positions. One to one model of intrapartum care is unlikely to happen due to overcrowding."* [46]

	Lack of evidence-based clinical guidelines	No clinical guidelines to support providers. No specific education and training	*"No specific hospital guideline that informs nurse-midwives decision(s)" (author)* [48] *"There is no formal protocol for precautions against potential risks of upright positions in our labour ward (midwife). A senior midwife told me how to conduct the upright positions… but there is no guideline in our labour ward… sometimes we talk about it…"(midwife)* [52]
Engaging Key Stakeholders	Informing, engaging, and empowering women	Women's involvement in decision-making Giving specific suggestions for birthing positions Providing supportive direction Empowering women through informed consent and choice Individual needs and preferences Giving information to women Educate using different materials.	*"Providers moved between listening to the woman, encouragement, giving information, offering choices and supporting directive approach depending on the needs of the woman and clinical assessment." (Author)* [53] *"A woman-centred model promotes women's informed consent and choice, participation, responsibility-sharing, decision-making ability and will empower women. (midwife)"* [44] *"Women were more likely to choose if they were actively looking for birth information, felt in control of their birth, had confidence in their own body and did not feel embarrassed about less common positions." (Author)* [49]

		Timing of women accessing information Discussions during pregnancy Part of antenatal care Promoting women's autonomy Offering choice	*"Giving women information about position options were classified as letting women's preferences prevail, encouraging women to trust bodies to find that most comfortable positions and being prepared to try positions that women want to use." (author)* [49] *"If women get the education and are encouraged, this education needs to start during antenatal care, and the people at home should know the importance of mobility" (Author)*[48] *'unless women undergo preparatory exercise & education classes during pregnancy to try upright positions during labour, they are unlikely to follow their own inclinations, highlighting the need of informed choice.'(midwife)* [10] *'The value women placed on the educational sessions in increasing their knowledge, confidence, being in control or knowing about options available (author); after the session I felt more confidence in choosing positions (woman); I was able to try all the positions recommended to get comfortable (woman); the*

			session gave me more confidence, I was more mobile and laboured at home most of the time (woman).' [10]
	Knowledge and skills development of professionals	Special training for health professionals Continuity of care models in education Evidence-based practice to provide the best care. Reduce traditional hospital norms. Increase awareness. Providers' willingness to learn new methods	*"Six participants stressed the importance of the provision of special training for health professionals in the use of upright birth positions to increase awareness and preparing both women and health professionals are vital for a change in practice" (author)*[42] *"Obstetricians clearly showed a willingness to support women in their choices of birthing positions, stressing the need for a good knowledge base to support a change in their clinical practice. (author)* [43]
	Engaging influential stakeholders to initiate behavioural change	Better birth initiative Accessibility to up-to-date information Evidence-based approaches Guide to clinical practice. Continuity model of care and education	*"The better birth initiative is one of the guidelines used in midwifery practice to guide the best evidence-based practices, encourages providers to change the known practices." (Author)* [44] *"It is imperative to develop a comprehensive, evidence-based protocol for implementing upright positions during labour and second stage of labour* to

		Developing provider confidence and clinical skills	guide the clinical practice and contribute to the successful use of upright positions*." (52)* *"Continuity of care models will enable the development of confidence in using observational assessment skills and clinical skills." (author)* (41) *"Continuity of care models to be incorporated into student midwife training, whereby physiological birth positioning is one of the focuses." (author)* (41)

5.2.12 Reflexivity

Reflexivity relates to sensitivity to how a researcher's prior assumptions and experience may shape their approach to a study and analysis. [54] The lead author (MK), who conducted the synthesis, is a doctorate student undertaking an evidence-based healthcare program. She engaged in reflexivity throughout the review process and discussed her thoughts with her supervisors, who had different backgrounds from her (in terms of academic/clinical experience and gender). Here are some reflections on her knowledge and how this may have shaped the research process (written in the first person).

The focus of the study is on the field of midwifery. I have 16 years of experience as a community midwife caring for labouring women in midwifery-led facilities (i.e., stand-alone birthing centres and home births). According to Bohren et al. [55], the perspectives of the review author regarding subject expertise, employment, views of the phenomenon of interest, and other background factors may affect how data are collected, analysed and interpreted. I had to be cognisant of my prior knowledge and experience in assuming squatting and different positions in childbirth were beneficial when working with the data.

The only position I observed and taught during my midwifery training was supine. This illustrates a gap in evidence-based practice following the failure of traditionally taught techniques to manage squatting vaginal births. My experience of assisting birth using alternative positions to supine, such as squatting, kneeling, and birthing stools, was primarily encountered when working in standalone birthing centres and home births. This experience led me to challenge clinical practice. My perception is that midwifery is an art and science, whereby midwives are responsible for being 'creative' practitioners guided by scientific knowledge to assist women in assuming any positions found to be comfortable in childbirth.

However, as the review shows, there are some barriers to successfully implementing upright positions at birth.

I reflected upon my assumptions by laying out my preconceptions at the start of the review and following a quality standard recommendation by the Cochrane EPOC Group [14] on the dependability of including at least one other researcher to give robustness to the review. Patient and public involvement group discussions were conducted on three occasions at the University of Oxford to help design the research questions and data analysis. I conducted the methodological sections of this review and then discussed them firstly with one researcher (Valerie Smith [VS], previous supervisor) and later with another senior qualitative researcher (ST), who had different perspectives on the topic.

Dingwall [56] has suggested that one way of reducing bias in qualitative research is to ensure that the research design explicitly incorporates a wide range of different perspectives, an analytic technique he has referred to as 'fair dealing'. For this review, qualitative data were drawn from a range of papers. Thematic synthesis, using an inductive approach, seeks to stay close to the original findings from included studies during the early stages of the review. Only later does the interpretive synthesis move on to develop more abstract, analytical themes. No study was 'privileged' over others. Data analysis included a constant comparison between accounts of each paper to uncover similarities and differences. In line with advice from Bicks et al. [54], the review aimed to analyse the views and experiences of participants from a broad range of stakeholders, including women, their families, and healthcare providers, who were all taken as equal to answer the research question.

5.2.13 Reporting of the QES

The reporting of the review was guided by a framework developed by Tong et al. [16] called ENTREQ. It sets out well-defined stages and requires careful documentation of the review's

background, aims and objectives, design, conduct, and synthesis of findings using a systematic method. It has been acknowledged that using ENTREQ supports the production of a well-reported qualitative synthesis; transparency is improved, such that readers can make judgements about the trustworthiness of the findings. [57]

5.3 Results

Following the removal of duplicates, the search strategy yielded 2198 references, which were screened for eligibility. After screening the titles and abstracts, MK read 39 full papers. Of these, 15 articles did not meet the eligibility criteria either because they were not qualitative studies or were not related to childbirth (see Figure 40). Finally, 24 articles were eligible and included in this review (see Appendix 15). It has been recommended that the inclusion of too few studies (less than six) in a qualitative systematic review limits the support for the entire synthesis. [58] In contrast, the inclusion of more than 40 studies may weaken the data analysis because it is difficult to maintain insight across a large number of studies. [59] Therefore, the number of included studies was adequate to maintain sufficient familiarity between the included studies. Appendix 16 shows a list of references for the excluded studies.

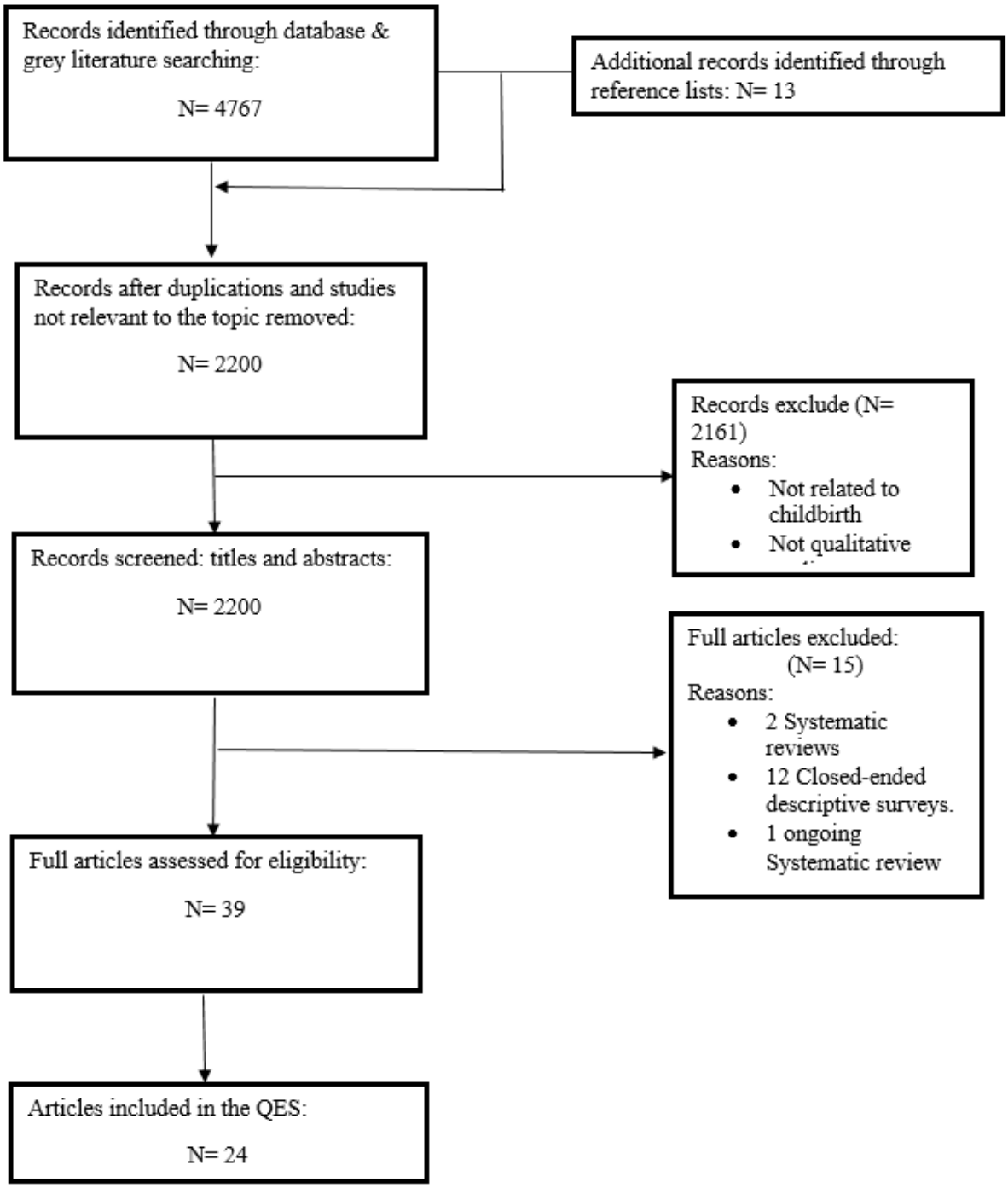


Figure 40: PRISMA – Flowchart for Literature Review

The papers included were published between 2002 and 2021. Various qualitative data collection and analysis methods were reported within these articles. Appendix 17, is a table of the characteristics of the included studies in the QES.

5.3.1 Types of Settings

It was essential to explore the perceptions of healthcare staff, women, and their partners on using upright positions during labour and birth, from low, medium, and high-income countries. The aim was to gain a broader understanding of how diverse settings facilitate or inhibit the use of upright positions in childbirth. Ten studies were conducted in high-income countries [10, 11, 41, 45, 49, 50, 53, 60-62], four in middle-income countries [47, 51, 52, 63] and 10 were in low-income countries. [42-44, 46, 48, 64-68]

5.3.2 Types of Sample/Participants

A total of 1010 participants from the 24 included studies provided a mixture of perspectives from women, healthcare providers (midwives, nurses, and doctors), male partners, grandmothers, doulas (companion who provides support and advice during pregnancy and childbirth), and traditional (no formal training obtained) birth attendants. No studies included the perspectives of women or partners in non-heterosexual relationships. Six included studies were the views of women-only. [11, 45-47, 51, 63] Two studies focused on women and members of their families [62, 68], while nine considered healthcare providers only. [43, 44, 49, 52, 61, 64-67] One study looked at partners only [60], and six assessed diverse perspectives (i.e. from women and healthcare providers). [10, 41, 42, 48, 50, 53] It was impossible to compare the women participants' obstetric characteristics (low or high risk) since none of the studies provided this information.

5.3.3 Types of Studies

Only two trial-related qualitative studies were eligible for this review. [45, 49] The other 22 studies were unrelated qualitative studies drawn from similar contexts (i.e., conducted in consultant-led or midwife-led care). [10, 11, 41-44, 46-48, 50-53, 60-68] Seven studies investigated

research questions directly focusing on birthing positions, [10, 11, 41-49, 52, 53, 60, 63, 65, 66] while seven provided themes, within the findings, on birthing positions in childbirth. [50, 51, 62, 64, 67, 68]

5.3.4 Phenomenon of Interest

All included studies elicited views and experiences on different upright birth positions. Some providers in the included studies valued using upright positions to enhance good maternal and neonatal health outcomes during childbirth. [41, 53] Participants perceived upright positions to include sitting with knees to chest, holding onto a rope hanging from the ceiling, [10, 11, 65] kneeling, [50, 63] standing, [42, 50] squatting, both unaided and aided (birth stool or cushions, bean bags or ball) and non-supine (i.e., upright). [10, 11, 43, 45, 62, 63, 65] Other horizontal positions mentioned included left lateral, supine, lithotomy, semi-recumbent and supine. [42, 45, 49, 63]

5.3.5 Critical Appraisal of Included Studies

Studies included in this review were of variable quality. Thirteen were classified as good quality because they reported a focused research question, had an appropriate research design, appropriate justification of sampling strategy, well-described data collection and analysis method, an explicit discussion of ethical issues, researcher reflexivity, and there was coherence between the results and the conclusions drawn. [10, 11, 42, 43, 45, 47-49, 53, 63, 65, 69, 70] Ten studies poorly reported recruitment strategies, data collection and analysis, or researcher reflexivity. [10, 11, 50, 51, 60-62, 64, 67, 68]. The credibility of the ten included studies was unclear due to minimal quotations to support themes. [10, 11, 50, 51, 60, 62, 64, 66-68] One study failed to reproduce several components of the CASP tool; it was an abstract of 500 words and, although a full article was published, this was in the Pashto language, and it was not possible to find an interpreter for a translation. [66] This study was considered appropriate for inclusion because the English language abstract reported the aim of the study, the type and number of participants, the method

of research data collection and analysis, the main qualitative findings, and recommendations. Its findings were considered to offer valuable insights (i.e., it was the only study that considered squatting unhygienic and difficult to support birth when a woman is standing). [66] Appendix 18 provides further information on the critical appraisals for the included studies.

5.3.6 Overarching theme: Adopting a Woman-Centred Care Approach Facilitates Positive Birth Experiences.

This review aimed to explore the views and experiences of all of those involved in developing, delivering, or receiving upright positions in childbirth using thematic synthesis. The analysis identified that a woman-centred approach paved the way for positive birth experiences for the woman, those around her, e.g., her partner, health professionals, and the setting in which she is having her baby. Woman-centred approach means putting a woman at the centre of care, [71] involving them in shared decision-making and supporting them to make choices about what is comfortable unless an obstetric complication occurs requiring medical expertise. [44, 49, 53] It is about being led by a woman's needs during labour and birth, giving her the freedom to walk, adopt upright and change positions freely rather than what is most convenient for healthcare staff. It involves providing women with accessible information about pregnancy and childbirth and respecting their risk perceptions. It involves an increased recognition of birth as a bio-physiological (natural) rather than a biomedical process.

It has been suggested that maternity environments adopting a midwifery-led model of care are more likely to support women in upright birthing positions than medicalised birthing environments. [10, 11, 43, 46] It has been acknowledged that a midwifery-led model of care supports midwives to work autonomously with flexibility, allowing them to embrace a woman-centred care approach, playing a crucial part in utilising upright positions in childbirth. [11, 41, 44] Reviewed data highlighted that the application of upright positions in childbirth fits into a

model of childbirth focused on woman-centredness rather than a biomedical model of childbirth. [11, 41, 47, 49, 53]

However, the review showed that not all maternity systems embrace a woman-centred model of care; maternity hospital settings, culture, policies, and procedures can support the medicalisation of childbirth. [44, 47, 52]. Data reviewed suggested that clinicians working in these settings tend to be guided by policies focused on delivering routine obstetric care, even to women with low-risk pregnancies and labour. Providers working in these environments are not exposed and are less confident to support women in upright positions. This inhibits the use of upright positions during labour and birth.

A woman-centred care is a multifaceted concept that encompasses various dimensions, reflecting its complexity and dynamic nature. This approach places women at the centre of maternity care and considers their holistic well-being. The holistic approach extends beyond physical health, by emphasising the importance of addressing not only the obstetric aspects of women's health but also the emotional and social aspects that contribute to a woman's overall health and satisfaction. It is guided by principles that align with women's needs, expectations, and safety, and it involves healthcare providers and organisational systems in shaping maternity education, policy, practice, delivery, and research. The review identified four analytical themes that contribute to the overarching theme of woman-centred care.

5.3.7 Analytical and Descriptive Theme

Extracted data from included papers are presented below to support the interpretations. Table 17 provides a summary of the results. It is expanded on in the narrative section that follows, which summarises each analytical theme and underpinning descriptive themes.

5.3.7.1 Analytical theme 1: Recognition of Different Philosophies of Maternity Care

One of the main factors that influenced the position of labouring women identified within this review was the two contrasting philosophies of maternity care between obstetric and midwifery-led models. These models dominate the implementation or lack of performance of certain positions during childbirth. Variations in practices were observed for using non-supine positions compared with supine between obstetric (hospital or health centre facilities) versus midwifery models of care. However, data highlighted that both could embrace a woman-centred approach, but women and midwives typically report increased opportunities for shared decision-making in the latter.

5.3.7.1.1 Practice Shaped by the Medicalisation of Childbirth.

Findings suggest that the supine position is a routine method mainly used in medicalised childbirth under the obstetric model of care. [10, 11, 42, 49, 52] One of the key barriers is a prescriptive obstetric model in hospital units that limits the ability of clinicians working in the labour ward to offer the full scope of options for birth positions. [41] The obstetric model of care is governed by policies, protocols and guidelines that comply with hospital procedures to assist providers in performing routine clinical assessments and medical interventions. For example, continuous monitoring of the foetal heart on a cardiotocograph (CTG) restricts women from lying on the bed, minimising the potential to use upright birthing positions. [11, 41, 49] Other medical interventions that limit the use of an upright position during childbirth, mentioned in reviewed papers, included: performing vaginal examinations to determine the progress of labour, administering epidural analgesia to allow pain-free birth, enabling protecting perineal integrity and controlling the foetal head during vaginal birth. [11, 44] All these care methods are influenced by medical practices, limiting the recognition of women's choice of birthing positions. [11, 41, 49, 51, 58] Some of these routine practices are associated with convenience for professionals but not for the benefit of women, as suggested in the following quotation: "*Supine*

position is the best, it gives freedom and support to the midwife while conducting the delivery" (midwife). [61] Some care providers commented that vertical positions are not clinician friendly. For instance, the use of standing and birth stools can particularly affect their backs, resulting in reluctance or even refusal to offer upright positions. *"But I always say that it does not satisfy proper working conditions, but I conduct many birth stools, and I notice that it is not so great for own back" (midwife);* [49] *"Well and then you sometimes have to manoeuvre yourself in all kinds of different angles literally and figuratively" (midwife).* [46]

In contrast, it was apparent that some midwives working in obstetric-led units showed advanced skills in supporting the use of upright positions among labouring women. These midwives facilitated optimal upright positions by improvising the technical use of some medical interventions and using creative persuasion to encourage women out of bed. [10, 11, 53] This included the use of Cardiotocography (CTG) foetal heart monitoring while supporting a woman in upright positions, women undergoing induction of labour and performing a vaginal examination in a water-filled pool: "*I've done an induction in the delivery suite, and I made her stand up. Even with the CTG strapped on her belly, I got her up, and she delivered standing" (midwife) "I've even done vaginal examinations in the bath. They've been in the bath, and I just do it in the bath, 'because you think, well, why get them out?" (midwife)* [41] This shows that some midwives' philosophy of care differs from other providers caring for women within a medicalised childbirth facility.

It should be noted that obstetric-led facilities provide intrapartum care for low-, medium-, and high-risk pregnant and labouring women, while midwifery-led care is for only low-risk women. However, in one study, midwives perceived that labouring women not eligible for midwifery-led care, those categorised with moderate risk factors (e.g. with non-insulin gestation diabetes) could assume upright positions in labour. [52]. Hence, there is a high opportunity for the obstetric-led model to facilitate an upright position during birth in a hospital setting, promoting

the philosophy of better births for all (i.e., using upright in both low and high-risk women) as a way of fostering woman-centred care by reducing inequality in the provision of care.

5.3.7.1.2 Practice Shaped by a Midwifery-Led Model of Care.

A midwifery-led model of care was perceived as one of the most critical factors in facilitating upright positions within reviewed papers. Both providers and women expressed that physiological birth or normality, and the natural ability of women to give birth without routine medical interventions, underpins the philosophy of care in midwifery or home-like environments. This model embraces woman-centred philosophies that emerged in response to the increasing medicalization of pregnancy and birth. [10, 11, 41] Some women opted to have their births at home rather than at health centres or hospitals because of this: "*Mothers who gave birth at home retained control over their birth positions, while at the hospital, they feared unfamiliar birthing positions, including supine" (Author).* [61] In low-income countries, some women preferred to be supported by traditional birth attendants at home, who are untrained staff, [42] to assume birth positions of their own choice. This indicates that even if providers are skilled in managing complications, women may refuse to seek care when they have previously experienced disrespectful care and may discourage others, mainly their friends and family members, from seeking such care. [68]

Under the midwifery model of care, women were supported to birth instinctively in an environment with minimal medical interventions; they could walk and assume a variety of birth positions. [11, 41, 49] *"I think if you are in your own home, you feel at ease and in the right place… then you are going to try out more things for yourself. I don't think you do that as easily in a hospital. Because familiarity is not there, fewer ideas occur in your head, I think I could do that, or I could do that". (Woman)* [68]. The main features of the midwifery-led environment that were found to enable the use of upright position were spacious rooms to allow mobility,

equipment such as a water pool, balls, bean bags, chairs, and adjustable obstetric beds. [10, 11, 41] This shows that the environment may impact different positions during childbirth and, therefore, on women's ability to adapt to upright birthing positions. However, low-risk midwifery philosophy care [41, 53], limits the philosophy of better births for all that incorporates both low and high-risk pregnant women.

5.3.7.1.3 Autonomous Practitioners

A major enabling factor in promoting upright positions in childbirth was that some providers could work autonomously and independently from the medical team. [41, 53, 63] The level of expertise determines this hierarchy, through observations, experience, motivation of the individual providers and self-development of practical skills by supporting women in various positions. [6, 8, 41] In midwifery-led units or home births, midwives possess autonomy and have a flexible approach to working with women, providing them with many options, and increasing the use of upright positions compared with hospital midwives. [41, 52] "*Midwives who work in settings where they have a great deal of autonomy are more likely to use upright positions" [63]* *"Upright positions are more likely to be used in settings where midwives are autonomous practitioners" (Author). [49]*

Some midwives work autonomously in obstetric-led care, although they are more challenged. Nieuwenhijze *et al.* [53] found that promoting upright positions is possible by providing practical support or guidance in labour using different communication styles that encourage women to use different birthing equipment in hospital settings. Some midwives took the initiative to develop knowledge and skills to facilitate upright positions during childbirth without specific training. *"Midwives' knowledge of assisting women in upright positions was gained mainly through clinical experience." (Author) [52]* This indicates that the clinical expertise among providers on the implementation of upright positions is variable. [41, 49]

7.3.7.1.4 Ignoring Women's Choice

The reviewed papers demonstrated that women sometimes recalled poor experiences with maternity care in labour wards, including harmful, disrespectful, and abusive interactions with some healthcare providers. [10, 46] Women in included studies talked about not knowing that they had a choice about the different options of birthing positions. *"…you can go to the labour room with experience of giving birth, you had three or five deliveries… you tell the nurse how you feel, what you want, but they can't listen to you". (Woman)* [68]; "*Women are not allowed to choose the birthing position when they are at the hospital, why should the midwife allow the woman to choose the position? It is wrong and not the right decision." (midwife)* [61]. Some providers stressed that because they had difficulty assisting women in upright positions, they coaxed women into supine positions. [53-55] This indicates that some providers, although they know about upright positions, tend to comply with the institutional risk discourse and the routine use of supine positions. [42, 48, 49, 63, 65] Hospital traditions reduce providers' power to deliver woman-centred care and impact providers' ability to encourage different positions. Hence, women could feel powerless in deciding positions to adopt for birthing.

5.3.8 Analytical Theme 2: Enhancing a Positive Birth Experience.

Some women and providers perceived that upright or squatting birthing positions facilitate labour through natural physiological functioning that uses the force of gravity to allow good progress of labour. [10, 11, 42, 44, 47, 53]. There was a perception that women should be supported by a family member, friend or provider when they needed to use upright positions because they can be difficult to maintain. This results in the normalisation of childbirth, improving outcomes and providing a positive birth experience.

5.3.8.1 Physiological Effects on Childbirth

Upright positions were depicted, in reviewed papers, as a natural or physiological response to childbirth that promoted normal vaginal birth. [10, 11, 41, 49, 53, 63] "*I like squatting better, the body's nature asked me to sit, the advantage is that it is natural to sit to have a baby" (woman); [63] "my own body asked me to wake up and sit…"(Woman). [45] I do not know who goes to the toilet lying down, … having a baby your body tells you to squat but the midwife asks you to be lying down (woman).* [11] It is also described as promoting optimal foetal positioning, enhancing the progress of labour or birth; "*upright is natural, considering the facts about the force of gravity and even how the birth canal is made" (Doctor)*. [42] Perspectives from providers and women were that upright positions induce gravitational force, resulting in stronger and more efficient uterine contractions, enabling the foetus's head to descend into the birth canal, and shortening the length of labour. [10, 11, 42, 49, 53] In most cases, using upright positions can contribute to a positive experience due to easier pushing efforts, thereby reducing interventions (e.g., the need for augmentation and fewer episiotomy rates). [43, 44] However, lying on a bed was still regarded as the more used approach when giving birth. [41, 42, 49]

5.3.8.2 Psychological Effects in Childbirth

Using upright positions in labour and birth was associated with relaxation, supporting women's weight and the psychological impact of being in control of childbirth. [11, 63] Labour pain is inevitably experienced by women during childbirth. Women's pain perspectives vary and are affected by both physical and psychological factors. Upright positions are classified as one of the non-pharmacologic methods of coping with labour pain for women. "*In the pool, I was on my front… I was comfortable but, in my mind, I knew that I was in the right position"; [41]. "On a birthing ball, I thought it was quite helpful, and it does alleviate the backache because you can rotate your hips on it". (Woman)* [63] Furthermore, assuming an upright position in

childbirth was reported in some papers to facilitate faster postnatal recovery and shorten the length of hospital stays, promoting good birth maternal and family experiences. "*Using squatting, it seems I recovered faster because they didn't cut anything" (Woman)* [45] "*A shorter length of labour reduces the crowding in the labour room because after delivery the women are discharged home" (Midwife)*. [42]

Severe perineal trauma during childbirth can lead to major psychological and social problems that can affect the woman's ability to care for her new baby. Authors claimed that a woman's body relaxed when upright, relaxing the perineum. [11, 40, 43, 44, 47, 52, 53] In contrast, some providers expressed uncertainty regarding the potential harms of upright positions, which prevented them from encouraging their use. [10, 11, 52]

5.3.8.3 Acknowledging the Role of Companionship

Partners or family members were depicted, within reviewed papers, as helping labouring women to feel in control, giving them confidence and support in maintaining upright positions. *"Fathers' responses focused on practical supporting behaviours such as trying to make the woman comfortable by walking with her, holding her hand, holding her leg" (Author).* [51] Women valued practical support from companions, which included offering encouragement and helping women mobilise throughout labour or change positions, such as squatting or standing and walking to the bathroom. *"Women mentioned their partners could give most support on the birthing stool so that the partner could push against her lower back "(Author).* [45] Furthermore, a labour companion during childbirth promotes respectful maternity care, whereby a supporting person can advocate for the woman and potentially promote her choice of birthing positions. [60]

5.3.9 Analytical Theme 3: Preserving Safety

Preserving safety is an important issue surrounding the care of women during childbirth. This analytical theme focuses on how a safe environment can be promoted, advocated for, and protect the well-being of women and their babies when assuming upright positions in childbirth.

5.3.9.1 Safety in a Home Environment

A critical barrier to encouraging mobility among women birthing at home was midwives' fears around safety. Four studies in this review recommended that the criteria for having a home birth should apply to only those women categorised as low-risk without any pregnancy or labour obstetric complications. [10, 11, 49, 52] Fear and perceived risk of litigation directed focus to safety in obstetrics, observed as tightly controlled maternity structures and systems. *"... a thorough assessment should take place before a woman is allowed to move around, (Author); proper assessment and monitoring are good, if there is no problem with the labour, the woman should be allowed to walk." (Doctor)* [42] In one study, all women requesting to use upright positions received care from a healthcare provider who provided clinical assessment, including finding out about women's wishes and priorities, mainly their current concerns and past obstetric history. [53] However, none of the included studies in this review adequately explored the issue of safety among women opting for home births as a strategy to promote the use of upright positions.

5.3.9.2 Appropriateness of Upright Positions

Providers perceived that defining clear indications and contraindications for a diverse population of pregnant women is a central factor that can help them understand who is eligible to assume upright positions. [10, 11, 52] In one qualitative study, midwives perceived the indication of using an upright position as: "*nulliparous and multiparous women with a*

singleton full-term pregnancy, cephalic presentation at 37-42 weeks of gestations, normal foetal heart rate patterns and sufficient physical strength (author).” [52] Likewise, other perceptions indicated by midwives about labouring women suitable to assume upright positions included slow labour or inadequate uterine activity, those with abnormal foetal positioning, foetal distress based on abnormal foetal heart rate (FHR) patterns, [41, 52] foetal macrosomia, ineffective pushing [49, 52] and women with some obstetric complications such as gestational diabetes and gestational hypertension. [52]

5.3.9.3 Approaches to Implementation

There were various opinions among healthcare providers about the duration of upright positions during childbirth. One study [10] indicates that squatting or semi-squatting can be maintained until after the expulsion of the baby. It is also favoured during the birth of the baby, separation of the placenta and involution of the uterus. [10] Another study stated that some midwives recommended maintaining these positions for about 15-30 minutes, others for less than 15 minutes, or 30-60 minutes before they change to a recumbent or lateral position to rest or at the crowning of the foetal head. *[52]* Other midwives felt that the duration of maintaining an upright position should be determined by women rather than prescribed by the provider. *[52]* Birth positions vary in type, techniques and optimal timing, which might explain such discrepancies in perceptions. It was clear from the included studies that the duration for maintaining an upright position depends on the position, women's preference, perceived benefit and harm factors and care provider. [11, 43, 52] However, qualitative studies in this review did not specifically explore views and experiences on the intensity, optimum timing and interval of implementing upright positions.

5.3.9.3 Potential adverse events

The review found that providers expressed uncertainties around the eligibility for using alternative positions to supine during childbirth. These included preserving perineal integrity, multiparous labouring women and managing abnormal foetal heart rate patterns. For example, one study showed that some midwives indicated multiparous women as eligible. In contrast, another midwife stated: "*It's unsafe for multiparous women to use upright positions in the second stage of labour. Sometimes it's unpredictable; it's too dangerous. (Midwife)* [52]. Similarly, another study supported this view that supine rather than upright positions should be encouraged in anticipation of a quick birth to reduce the likelihood of severe perineal trauma. [49] *"If labour was very fast, they used the recumbent position to make the birth more controlled." (Author)* [49]

Women experiencing vaginal birth may sustain perineal trauma, resulting in both short and long-term morbidity after birth. One study showed that midwives had various views regarding the potential risks of perineal trauma for women assuming upright positions. Midwives perceived that women might sustain some degree of vaginal tear or oedema by using a birth stool for over 60 minutes or when using a birthing chair since it can be difficult controlling the speed of the foetal birth of the head. [49] In contrast, some midwives felt that perineal trauma could be avoided if women in an upright position avoided pushing during a contraction or used a birthing stool for less than 30 minutes. [52] This shows that there is no consensus on the protective effect of these positions on reducing perineal trauma.

The rushing of normal vaginal birth was the worst enemy of uncomplicated labour contributing to perineal trauma in comparison with other factors, including maternal positions. "*We do not think of watches as machines, but I would say that it is the one subject that threatens normal*

birth and makes the women tear." [43] Having good communication was also considered to be one of the most important factors in avoiding injuries during birth. During the pushing phase, it was assumed that a woman would depend on the clinician's guidance to moderate her pushing effort to allow a non-rushed gentle birth of the foetal head. [52] This can be achieved by intermingling short pushing efforts with periods of painting, giving the tissues time to relax and stretch under pressure.

It is important to note that when considering the causes and clinical management of perineal integrity, optimal positioning, knowledge, and skills of the healthcare providers can be regarded as a preventative measure or management for women using upright/squatting positions. This implies that upright positions mainly squatting is a practical skill. Gholitabar [11] suggested that *'it is crucial to understand how clinical birth outcomes of different positions are related to pelvic moulding, uterine activity, maternal hypotension, cord compression, need for analgesia maternal pain & fear, perineal integrity and foetal status during childbirth.*

5.3.9.4 Exposure to Upright Positions

A key barrier to the delivery of upright birth positioning was a lack of experience and confidence in supporting such an approach. Hospital providers are educated and trained to facilitate women giving birth in the supine position, reducing their opportunity to support upright positions among labouring women. [10, 11, 42, 66, 70] "*Providers are used to supine position, we are taught that way. Therefore it is difficult to change without being exposed to the procedures of conducting a delivery in non-supine" (Doctor)* [42].

The review showed that maternity units that embrace the obstetric model of care tend to offer provider training that standardises the use of supine positions in childbirth. [10, 11] "*Students often gain experience in assisting supine births. When qualified, they supervise students, exposing them only to supine birth. This vicious circle maintains the dominance of supine positions." (author),*[49] *"My mother was a popular traditional birth attendant, and I used to*

observe her taking deliveries using kneeling and squatting positions for most deliveries, but I have not seen these positions in hospital as a midwife" (Midwife). [58] This is not unexpected because supine is the position most promoted in practice and has come to be the only position known to some providers. [48, 53, 66] Therefore, labour ward systems where the practice is conducted in a specific way act as a significant challenge to professionals, mainly midwives, offering women an alternative to the supine position.

Providers reported a range of organisational barriers hindering their ability to incorporate upright positions into their practice, specifically heavy workload, limited resources, lack of time, lack of privacy, and conflicts with organisational priorities. This is reflected in the following quotations from papers included in the review: "*Staff shortages and work overload hinder health workers' ability to display support for using upright positions. There are sometimes 20 patients to one midwife" (midwife),* [43] "*women in the normal progress of labour do not assume an upright position because there are not enough midwives; you can't imagine how busy we are." (midwife)* [52]. Clinicians balancing heavy workloads and mastering clinical skills seemed to find it difficult to support the use of alternative positions to supine in their interactions with women during childbirth [42, 52]. "*I have tried several times to get women out of bed, but it is impossible; the room is completely overcrowded (Doctor)".* [42]

One of the included studies compared positions adopted during the second stage between midwifery-led and obstetric-led units. [41] It was reported that more upright positions were used in the birth centre, including standing, all fours, left lateral, and birth stool with minimal semi-recumbent use. Compared with the obstetric-led unit, most women adopted a semi-recumbent position, while the most adopted positions in the birth centre were upright during the second stage. [41] This could be due to the organisational policies and procedures, such as the sufficient staff permitting the delivery of one-to-one labour support to women birthing in midwifery-led

units. The review suggested that having one midwife caring for many women is a challenge to allowing women to adopt upright or squatting positions in hospitals. [42, 46, 52]

5.3.9.5 Lack of evidence-based care pathways

As mentioned above, the review found variations in practice, which could be due to a lack of relevant evidence-based clinical guidelines. Whilst some providers expressed confidence in implementing an upright position in childbirth, most studies identified uncertainty in terms of good practice. Midwives reported that evidence-based clinical guidelines are a prerequisite to assist providers in making decisions about the appropriate implementation of upright positions during birth. For clinicians, guidelines can summarise the relevant scientific literature and help them decide which type of position is beneficial while discouraging ineffective or potentially harmful positions. This may help to provide care that is evidence-based rather than organisation-focused.

5.3.10 Analytical Theme 4: Engaging Key Stakeholders

This review found that the engagement of key stakeholders can make a solid contribution to the uptake and implementation of upright positions in childbirth. Qualitative evidence has shown that the performance of vertical positions is complex, uncertain, and ambiguous. The complexity lies in the context within which maternity care is delivered and the barriers and facilitators associated with implementing upright positions. [49, 52] Engaging key stakeholders in helping to address or mitigate some of the uncertainty and ambiguity was a finding of the review.

5.3.10.1Informing, Engaging, and Empowering Women

A key element of the provision of woman-centred care identified in the studies was giving women a choice, control, and autonomy over birthing positions through effective

communication. Communication is an essential component of empowerment - taking what the woman wants as the starting point to enable full participation in shared decision-making regarding different birthing positions. In line with a woman-centred approach, this review showed that the opportunity for empowering women and increasing their awareness was through active birth counselling. The counselling may involve one-to-one or group discussions about birthing positions during antenatal clinics and classes, not just at the onset of labour. [47, 49, 63] They should focus on individual preferences, concerns, and questions about various birth positions. Then, women's understanding, and involvement can be enhanced, with providers working in partnership with women as part of personalised care. Studies offered examples of the importance of effective communication, including listening as a component of compassionate and respectful care: "*I want to try the bar (woman), okay here's the bar ... if that is comfortable for you, you can try it (squat bar) if you don't like it, we can take it right off"(Midwife).* [53] Providing options and clear, practical guidance for women on using different equipment to support upright birth positions was essential. [53] The findings also highlighted that obstetricians should be willing to listen to women and support them in their preferred birthing positions. [41, 44,52]

Two studies showed that midwives provided the choice of positioning using various styles of support during childbirth [49, 53]. One study reported that midwives used the shared decision-making process by either asking which position a woman preferred (informed consent) or offering information and suggestions to help her make her choice (informed choice). [49] In another study, midwives used supportive (giving options to choose upright positions), or directive (forced if obstetrically needed in slow labour) approaches to facilitate upright birth positioning. [53] Evidence suggests that clinicians should engage women in allowing them to make an informed choice about birthing positions that are best for them. [49, 53] However, labour

wards and antenatal clinics are often very time-constrained and may not permit this level of interaction.

Furthermore, collaborative work with obstetricians, midwives, physiotherapists, and other providers is necessary to incorporate birthing positions including squatting into standard childbirth care practices. Healthcare providers play a key role in reinforcing the importance of these positions and addressing any concerns or misconceptions. The included qualitative studies described methods for disseminating information, including practical demonstrations of different maternal positions and the use of different media. [41,58] The provision of visual materials such as diagrams, leaflets, online websites, or magazines is another strategy that can demonstrate the benefits of squatting during pregnancy and childbirth, along with instructions on how to do it correctly and safely. Within the included studies, empowerment (through information and communication) was crucial to the delivery of woman-centred care. [44, 45, 53]

5.3.10.2 Knowledge and Skills Development of Professionals

Eight studies called for further training and education of healthcare providers to promote upright positions in labour and birth. [42, 44, 46-49, 52, 66] Only one evaluated the impact of an educational intervention on improving providers' knowledge and skills and introducing evidence-based care on upright positions in childbirth. A multi-method training of providers was employed, including a printed training manual, oral presentation, video, and open discussions. This study showed that developing practice-based training packages might improve the use of upright positions. *"Evidence-based packages such as Better Birth Initiative training strategy facilitated attitudes and behaviour change among doctors and midwives working in a hospital to support women to assume upright positions in labour and implement evidence-based findings to inform decision-making in clinical practice." (Author)*[42] They found that interactive education workshops for midwives and doctors can increase their

knowledge, skills, competence and confidence to deliver care for labouring women opting to mobilise. Furthermore, providers require an understanding of the biomechanics associated with birthing positions and a commitment to applying the most up-to-date evidence to clinical decisions. The implication is that all providers have a duty of care to improve their knowledge and skills in delivering upright positions, which might require them to change their behaviour.

5.3.10.3 Engaging Influential Key Stakeholders to Initiate Behavioural Change.

The reviewed evidence highlighted that multiple healthcare providers, from different professional backgrounds, may work together with women, their families, and friends to optimise birth outcomes and decrease inappropriate or potentially harmful use of upright positions. Hence, a range of stakeholders can influence behavioural change concerning upright positions in childbirth, including those a) supporting women in labour (i.e., midwives, obstetricians); b) responsible for continuing professional development (i.e., clinical specialists); c) conducting education and training initiatives (training facilitators); d) accountable for service development and evaluation, evidence-based guidelines development or opinion leaders (i.e., managers, policymakers, and others); e) part of regulatory professional/government bodies; f) women and their companions (i.e., partner, family members and friends). The most repeated strategy for engaging stakeholders was providing education and training to improve knowledge and skills among healthcare providers. [42, 47, 49, 63]

One study highlighted the value that hospital staff and family members place on having access to care experts, staff accessing sufficient training and involvement of frontline providers and opinion leaders. [40] Opinion leaders were obstetricians, clinical specialists, policymakers, and managers. Obstetricians facilitated experience-based interactive training and clinical specialists disseminated best practices results and provided continuing practice development workshops on the relevant topic. Policymakers together with managers should ensure that

maternity care involves evidence-based guidelines and policies to reduce traditional hospital routine care. [42] *"Having doctors from the same peer group provide examples of how they have implemented the best practices enabled participants to determine feasibility in their settings and discuss how best to encourage their use."(author)*[42] Other relevant key stakeholders included government officials and regulatory bodies involved in various implementation efforts with responsibility and commitment to changing behaviours and attitudes to initiate or participate in content-specific evidence-based policy. [42] This illustrates that leadership is crucial in establishing care practices to facilitate upright positions in childbirth and that it requires collective and multidisciplinary leadership.

Another critical aspect of engendering behavioural change identified from papers is a midwifery continuity model. This is care where the midwife or a group of midwives are the lead professionals in planning, organising, and delivering care for a woman. This model enables providers to offer continuous support that goes beyond the antenatal period, extending to the postnatal period, to help women transition into motherhood and address any concerns or challenges that may encounter. Adopting this model of care in the maternity setting is associated with increased levels of positive physiological vaginal birth outcomes while reducing the use of medical interventions during labour and birth. [41, 53] The model also supports shared responsibility with obstetricians in case of any obstetric complications. [49] Advocacy and navigation by a midwifery continuity model of care in current midwifery education and maternity systems can facilitate access and improve students' exposure to upright positions. It also promotes their confidence in using observational assessment and practical skills to promote a range of birth positions. [41, 52]

5.4 Discussion

This review aimed to synthesise the views and experiences of women, their families and healthcare providers on upright positions during childbirth. Twenty-four studies were eligible for inclusion, from low- and high-income countries, particularly in Africa and Europe. Sixteen descriptive themes from the thematic synthesis underpinned four analytical themes. The synthesis showed how far and in what ways a woman-centred approach can promote and facilitate the use of upright positions in childbirth.

A fundamental perspective from both women and healthcare providers is that birth positions are facilitated or constrained by the policy and philosophy of the birth environment. The primary justification for supporting the adoption of upright positions in childbirth is the physiological functioning of these positions to promote spontaneous vaginal birth. It can also increase the woman's level of satisfaction. The findings of the review suggest that a significant inhibitor of utilising upright positions in childbirth is the dominance of the biomedical or obstetric model of care, and a focus on risk aversion. This model negatively advocates for routine supine positions in childbirth through maternity care organisations, education systems, and healthcare providers, with diminished valuing of women's choices, needs and expectations, which is not in line with a woman-centred approach. [46]

The findings of this review are consistent with those of previous SRs in showing that routine clinical assessments performed during labour involve medical interventions such as foetal heart monitoring, performing vaginal examinations and epidural analgesia that can limit the use of upright positions in labour and birth. [7,8] Factors associated with increased obstetric intervention include expected obstetric practices and medico-legal pressures that meet the needs of the institution. Midwives expressed a sense of being observed and monitored, working under direct medical surveillance, and adjusting their practice to protect themselves against the consequences of not meeting the needs of the institution. [7;41]

The review indicated that birthing at midwifery-led units or home births was associated with increased use of upright positions. Midwifery-led units can enhance core elements of woman-centred care by promoting women's choice, control, and continuity of care. [72] The WHO designated 2020 as the 'Year of the Nurse and Midwife', bringing recognition to the central role of midwives, which serves as a catalyst for midwifery models of care. [74] The review addressed several crucial characteristics of a midwifery-led model of care. These included care from one provider or a small team of providers sharing evidence-based practices, continuous one-to-one support in labour, autonomous practitioners, home-like environments, and engaging key stakeholders in the care. All these elements are associated with better birth outcomes, [42, 73, 75, 76] contributing to a positive maternal experience. [77, 78] It can be suggested that the role of clinicians in supporting women assuming different positions during childbirth is to enhance a positive birth experience and reduce unnecessary medical interventions. This view is supported by literature, which states that a positive experience contributes to a woman's sense of accomplishment, self-esteem, feeling of competence and well-being in childbirth. [82)83] Some women in this review were especially committed to adopting upright positions for its non-medical approach to reducing anxiety and pain, improving normal labour progress, and improving their cultural and personal birth experiences. [43, 45, 63]

The lack of education and training of midwives, nurses, and doctors in supporting upright positions appears to be a significant factor hindering implementation even when a policy of offering upright birth options is in place. [42, 48, 49, 66, 82]. Such training is essential for allowing safe implementation of different positions. It is related to the inconsistencies in midwives' opinions and experiences of promoting upright positions in childbirth reported in reviewed papers. Appropriate pre- and post-professional training and delivery of supportive birth environments addressing safety concerns, practice methods and cultural norms of applying upright positions may be required before it is more readily offered to women during childbirth.

5.4.1 Strengths and Limitations

A strength of this type of review is the use of evidence from multiple qualitative studies. [16, 86, 87]. The review was not a mere summary of their findings but included a synthesis of their results across different contexts. Interpretation of the similarities and diversities in the data set was used to create new knowledge and to identify research gaps. Flemming *et al.* [34] demonstrated that findings from a qualitative synthesis can provide rich interpretation relating to the impact of the phenomenon of interest, enabling a greater understanding of key stakeholders' experiences, views, beliefs and priorities for healthcare.

One significant limitation is that only one reviewer (MK) conducted the synthesis. However, the scope and methods of the review, ongoing engagement with the data and subsequent interpretations of the findings were discussed on several occasions with a senior qualitative researcher with different perspectives on the research topic (ST).

Although the search method was comprehensive, some potentially relevant studies may have been missed, especially unpublished studies. In addition, non-English language papers were excluded. However, the included studies permitted the development of variation in concepts; data were perceived as adequate, permitting a sufficient 'depth' or 'density' of descriptive and analytical themes to allow the researcher to build a theory.

The objectives of this review are reflected in those addressed by WHO. [57] According to WHO [57] interpretive naturalistic approaches help us to understand patients' experiences of conditions, their priorities and concerns, perspectives on implementations and how and why people choose to utilise health services.

The characteristics of the key stakeholders in this review were limited to mainly midwives, obstetricians, and women. A broader exploration of the topic including birthing partners, researchers, opinion leaders, managers and commissioners was lacking.

Another limitation is that included studies were mainly conducted in Europe, Asia and Africa. Most European studies were conducted in the Netherlands and Sweden [45, 49, 53, 60], with no qualitative research conducted in the United Kingdom. It is unclear how these qualitative findings apply to other parts of the world. Furthermore, qualitative studies eligible for this review excluded high-risk pregnant women (e.g., all women undergoing labour induction; all women with gestational diabetes or obesity; vaginal birth after one caesarean section; all women planning to have epidural pain relief before labour). Therefore, the review findings may not apply to these population groups.

5.4.2 Agreements and Disagreements with Clinical Guidelines

The qualitative findings in this review suggest that midwifery-led facilities alone should not be the only settings that promote the use of upright positions during childbirth. Giving women a choice over the place of birth, including home, midwifery-, and obstetric-led units has been supported by several international guidelines. [78-80] The need to shift medical model practices in the labour ward towards fully accepting a woman-centred approach is critical. This review proposes that evidence-based practice should substitute "medicine by authority" by integrating midwifery continuity of care.

A CSR found that the midwifery continuity model of care promotes maternal and foetal safety since collaboration with obstetricians when necessary is one of the features of this model. [73] Likewise, the NICE recommends midwifery-led services as the safest birthplace for healthy women experiencing uncomplicated pregnancies in the UK. [79] The integration of midwife-led continuity models of care into existing maternity systems will provide attributes of both midwifery and obstetric-led care. This strategy facilitates a multi-professional collaboration to promote upright childbirth positions, in which the woman's needs, preferences and health well-

being are placed at the centre stage. Combining these two models offers biopsychosocial safety in these environments to encourage better birth outcomes.

Four published evidence-based guidelines recommend that women in the second stage of labour be discouraged from lying supine or semi-supine and be encouraged to adopt any position they find most comfortable. [79, 80, 89, 90] These guidelines did not provide a detailed account of why and how upright positions can be applied during childbirth and lacked explicit characteristics of who should implement the upright positions. The review described in this chapter suggests that information on the application of upright positions is an important factor affecting their successful implementation.

5.4.3 Agreements and Disagreements with other Systematic Reviews

Two published qualitative reviews are related to the topic of interest but there was unclear reporting of a method of data analysis/synthesis in both. One review evaluated qualitative evidence on how European midwives' knowledge, values and attitudes underpin their practice concerning women's birth position. [7] A more current review explored the barriers midwives face, which hinder them from effectively promoting upright positions during the second stage of labour.[8] The two reviews both included studies published in high-income countries. The reviews include two [8] or three qualitative studies [7] which were eligible for this review.

One of the two previous reviews included three qualitative studies and four descriptive surveys conducted in Europe published in English in 2004 or 2005. [7] Some of the findings [7] were consistent with the review in this chapter. It suggested that midwifery-led units or home births are associated with women's increased use of upright positions. [7] The same review found that recumbent positions are associated with midwives' lack of training or experience, encouraging midwifery educators to help affect change through training that normalises upright birth positions. [7]

The second review assessed the obstacles midwives face when promoting upright positions for low-risk women during the second stage of labour. [8] It included three descriptive surveys and five qualitative studies. Four studies were conducted in America, two in the Netherlands, one in Ireland and one in Australia. Its primary finding was that institutionalisation of birth engendered a practice dominated by medical policies and procedures, making it difficult for midwives to offer women alternative positions to bed birth. [8]

Both previous reviews [7, 8] excluded qualitative studies conducted in low-income countries and included only the perspective of midwives or nurses on the use of upright positions in childbirth. The purpose of the review reported in this chapter was to integrate the findings of a systematic qualitative review alongside quantitative review findings to help explain heterogeneous results in the latter (Chapter 4). Chapter 4 of this thesis pooled studies from various parts of the world (i.e., low- medium and high-income countries).

The results of the review presented in this chapter provide additional insight into the factors that might improve the implementation of upright positions. It addressed how a woman-centred approach can facilitate the use of upright positions. It adds to knowledge by presenting themes that are novel for this topic. These include acknowledging the role of companionship in labour, addressing potential adverse events associated with adopting upright positions, managing approaches to implementation, appropriateness of upright positions, and integrating the midwifery continuity model of care into maternity systems and strategies to engage key stakeholders.

5.4.4 Implications for Clinical Practice

There is some evidence to support the idea that midwives or nurses are the primary providers of care for low-risk women using squatting positions, with obstetricians taking clinical responsibility for those women with obstetric or medical complications. [41, 73] Obstetricians are

needed to provide care and advice in the case of deviations from normal, and midwives are qualified to detect such deviations and refer to obstetricians when appropriate. Midwifery care is safe and central in promoting and preserving physiological or normal birth, including facilitating diverse birthing positions. [78, 79] During childbirth, midwives are responsible for providing women and their partners with necessary support or guidance, such as considering women's preferences while preventing any potential risks.

Access to a midwifery continuity model of care should be provided, fully supporting a woman-centred model in all maternity settings. Placing women at the centre of their care on any issues surrounding utilising upright positions in childbirth should start in the antenatal period. It is also essential to initiate inter-professional collaborative practice that can motivate the eradication of barriers between midwives, obstetricians, and other professionals to deliver woman-centred care. While providers revealed that collaboration is essential for providing clinical practices within the complex clinical environment, maternity and specialist clinicians need resources to influence behavioural change in clinical practice and work more collaboratively with other service providers.

This study emphasised the necessity for midwives to advance their knowledge and practice skills in the implementation of upright, including squatting, vaginal birth. This plays a critical role in promoting positive birth outcomes and reducing adverse events during pregnancy, childbirth, and the postpartum period. Skilled midwifery care encompasses a range of clinical, technical, interpersonal, and holistic skills that are essential for providing safe and effective care during a squatting vaginal birth. The Quality Care Framework (QCF) in the UK [92, 93] emphasises the central position that professionals need to play in delivering care during pregnancy and childbirth. They have set standards and recommendations focusing on the fundamental principles of patient-centred care, safety, effectiveness, efficiency, equity, and timeliness. These quality care attributes have been endorsed by the WHO, [77] NICE and Care

Quality Commission (CQC), NHS England, NHS Improvement, Public Health England, NICE and Health Education England. [93]

Similar attributes of quality maternity care have been identified through the interpretive analytical themes developed in this QES. The assumption is that quality care for women using upright or squatting vaginal birth requires an integration of the four analytical themes, namely philosophies of maternity care, enhancing a positive birth experience, preserving safety, and engaging key stakeholders. Preserving safety within the care process, i.e., technical quality in this QES, emphasizes knowledge, skills, and the accuracy or competence of practices and procedures, including obstetric assessments.

Readiness to provide squatting vaginal birth encompassing structures such as home-like settings and managerial systems through which maternity care can take place. Functional/efficient quality, represented by the implementation of various maternal positions in childbirth, focuses more on the philosophies of maternity care that establish interprofessional collaborative working and partnerships between providers and service users to ensure that care respects service users' needs and preferences. Equitable service is achieved by adopting a 'better birth for all' approach, providing care that does not vary in quality based on service users' characteristics. The effectiveness of squatting vaginal birth refers to promoting positive birth outcomes, influencing women's health to return to its initial physical well-being, or maximising benefits while minimising adverse events for patients. In addition, these QES interpretive themes support the eight evidence-based qualities of care 'Rights' framework. These include the '*Right Care*', in the '*Right Way*' for the '*Right Individual*', in the '*Right Place*', at the '*Right Time*', by the '*Right Person*', and for the '*Right Price*' to achieve the '*Right Results*'. [94] Quality improvement involves continual actions to enhance birth outcomes for service users using squatting vaginal birth, improving maternity systems, and developing a workforce that supports a woman-centred approach.

5.4.5 Implications for Future Research

To advance our understanding and implementation of upright birthing positions within the UK, more qualitative research is essential. Specifically, research should focus on exploring the successes, concerns, and environmental factors that influence both women and healthcare providers when adopting a woman-centred model in diverse contexts. This research should aim to identify effective strategies for integrating upright birthing positions in both obstetric-led and midwifery-led birth environments.

A key area for exploration is the introduction and sustained use of this model in settings that traditionally follow an obstetric-led approach. The goal is to determine how a woman-centred philosophy can be successfully implemented and maintained in these environments to enhance the use of upright positions during childbirth.

To achieve these aims, a participatory action research approach is recommended. This methodology would facilitate collaboration between researchers and participants, enabling them to jointly identify and address institutional challenges, understand women's preferences, and develop innovative practices. This collaborative effort is crucial for creating and sustaining changes that lead to better birth outcomes. By working together, stakeholders can generate practical solutions and strategies that are grounded in the real-world experiences and needs of women and healthcare.

Data from the included studies were collected using semi-structured interviews and focus group discussions. These data collection methods provided an opportunity to explore detailed accounts of participants' experiences, including their emotions, feelings, motivations, and cultural perspectives. However, they rely on the self-report of participants. It would also be valuable to employ other data collection methods, such as nominal group consensus discussion. In comparison with focus groups, conducting a nominal group prevents the domination of

discussion by a single person, encourages more passive group members to participate, and results in a set of prioritised solutions or recommendations developed through consensus. [91] Such studies can assist in prioritising sets of clinical practices essential for successfully implementing upright positions and generating agreements on the methods for integrating a woman-centred into the maternity system.

Further research should clarify which approaches are more practical to engage key stakeholders in supporting upright positions in childbirth. This research should include the content of training programmes and the development of evidence-based guidelines on the topic. These strategies could guide practitioners, to reduce barriers and promote the benefits of safe practices supporting upright positions during labour and birth.

In addition, the findings of this review support the findings of previous research identifying the empowerment nature of the birth experience when women assume an upright position during labour or birth [63, 82, 84] This feature of birth requires further research including an examination of how clinical practice influences women's sense of empowerment.

QES has reported potential effect modifiers that can be tested in subsequent subgroup analyses in quantitative studies. The modifying factors identified include maternity setting, co-interventions such as various clinical practices in the second stage of labour, training, written materials for education and training, and duration and timing of squatting to list a few. Subgroup analyses can assist in testing the significance of whether these modifying factors when interacting with squatting positions during the 2nd stage of labour can influence positive birth outcomes. It is considered important to conduct such analyses carefully in the subsequent chapter of this thesis and consider the limitations of the available data and methodology.

5.5 Conclusion

This systematic qualitative review brought together 24 qualitative studies exploring the views and experiences of women, their families and healthcare providers about the use of upright positions in labour and birth. People's opinions were consolidated into four analytical themes. The primary findings of this review showed that women are more likely to assume the upright position when labouring in a home-like environment because it embraces woman-centred care.

A significant obstacle to facilitating upright positions in childbirth was birthing in a hospital setting because of the dominance of the obstetric model of care. This review found that this model of care inhibits the use of upright positions mainly through education and clinical policies that encourage routine use of medical interventions whereby women must use supine positions. Furthermore, it highlights the conflict between the current professional level of expertise, women's needs and expectations of care, and organisational service structures. Chapter 6 presents subgroup analyses aiming to resolve the contradictory findings for the effects of squatting position in the second stage of labour. It builds on the research findings presented in chapters 4 and 5.

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CHAPTER 6

Subgroup Analysis

6.0 Subgroup Analysis

6.1 Background

This Chapter builds on chapters 4 and 5. It describes subgroup analyses where there was a substantial number of RCTs to identify potential moderator variables that might interact with squatting during birth. The primary a priori objective was to identify sources of variable effect estimates between different RCTs and to establish the most effective intervention by squatting type for reducing maternal or foetal morbidity (i.e. pre-specified subgroup analysis in Chapter 4). Secondary (post hoc) objectives were to determine whether interaction effect moderation when one or more secondary interventions (see below for a description) are implemented together with squatting vaginal birth, might improve birth outcomes, which arose from the qualitative synthesis presented in Chapter 5. The study addressed whether secondary or co-interventions modified the results by producing larger effects when interacting with squatting positions during birth.

In this chapter, secondary or co-interventions refer to additional procedures or confounding variables that were not randomised in the RCT but were implemented by service providers and/or participants in either the study group or the control group. Co-interventions include education and training, theoretical materials related to the interventions, and clinical guidelines on the management of birth, which might impact birth outcomes. Specifically, they encompass evidence-based care practices that could interact with squatting position during childbirth, potentially shortening the duration of the second stage of labour, reducing medical interventions (leading to a decrease in operative births and the need for analgesia/anaesthesia), and lowering the occurrence of adverse events (such as postpartum haemorrhage (PPH) ≥ 500mls and perineal trauma requiring suturing), thereby promoting normal vaginal birth.

Within the scope of this thesis, a normal vaginal birth is defined as an uncomplicated labour process characterised by the second stage of labour not exceeding expected time limits (i.e., an active expulsive maternal effort to birth within < 60 minutes in the second stage of labour) accompanied by minimal or no medical interventions. This definition applies to both low-risk or selected high-risk women eligible for a squatting vaginal birth. This definition draws inspiration from the normal vaginal birth criteria issued by the Maternity Care Working Party [(1)] in the UK.

The primary focus of this chapter is to address the question: *Do various types of squatting positions and secondary factors (such as co-interventions or effect moderators) modify treatment effects (results) on birth outcomes or explain heterogeneous effects observed between quantified quantitative studies?*

6.2 Methodology

As stated above, two common approaches in meta-analyses for detecting moderators and ascertaining their effects are by hypothesising potential moderator variables either before (pre-specified) or after (post hoc) the data analyses. Pre-specified analyses are generally considered more reliable than post hoc testing. [(2)] However, empirical evidence by Paquette *et al.*, [(3)] strongly recommends considering both pre-specified and post hoc hypotheses subgroup testing. As a result, both *a priori* (i.e., defined as confirmatory testing) and post hoc (i.e., defined as exploratory) are considered and reported separately here. The anticipation is that interactive effect modifiers can be identified by clustering studies according to clinical questions related to the practical application of squatting compared to other positions during childbirth. Due to time constraints, no additional literature search or systematic study selection was conducted.

Criteria for Inclusion and Exclusion of Studies

6.2.1 Pre-specified Subgroup Analyses

This study employs pre-specified subgroups that have been widely used in previous meta-analyses (see Gupta *et al.;* [4] Lawrence *et al.*; [5] Walker *et al.* [6] Deliktas& Kukulu [7]). It identifies substantive subgroups (such as squatting type, potential interventions for reducing PPH and perineal trauma requiring suturing), that have been explored in a limited number of primary studies focusing on improving birth outcomes for women assuming squatting positions (e.g., see Moralogiu [8] Cottrell & Shannahan [9]; Sabatino et al.[10]). Given the conflicting findings and the identification of moderator variables possibly correlated with birth outcomes during squatting vaginal births, subgroup analyses may yield novel insights into the moderation effects within this critical relationship. Three subgroup analyses of RCTs were pre-specified during the protocol stage (as outlined in the updated protocol: PROSPERO: CRD42020166032, registered on 26 February 2020) and are described below.

6.2.1.1 Types of Squatting Positions

Studies were eligible if they evaluated any type of squatting in comparison to any position other than squatting. This analysis considered both full squatting versus other positions and modified squatting versus different positions, aiming to determine the direction and magnitude of effect estimates between them. The goal was to identify the most effective type of squatting for two birth outcomes: duration of the second stage of labour and operative births.

6.2.1.2 Secondary Interventions to Reduce PPH ≥500 mls

Anticipating potential interactive effect modification between RCTs, this analysis explored the effect of discontinuing squatting positions at various time points during the second stage. RCTs that reported discontinuing squatting positions either at the crowning of the vertex or upon the visibility of the foetal head (vulval gaping), or immediately transitioning to a horizontal position for the actual birth, were compared with those reporting discontinuations of squatting after the birth of the placenta and membranes (third stage of labour). These factors could serve

as confounders influencing the direction and magnitude of estimates concerning the effects of squatting position on PPH > 500mls and perineal trauma requiring suturing. [9-11]

6.2.1.3 Different Classifications of Perineal Trauma Requiring Suturing

An additional hypothesis was posited that the magnitude and direction of the effect estimates may be influenced by the classification of perineal trauma necessitating suturing, specifically episiotomy, 2nd-, 3rd, - and 4th-degree tears when squatting in the second stage of labour. These subgroups were derived from prior literature. [4, 6]

6.2.2 Post hoc Subgroup Analyses

This section identifies potential moderators (i.e., secondary interventions) addressed in the post hoc analyses. These analyses were guided by analytical and descriptive themes emerging from the qualitative synthesis of key stakeholders' perspectives and experiences. In essence, all assumptions related to barriers and facilitators were used to extract, cluster, and map primary and secondary interventions delivered and reported in the RCTs. This approach aimed to investigate whether the synthesised viewpoints and experiences of key stakeholders regarding adopting upright/squatting positions, as reported in the qualitative synthesis, aligned, diverged, or influenced the effects of squatting in quantitative studies. Questions were formulated to enable the integration of qualitative synthesis findings through hypotheses correlating with narrative findings from RCTs evaluating intervention effects. This facilitated the development of transparent hypotheses suitable for testing via subgroup analyses. The subsequent subgroup analyses were predicted and shaped by the qualitative evidence synthesis presented in Chapter 5.

6.2.2.1 Types of Settings (Obstetric versus Midwifery-led Units)

Qualitative data underscored that both obstetric and midwifery models of childbirth can embody a woman-centred approach, but upright positions, including squatting, were

predominantly facilitated in midwifery-led units (MLUs). [12-14] Therefore, it was imperative to incorporate data regarding the setting in which the RCTs were conducted, encompassing both MLUs and obstetric-led units (OLUs) or a combination of both. The analysis compares subgroups of women giving birth in hospitals or OLUs versus those in birth centres or home-like settings. The goal was to assess whether women who gave birth in environments influenced by MLU exhibited a more pronounced effect size than those birthing in hospital settings characterised by obstetric-led care.

6.2.2.2 Types of Target Population

The primary participants were pregnant women. The appropriateness of adopting squatting during birth involved evaluating the inclusion and exclusion criteria for study participation (considered as low or high-risk pregnancy or labour). RCTs with women classified as low risk during birth were grouped and compared with those featuring high-risk labouring women. [14-16] This analysis aimed to ascertain whether a significant interactive subgroup effect existed between high and low-risk women and squatting positions during birth.

Secondary participants encompassed healthcare providers and companions present during labour. Healthcare providers included skilled birth attendants who supported the use of squatting positions during birth, such as doctors, midwives, nurses, physiotherapists, or unskilled birth attendants who are particularly active in low-income countries. Other provider characteristics of importance encompassed disciplinary background, specific pre-existing skills, level of expertise, and years of experience (if applicable) in supporting women adopting squatting positions. Furthermore, the presence of companions during labour, providing physical and/or psychological support, including doulas, spouses, partners, family members, or friends, was also considered.

A subgroup of RCTs that reported on the implementation of one or more co-intervention activities designed to engage key stakeholders based on theoretical arguments [12, 14-18] was

contrasted with those that did not address these activities. The co-interventions included are provided in the section below.

6.2.2.3 Reported Secondary or Co-intervention.

QES identified co-interventions or complementary practices that are often used alongside squatting during childbirth. Subgroup analyses can investigate whether the combination of squatting with specific co-interventions has a greater impact on birth outcomes compared to squatting alone. Secondary intervention characteristics aimed at facilitating the implementation of squatting vaginal birth included methods to engage both recipients and healthcare providers, which held particular significance for this study.

For engaging pregnant women, intervention components involved empowering them through information dissemination, including antenatal education group discussions, information leaflets, relaxation and birth preparation classes, or instructional guidance. Additionally, supporting a person during birth and one-to-one discussions between women and providers in the antenatal clinic and at the onset of labour to aid decision-making about the choice of birthing position were considered. [14, 16]

Similarly, intervention components targeting healthcare providers included education and training, clinical guidelines, or any other intervention reported by authors. [13, 20, 21] Methods involving evidence-based materials with specific instructions on maternal positions were included, such as written or online information, face-to-face simulations, workshops, seminars, online group discussions, and other methods of disseminating information. Furthermore, evidence-based clinical guidelines or protocol components were taken into account, including topics and evidence bases for information, descriptions of other components, and adherence to theoretical assumptions generated in Chapter 5. [15, 20, 21]

The training and skills of healthcare providers or birth attendants in assisting women who choose to squat during childbirth may be an effect modifier. Subgroup analyses can examine whether outcomes vary based on the level of provider training and experience. It was essential to discern whether additional training specific to facilitating squatting and other positions during the second stage of labour was provided or if care was delivered as part of the normal role. Also, of importance was whether competence in delivering these positions was assessed or monitored throughout the RCT to ensure consistent and appropriate delivery for all women. Instances where providers lacked competence were noted. The analysis predicted an interaction effect modification between RCTs that reported one or more secondary interventions to engage key stakeholders compared to those that did not report such interventions across various birth outcomes.

6.2.2.4 Variation in Total Duration and Timing of Squatting Positions (dose)during the 2nd Stage of Labour

This analysis focuses on reporting and evaluating RCTs based on the total duration of assuming squatting or other positions. Both quantitative and qualitative data (Chapters 4 & 5) revealed variations in the duration and timing of squatting. Chapter 4 showed the optimal dose of squatting varied across the included studies from the onset of the first stage through the second stage up to the birth of the placenta and membranes. Subgroup analyses were to explore whether the length of time a woman squats or the timing during labour (early vs. late or passive or active) influences birth outcomes differently during the second stage of labour.

Furthermore, qualitative research reveals that squatting is more beneficial in influencing spontaneous labour in full-term pregnancies when used during pregnancy, or the 1st stage of labour compared with 2nd stage of labour. Subgroup analyses can assess whether the effect of squatting on birth outcomes is influenced by various timing stages of pregnancy, labour, or

birth. However, Chapter 4 included RCTs considering the 2nd stage of labour. Although this type of subgroup was indicated in the qualitative synthesis it was not possible to include it in this chapter.

6.2.3 Outcome Measures: The following outcomes were measured in the subgroup analyses:

- Duration of the 2nd stage of labour
- Operative births (caesarean section and instrumental vaginal births)
- Perineal trauma requiring suturing (i.e., 2nd, 3rd and 4th degree tears and episiotomy)
- PPH ≥500mls
- Need for analgesia/anaesthesia (why these outcomes were selected)

Duration of the 2nd Stage of Labour: This outcome helps assess the efficiency of the birthing process when women are upright compared with horizontal positions. A shorter second stage of labour can be indicative of more effective contractions, maternal efforts and is known to reduce birth complications such as 3rd & 4th perineal trauma, use of epidural analgesia and need for assisted vaginal birth.

Operative Births: The rate of operative births, which includes both caesarean sections and instrumental vaginal deliveries (e.g., forceps or vacuum extraction), is a crucial measure of the overall safety and ease of childbirth. A reduction in these interventions may suggest a more natural and less medically intervened birth process leading to less maternal and neonatal morbidities.

Perineal Trauma Requiring Suturing (2nd, 3rd, and 4th-Degree Tears and Episiotomy): Perineal trauma is an important consideration during childbirth. The degree of perineal injury can impact a woman's postpartum recovery and long-term well-being. Monitoring perineal

trauma requiring suturing helps assess the potential benefits or risks of different birthing positions.

PPH 500mls: PPH is a serious complication that can occur after childbirth. Measuring PPH helps assess the safety of different birthing positions. A reduction in PPH suggests that adopting upright positions may contribute to better maternal outcomes.

Need for Analgesia/Anaesthesia: This outcome is essential to understand the pain management requirements of women during labour. A reduction in the need for analgesia or anaesthesia may suggest that upright positions are associated with less discomfort or pain, potentially improving the birthing experience for women.

These outcomes collectively provide insights into various aspects of childbirth, including the duration of labour, safety, maternal comfort the potential for medical interventions. Analysing these outcomes in subgroup analyses allows researchers to explore whether adopting upright positions has a different impact on specific subgroups of women, such as those with or without epidural analgesia, as mentioned in Chapter 4.

6.3.4 Study Selection, Data Extraction, Moderation Effects and Hypotheses Development.

Data were extracted from eligible studies by one reviewer (MK) using customized extraction sheets tailored to the characteristics pertinent to the subgroup analyses. The data extraction form was designed to reflect a priori, and post hoc analyses outlined above. [22-24]

6.3.5 Data Analysis

Statistical analysis was conducted using Rev-Man 5.3. Given that all analyses involved comparisons between different squatting and other positions in RCTs, a random-effects model was consistently employed across the analyses. The random-effects summary was treated as an

estimate of the average of the potential treatment effects range, acknowledging that the clinical implications of treatment effects might diverge between various RCTs.

In cases where there was sufficient data (at least 5 RCTs in each subgroup), [2, 3] forest plots of subgroup analyses were generated using the interaction tests available in Rev-Man 5.3. [30] Significant differences in interactions for birth outcomes were determined based on a threshold P-value of <0.05. The outcomes of the subgroup analyses were conveyed by citing the Chi-squared (Chi^2) and P values, along with the I^2 statistic value from the interaction test.

The interpretation of the subgroup analyses adhered to the Richardson et al. framework, which addresses five key criteria. [31] First, the framework suggests reporting whether a statistically significant subgroup difference (interaction) was identified or if no subgroup effect was observed while considering the presence or absence of substantial unexplained heterogeneity. Second, when at least ten RCTs are in the subgroup analysis, it is imperative to investigate the extent of heterogeneity within each subgroup. [2, 31, 32] Third, the covariate distribution of each analysis was critically examined, particularly when each subgroup involved a minimum of ten RCTs and at least 400 participants. Fourth, the plausibility of an observed interaction or its absence was weighed to guide the assessment of the reliability of the subgroup analysis results. [33] Fifth, additional factors were considered when interpreting subgroups, including the importance or lack of interaction and the potential for confounding. [2, 31] Consequently, the results presented in this chapter were interpreted by considering the presence or absence of a statistically significant subgroup difference along with substantial unexplained heterogeneity, the evenness or unevenness of covariate distribution, the plausibility and significance of the interaction, and the potential for confounding. [31]

6.3.5.1 Subgroup Analysis and Investigation of Heterogeneity

The analytical scope was limited to determining the association between the presence or absence of statistically significant main effects in one or more intervention components. Subgroup analyses were focused on the primary outcomes documented in the effectiveness review in Chapter 4. To derive meaningful insights, the covariate distribution relevant to each subgroup analysis was considered. [25-27]

The characteristics of the RCTs were analysed following the methods detailed in the section concerning specified primary outcome measures. It was predetermined that a subgroup analysis of the NRSIs identified for the review in Chapter 4 would not be undertaken. This decision was made because all NRSIs included in Chapter 4 were retrospective studies comparing exceedingly small samples of squatting with large samples on other positions, potentially yielding misleading results. [28, 29] Nonetheless, data from the NRSIs were coded to identify moderator variables that may have been missed in the RCTs and that might inform subgroup analyses.

RR was calculated to compare the effect of interventions for categorical data, such as one or a set of co-interventions versus no co-interventions. These RRs were accompanied by their corresponding 95% confidence intervals (CI) to evaluate the impact of interventions on dichotomous data. Additionally, mean differences (MD) were calculated with their 95% CI for continuous data. Heterogeneity was assessed using the I-square (I^2) statistic, where values of 30%, 50%, and 75% were indicative of mild, moderate, and substantial heterogeneity, respectively. Data entry into Rev-Man 5.3 was performed by a single reviewer (MK), followed by a subsequent discussion involving ST, IO, and MC regarding the data entry process.

6.4 Results

This chapter does not include a study flow chart, overall effectiveness assessment, risk of bias evaluation, or certainty of evidence assessment using the GRADE because these were reported in the effectiveness review (chapter 4).

6.4.4 Included Studies and Participants.

Data from a total of 30 RCTs, seven quasi-RCTs and 16 NRSIs, (i.e., 2 case-control studies and 14 cohort studies) were extracted from the review presented in Chapter 4. These studies encompassed a combined total of 578,359 participants. Specifically, among the RCTs and quasi-RCTs. There were 37 studies involving a total of 16, 694 participants. Only narrative data were collected from 16 NRSIs, consisting of a total of 561, 665 participants. The 53 studies varied in the key features of the target populations that assumed squatting and other positions during childbirth. The criteria for pregnant women's inclusion included demographic characteristics (e.g. age ≥ 18 years), clinical context (obstetric, medical, and surgical history), and geographical aspects. Authors of both RCTs and NSRIs considered low-risk women with no medical, surgical, or obstetric complications, a singleton pregnancy, cephalic presentation, full-term pregnancy (≥ 37 – 42 gestational weeks), and women of various parity (primigravidae and multigravida). It is worth noting that although assuming upright positions during birth is not typically recommended for women with high-risk pregnancies, only one RCT examined women with gestational diabetes, those who used epidural analgesia, and women undergoing vaginal birth after a previous caesarean section. [34]

6.4.5 Experimental Interventions and Comparisons

All the included studies featured two intervention groups that could be categorized as either squatting or other positions. Thirteen RCTs [8, 35-46] and nine NRSIs [11, 47-54] evaluated the effects

of full squatting versus other positions. Additionally, 24 RCTs [9, 34, 55-76] and 12 NRSIs [11, 47-54] examined the effects of modified squatting versus other positions.

6.4.6 Secondary or Co-interventions

A subset of the included studies reported secondary interventions that might interact with the use of squatting positions during birth, influencing factors such as the duration of labour, rates of operative birth, episiotomy, PPH ≥ 500mls, perineal trauma requiring suturing and use of analgesia. There were two sets of interventions. First, four clinical practice interventions were reported. Five RCTs reported scenarios involving spontaneous pushing or no maternal effort during the birth of the foetal head, [35, 36, 61, 65, 66] and one RCT reported a passive second stage of labour. [61] Nine RCTs and one NRSI documented instances where squatting was transitioned to a horizontal position at the crowning of the foetal head, encouraging a slower birth. [8-10, 34, 36-38, 57, 60, 62] Five RCTs and one NRSI [8, 34, 36, 42, 77, 78], reported methods of implementing squatting positions including intermittent squatting for 2 to 3 minutes during contractions.

Secondly, various techniques were used to engage key stakeholders or facilitate behaviour change to encourage the implementation of squatting during vaginal birth. Four secondary or co-interventions aimed at engaging key stakeholders were noted. Two RCTs and one NRSI incorporated effective communication methods during the antenatal and intrapartum periods to engage women [36, 69, 78] and six RCTs and two NRSIs involved support persons during labour. [35, 36, 39, 55, 65, 77-79] In addition, healthcare providers were engaged through three RCTs employing education and training, clinical guidelines [34, 38, 61] and seven RCTs and three NRSIs involved specialized providers with adequate skills and experience. [11, 35, 38, 65, 66, 73, 77, 78, 80, 81] However, the frequency of delivering the behaviour change techniques and the level of engagement were not consistently reported.

6.4.7 Duration (dose) or Timing of Squatting Positions during the 2nd Stage of Labour

The duration of the intervention varied across studies, ranging from when participants were at 3cm dilated in the first stage of labour to the birth of the placenta and membranes. Eight studies[37, 40, 45, 55, 57, 60, 69, 82] specifically confined the period of randomisation to the second stage of labour (both passive and active second stages). Four studies [39, 46, 73, 74] explicitly encompassed the first stage of labour within the randomised period. Conversely, in eight studies, randomization was limited to the active second stage of labour until the crowning of the foetal head or the actual birth. [8, 34, 35, 38, 61, 65, 71, 72] In one study, randomization solely took place during the passive second stage of labour. Two RCTs used percentages (e.g., 50% or 90%) of the active bearing-down phase to determine the timing of randomization for the intervention. [58, 65]

6.4.8 Outcome Measurements

All the included studies provided data on various birth outcomes, which encompassed the duration of labour, operative birth (including both caesarean sections and instrumental vaginal births), perineal trauma requiring suturing (encompassing 2nd, 3rd, & 4ht degree tears as well as episiotomy, PPH ≥ 500mls, and the need for analgesia/anaesthesia.

Characteristics of Subgroup Analyses

This chapter introduces seven hypotheses, five of which were investigated through subgroup analyses with a satisfactory number of RCTs available for analysis.

6.4.9 Pre-specified Subgroup Analysis

6.3.6.1 Subgroup analysis: Positioning by type: Outcome – duration of the second stage of labour

Thirty-one RCTs reported this outcome and, therefore, provided data on this moderator variable with the results stratified by type (i.e., full or modified). The test for subgroup

differences indicates no statistically significant subgroup effect with the same direction of effect, and adequate covariate distribution (i.e., ≥10 trials and ≥400 participants, Figure 41). The results suggest that the duration of labour is not moderated by the type of squatting position. The results of both subgroups were consistent with the overall summary of the estimated effect of 21 trials on the duration of birth reported in Chapter 4. A significant reduction in duration of the 2nd stage of labour was shown for full squatting compared with other positions (MD -11.67, 95% CI, -20.30 to -3.04; I^2 = 98%; P = 0.00001; 11 RCTs; 1981 women). Furthermore, a significantly shorter second stage of labour was shown in the subgroup of modified squatting (MD −6.10, 95% CI, −11.03 to −1.17 minutes, I^2 = 95%, P < 0.00001, 12 RCTs, 4656 women) compared with other positions. There was some evidence of funnel plot asymmetry from visual examination, indicating the possibility of publication bias (Figure 42).

The effect estimate results presented in figure 41 were interpreted as follows: a significantly larger reduced duration of the second stage of labour was shown in the subgroup of full (i.e., the MD of 11 minutes and 40 seconds) compared with modified squatting position (i.e., MD 6 minutes and 6 seconds shorter) with 4 minutes and 8 seconds shorter if assuming full squat (i.e., 11 minutes and 40 seconds vs 6 minutes and 6 seconds). This indicates that the duration of the second stage of labour is slightly shorter by 4 minutes and 8 seconds compared with modified squats.

Substantial unexplained heterogeneity was observed between RCTs in each subgroup when examining the duration of birth based on squatting type and co-interventions. The subgroup analyses failed to provide an explanation for this heterogeneity in the overall analysis, which is reflected in the high I^2 values: modified squatting I^2= 95%; full squatting I^2= 98%; timing of squatting from first to second stage I^2= 90%; active second stage I^2= 97%; second to third stage

I^2= 96% (refer to Figure 41). Therefore, it is not appropriate to conclude different effects within these subgroups without exploring other factors confounding the subgroup analysis.

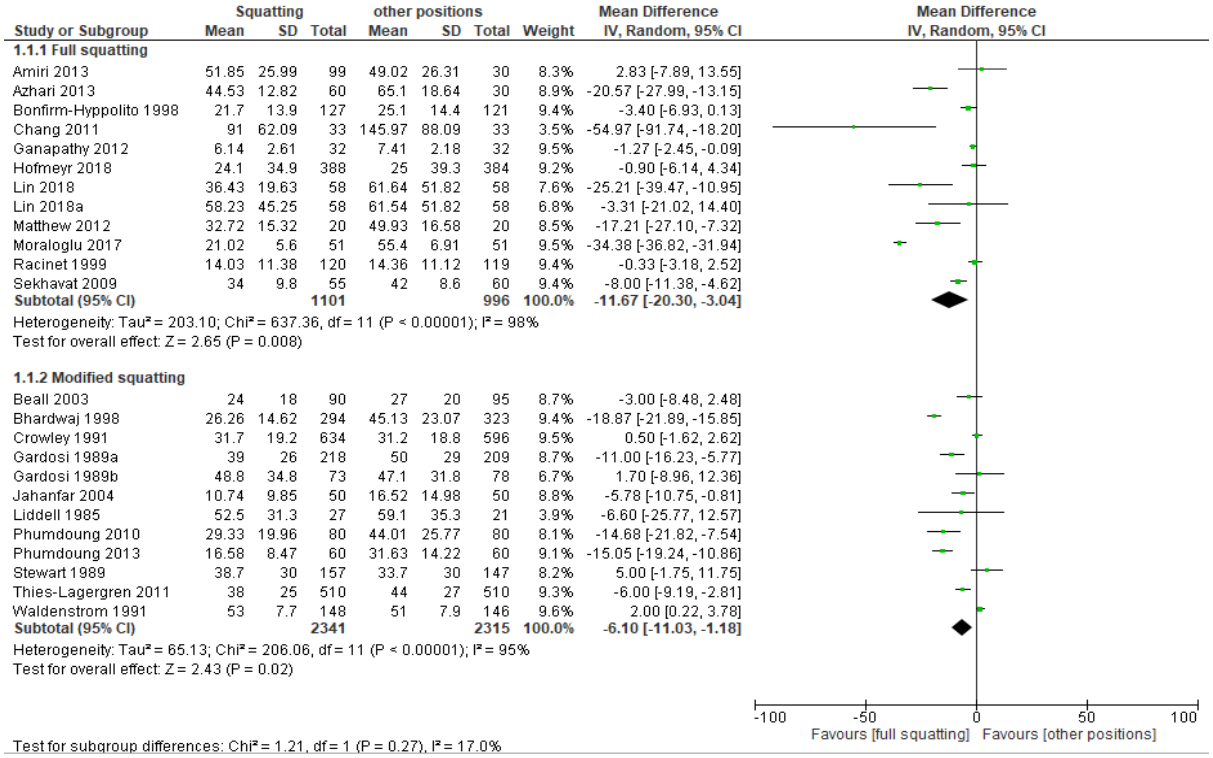


Figure 41: Forest Plot: Squatting by Type on Duration of 2nd stage.

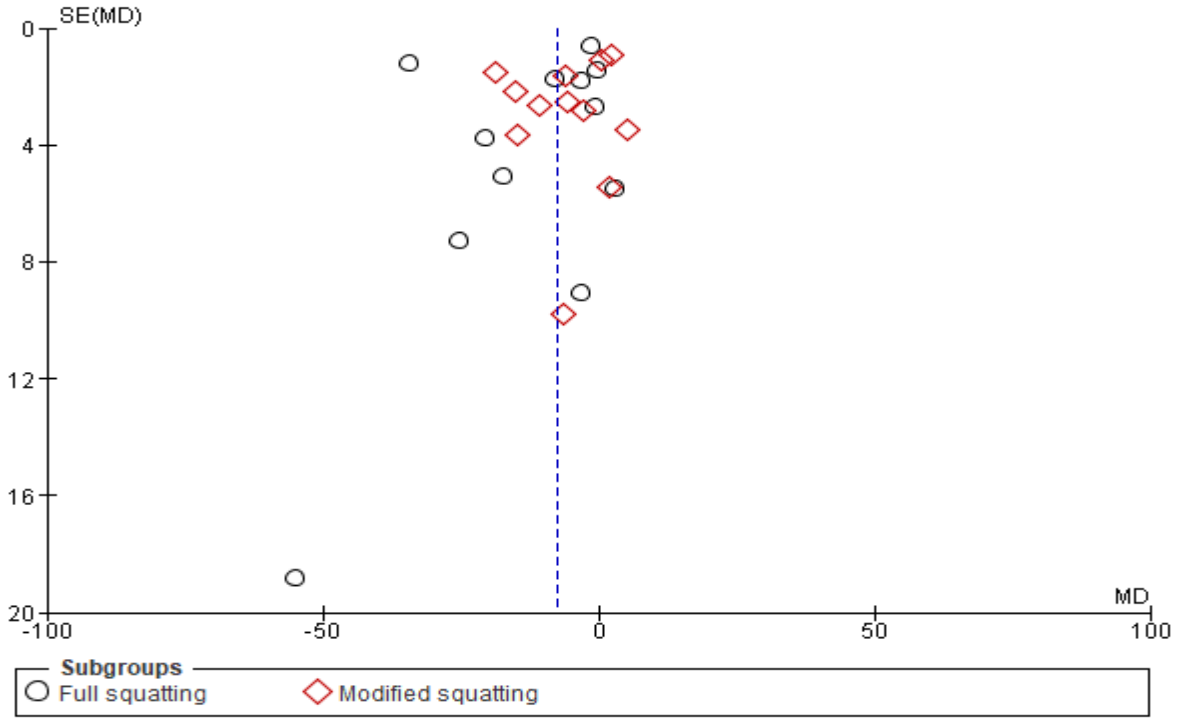


Figure 42: Funnel Plot: Squatting by Type on Duration of 2nd stage.

6.3.6.2 Subgroup analysis: Position-by type of squatting - Operative birth (i.e., a sum of caesarean sections and instrumental vaginal births)

A subgroup analysis was conducted to investigate the relationship between the position during childbirth and the type of squatting position used (operative birth, including caesarean sections and instrumental vaginal births). The analysis for position-by-type of squatting did not show any significant subgroup effect on operative birth. This means that the different positions during childbirth did not have a statistically significant impact on the likelihood of operative birth when considering both caesarean sections and instrumental vaginal. Although one subgroup showed significant differences favouring modified squatting compared with other positions (reporting co-interventions: RR 0.60, 95% CI 0.42 to 0.87; 5090 women; RCTs = 10; I2 = 73%. In contrast, there was no significant difference between full squatting compared with other positions since the 95% CI touched the no-effect line: RR 0.76, 95% CI 0.58 to 1.00; 2,727 women; RCTs = 9; I^2 = 33%) [Figure 43]. The studies are concentrated in the upper part

of the funnel plot showing different results (Figure 44), which may indicate a possible reporting bias from the lack of studies in the bottom part, and one large trial showing minimum effect.

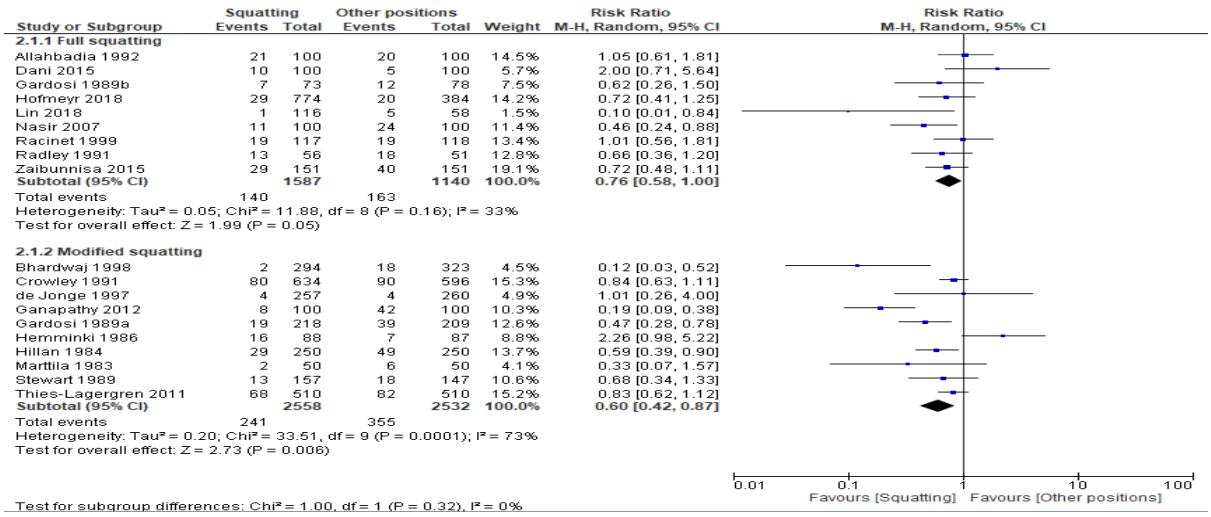


Figure 43: Forest Plot: Squatting by Type on Operative Birth

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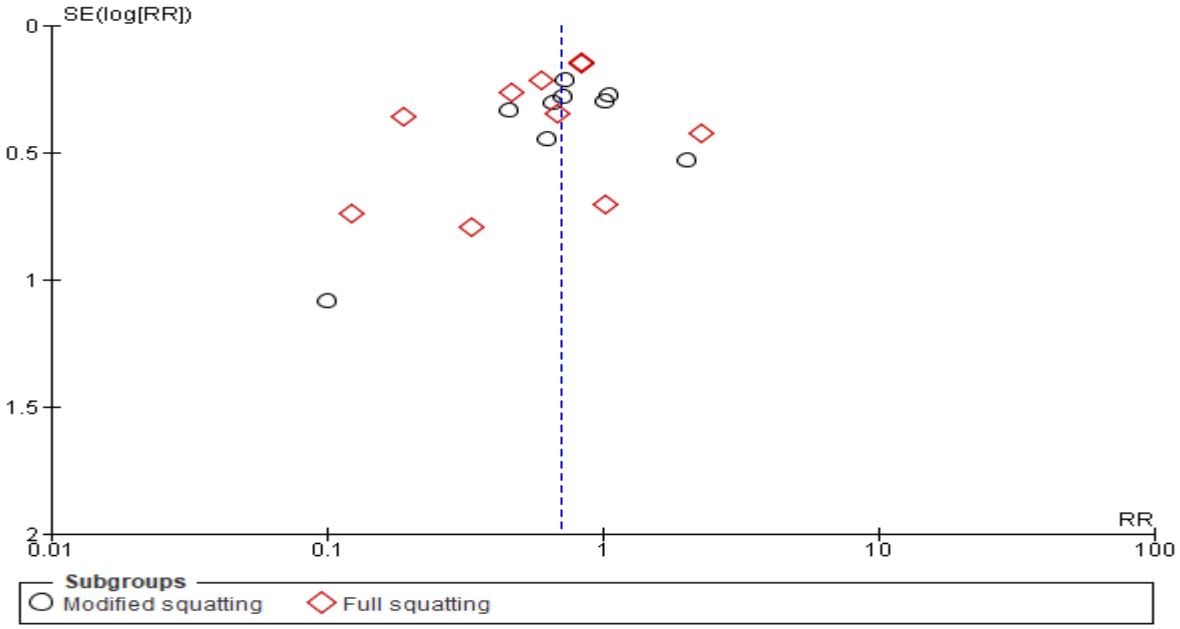


Figure 44: Funnel Plot: Squatting by Type on Operative Birth

6.3.6.3 Subgroup analysis: Perineal trauma requiring suturing by classification: Episiotomy, 2nd-degree tears, and 3rd and 4th-degree tears.

The test for subgroup differences indicates a statistically significant subgroup effect according to the subgroup interaction test with the same direction of effect favouring squatting in two subgroups and opposite direction of effect for one subgroup favouring other positions, adequate covariate distribution, Figure 45). There were significantly smaller rates of episiotomy showing a slight relative risk reduction (RRR) of 21% if assuming squatting compared to other positions (RR 0.79, 95% CI 0.72 to 0.87; RCTs=19; I^2=44%; women = 7624). Similarly, the direction of the effect favoured squatting with an RRR of 28% (but the CIs showed no significant difference) in the 3rd and 4th-degree tear rate between the two position groups (RR 0.72; 95% CI 0.46 to 1.13; RCTs = 7; I^2=0%; 2976 women). In contrast, the third subgroup showed the opposite direction of effect with a slight increase in risk of 3% against adopting squatting positions compared with other positions, but the result was non-significant (RR 1.03; 95% CI 0.84 to 1.27; RCT = 20; I^2= 68%; 8472 women).

Based on the criteria proposed by Cohen [83], the summary effect size for the three subgroup analyses was small. There was some evidence of funnel plot asymmetry from visual examination, indicating the possibility of publication bias (Figure 46).

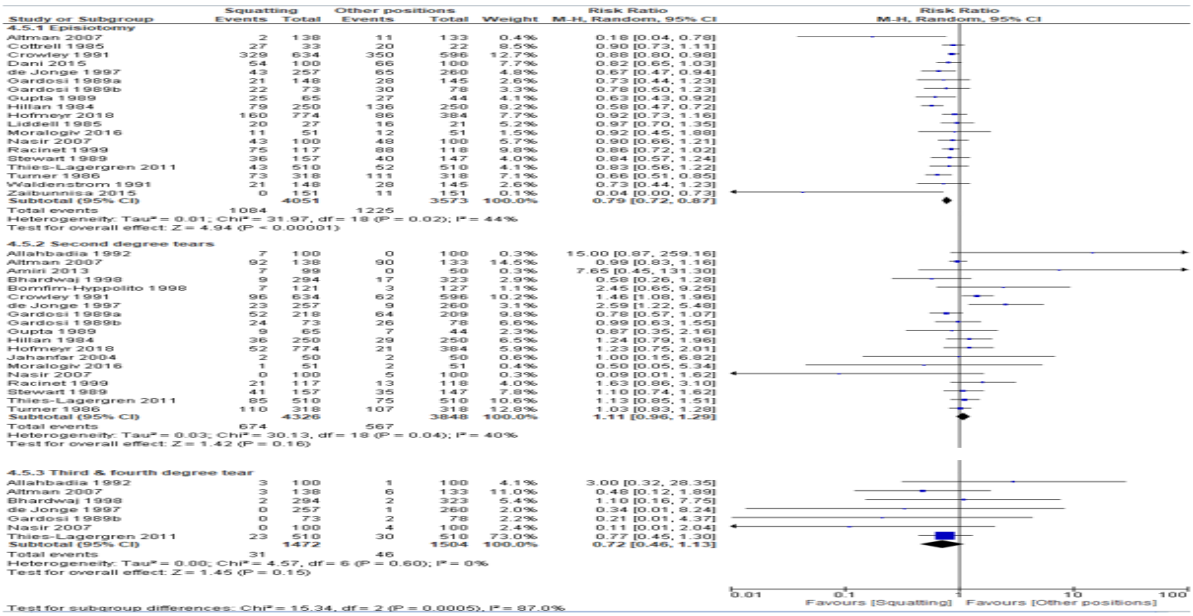


Figure 45: Forest Plot: Perineal Trauma Requiring Suturing by Classification

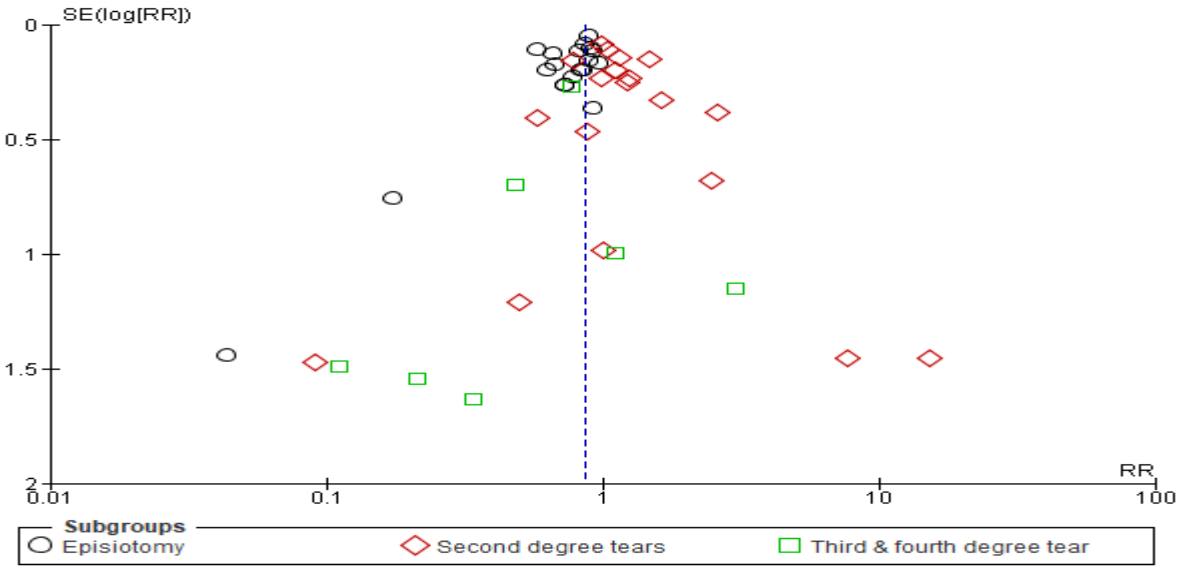


Figure 46: Funnel Plot: Perineal Trauma Requiring Suturing by Classification

6.3.6.4 Subgroup analysis: PPH ≥500mls

The test for subgroup differences suggests a statistically significant subgroup effect on PPH ≥500mls with the same direction of effect favouring other positions, but different effect estimates, and adequate covariate distribution). A subgroup analysis for interactive secondary interventions showed that squatting may make little or no difference to PPH >500mls compared with other positions during birth (RR 1.03, 95% CI 0.77 to 1.38; 4809 women; RCTs = 7; I^2 = 0%). In contrast, subgroup analysis with no interactive interventions showed a significant increase in PPH ≥ 500mls when squatting (RR 1.98, 95% CI 1.50 to 2.62; 2719 women; 8 RCTs; I^2 = 27%). This suggests that the interaction of secondary interventions with squatting positions significantly modifies the reduction in PPH ≥ 500mls. This is different to the overall meta-analysis result for all trials, which favours the use of other positions compared with squatting during birth (RR 1.98, 95% CI 1.50 to 2.62; 2719 women; RCTs = 8; I^2 = 27%), leading to increased rates of PPH > 500mls if squatting. (Figure 47)

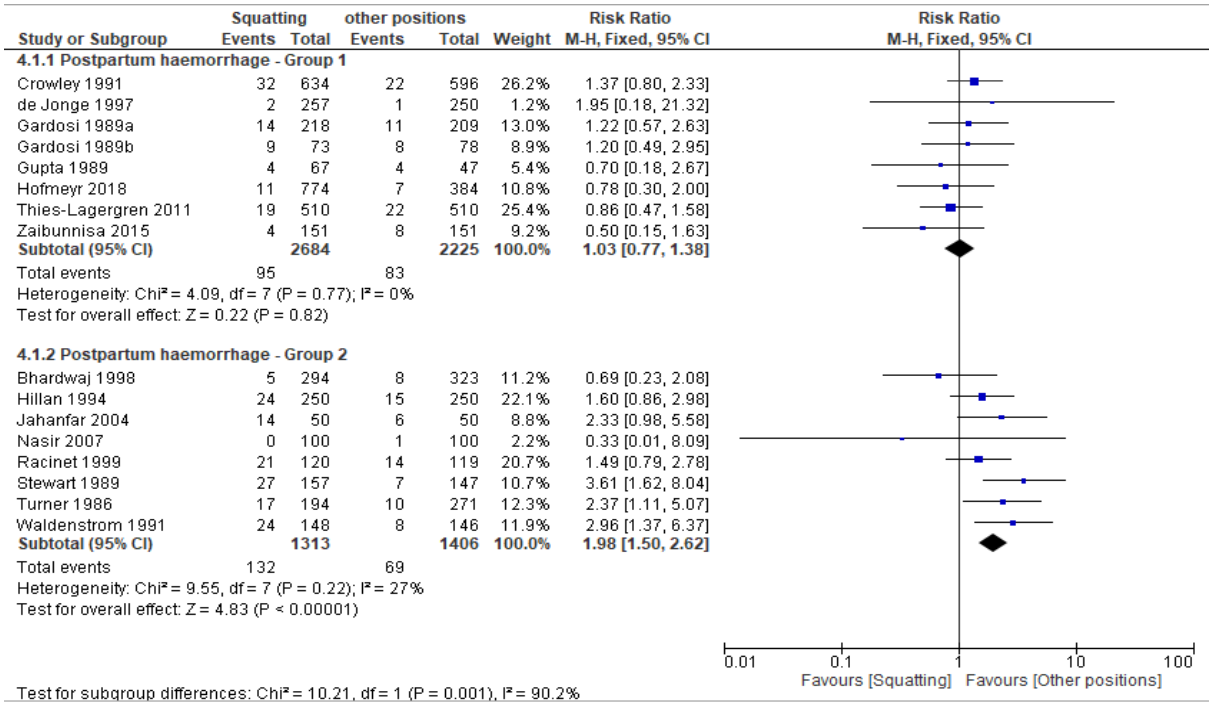


Figure 47: Forest Plot: PPH ≥ 500mls.

6.3.7 Post-hoc sub-group analyses

6.3.7.1 Subgroup analysis: Perineal trauma requiring suturing (a sum of 2nd, 3rd, and 4th-degree tear and episiotomy)

The test for subgroup differences indicates no statistically significant subgroup effect with the same direction of effect favouring squatting position, and adequate covariate distribution, Figure 48). This suggests that a set of co-interventions implemented during birth does not modify the effect of squatting compared to other positions on perineal trauma requiring suturing. Both subgroups showed significant differences favouring squatting compared with other positions (reporting co-interventions: RR 0.87, 95% CI 0.82 to 0.92; 5585 women; RCTs = 11; I^2 = 72%; and not reporting co-interventions: RR 0.82, 95% CI 0.76 to 0.89; 3513 women; RCTs = 13; I^2 = 66%). There was some evidence of funnel plot asymmetry from visual examination, indicating possible publication bias (Figure 49).

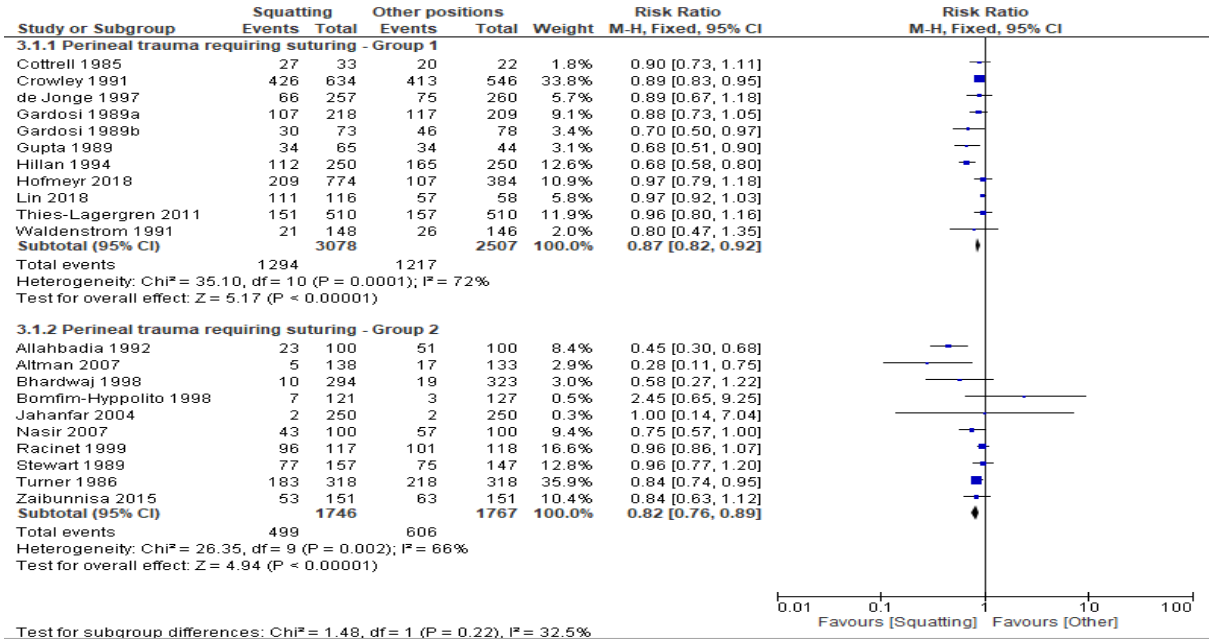


Figure 48: Forest Plot: Secondary Intervention vs no interventions: Perineal Trauma Requiring Suturing

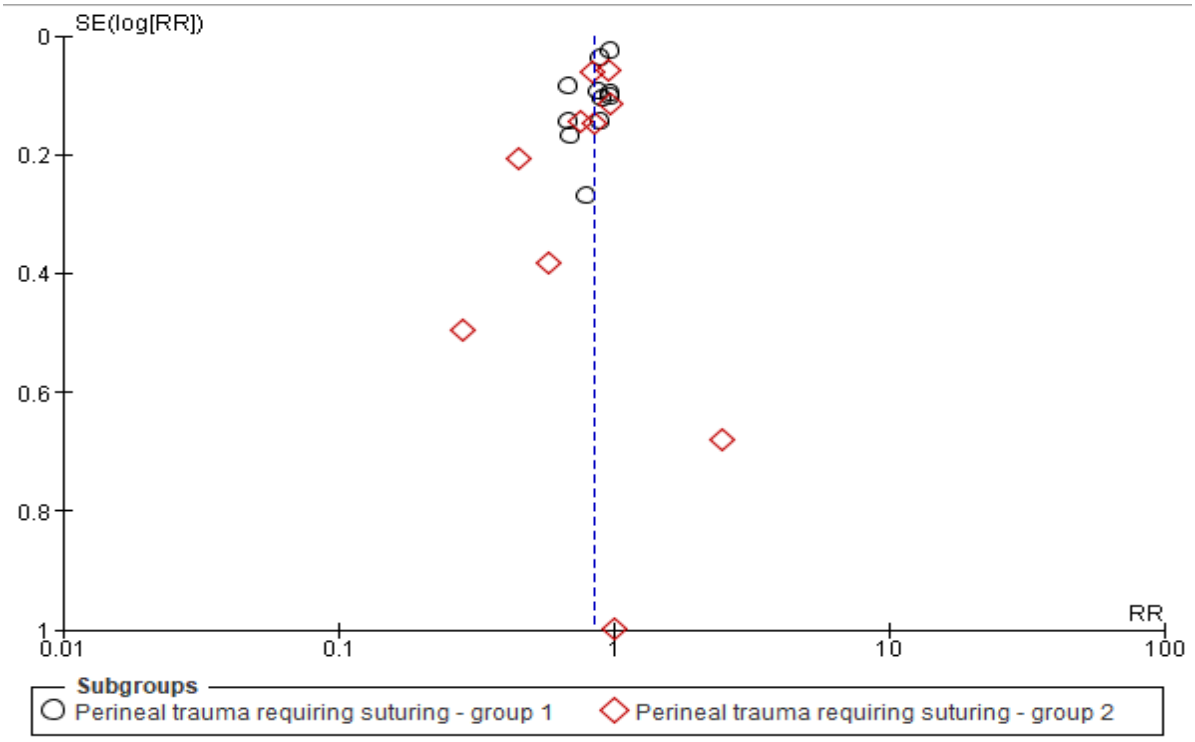


Figure 49: Funnel Plot: Secondary Intervention vs no interventions: Perineal Trauma Requiring Suturing

6.3.7.2 Subgroup analysis: Characteristics of the target population

A subgroup analysis comparing the effects of squatting during birth between low-risk and high-risk pregnant women could not be conducted due to the limited inclusion of high-risk pregnancies in the trials. Specifically, only one trial included women with high-risk conditions, such as gestational diabetes, those using epidural analgesia, and those undergoing vaginal birth after a previous caesarean section. [34]

6.3.7.3 Subgroup analysis: Characteristics of settings

Most RCTs (n=33) included in this chapter were carried out in obstetric-led units. Only two took place in obstetric and midwifery-led units, [37, 39] and information regarding the setting was unclear in one. Consequently, it was not feasible to stratify subgroups based on setting characteristics.

6.3.7.4 Subgroup analysis: Secondary versus no secondary interventions - Operative birth (i.e., a sum of caesarean sections and instrumental vaginal births)

The test for subgroup differences indicates no statistically significant subgroup effect (test for subgroup differences with the same direction of effect favouring squatting position, adequate covariate distribution. The subgroup test confirms that the interaction of squatting position during the second stage of labour with implementing multiple components of intervention used to engage key stakeholders does not modify the result on the rates of operative birth. A significant intervention effect was apparent in both subgroups (average RR 0.73, 95% CI 0.61 to 0.87; 4526 women; RCTs = 11; I^2 = 32% and when no interventions are used for key stakeholders to engage in the research study (average RR 0.79, 95% CI 0.68 to 0.93; 3928 women; RCTs = 12; I^2 = 39%) [Figure 50]. There was no clear evidence of funnel plot asymmetry from visual examination [see Figure 51].

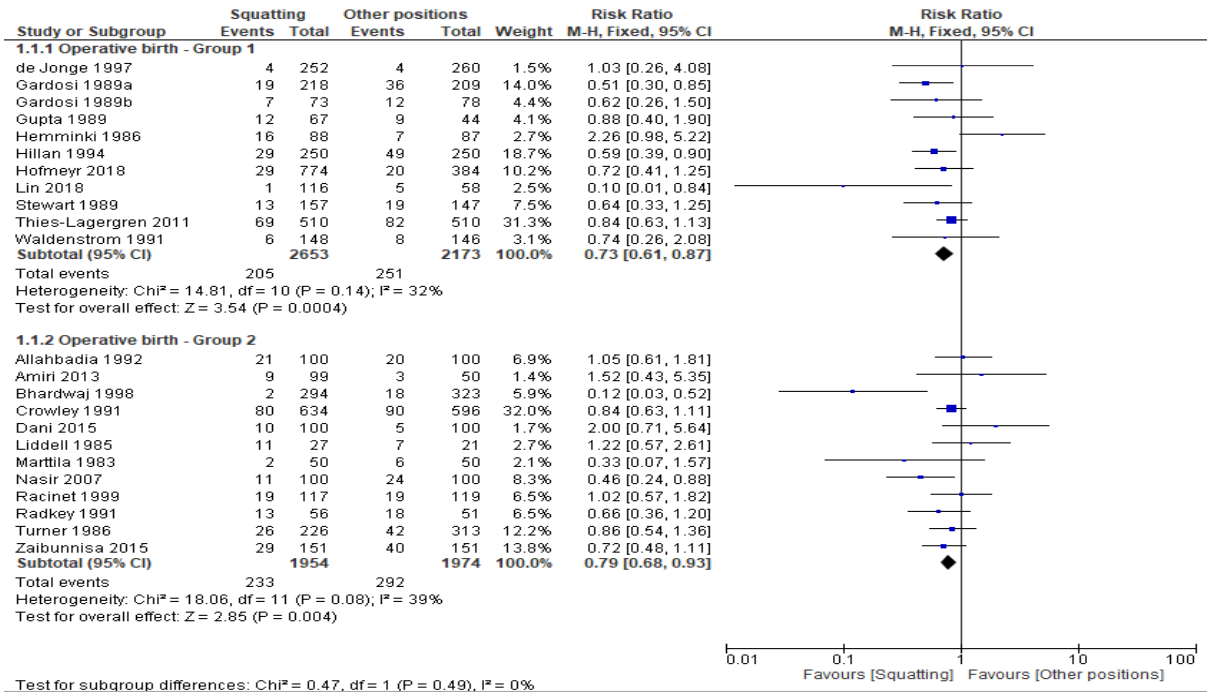


Figure 50: Forest Plot: Secondary Intervention vs no interventions: Operative Birth

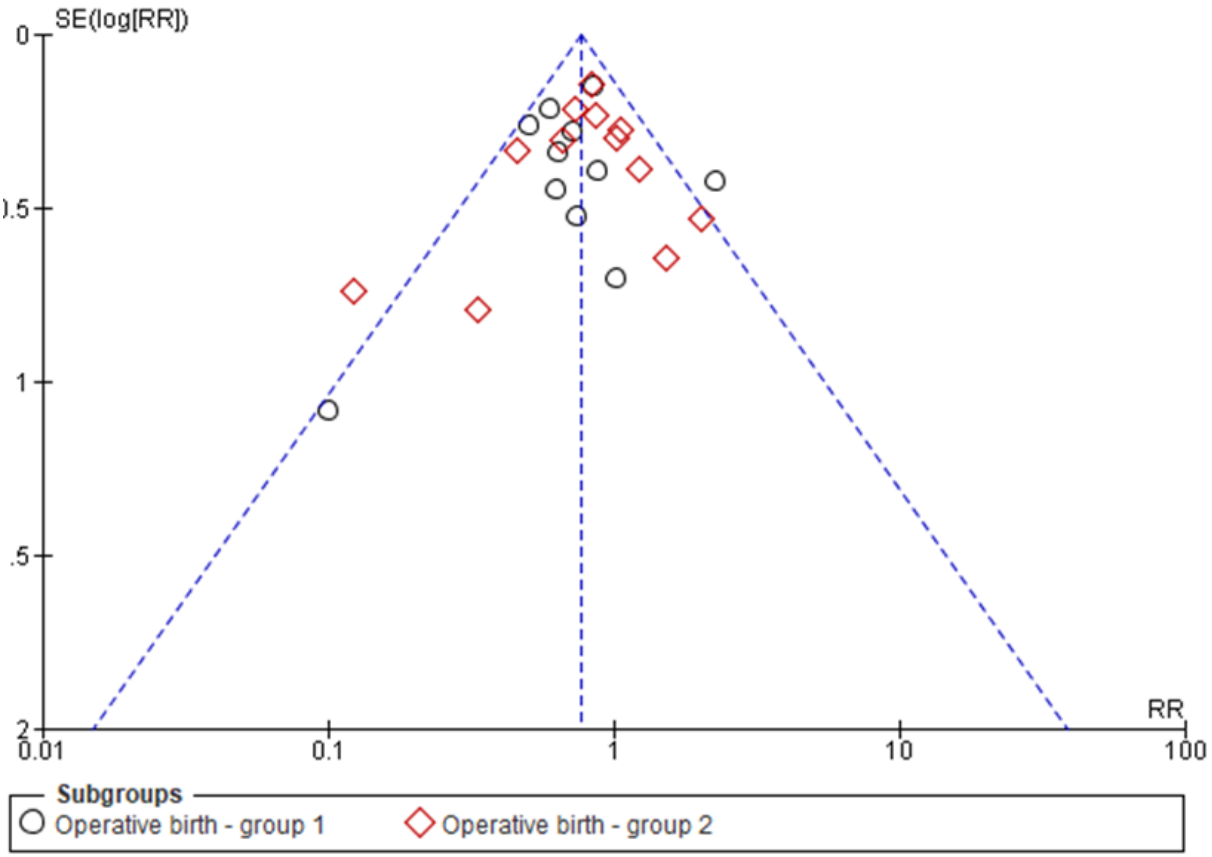


Figure 51: Funnel Plot: Secondary Intervention vs no interventions: Operative Birth

6.3.7.5 Subgroup analysis: Need for analgesia/anaesthesia.

A subgroup analysis was performed to test whether implementing multiple interventions to engage key stakeholders modifies the effect of squatting compared with other positions during birth on the need for analgesia and anaesthesia. Ten studies were coded for this outcome, leaving one subgroup with only four pooled studies. The test for subgroup differences indicated no statistically significant subgroup effect on the need for analgesia/anaesthesia (test for subgroup differences: P = 0.31), I^2 = 4.1% with the same direction of effect favouring squatting position, adequate covariate distribution, Figure 52). This suggests that implementing multiple interventions to create engagement among key stakeholders does not modify the effect of squatting compared to other positions on the need for analgesia/anaesthesia.

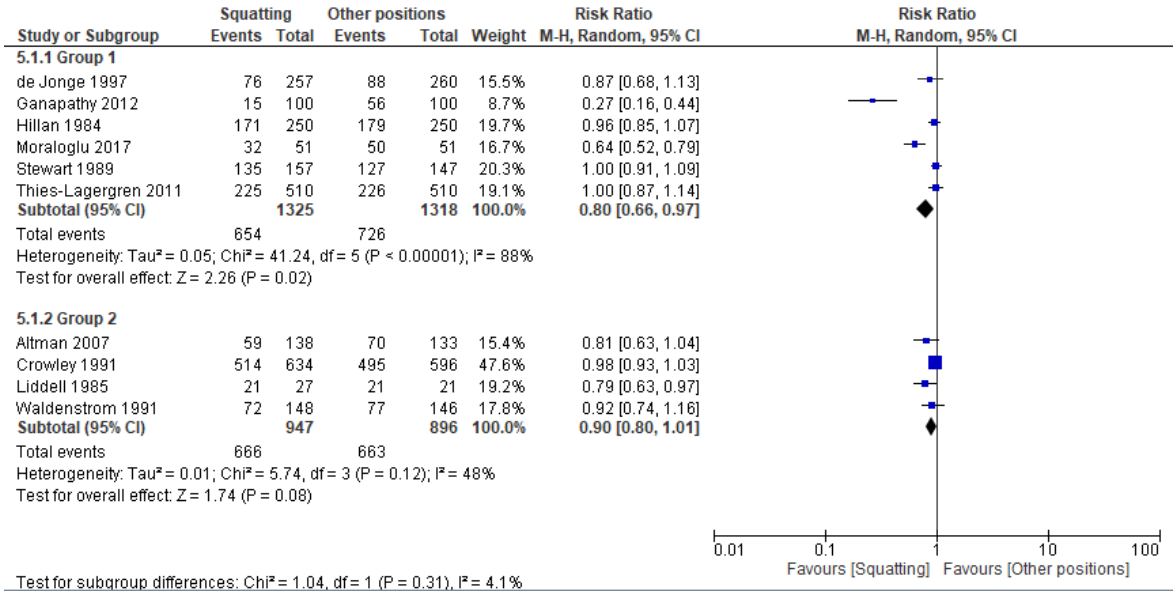


Figure 52: Funnel Plot: Secondary Intervention vs no interventions: Need of Analgesia/Anaesthesia

6.3.7.6 Subgroup analysis: Analysis by time (dose) of randomisation of squatting on the length of the second stage of labour – 4 subgroup analyses

The test for subgroup differences suggests a statistically significant subgroup effect between the four groups (test for subgroup differences: Chi = 446.40, df = 3 (P < 0.00001), I^2 = 99.3% with the same direction of effect favouring squatting position for three analyses and opposite direction in one analysis, adequate covariate distribution, Figure 53). Overall results of these subgroup analyses showed that different durations or doses of maintaining a squatting position during the second stage of labour significantly modified the effect of squatting compared to other positions. In three of the four subgroups (see Figure 53), a significant reduction in the duration of the second stage of labour was reported with intervention effect in the same direction but with slightly different magnitudes. One group showed a significant reduction of the duration of birth if squatting in the active second stage of labour until the crowning of the foetal head (MD −19.84 minutes, 95% CI −21.40 to −18.28 minutes, I^2 = 90%, P < 0.00001, 8 RCTs, 2556 women); a second group squatting during the 1st and 2nd stages (MD −8.47 minutes, 95% CI −11.18 to −5.75 minutes, I^2 = 90%, P < 0.00001, 4 RCTs, 574 women); and a third group, squatting from 2nd stage of labour until the expulsive of the placenta (MD −11.17

minutes, 95% CI −13.25 to −9.08 minutes, I^2 = 96%, P < 0.00001, 965 women, inadequate covariate distribution due to 3 RCTs).

Only four trials contributed data to one of the groups and three trials to one of another group, suggesting that there is insufficient evidence to conclude that there is a true subgroup effect. In addition, there is extreme unexplained heterogeneity (with I^2 ranging from ≥ 90% to 97%) in the mean duration among three out of the four subgroups. Therefore, the subgroup analyses did not explain the heterogeneity in the overall meta-analysis of all trials reported in Chapter 4 (MD −8.48 minutes, 95% CI −13.08 to −3.87 minutes, I^2 = 97%, P < 0.00001, 23 RCTs, 7056 women). Hence, there is uncertainty due to inadequate covariate distribution and inconsistency between pooled trial results. This implies that there is potential for additional confounding factors interacting with the optimal timing of assuming the squatting position. Further exploration of unexplained heterogeneity is essential to make a meaningful clinical conclusion.

The fourth subgroup consisting of seven RCTs in which squatting was maintained during the passive and active second stage of labour showed that positions other than squatting might lead to reduced duration of the second stage of labour, but the result was not statistically significant (MD 0.77, 95% CI -0.39 to 1.94 minutes, I^2= 0%, P = 0.50, 7 RCTs, 2897 women). There was no heterogeneity between results from the pooled trials of this subgroup that requires further exploration.

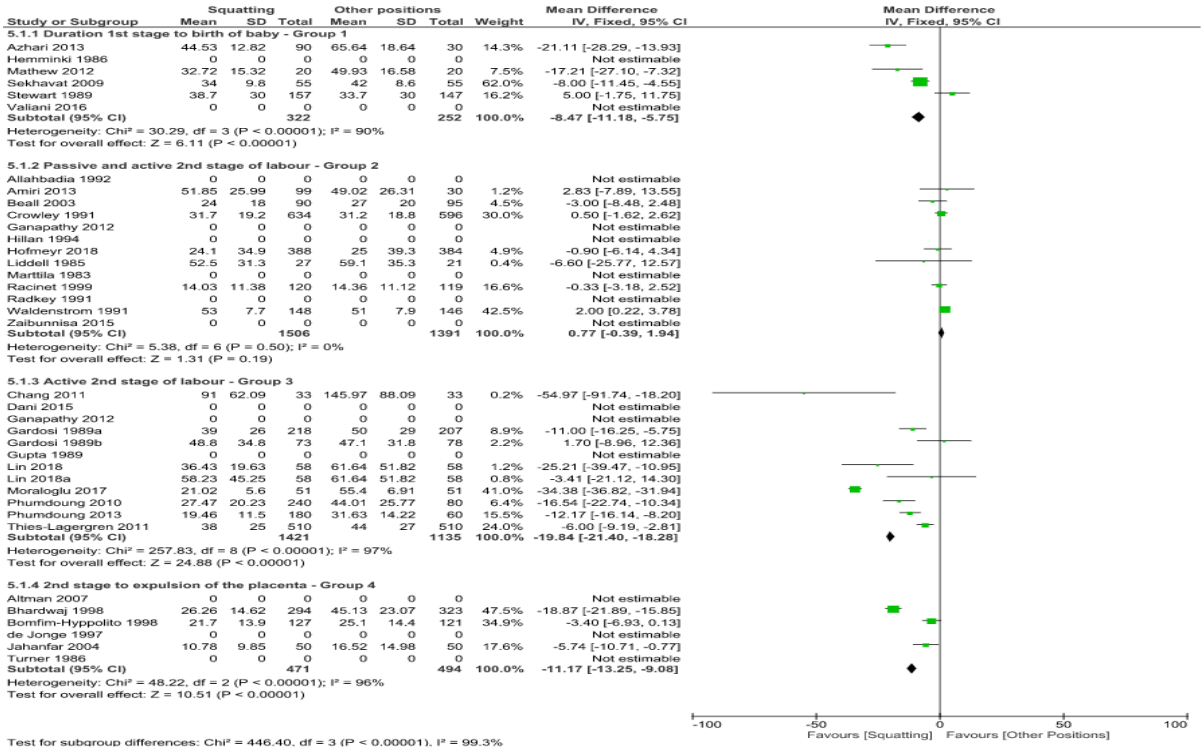


Figure 53: Duration (dose) of Squatting Positions: Duration of 2nd Stage of Labour

6.3.7.7 Summary of exploration of the source of heterogeneity in RCTs

As a result, the intervention effect estimates for each subgroup are uncertain due to the inconsistent results observed between different RCTs. This highlights the need for further investigation into the sources of heterogeneity in the duration of birth outcomes. It is plausible that other factors not considered in the subgroup analyses could be influencing these results, thereby confounding the interpretation of the outcome. Tables 18 and 19 present a summary of the overall findings of the subgroup analyses on the reported birth outcomes.

Table 18: Summary results of pre-specified subgroup analyses

Outcomes	Name of Subgroup	No. of Participants	No. of Studies	I^2	MD or RR	Risk measure interpretation	Subgroup effect interpretation
Duration of birth	Full squat	2097	11	98%	MD -11.67 (CI -20.30 to -3.04)	Favours squatting	Nonsignificant subgroup effect. P = 0.27 The similar direction and magnitude of the effect
	Modified squat	4656	12	95%	MD – 6.10 (CI -11.03 to -1.18)	Favours squatting	
Operative birth	Full squat	2727	9	33%	RR 0.76 (CI 0.58 to 1.00)	No significant difference	Nonsignificant subgroup effect; P = 0.32 The similar direction, a different magnitude of the effect
	Modified squat	5090	10	73%	RR 0.60 (CI 0.80 to 0.99)	Favours squatting	
PPH ≥ 500mls	G1: RCTs reporting moderator variables	4909	8	0%	RR 1.03 (CI 0.77 to 1.38)	No significant difference	Significant subgroup effect

	G2: RCTs no reporting moderator variables	2719	8	27%	RR 1.98 (CI 1.50 to 2.62)	Favours other positions	P <0.001 Similar direction, a different magnitude of the effect
Perineal trauma by classification	Episiotomy	7624	19	44%	RR 0.79 (CI 0.72 to 0.88)	Favours squatting	Significant subgroup effect P = 0.05 The similar direction, a different magnitude of effect in 2 out of the 3 subgroups
	2nd-degree tears	8174	19	40%	RR 1.11 (CI 0.98 to 1.29)	No significant difference	
	3rd & 4th degree tears	2976	7	0%	RR 0.72 (CI 0.40 to 1.13)	No significant difference	

Table 19: Summary of the results of post hoc subgroup analyses

Outcomes	Name of Subgroup	No. of Participants	No. of Studies	I^2	MD or RR	Risk measure interpretation	Subgroup effect interpretation
Operative birth	G1: RCTs reporting moderator variables	4826	11	32%	RR 0.73 (CI 0.61 to 0.87)	Favours squatting	Nonsignificant subgroup effect P = 49 The same direction & similar magnitude of the effect
	G2: RCTs no reporting moderator variables	3928	12	38%	RR 0.76 (CI 0.68 to 0.93)	Favours squatting	
Need for analgesia/anaesthesia	G1: RCTs reporting moderator variables	2830	6	84%	RR 0.91 (CI 0.85 to 0.97)	Favours squatting	Nonsignificant subgroup effect P = 3.4 The same direction & similar magnitude of the effect
	G2: RCTs no reporting moderator variables	1549	3	64%	RR 0.89 (CI 0.80 to 0.99)	Favours squatting	
Perineal trauma requiring suturing	G1: RCTs reporting moderator variables	5585	11	72%	RR 0.87 (CI 0.82 to 0.92)	Favours squatting	Nonsignificant subgroup effect

	G2: RCTs no reporting moderator variables	3513	10	66%	RR 0.82 (CI 0.76 to 089)	Favours squatting	P = 22 The same direction & similar magnitude of the effect
Duration of birth	Length of squatting: 1st & 2nd stage	574	4	90%	MD – 8.47 (CI -11.18 to -5.75)	Favours squatting	Significant subgroup effect P < 0.00001 The same direction & some differences in the magnitude of effect in subgroups 1, 3 & 4 but not 2nd group.
	Length of squatting: passive & active 2nd stage	2897	7	0%	MD 0.77 (-0.39 to 1.94)	No significant difference	
	Length of squatting: active 2nd stage	2556	7	97%	MD -19.84 (CI-21.40 to -18.28)	Favours squatting	
	Length of squatting: 2nd & 3rd stage	965	3	96%	MD -11.17 (CI -13.25 to -9.08)	Favours squatting	

6.4 Discussion

6.4.1 Summary of the main findings

This chapter presents subgroup analyses of intervention effects based on various characteristics of the RCTs. The primary objective was to address the unexplained heterogeneity observed in the results in Chapter 4, particularly with the duration of labour. Additionally, another objective was to identify and assess potential effect moderator variables that could interact with assuming squatting positions compared to other positions during childbirth, ultimately impacting birth outcomes. The analyses investigated whether the interactions between different types of squatting positions and secondary interventions (i.e., moderator variables) applied during the second stage of labour would lead to variations in the direction and strength of effect estimates on various birth outcomes. The chapter explored eight subgroup analyses, comprising four pre-specified and four post hoc analyses.

6.4.2 Statistically Significant Subgroup Effects

Squatting combined with specific secondary interventions reduced the rates of PPH ≥ 500mls during birth. A shorter duration of birth was observed with squatting during the active second stage of labour. Squatting during birth was associated with a reduction in episiotomy rates compared to the likelihood of sustaining 2nd-degree tears.

6.4.3 Non-Statistically Significant Subgroup Effects

Squatting type did not modify the effects on the duration of birth, operative birth, and perineal trauma requiring suturing. No significant modification effect was observed when squatting interacted with secondary interventions for perineal trauma requiring suturing, operative birth,

and the need for analgesia/anaesthesia. However, there is uncertainty in the findings of the included RCTs because of a lack of sufficient data.

Due to limited available data, it was not feasible to thoroughly evaluate changes in outcomes across subgroups involving different categories of pregnant women (low and high-risk) or diverse maternity settings (OLUs or MLUs). Consequently, out of the seven subgroup analyses planned for this chapter, four post hoc hypotheses were tested. This underscores a gap in the existing literature, suggesting that further research is needed to address these specific areas and provide a more comprehensive understanding of the potential moderating factors influencing the effectiveness of squatting positions during childbirth.

Overall, there is not enough evidence supporting the interactions of secondary interventions with squatting positions during the second stage of labour can improve birth outcomes mainly operative births and perineal trauma requiring suturing. This finding may be due to poor reporting of secondary reporting within and across RCTs included in the study. Robust RCTs are required to demonstrate the modifying variables associated with squatting positions that can potentially contribute to the increase of better birth outcomes.

6.4.4 Subgroup effect on adverse events: perineal trauma requiring suturing by classification and PPH ≥ 500mls.

The included RCTs considered two main types of perineal injuries that can occur during childbirth. These classifications encompassed 2nd, 3rd, and 4th-degree accidental tears, as well as intentional surgical incisions known as episiotomies. These various categories of perineal injuries can lead to adverse events that may have short-term or long-term consequences for women. However, it is important to note that 3rd and 4th-degree perineal injuries have a particularly significant impact on a woman's quality of life, [89-92] [89, 90] On the other hand, episiotomies and 2nd-degree tears are anterior perineal injuries that involve structures such as

the labia, anterior vagina, urethra, or clitoris. [91-96] The consequences of these injuries can also vary in terms of their impact on a woman's well-being. Severe perineal trauma causes long-term complications (i.e., anal incontinence, chronic pain, dyspareunia and urinary incontinence) [97] and can affect subsequent births leading to an elective caesarean section. [98] It also has some litigation costs for the National Health Service (NHS) in the United Kingdom (UK). [99] Therefore, it was important to investigate through subgroup analyses the modifying factors that influence perineal outcome during a squatting vaginal birth and to identify opportunities for prevention.

The subgroup analysis revealed an interesting pattern. There was a statistically significant subgroup effect indicating a lower likelihood of undergoing an episiotomy when assuming a squatting position during childbirth, as opposed to other positions. However, the analysis did not show a significant difference in the rates of 2nd-degree tears and 3rd/4th-degree tears between squatting and other positions. This finding suggests that women who adopt squatting positions during labour might experience a reduced likelihood of undergoing an episiotomy while having no apparent impact on the rates of 2nd, 3rd, or 4th-degree perineal tears. This information is valuable for understanding the potential benefits and risks associated with different birthing positions and their implications for perineal injuries.

It is not uncommon to find divergent evidence on the risk of perineal trauma requiring suturing among women who choose to assume squatting positions during the second stage of labour. Some systematic reviews have findings that align with the conclusions drawn in this chapter, [4, 7, 88, 100] indicating certain trends or effects.

This Chapter assessed the potential benefits of both single and multiple interventions in the context of squatting vaginal births. The secondary interventions reflect a range of evidence-based care practices that might enhance birth outcomes when combined with squatting

positions during childbirth. They are drawn from various sources, including the theoretical assumptions derived from the qualitative synthesis, and existing literature, [4-6] and are supported by several international clinical guidelines. [104-107] Some of the secondary interventions considered included: a support person during labour, [14, 108, 109] the continuity of midwifery-led care, [15, 110] the presence of specialist healthcare providers, [11, 19] various techniques for pushing during the second stage, effective communication strategies, [106] perineal support techniques, and perineal massage. [15, 17, 111, 112]

Notably, these interventions aim to address different aspects of the birthing process, from promoting controlled and gradual foetal head descent to minimizing the risk of perineal trauma. Recently several studies have introduced evidence-based practice packages demonstrating effective results in lower rates of episiotomy and serious lacerations when that implementation. [97, 113-115] Their findings highlight the potential benefits of implementing a multi-intervention approach and further emphasise the value of a comprehensive strategy to reduce perineal trauma. Overall, the study presented in this chapter underscores the complexity of addressing perineal trauma and the potential impact of combining evidence-based practices to improve birth outcomes for women in various positions during childbirth.

The important relationship between the application of secondary interventions and squatting positions during birth concerning PPH >500mls was investigated. The results indicate a positive relationship between implementing specific secondary interventions (such as changing from a squatting position to a horizontal position at the crowning of the foetal head or immediately after birth) and reduced rates of PPH >500mls. This aligns with evidence-based practices aimed at reducing the incidence of PPH in women who assume upright positions during childbirth.

It is noteworthy that the finding of no significant difference in PPH rates between squatting and horizontal positions contradicts some published literature, which suggests that upright positions might lead to higher rates of PPH. [4] The approach of evaluating the interaction between specific secondary practices and primary interventions (squatting positions) provides valuable insights into these contrasting results. This type of analysis allows for a more nuanced understanding of the impact of combined interventions on birth outcomes and is also supported by evidence from other studies. [114, 116, 117] Overall, the findings underscore the significance of evidence-based practices in reducing PPH for women who assume squatting positions during childbirth and highlight the importance of evaluating the combined effects of interventions to provide a more comprehensive perspective on birth outcomes.

6.4.5 Summary Effect Size Adjustment Methodology

The main strength of this study is the utilisation of secondary data through subgroup analyses. Rather than solely providing overall summaries of effect estimates in Chapter 4, the study investigates deeper into considering the influence of various factors that may affect the outcomes. The study expanded the depth and breadth of the investigation, allowing for a more nuanced understanding of the relationships between interventions and birth outcomes. The inclusion of a variety of factors such as squatting type, perineal trauma classification, and interactive effects of co-interventions is a significant advancement. This approach made it possible to explore not only the main relationships but also how these relationships might vary under different circumstances. This not only provides more insights into the interventions' effectiveness but also allows for the identification of potential modifying variables that can influence the outcomes. This approach is consistent with established methodologies used by other researchers in the field. [118-124]

In this study, the often-mentioned problem of conceptual assumptions that are associated between squatting with maternal morbidity (e.g., perineal trauma requiring suturing and PPH ≥ 500mls) [51-54] with contradictory evidence [47, 78, 81, 125] was partially resolved by examining post hoc subgroup analysis. These assessed relationships between primary (i.e., squatting) and secondary interventions that are likely to affect women if implemented during birth. Some authors have proposed that, although post hoc subgroup analyses can lead to spurious findings, they provide a route to theory development that can then be confirmed in future research. [126, 127]

The study addressed conflicting evidence surrounding the relationship between squatting positions and maternal morbidity. Post hoc subgroup analyses can help shed light on why such discrepancies might exist by examining how different factors interact with the primary intervention. This in turn can guide future research by identifying which secondary interventions or modifying variables are crucial for understanding the overall relationship.

The approach to subgroup analysis and interpretation is well-founded and aligned with best practices in meta-analysis, by considering statistical significance, even distribution of trials and participants, plausibility, and importance of subgroup effects. The study's emphasis on detecting and interpreting subgroup differences is particularly valuable since subgroup analyses can provide insights into how interventions interact with different factors and variables to influence outcomes. However, the acknowledgement of the potential for spurious findings in post hoc subgroup analyses means that these findings can serve as a starting point for theory development that should be further confirmed in future research. This is a prudent approach that balances the exploratory nature of subgroup analyses with the need for rigorous validation.

6.4.6 Limitations of the study

The complexity of managing the second stage of labour, combined with the numerous unknown factors influencing birth outcomes, illustrates the multifaceted nature of childbirth-related care. It has been recognised that birth outcomes are the result of a multitude of interacting factors, making it difficult to isolate the effects of a single intervention like squatting positions, which constitute a range of approaches. This complexity can lead to inconsistent evidence and challenges in drawing clear causal relationships. In many cases, successful implementation of interventions in clinical practice requires a comprehensive approach that goes beyond the intervention itself and addresses broader contextual factors, provider attitudes, patient preferences, and more.

Synthesising secondary data was a valuable approach in this research, but it comes with its own set of limitations. The quality of secondary data varied significantly. Some were outdated, and incomplete due to publication limitations. When combining evidence and secondary data, caution is necessary due to the potential for unmeasured confounding factors and biases that can affect the observed outcomes. The lack of detailed information in the most included RCTs about the implementation process during squatting vaginal birth to provide the necessary context for the research questions was pointed out. This can lead to ambiguity in determining the precise impact of squatting positions on the length of birth and other birth outcomes. This implies that some information about the specific circumstances under which the data was collected was lacking, which can limit the interpretation of the findings.

6.4.7 Implications for Clinical Practice

This study shows the importance of using multi-interventions and evidence-based practices to improve birth outcomes for women assuming squatting positions during childbirth. The implementation of a combination of interventions alongside squatting positions can lead to

more positive outcomes, particularly in reducing the length of birth, PPH ≥500mls and perineal trauma requiring suturing. Current studies support the integration of the use of upright positions including squatting with a set of 3 to 5 evidence-based co-interventions such as spontaneous pushing style or encouraging passive 2nd stage of labour and control of the speed of birth at the crowning of the foetal head as a strategic measure improving birth outcomes during childbirth. (114)

Furthermore, the study reveals evidence-based practices that lower the rates of PPH in women adopting upright positions by changing their position from upright to horizontal at the crowning of the baby's head. This strategy is supported by previous research and current RCTs such as Zaibunnisa *et al.* (42) and Moralogiu *et al.,* (8) as well as observational studies. (9, 10) The rationale behind these practices is that changing from an upright to a horizontal position at the time of birth can mitigate the effect of gravity, potentially reducing the risk of excessive bleeding. This approach considers not only the physical mechanics of labour but also the psychological, emotional, and supportive aspects that can influence maternal and neonatal well-being.

6.4.8 Implication for Future Research

Findings regarding the lack of significant subgroup effects on the interaction between squatting and secondary intervention strategies shed light on the importance of healthcare provider expertise and proper implementation of interventions. The empirical evidence highlights that the proficiency of healthcare providers plays a crucial role in determining the effectiveness of interventions such as squatting positions during childbirth. The emphasis on better reporting and adherence to guidelines such as the Consolidated Standards of Reporting Trials (CONSORT) (128)and the Template for Intervention Description and Replication (TIDieR) framework(129) is essential for ensuring the quality of research. Meaningful subgroup

analyses and robust evidence-based conclusions rely on transparent reporting of intervention processes and factors that interact with the primary intervention to influence outcomes.

The confirmation of the lack of education, training, and clinical guidelines (i.e., which was highlighted in Chapter 5) for supporting upright practices, emphasises the need for a comprehensive approach to improving birth outcomes. The suboptimal technical skills and unclear definitions of squatting positions can limit women's choices during childbirth and lead to flawed results in RCTs. Therefore, developing a consensus definition and understanding of squatting positions during childbirth is a valuable step forward. Establishing clear identification, differentiation, and codification of the features of squatting positions can contribute to the validity and reliability of research results. This effort can enhance the accurate implementation and evaluation of interventions in both research and clinical practice.

Four research questions outlined below are proposed for future study. They address crucial aspects of understanding and improving the effectiveness of squatting positions during childbirth. The questions touch on the implementation of interventions, the context in which they are delivered, and the characteristics of the populations they aim to benefit.

6.4.8.1 Effective Intervention Strategy for Engaging Key Stakeholders

What is the most effective intervention strategy for engaging key stakeholders to reduce operative birth and the use of anaesthesia when squatting in the second stage of labour?

This question delves into how healthcare providers, pregnant women, and other stakeholders can be effectively engaged to reduce operative birth and the use of anaesthesia when squatting during the second stage of labour. It is important to identify strategies that can promote proper implementation, adherence, and collaboration among stakeholders to achieve improved birth outcomes.

6.4.8.2 Incorporating Heterogeneous Clinical Practices into RCTs:

How can heterogeneous sets of clinical practices be incorporated into an RCT to test the effectiveness of squatting positions on birth outcomes?

Addressing this question involves finding ways to incorporate the diverse range of clinical practices associated with squatting positions in childbirth into RCTs. These practices are heterogeneous and may interact differently with squatting. Designing RCTs that account for this complexity, while still maintaining rigour and validity, is a challenge that requires careful consideration.

6.4.8.3 Effect of Maternity Setting on Squatting Positions:

Is the effect of squatting position during birth related to the setting where the intervention is delivered (characteristics of maternity setting consisting of midwifery compared with obstetric-led care)?

Investigating whether the effect of squatting positions during birth is influenced by the characteristics of the maternity setting (midwifery-led vs. obstetric-led care) is crucial. Different settings may have varying protocols, resources, and approaches, which could impact the outcomes of using squatting positions. Acknowledging the need for context-specific research is important because practices and cultural norms vary across different regions and settings. Conducting studies in various contexts will strengthen the evidence base and increase confidence in the findings.

6.4.8.4 Effect of Population Characteristics on Squatting Positions

Is the effect of squatting position during birth associated with the characteristics of the targeted population (low or high-risk pregnant women)?

Understanding whether the effect of squatting positions during birth varies based on the characteristics of the targeted population (low or high-risk pregnant women) is essential. Different risk profiles and medical needs could interact with squatting positions differently, potentially influencing birth outcomes.

These research questions reflect the complexities and nuances of implementing and studying interventions like squatting positions during childbirth. Answering these questions could contribute significantly to evidence-based practice, improve birth outcomes, and guide healthcare providers and researchers in making informed decisions about maternity care.

6.5 Conclusion

The subgroup analyses presented here expand our understanding of the effects of maternal positions during childbirth, particularly in the context of squatting positions. By examining various subgroups and their interactions with squatting, the study's findings suggest directions for future research to explore and validate the interactions between squatting positions and various influencing factors. The key points related to these subgroup analyses are:

6.5.1 Theoretical Assumptions

The subgroup analyses were based on both pre-specified theoretical assumptions and post-hoc explorations. This approach allowed the examination of factors and variables that might moderate the effects of squatting positions on different birth outcomes, providing a framework for investigating the complex interactions between squatting and other influencing factors.

6.5.2 Complementing Existing Evidence

The subgroup analyses complement the findings from earlier chapters. They generate hypotheses that could help develop theories about how squatting positions interact with various

aspects of childbirth to impact birth outcomes. These hypotheses could serve as starting points for future research and guide the design of more targeted studies.

6.5.3 Significant Subgroup Effects

The study identified significant subgroup effects on three specific birth outcomes: perineal trauma requiring suturing, the interaction of co-interventions or moderation variables with squatting on PPH ≥ 500mls, and the duration of birth when squatting was introduced at different stages of labour. These findings suggest that certain factors, interventions, or timing may influence the effects of squatting positions during childbirth on these outcomes. However, there are no significant effects on some outcomes, and some variables, such as squatting type, did not modify the effects on specific birth outcomes.

6.5.4 Identification of Moderator Variables

The significant subgroup effects indicate the presence of potential moderator variables that interact with squatting positions to influence birth outcomes. These variables could include factors related to the implementation of interventions, the timing of interventions, the context of care, and the characteristics of the population under study. Identifying these moderator variables is essential for understanding the nuanced impact of squatting positions.

6.5.5 Theory Development and Future Research

The significant subgroup effects and the hypotheses generated through the subgroup analyses contribute to theory development in maternity care. These findings provide directions for future research to explore and validate the interactions between squatting positions and various influencing factors. They also highlight the complexity of childbirth-related care processes and the need for more nuanced investigations.

However, the study findings should be taken with caution due to small group effect sizes and poor reporting of RCTs. The focus now shifts to the next chapter, which investigates into the development of a consensus definition for squatting positions during childbirth. This indicates a commitment to enhancing clarity, standardization, and understanding of the intervention itself, ultimately contributing to more robust research and informed clinical practices.

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CHAPTER 7

Consensus Development Methods

7.0 Consensus Development Methods

7.1 Background

The contents of Chapters 3 and 4 demonstrated that over the years, various modified squatting positions have been used during childbirth across and within countries. Meta-analyses of RCTs on squatting vaginal birth have shown contrasting, fragmented, and weak results due to the dynamics of various institutional philosophies of maternity care. In studies, lack of adequate information and inconsistencies in the descriptive criteria regarding squatting in childbirth hinder the ability of the reviewer to compare and combine their findings. Failure to describe these positions adequately might lead to incorrect use, misuse [(1)] or use of the position by chance, depending on by whom, to whom, how and in what setting the instructions regarding the position are explained. In addition, given the multiplicity of styles and lack of adequate descriptions of squatting methods, Glasziou et al [(1)] state that researchers must state the type of intervention studied, the core active components that have been included, the timing (when the position is used) and the frequency of its use, duration of each use and the total duration of practice. Other issues involve the criteria applied to select the target population, and the clinicians and setting required to ensure that interventions can be performed safely.

7.1.1 Significance of the study

There is global acceptance that the use of upright natural positions including squatting during childbirth is associated with significant benefits, the main one of which is increased rates of normal vaginal birth. [(2-4)] A normal vaginal birth is classified as a quality measure in childbirth; it indicates a birth that has required minimal low-risk interventions (such as vaginal examinations) or no medical interventions (such as operative birth or epidural analgesia), and therefore is of low maternal or neonatal morbidity risk. As a result, various international

evidence-based guidelines have incorporated recommendations regarding the implementation of upright positions during childbirth. [2-4, 6]

Despite continuous research investigating squatting positions in childbirth, an agreed or expert-opinion-based definition of squatting positions has yet to emerge. A clear description is relevant to understand the content of the intervention technique, how it is delivered, by whom and to whom to increase the rate of normal vaginal births. [7-9]

7.1.2 Clarification of the definition of squatting

The two types of elements that are central to a definition are terminologies and parameters of squatting positions during childbirth. Terminological definition outlines a system of practical terms or names used for describing squatting positions, during pregnancy and childbirth. However, this chapter also outlines factors that highlight the parameters that set the conditions for implementation or the scope of squatting positions in childbirth. The parameters are the descriptions of different active components that explicitly define what squatting positions are. Their publication enables replicability and generalisability in clinical practice or subsequent RCTs. The description of squatting that will ensure replication includes the content, intensity, frequency, when applicable and how it is delivered.

Generalisability, also known as external validity, is an important concept in research. It refers to the extent to which the findings of a study can be applied or generalised to a broader population, settings, or conditions than those used in the specific context of the study. In the context of this study, generalisability includes considerations related to the setting, eligibility criteria of participants (pregnant women), and the providers of the interventions.

There is a lack of consensus on both terminologies and parameters that describe squatting positions during childbirth. Consensus methods are widely used in health science to achieve expert agreement, and particularly to establish agreed definitions. [10-14] The research question

to be answered in this chapter is: ‘What are the important key components of the terminologies and parameters of squatting positions in childbirth among women and healthcare professionals?’

7.1.3 Chapter Aims.

The main aim of the work described in this chapter was to develop key terminologies and parameters to describe squatting positions used during labour and birth, using consensus methods in a study that involved postnatal women and health professionals including midwives, obstetricians, and other clinicians.

7.1.4 Chapter Objectives

The objectives of the work explained in this chapter were:

to establish a consensus and expert opinion on the types, characteristics, functions, and key components that defined squatting positions during childbirth; and

to use interactive consensus methods involving experts to reach a consensus and to generate their opinions on the factors that were important for the application of squatting positions during childbirth.

7.2 Methodology

7.2.1 Study Design.

Consensus techniques are methods for forecasting, decision-making and collecting expert opinions to gain projections and expertise when a state of uncertainty exists [15], often regarding undefined components. Furthermore, they synthesise accumulated expert opinion regarding which the evidence alone is insufficient [16] or conflicting information exists. [17-21] They may also be used to examine the appropriate indications for using clinical interventions. They are based partly or largely on the views and experiences of clinicians and others with knowledge

of the subject. (22) Consensus methods are increasingly used to aid in problem-solving and to identify shared priorities among experts. Hence, a consensus opinion from a panel of experts was considered as a first-choice methodology to develop a definition of the squatting position.

7.2.2 Study Methods.

7.2.2.1 The Delphi Method

The Delphi Technique is a method by which judgements on a particular topic can be solicited and collated systematically through the use of a set of carefully designed sequential questionnaires interspersed with summarised information and feedback of opinions derived from earlier responses. [23] The Delphi method is defined as an interactive route through which expert opinions can be obtained. It can be used to reach agreement among experts in cases in which there is uncertainty about the value of different options, and variable clinical practice. [22] This situation is directly relevant to this study. The participants in this project to create a definition did not meet but were sent questionnaires and asked to record their independent views on the definition of squatting positions in childbirth. Like the classic Delphi, the Delphi e-survey method involves the use of an online survey that is implemented via Email. [24] The e-Delphi method was chosen for this study as it was less time-consuming and less costly than the in-person research method would have been.

7.2.2.2 Nominal Group Technique

The NGT is a structured way to generate data from experts during group face-to-face discussions. Delbecq and Van de Ven (1971) [25] suggested that the NGT was superior to the use of informal groups for two reasons. Firstly, informal groups can inhibit members from speaking freely and sharing what may be under-developed ideas. Secondly, informal groups may focus too much on one idea, often one generated early on, and fail to explore the problem

thoroughly. NGTs avoid evaluation and elaboration of ideas during the phase of their generation, thereby allowing more ideas to be expressed.

7.2.3 Population

The use of consensus methods was particularly important in this study to gain more understanding and/or generate consensus statements about the topic through anonymous gathering and synthesis of the knowledge held by geographically scattered experts. [24, 26, 27] Consensus methods require the input of qualified experts who have a deep understanding of the issues. One of the most critical components of consensus development methods is the selection of qualified experts since the output of the study is based on their opinions. [28-30] It was hypothesised that participants suitable for this research were individuals with knowledge of and experience in the field of childbirth, with the capacity and willingness to engage in the inquiry process and to articulate judgements and views. The researcher closely examined and considered the qualifications and experience (clinical and personal) of each study participant. However, before recruitment was commenced, ethical approval was obtained.

7.2.4 Ethical Considerations, Incentives and Access to Participants

Before inviting participants to take part in the study, the researcher MK sought and obtained ethical approval from the UK, NHS Research Ethics Committee (REC). The NHS integrated research application system (IRAS) REC form was considered at a REC hearing on the 28th of July 2014. The process of NGT discussions and the Delphi e-survey were depicted in the IRAS including an ethical approval letter (Appendix 19), eleven research supporting documents (Appendix 20) and a research proposal (Appendix 21). Ethical approval was granted on the 13th of August 2014 by the East of Scotland Research Ethics Service (EoSRES REC1 ref: 14/ES/1048). An electronic letter of informed consent was sent to prospective participants at the point of preliminary contact. Personal financial rewards or any other direct incentive to take

part was not provided to participants. However, indirect incentives (£30 each) of charitable money were allocated to three women for childcare upon completion of the NGT discussion meeting. The eight-hour normal rate of payment for participants working for East Kent NHS Hospitals was initiated as a continuous professional development initiative.

7.2.5 Recruitment process

7.2.5.1 Preparation of a Standardised Nomination Worksheet

It is considered that the participants selected to take part in consensus methods have a direct influence on the validity of the results; hence, the credibility of participants is crucial. [31] Experts should be selected for their contribution to and reputation in the field under study. [32] The nomination worksheet was developed to list relevant categories of experts before specific names were written down [33], to prevent the omission of any important class of experts. [34, 35] The researcher (MK) completed the worksheet, which covered experts from appropriate disciplines and organisations, and service users who were required to answer the research questions. The list was discussed with academic supervisors to ensure the appropriateness and completeness of the classification of the identified experts.

7.2.5.2 Populating the Nomination Worksheet with Names and Status

After the nomination worksheet had been completed, participants were identified in several ways: by checking reference lists of studies included in Chapters 2, 3, 4, and 5; undertaking Google searches and searches of Cochrane Library and PubMed databases on the subject; through the researcher's networks; and with snowballing. Participant categories according to their professional status (e.g., clinician, researcher, policy maker, etc.) or as service users were completed with names of potential experts with their Email addresses and telephone numbers.

A multidisciplinary panel was sought for this study to reflect the full range of key characteristics of the population that might have opinions related to the research question. It

was anticipated that having a range of experts with different points of view might enhance the credibility and acceptance of the developing description of squatting positions. This was important since their opinions would underlie the output of the study. [28-30] Empirical evidence suggests that the development of a decision through the use of consensus methods should involve opinion leaders (decision/policy-makers) who will utilise the findings of the study, [33, 36] authors of research publications on the topic of interest [33, 37, 38] who may wish to test further the findings of the study, healthcare providers with first-hand clinical proficiency with a particular intervention, [22, 39] service users (i.e., pregnant women) whose judgement is sought on the experience and satisfaction of a particular intervention, [33, 40] and representatives of various professional organisations that are interested in the setting of clinical standards about the interventions and the development of evidence-based practice materials for healthcare providers and pregnant women.

7.2.5.3 Targeted population

For this study, the target population was defined as frontline maternity healthcare providers and postnatal women who had experience and knowledge of squatting vaginal birth.

Therefore, in terms of the inclusion criteria, a frontline worker was defined as a person working in any role or having experience that brought them into direct, indirect, or potential contact with the development, provision, or receipt of the intervention under study.

People with direct contact who were eligible to take part were: those with a history of experience in assuming squatting positions during childbirth (postnatal women of any parity, who had undergone high- or low-risk pregnancy, of any ethnicity); or those who were actively involved and experienced in the performance of squatting vaginal births (midwives, obstetricians, doulas and others), skilled or unskilled, clinical or nonclinical, with good or bad experience of the use of squatting positions.

People who had indirect contact were: those responsible for maternity care services, continuous practice development programmes, monitoring and evaluation of care, policy developments and updates, and their input during intrapartum care (i.e., opinion leaders in midwifery and obstetrics); someone involved in producing evidence-based information and conducting research on the effectiveness of squatting positions during childbirth (i.e., researchers and authors of published articles on squatting and upright positions); and those actively involved in education and training in the use of squatting during childbirth (i.e., academics/ lecturers, clinical development providers).

People with potential contact were those involved with professional organisational bodies (e.g. the Royal College of Midwives (RCM), Royal College of Obstetrics & Gynaecology (RCOG), the National Perinatal Epidemiological Unit, NICE, and AWHONN who oversaw or influenced the maternity education, training and examination of midwives, obstetric nurses/midwives, obstetricians and gynaecologists concerning the intervention under study.

Regarding the NGT meetings, the inclusion criteria for the expert panel were those mentioned in the previous section who had had direct contact with the use of squatting positions during childbirth.

7.2.5.4 Initial contacts and snowballing

The researcher developed a list with names and contact information for over 250 experts from across the globe. This range of frontline experts from different countries was determined through a comparison of their expertise in childbirth. The researcher contacted experts identified from the nomination worksheet list and asked them to nominate others (colleagues, family members or friends) who would be interested in taking part in the study. A brief description of the research study was provided, and it was explained to them that they had been identified as experts who could contribute to the study on maternal positions during childbirth.

The collection of the first round of contacts was aimed primarily at extending the nomination worksheet to ensure that as many diverse experts as possible were identified and could be accessed.

7.2.5.5 Experts' status by type

The researcher obtained basic biographical information for each named expert on the list to determine their eligibility to take part in the study. First, two stratified groups of experts were formed: one for the Delphi e-survey and the other for the NGT meetings. Second, different cluster groups of participants were created based on the type of population mentioned above (i.e., related to direct, indirect, or potential contact) to ensure that all levels of expertise were identified. Third, the experiences and lines of work of those on the list of experts were compared and they were ranked in priority for invitation to the study. In some cases, some experts played multiple roles (i.e., one consultant obstetrician was a lecturer and researcher), so an expert could be placed in more than one cluster.

7.2.5.6 Inviting experts to the study

The experts were invited to participate in the study by email, personal contact, or both. Contacted participants were asked to include their demographic details and information on their experience or knowledge of the topic. A maximum of three reminders were sent to non-respondents.

Three midwifery-led and three obstetric-led units under East Kent NHS Hospitals were identified through emails and face-to-face contact with obstetrics and midwifery managers. Administrators working with these NHS hospitals agreed to display advertisements and make public broadcasts to encourage pregnant women to participate in the study. The adverts were distributed in their entrances, wards and waiting rooms.

Regional, national, and international healthcare providers were recruited via email advert. The advert included the aim and objectives of the study and brief instructions on how to take part. Interested participants could contact the researcher via email, telephone or a web-based link, and each was screened for eligibility. A registration form was then e-mailed or orally communicated to participants to assess their eligibility for the study. Eligible and ineligible participants were notified promptly or e-mailed with potential Delphi survey times.

7.2.5.7 Sampling strategy

A purposive sampling technique was used for both the Delphi and NGT methods to select suitable experts to represent a range of different characteristics in their lines of clinical work, knowledge and experience related to the study topic. [22, 35] A purposive sample was necessary to identify the initial group of experts and then to use the snowball sampling technique to generate subsequent participants. This type of sampling was required to assure the generalisability of the study and that the data collected was consistent, reliable, and useful. [41, 42] Purposive sampling is a type of non-probability sampling in which the investigator determines who should be included in the sample based on several characteristics such as subject matter expertise or the ability and desire to engage in the study. [43]

The use of this technique applies principles of maximum variation, which means that vast and varied sampling is used to capture and describe a diversity of opinions and views [44] about the research questions. Maximum variation sampling is undertaken to gather different points of view (i.e., those of postnatal women and those who help them to give birth) that can add to existing knowledge, which is generally provided by those who work in the field (i.e., experts on the definitions of squatting) and can boost the evidence to include the extraordinary.

7.2.5.8 Delphi sample size

The sample size for Delphi studies varies from one study to another and has ranged from six to more than 100 participants. [22, 30, 31] A homogeneous expert sample of small size (participants with similar characteristics or backgrounds) can yield satisfactory results for consensus methods. This sample size ranges typically from a minimum of seven to 35. [45-47] This range is considered appropriate for many Delphi studies, as it enables a sufficiently diverse and expert group to generate meaningful consensus judgements and insights. Dalkey's [46] recommendation that seven be taken as a minimum number of participants is often cited as the lower limit for a Delphi panel. Application of this recommendation can be useful when researchers find it challenging to recruit a larger group of experts or when the topic is relatively focused and can be adequately addressed by a small panel. In this study, it was decided to recruit as many experts as possible until at least 14 to 20 had agreed to participate. This approach aligned with the general recommendation that a panel should comprise 14 to 35 members. This figure is considered suitable to reach valid and reliable consensus judgements. [22]

Two homogeneous samples, one of service users and the other healthcare providers, were selected as they would supply distinct perspectives related to the topic. The goal was to ensure that the Delphi panel was sufficiently representative and knowledgeable to provide valuable insights and reach a meaningful consensus on the research topic. However, the overall opinion was generated using a heterogeneous sample, which means that opinions and input from participants with various backgrounds and characteristics were considered collectively. This approach can be valuable to obtain a well-rounded and inclusive view of the topic, as it considers the diverse viewpoints and expertise of different stakeholders.

7.2.5.9 NGT Sample Size

The objective of using the NGT was to add to, revise and refine the content from the data collected during the first Delphi e-survey. Information from the NGT meetings was used to expand opinions and to generate a revised Delphi questionnaire (the 2nd Delphi e-survey). NGT discussions were employed to gather input, output and opinions from local clinical midwives and postnatal women at East Kent Hospitals University NHS Foundation Trust. The key points related to the conduct of the NGT meeting included consideration of the eligibility criteria, the stratification of the participant groups, the group size and the duration of discussions.

7.2.5.10 Eligibility Criteria

Only participants who had completed the first round Delphi e-survey were eligible to take part in the NGT discussions. This approach ensured that participants in the NGT discussions had already engaged with the Delphi survey, which should have provided them with a foundation of knowledge and opinions on the topic.

7.2.5.11 Stratification of Participant Groups

As in the Delphi study, the participant groups were stratified into two homogeneous groups, one of postnatal women and the other of healthcare professionals (midwives) who were responsible for undergoing and delivering squatting positions. This separation was designed to gather different opinions on the definition of squatting positions from experts and service users, as each group would have distinct perspectives. The diversity in clinical practice and roles across healthcare providers further enriched the discussion.

7.2.5.12 Group Size.

The ideal NGT sample size has been suggested to be between five and 12 participants. [22] This range is considered optimal to ensure active participation and the generation of diverse ideas

while discussions are prevented from becoming unwieldy or uneven. Moreover, it has been stated that there is no advantage in having a larger sample size; in groups of more than 12 people, participation becomes more uneven. [22, 48] Consequently, it was decided at the protocol stage of this study that six participants would be invited for each NGT discussion, but that it would be desirable to invite more than six to attend each NGT discussion. The purpose was to provide a buffer in case of attrition, even though participant drop-out tends to be very low when respondents have verbally committed to participate. [35]

7.2.5.13 Duration of Discussions

Participants were committed to attending for at least four hours of face-to-face discussion. This commitment to a substantial discussion period enabled in-depth exploration of ideas and opinions and increased the likelihood that a consensus would be reached or that valuable insights would be obtained. [22]

7.2.5.14 Generating Consensus

In the final Delphi e-survey round, the preferred and fine-tuned definition was shared with the participants. The definition of consensus for the Delphi e-surveys was based on the participants' rankings of statements with a 1-10-point Likert scale, and it involved the calculation of a weighted mean score for each statement. There is no hand cut-off for the level of agreement in consensus studies. [49] Researchers have defined levels of agreement for consensus methods in several ways, ranging from 51%, [50] through 65.5%, [22] 70%, (51) and 80% [18] to 97% agreement of the ranking scores on a statement. [52] The final consensus definition agreed upon by NGT participants was that the statement must reach at least a minimum mean score of 6 out of 10. This meant that for a statement to be considered as having achieved consensus, on average, participants must have rated it as important (with a mean score of 6 or higher). The Likert scale was used to interpret the participants' responses and to categorise them into three

levels of importance: a mean score of 1-5 was categorised as less important; a mean score of 6-8 as important; and a mean score of 9-10 was categorised as most important.

One of the objectives of this study was to generate various expert opinions on the research topic. This meant that statements rated as less important were to be excluded but could be informative to address areas that required further exploratory research studies. This approach was valuable for synthesising expert opinions and reaching informed conclusions in the study.

This study consisted of two Delphi rounds and NGT discussions. Delphi studies can consist of several rounds [37] that range from one to five depending on the objectives of the study. The pre-specified number of Delphi rounds for this study was one to five. This requirement was based on previous studies that had incorporated both Delphi and NGT discussions. [22, 30, 31] In addition, it has been found that if more than three Delphi rounds are held, there may be a reduced number of responses, [22] and this increases the risk of consensus by chance.

7.2.6 Data Collection and Analysis

The design of the data collection instrument is critical in consensus methods (i.e., Delphi e-survey and NGT meetings). The success of the method is dependent upon the number of questions asked. [22] Hasson et al. [53] suggest that there should be a minimum of six questions. However, there are no clear rules for this. For example, anywhere between five and 34 questions have been asked in different studies. [48] The key necessity is to formulate clear, concise, and unambiguous questions and to provide clear instructions to the participants. Most researchers suggest that three iterations (rounds) are sufficient to collect the information to reach a consensus if the sample is heterogeneous. [20, 22, 54-56] Since the first Delphi e-survey comprised mainly open research questions, up to five questions were asked. These questions guided the study throughout the subsequent phases.

7.2.6.1 Step One – Pilot Study.

The pilot study for the Delphi and NGT research was conducted by the researcher and took place on the 26th of October 2014. The purpose of this pilot study was to test the initial survey research questions and to make any adjustments necessary to improve clarity, length, and overall adequacy before proceeding with the main study. This was performed between 1st November 2014, and 31st August 2015. The pilot study involved three participants: two women who had used squatting positions during childbirth and one midwife. The researcher administered a face-to-face structured questionnaire to these participants.

The pilot study was aimed to assess the research questions that had been initially designed for the Delphi and NGT studies. The goal was to ensure that these questions were clear, concise, and comprehensive. Participants in the pilot study were asked to provide feedback on the questionnaire. This feedback included comments on question length, wording, and overall clarity. Based on the feedback received from the pilot study participants, the researcher made necessary adjustments to the Delphi e-survey. Some questions were revised or rephrased to improve comprehension.

The decision to complement the initial open-ended questionnaire for the 1st Delphi survey with a closed-statement questionnaire is a common approach in Delphi studies. [22] Such a design serves several purposes. Starting with an open-ended questionnaire in the first round enabled participants to express their initial, unfiltered opinions. Open-ended questionnaires can yield a wide range of responses, but their analysis can be time-consuming and complex. By incorporating closed statements, the data collection process could be streamlined. Closed statements can be more engaging for participants because they provide specific options or choices from which participants select their answers. In this study, the use of a structured format simplified the collection and analysis of the data because responses could be quantified and categorised more easily than the answers to the open-ended questions. These statements

enabled the formulation of a clear comparison of participants' views and facilitated the identification of areas of consensus or divergence. Closed statements were designed to cover a range of possible responses, including types, characteristics, and parameters of squatting positions in childbirth. In the subsequent NGT discussions, both open- and closed-ended statement questionnaires were reviewed and refined to expand knowledge on the topic. However, closed-ended statements were directly extracted from available literature by MK.

The transition from open- to closed-ended statements enabled the distillation of diverse inputs into focused and manageable statements. Overall, the pilot study played a crucial role in refining the questions posed for the Delphi and NGT studies, as it ensured that the questions were more effective in gathering the necessary data from participants. This iterative process is common in research to enhance the quality and validity of a study's findings.

7.2.6.2 Step two – Delphi Round 1 (2nd November to 30th December 2014)

The objective of this round was to identify the specific content that would define squatting positions during childbirth with a Delphi Email survey (e-survey). The key activities and procedures during the Delphi e-survey round could be categorised into five phases, as explained below.

The first phase was participant recruitment: participants were contacted through email addresses that had been obtained from international contacts, and local participants were approached through a combination of email and face-to-face contact. Most of the participants were clinical midwives.

The second phase involved the set-up of survey software and survey administration. The researcher utilised the Web-Learn University of Oxford online e-survey software to administer the Delphi surveys.

The third phase covered consent to participate: participants were required to complete online consent forms before they took part in the study. They received a secure link to the web-based survey in their Email, along with detailed information about the research procedures and informed consent instructions. Once they had provided consent, they were directed to complete Delphi Round 1.

The fourth phase covered survey content and format: the Delphi e-survey was conducted via email and comprised four pages. Five open-ended questions were asked regarding squatting positions during childbirth. The e-survey aimed to gather input and divergent opinions from participants regarding definitions, key components and factors that influenced the use of squatting positions during childbirth. These elements were considered important for the development, delivery, and receipt of squatting positions in childbirth. The questions that were asked are listed below:

Definition of Squatting Positions:

Please provide your definition of squatting positions during labour and birth.

Key Elements of Squatting Positions:

List all the key elements that you believe best describe squatting positions during labour and birth. This could include details about how a squatting position is applied, delivery methods, and any relevant equipment.

Barriers to using Squatting Positions:

Identify and list all the factors that you consider vital for hindering the use of squatting positions during labour and birth. This may include obstetric, cultural, personal, organisational, and other factors.

Facilitators for using Squatting Positions:

List all the factors that you believe are the most important in facilitating the use of squatting positions during labour and birth. This could encompass maternity care practices, support from healthcare providers, and women's preferences.

Additional Comments:

Please provide any additional comments or insights you have regarding the use of squatting positions during childbirth. This might include personal experiences, observations, or any other relevant information.

In addition, the e-survey consisted of six closed-ended questions that had been obtained from published literature. The closed-ended statements served as the foundation for defining squatting positions and were rated on a 1-to-10 Likert scale. The Oxford Web-Learn survey software was used to calculate immediately the Weighted mean score for each statement and to group responses. Weighted mean is an average computed by giving different weights to some of the individual values. [57] It represents the average of a given data, but the weighted mean average offers more nuance than the regular average. [57] This feature was helpful for the subsequent analysis of the data, but consensus was not screened at this stage. Participants had the opportunity to review, edit, or add to the preliminary list of definitions. The inclusion of this step ensured that no important viewpoints were overlooked.

Lastly, the fifth phase was the timeframe for completion: participants were given three weeks to respond to the survey. Email reminders were sent ten days and then three days before the closing deadline of each round to encourage participation. Participants who did not respond were removed from the study.

The Delphi Round 1 served as the initial phase of the research, in which experts provided diverse perspectives on the definitions and factors related to squatting positions during childbirth. This phase laid the foundation for subsequent rounds of the Delphi study and the NGT discussions.

7.2.6.3 Step three – Distillation Phase through NGT Discussions (12th January to 9th March 2015)

In this phase, the aim was to bring together selected local members of the expert panel who had participated in Delphi Round 1 to discuss further and refine the results. The procedures and activities that occurred during this phase were participant selection and invitation, plan of structure of NGT meetings, stages of the NGT meetings, discussions and distillation of ideas and ranking of statements, and development of a second Delphi e-survey.

Participants were invited via email three weeks before the scheduled NGT meetings. Each invitation included information and consent leaflets which outlined the purpose of the NGT meeting and what was expected from each participant on the day. The venue selected for the meetings was centrally located and easily accessible, and participants were given options regarding the date of the meeting.

NGT consensus meetings had a different structure than did the Email rounds of the Delphi study. During the NGT meetings, participants were tasked with discussing the results of the first e-Delphi round with their group members. Discussions were open and enabled interactions among participants, which influenced the formation of statements, ranking and conclusions. The goal of these discussions was to generate multiple opinions, to clarify any uncertainties or ambiguities, and to revise responses based on group input. Participants also discussed issues related to feasibility, practicality, and barriers and facilitators that hindered or helped mothers to use squatting positions during childbirth, with a focus on responsiveness to change. Strong

discussions about the research topic were encouraged, to keep all ideas visible and clear, rather than seek consensus.

The NGT discussions followed a structured process consisting of five key stages, as described by Delbecq and Van der Ven. [33]

1. Introduction and explanation: participants introduced themselves, and the facilitator (MK) provided an overview of the study and described the aim, objectives and NGT procedures.
2. Silent generation: each participant received a copy of the first Delphi e-survey results and was given time independently to record their ideas on 3x5cm cards. No discussions took place during this stage.
3. Round-robin listing of ideas without discussion: participants shared their ideas one by one, and these ideas were listed on a flipchart, which was visible to all participants. This continued until all ideas had been listed.
4. Group discussion and clarification of ideas: participants discussed each idea or statement from the flipchart to determine its relevance to the research questions. Questions and input were encouraged, and notes were taken by each participant at this stage. Video recording/audiotaping was done with participant consent.
5. Voting or ranking and ordering of ideas without discussion: before ranking, the group decided on the number of ideas that should be included on the final list (e.g., top ten items). This ensured that participants had all the information they needed before ranking the ideas. Three questions, listed below, were posed to guide participants in their ranking.
    1. "Which of the items listed are most important to achieving the aims of the study and defining squatting positions during birth?" (Scoring 9 to 10)

2. "Which of the items listed are important to achieving the aims of the study and defining squatting positions during birth?" (Scoring 6 to 8.9)
3. "Which of the items listed are less important to achieving the aims of the study and defining the squatting positions?" (Scoring 0-5.9)

Participants were asked to select the top ten items that they considered the most important from the whole list. They assigned scores to these items, with the highest-priority item receiving 10 points and the lowest-priority item receiving one point (indicating less importance). Participants were provided with Post-it notes with instructions to number them 1-10, which enabled them to rank their preferred items. This scoring process allowed participants to rank the items individually in order of priority based on their perspectives and beliefs. They had the opportunity to create domains or categories in which ideas could be grouped. These domains helped to organise and structure the prioritised ideas. The scores of all the statements were read out and written on the flipchart. This stage was the longest but was described as the most interesting by participants; it took four to six hours, depending on the size of the group. The total scores involved the calculation of the weighted mean score (i.e., the total score divided by the number of votes) for each item and consideration of the voting frequency (i.e., the number of participants who voted for each item). The voting results were summarised on a flipchart during break time by MK for review and discussion of the final listings.

During NGT group discussions, all ideas were collated and summarised to enable the group collectively to rank a series of statements. The prioritisation process resulted in a consensus on the importance of recorded ideas or responses that were related to the research question. Participants were encouraged to reflect on their personal experiences and beliefs rather than to consider how others might vote. Each idea was prioritised under the relevant research question. The information gathered through this NGT process was used to generate a revised Delphi questionnaire. This e-survey was completed privately by the participants during the NGT

meeting and served as the survey instrument for the second Delphi round. Overall, the individual ranking and group prioritisation process in the NGT discussions enabled the synthesis of expert opinions and the identification of the most important elements related to squatting positions during childbirth. It helped to structure and refine the research questions for further investigation in the subsequent Delphi round.

7.2.6.4 Final phase – modified Delphi round 2 (9th March to 31st August 2015)

The final phase of the second e-survey was called a modified Delphi e-survey because it contained ideas or opinions that had been generated from a traditional Delphi survey along with those gathered during NGT discussions. The objective of conducting a final (second) Delphi e-survey round was to generate consensus among experts from diverse backgrounds on the core set of statements that were related to the definition of squatting positions during childbirth. Consensus was sought to determine the cut-off values of accepted parameters as well as terminologies that could be used for assessment, delivery, and management of squatting vaginal birth.

All participants who had responded to the first request in the Delphi round 1 were contacted again to participate in this second Delphi exercise. Participants were asked to review and rate the importance of selected items for inclusion in the definitions of squatting positions. Experts were given opportunities to suggest their own choices of items that should be included. If they felt it necessary, they could provide free text comments, suggest additional statements, express agreement or disagreement with proposed opinions, and comment on the wording and comprehension of the statements. However, the participants made very few comments. Two reminder emails were sent to participants who had not responded to the initial request, encouraging their participation in the survey.

7.3 Results

7.3.1 Characteristics of Participants

The study involved an international multidisciplinary panel of experts. A total of 135 participants were eligible, and an e-survey was sent to each. Of these, 56 (41.5% of 135) responded to the Email; of these, 25 had been identified through snowballing. A panel of 56 experts had participated in the Delphi round 1 e-survey; Of these, 23 (41% of 56) agreed to participate in the NGT discussions. The NGT group discussions involved 13 local practising midwives and 10 postnatal women. The final Delphi round 2 e-survey was completed by 36 participants (64.3% of 56), who were from four different countries across two continents. They represented various expert groups, with a variety of years of experience working in academic, research or clinical maternity settings.

Table 20 below provides an overview of the experts who took part in the Delphi and NGT meetings, categorised according to their professional criteria. It shows the number of participants invited, the number who consented to take part in the study and the number that completed each stage. This information gives insights into the engagement of different groups of experts in the study.

Table 20: Classification and number of participants in the study

Classification of Targeted Population	Participants invited into study	Participants who completed Delphi 1	Participants in the NGT discussion	Participants who completed Delphi 2
Postnatal women	22	18 (82%)	10 (46%)	10
Community and home birth midwives	36	9 (14%)	6 (17%)	6
Midwifery-led unit midwives	8	5 (63%)	2 (25%)	2
Labour ward midwives	24	4 (17%)	2 (8.3%)	2
Midwifery team leaders (band 7)	6	4 (67%)	3 (66%)	3
Cochrane reviewers (two were also consultant obstetricians)	5	3 (60%)	-	3
Midwifery researcher	3	2 (67%)	-	1
Midwifery lecturers	11	2 (18%)	-	1
Head of midwifery and Director of nursing/midwifery	6	2 (33%)	-	2
Midwifery matrons	4	2 (50%)	-	2
Consultant midwives	5	2 (40%)	-	1
Specialist risk and guideline midwifery managers	2	2 (100%)	-	2
Additional consultant obstetrician	3	1 (33%)	-	1
Total	135	56 [42% of 135]	23 [41% of 56]	36 [64% of 56]

Table 21 presents the characteristics of the postnatal women who were selected as experts, categorised according to five socio-obstetric factors. The table provides a snapshot of the diversity in terms of age, education levels and career paths among these experts. It highlights that the use of squatting is not limited to a particular maternal age, parity, or pregnancy history. However, all participants were educated to a similar level, which was a limitation of this study.

Table 21: Baseline characteristics of 18 postnatal women participants

Age	
≤ 25 years	1 (6%)
26 – 30 years	4 (22%)
31 – 35 years	8 (44%)
≥ 36	3 (17%)
Missing information	0
Education	
University students	2 (11%)
Bachelor's degree	12 (67%)
Master's degree	1 (6%)
Doctorate degree	3 (17%)
Missing information	0
Parity	
Primigravidea 0	5 (28%)
Multiparity 1 – 4	11 (61%)
Grand-multiparity >5	0
Missing information	2 (11%)
Obstetric factors	
No obstetric complications	10 (56%)
Gestation diabetic	2 (11%)
Previous x1 caesarean section	2 (11%)
Previous x1 traumatic birth	3 (17%)
Missing information	1 (6%)

7.3.2 Phase 1: Round 1 Delphi e-survey

The first Delphi round was conducted between November and December 2014. It accumulated divergent opinions using mainly open-ended questions via an e-survey. The questions are listed in section 7.7.7.2. A total of 263 statements were generated in this round (the postnatal women generated 166 statements and the healthcare providers generated 97 statements, see Appendix 22 and 23).

Table 22 presents the closed-ended statements that were used from published literature that were related to the definition of squatting positions in the context of childbirth, along with the number of healthcare providers and postnatal women who completed the survey and rated the importance of these statements. There was variation in the number of participants who rated each statement, and the importance ratings also varied between the groups.

Table 22: Round 1 literature-based definitions of squatting positions together with free texts from respondents

A list of definitions of squatting from the literature	*Out of 38 professionals rated this statement(s)*	*Out of 18 postnatal women rated this statement(s)*
Statement 1- Supported squatting – a woman rests her body weight on her thighs, placing her sacrum in the hole of the seat (obstetric chair or birth stool or obstetric bed), relieving the weight of her body from her sacrum.	15 (40%)	9 (50%)
Statement 2- Unsupported squatting – a woman's buttocks and thighs support her weight with her knees bent, her feet flat on the bed or floor or in the water pool.	16 (42%)	13 (72%)
Statement 3- Squatting is where the iliac crests move inwards as though the ilium were being squeezed together. The promontory of the sacrum moves downwards and forward, reducing the true conjugate.	13 (34%)	4 (22%)

Statement 4- Squatting is one of the upright sitting positions without using a backrest, or the backrest of the obstetric bed is raised higher than 85 to 90 degrees.	8 (21%)	10 (55%)
Statement 5- Squatting is the birth position which allows the enlargement of the dimensions of the pelvic outlet and enables it to bear down to the most significant advantage.	25 (65%)	11 (61%)
Statement 6 - Squatting is a vertical position with shoulders above the pelvis; thighs are abducted and flexed, which causes a separation of ischial tuberosities and an increase in the pelvic outlet diameter by as much as 28% compared with the recumbent position.	18 (47%)	3 (16%)

7.3.3 Types of squatting positions

Table 23 presents the proportions of the 18 postnatal women who knew each squatting method and who had used the methods during childbirth. Squatting on the floor was highly scored - 15 women (83%) had used it. In contrast, the obstetric bed with squatting with bars or ropes scored the lowest - two women (11%) used this position. This might indicate that women were more aware of squatting on the floor than of other types of squatting positions.

Table 23 also presents the proportions of the 38 clinicians who had experience using the different squatting positions with women in labour. There was a similar score to that for the women regarding squatting on the floor; 28 experts (74%) had knowledge and some experience of supporting women in this position. Squatting in the water pool scored the lowest (nine, 24%) among healthcare providers.

Table 23: Squatting methods known and used among the 56 participants.

Type of squatting positions	Number of Women (n=18)	Number of Healthcare Providers (n= 38)
Squatting on the floor	15 (83%)	28 (74%)
Birthing stool	9 (50%)	20 (53%)
Water pool	7 (39%)	9 (24%)
Birthing ball	6 (33%)	25 (66%)
Obstetric bed	2 (11%)	10 (26%)
Squatting bar/ropes	2 (11%)	23 (61%)
Other	1 (6%)	5 (13%)

7.3.4 Phase 2: NGT discussion meetings

NGT meetings were conducted on a single day between January and March 2015. The four meetings, two of women who had used squatting during childbirth and two of midwives, were conducted sequentially. The first NGT group discussion took place among six postnatal women and lasted for seven hours. For the second NGT women's meeting, six participants were invited to take part but only four attended; the meeting lasted for four hours. These two meetings were held in the common antenatal classroom of Kent and Canterbury Hospital. The next two meetings (the third and fourth NGT meetings) were of midwives. Seven were invited to take part in the third, but eight midwives attended and the meeting lasted eight hours. Seven midwives were invited to take part in the fourth meeting, but five midwives attended; this gathering lasted for five hours. Both clinicians' meetings took place in the postgraduate conference room of the Family Birth Centre at Dover Hospital.

All the written expert ideas from the round 1 e-survey, which totalled 252 statements (166 statements from postnatal women and 96 statements from healthcare participants) were presented to the NGT participants for discussion. The articles from the literature and one midwifery text, from which various definitions of squatting had been obtained, were also distributed to the participants. As a result of the NGT discussions, 189 statements were drawn up that reflected the participants' perspectives. The statements were sorted into ten categories, which were placed under the domains of the definitions of squatting, key components of squatting, acceptability of the squatting position, and factors that influenced the use of squatting positions in childbirth. Seventy-six statements were categorised by the expert participants as less important, important, and most important according to their exact language. Six literature-based definitions of squatting positions were also included in the final survey. These statements formed the Delphi e-survey round 2 (Appendix 24). Furthermore, all images illustrating the different types of squatting positions presented in this chapter were discussed at the NGT meetings.

7.3.5 Phase 3: final modified round 2 Delphi e-survey

The round 2 Delphi e-survey was used to generate a consensus from ideas that had been generated during the NGT sessions. Consensus on the methods associated with the assumption of squatting positions during childbirth was reached by including only the 25 healthcare professionals and 10 postnatal women who responded in round 2. It was hypothesised that the reason for the drop in the number of participants from 56 to 35 was related to a long gap of three months between Delphi rounds 1 and 2. Moreover, the provision of a forbidding list of literature-based squatting definitions (highlighted in Table 25), which was done to reduce research bias, may also have put off participants. A panel of 35 experts was considered an appropriate number to generate consensus.

7.3.6 Reasons for assuming squatting positions.

Table 24 illustrates the reasons why clinicians would recommend the assumption of squatting positions. A prolonged second stage of labour was considered an important reason, yet foetal malposition was not (even though foetal mal-position is a factor that might lead to a long duration of labour or birth). Maternal request and maternal comfort were considered important. The two least important reasons were personal or clinician preference and maternal safety, which did not reach a consensus.

Furthermore, the same table presents the reasons why the women used squatting positions during labour or birth. These women said that they mainly took up squatting because they felt the need to position themselves in that way to push the baby more effectively than they had been able to until that point; they had been pushing for a long time and the baby seemed stuck.

Table 24: Rationale for assuming squatting positions during childbirth.

Reasons for squatting	**Number of Women (n=10)**	**Number of Healthcare Providers (n= 25)**
Prolonged 2nd stage of labour (>60 mins)	9 (90%)	21 (84%)
Maternal request	2 (20%)	17 (68%)
Maternal comfort	1 (10%)	15 (60%)
Mal-foetal positioning	4 (40%)	11 (44%)
Personal preference	2 (20%)	6 (24%)
Maternal safety	5 (50%)	4 (16%)
Other	0 (0%)	2 (1%)

Table 25 presents the scores that were assigned by the NGT participants regarding the importance of the six definitions of squatting that were included in the Round 1 survey and listed earlier. They were scored by 25 healthcare providers and 10 women using Likert-type responses. A consensus was reached on statements 1, 2, 5 and 6, but not on statements 3 and 4. There was a large difference between the scores given to similar statements in Delphi round 1 compared with round 2. Poor scoring of some ideas such as statements 3 and 4, which were obtained from the literature, might illustrate a need for further interpretation of the statements or of total disagreement. All the six statements had similarities and differences. The experts found that they had to analyse and interpret these statements to work out their meaning during the NGT meetings in the context of a clear definition of squatting.

Table 25: Final Delphi e-survey responses of the literature-based definitions of squatting positions

A list of definitions of squatting from the literature	*Scores among 25 professionals' mean score*	*Scores among 10 women*	*Overall weighted mean in measurement figures.*
Statement 1- Supported squatting – a woman rests her body weight on her thighs, placing her bottom (sacrum) in the hole of the seat (obstetric chair or birth stool or obstetric bed), relieving the weight of her body from her bottom (sacrum).	6.0	8.32	7.6 Consensus reached. (important)
Statement 2- Unsupported squatting – a woman's buttocks and thighs support her weight with her knees bent, her feet flat on the bed or floor or in the water pool.	6.5	8.27	7.4 Consensus reached. (important)

Statement 3- Squatting is where the curved part of the top of the hip (i.e., iliac crest) moves inwards as though the upper portion of the hip bone and pelvis (i.e., the ilium) were being squeezed together. The bottom (i.e., sacrum) moves downwards and forward, reducing the upper part of the pelvis (i.e., true conjugate). In summary, the upper part of the birth canal (pelvis brim) is reduced, enlarging slightly the lower part of the birth canal (i.e., transverse and pelvis outlet).	5.6	5.95	5.8 Consensus not reached. (less important)
Statement 4- Squatting is one of the upright sitting positions without using a backrest, or the backrest of the obstetric bed is raised higher than 85 to 90 degrees.	3.9	6.29	5.1 Consensus not reached. (less important)
Statement 5- Squatting is the birth position that allows the enlargement of the measurements of the bottom level of the pelvis bone called the pelvic outlet and enables it to bear down to the most significant advantage.	7.0	7.76	7.4 Consensus reached. (important)
Statement 6 - Squatting is an upright position with shoulders above the pelvis; the movement of the leg coming closer to the abdomen (i.e., thighs are abducted) with knees bent (i.e., flexed = the limit is the calf pushing onto the back of the thigh), which causes a separation of the lower part of the pelvis sitting bone called ischial	6.4	8.64	7.5 Consensus reached. (important)

tuberosities and an increase in the bottom or final level of the pelvis (that baby descends and rotates through during birth) called pelvic outlet diameter by as much as 28% compared with the recumbent position.			

7.3.7 Acceptability of squatting position during childbirth

In round 2, on a scale of one (poor) to 10 (excellent), the ranking of the usefulness of squatting during childbirth was high among the participants and consensus was reached (Table 26, domain 2). The acceptability measure of squatting positions during labour and birth maintained its level of importance from Round 1. One woman who had used squatting stated: '*Squatting was the most successful position for me once I came to the end of the pushing phase*.' Another wrote that there was '*easier delivery than my first (on my back). Instinct was also kicking in and telling me to push back further'*. One participant stated: '*I had mentioned it to a couple of friends as an option when we were talking about their imminent childbirth*.' Another said that although she *'learnt the squat position by accident during my second childbirth experience at home while anxiously waiting for my husband to pick me up and take me to the hospital, I would recommend it 100%.'* This latter statement is interesting because it suggests that women naturally assume squatting or other upright positions if they are left alone, with fewer provider interventions.

The Delphi e-survey ended after Round 2 based on the criteria mentioned above for reaching consensus. In this round, statements were ranked on a Likert scale on the definitions of

squatting positions including terminologies (i.e., types of squatting), definition (i.e. what each type of squatting is and how to squat), characteristics (i.e., squatting-related body motions) and functions of squatting (i.e., physical, psychosocial, and obstetric factors).

Table 26 presents the 13 statements that were ranked as most important; this meant that a consensus was reached, and the ranking showed a mean of ≥9.0. These statements fell under seven domains which were: definition, acceptability of squatting, and five influencing factors. Table 27 presents the 45 statements that were ranked as important and reached consensus (i.e. scores from 6.0 to 8.9). These statements were reported under ten domains, which comprised two definitions of squatting with eight factors that influenced the use of the position. Table 28 presents 18 statements that did not reach a consensus because they were ranked from 1.0 or 10 to 5.9, but expert opinions are shown on the subject. These statements fell under seven domains which comprised of five influencing factors.

Seventeen healthcare providers and six women offered additional supportive ideas about the statements on the definitions of squatting: 19 midwives provided a list of types of squatting positions, and 25 midwives and 10 of the women provided a list of factors that hindered or facilitated the use of squatting in childbirth.

Table 26: Final Delphi: Statements ranked as most important (ranked ≥9.0)

	Health professionals (n=25) (weighted mean scores	Service users (n=10) (weighted mean	Overall mean in measurement ≥ 9.0
Domain 1: Definition of supported or semi-squatting			
1. Supported squatting is when hips come closer to the abdomen at 45 to 90 degrees (i.e., semi-abducting of the hips) while the knees are partially bent (semi-flexing the knees) with a supportive aid to maintain one squat position with assistance and distributing a woman's weight. In this position, the woman is assisted by a person (caregiver, partner, or doula) or equipment such as a birthing stool, water pool, obstetric chair or bed. In semi-squatting, a woman rests her body weight on her thighs, placing her bottom (i.e., sacrum) in the hole of the seat (obstetric chair or birth stool or obstetric bed), relieving the weight of her body from her bottom. One or two legs are raised on a step.	9.2	9.0	9.1
Domain 2: Acceptability of squatting			
2. On a scale of 1 (Poor) to 10 (Excellent), how would you rate the usefulness of squatting position during childbirth?	8.9	9.3	9.0
Domain 3: Maternal factors			
3. Squatting is natural and can be comfortable during pregnancy, labour and birth	8.68	9.4	9.0

4. Maternal preferences and cultural issues should be identified and respected	9.8	8.8	9.0
5. Maternal knowledge of advantages and disadvantages in relation to squatting	9.0	9.6	9.1
Domain 4: Provider factors			
6. Provider's confidence and competence	9.27	9.6	9.4
7. Collaborative multidisciplinary working	9.1	9.2	9.1
8. Negative attitude or lack of medical support	9.1	9.5	9.2
Domain 5: Models of care			
9. Women-centred continuity model of maternity care (i.e., having one midwife or small team of midwives looking after you during pregnancy and labour).	9.7	8.8	9.3
Domain 6: Environmental factors			
10. Home-like environment regardless of the setting	9.09	9.07	9.1
Domain 7: Obstetric factors			
11. Squatting can improve foetal descent through the birth canal	8.6	9.8	9.2
12. Squatting can be an intervention option in anticipation of slow progress of labour or birth	8.45	9.6	9.0
13. Assuming a good squatting position technique	9.6	9.0	9.3

Table 27: Final Delphi: Statements ranked as important (ranked ≥6.0 to 8.9)

		Health professionals (n=25) (weigthed mean scores 1-10)	Service users (n=10) (weighted mean scores 1-10)	Overall mean score ≥ 6 to 8.9
	Domain 1: Definition of unsupported squatting			
1-	Unsupported squatting is when a woman adopts a crouching position, when her weight is off the pelvis with hips come close to the abdomen (i.e., abduction of the hips) and the knees fully bent (flexed) at an angle ≥ 90^0, with feet flat or on tiptoe when pushing on the ground or bed in the passive stage. In this position, the woman's knees are apart while leaning forward with her back well-rounded and bringing her buttocks closer to the heels, whereas the head is facing down between her knees. When squatting, the upper part of the pelvis (i.e., length of the true conjugate) is reduced, while the lower part of the birth canal (i.e., pelvic outlet) is fully open or slightly widens by the descending baby's head. The lowest part of the bottom called the coccyx moves upwards and backwards expanding a little, allowing the enlargement of the anteroposterior and transverse diameters of the pelvic outlet when the baby's head descends through the birth canal. The woman crouches	8.2	8.23	8.2

	intermittently for 2-3 mins during a contraction, for 30 mins to 2 hrs in the 1st stage, & 10 to 30 minutes in the 2nd and 3rd stages of labour, to promote squatting abilities.			
	Domain 2: Definition of partial squatting			
2-	Squatting is when one leg is abducted and flexed, and the other leg is kneeling, which is usually achieved using a footstool, floor or a step. Hyperflexion as well as abducting maternal thighs up into the maternal abdomen simulates the squatting position while the woman's back is flat on to a bed or floor. This is a partial squatting position because the woman's spine is horizontal, not vertical.	5.57	7.5	6.5
	Domain 3: Key components			
3-	When = Pregnancy at 36 to 41 weeks, Dose = 20 minutes 3x a day, Total exposure = minimum of 3 days a week.	9.01	8.14	8.6
4-	When = Early labour, Dose = 20 minutes 3x a day, Total exposure = minimum of 4 hours in 24 hours.	7.5	9.09	8.3

5- When = 1st stage of labour, Dose = 10 to 20 minutes, Total exposure = minimum of 2 or more hours. Frequency of exposure is dependent on individual woman.	8.25	8.27	8.3
6- When = 2nd stage of labour, Dose = 10 to 20 minutes, Total exposure = minimum of 30 mins. Frequency of exposure is dependent on individual woman.	9.0	8.64	8.8
7- When = 3rd stage of labour, Dose = 10 to 30 minutes, Total exposure = minimum of 30 minutes. Frequency of exposure is dependent on individual woman.	4.7	8.27	6.5
8- Outcomes measures, = pregnancy and in early labour, include optimal foetal positioning in the pelvis resulting into optimal angle of the foetal progression through the birth canal, length of early labour, spontaneous vaginal birth, need of induction of labour and mode of birth.	8.9	8.14	8.5
9- Outcomes measures, = 1st stage of labour, including length of labour, mode of birth, the need of pain relief and foetal well-being.	8.3	8.47	8.4

10- Outcomes measures = 2nd stage of labour, including length of birth, mode of birth, intact perineum and perineal trauma requiring suturing, and foetal well-being.	9.1	8.45	8.8
11- Outcomes measure, = 3rd stage of labour, including length of 3rd stage, mode of birth, postpartum haemorrhage, maternal satisfaction with intervention.	5.5	8.44	7.0
Domain 4: Maternal factors			
12- Maternal flexibility (physical capability)	6.5	7.8	7.2
13- Information and advice given by midwives	8.14	8.45	8.9
14- Influence by media e.g., online images)	7.8	6.67	7.2
15- Squatting can promote a feeling of control in women, leading to a good birth experience	7.8	8,27	8.6
16- Supporting persons, e.g., partner, doula, or midwife	9.0	5.4	7.1
17- Frequency for full squat - It can be stressful and difficult for women to maintain an unsupported squatting position through the birth period. Frequency of exposure is dependent on a woman's ability.	7.9	8.6	8.3
18- Targeted population – Inclusions are women classified as low-risk, but there is no contraindication for women with medium or high-risk factors eligible	7.7	9.0	8.4

for a vaginal birth, including previous x1 caesarean section for a vaginal birth, well-controlled gestational diabetes, and low-dose epidural anaesthesia.			
Exclusions are women with:			
19- Deep vein thrombosis or high risk of DVT	8.0	6.0	7.0
20- Pre-term labour,	7.0	7.0	7.0
21- Assisted vaginal birth,	9.0	6.0	8.0
22- Chronic back problems or disc lesions	8.0	6.0	7.0
23- Antepartum haemorrhage	6.0	7.0	6.5
Domain 5: Providers' factors			
24- Respecting women's preferences or freedom of choice	4.5	9.86	7.0
25- Provider's preference	6.5	8.5	7.5
26- Care providers' flexibility	8.7	5.6	7.2
27- Good understanding of the benefits of squatting positions	5.6	9.7	7.7
Domain 6: Organisational factors			
28- Structure of antenatal education on active birth for pregnant women to increase the use of squatting	6.5	9.7	8.1
Domain 7: Models of Care			

29- Midwifery-led care at home, birth centres, hospitals, etc. (facilitates the use of squatting)	8.59	8.4	8.5
30- Obstetric-led care at the hospital	7.0	9.5	8.4
31- Domination of medical model in a consultant-led unit (barrier for using squatting)	7.7	8.7	8.2
Domain 8: Environmental factors			
32- Maternity-led units (MLU) tend to have rooms that are better equipped to facilitate women to give birth in a squatting position	8.59	6.5	7.5
33- Provision of aids or equipment that helps women to use different squatting, e.g., birth stool/balls/floor mats/bean bags/bars or ropes	8.5	8.6	8.6
34- More straightforward to bear down during birth	8.41	9.3	8.9
35- Less medical interventions	6.1	9.4	7.8
36- Some labour wards are very busy	8.2	8.6	8.4
Domain 9: Obstetric factors			
37- Expulsive phase - Squatting allows the use of the correct muscles necessitating bear down.	8.14	8.6	8.1
38- Analgesia - May require less use of pain relief medication and epidural analgesia	7.8	6.2	7.0
Domain 10: Evidence-base practices to minimise adverse events associated with squatting			

39- Promoting partnership in care through effective communication	10.0	6.7	8.4
40- Continuous provision of one-to-one care	9.0	8.7	8.9
41- Physiological pushing technique	8.2	9.1	8.7
42- Requires minimal expulsive force	8.9	8.4	8.5
43- Encouraging passive second stage of labour	7.3	8.7	8.0
44- Freedom of movement	8.2	8.9	8.6
45- Assisting women in finding a bearable squatting position	8.6	9.0	8.8

Table 28: Statements ranked by expert panel as less important (ranked 0.0 to 5.9)

	Health professionals (n=25) (mean scores 1-10)	Service users (n=10) (mean scores 1-10)	Overall weighed mean figure and % > 6
Domain 1: Maternal factors			
1- Culturally, women expect not to give birth in a squatting position but instead feel they should be birthing supported on a bed.	5.48	3.9	4.7
2. Freedom of movement during birth	7.9	3.6	5.3
3- Maternal high BMI (unable to use squatting)	6.0	5.6	5.8

	4- Maternal fatigue/exhaustion in the second stage of labour reducing the use of squatting	5.09	4.5	4.8
	Domain 2: Providers' factors			
5	Lack of support by senior midwifery staff prevents squatting.	5.9	5.6	5.8
6	Being unable to visualise the perineum during birth when squatting may increase the risk of 3rd or 4th-degree vaginal tears.	3.09	6.7	4.9
	Domain 3: Organisational factors			
7	Reviewing and implementing local and national clinical guidelines to increase the use of squatting	3.8	7.09	5.9
	Domain 4: Environmental factors			
8	Labour ward rooms are small and not suitable for squatting.	5.5	4.07	4.9
	Domain 5: Obstetric factors			
9	More likely to have blood loss more significant than 500mls without the need for a blood transfusion if squatting	4.05	5.6	4.8
	Domain 6: The squatting position can be contraindicated for some high-risk women			
10	Vaginal examination	3.0	5.6	4.3
11	Multiple births	4.5	5.5	5.0
12	Symphysis Pubis Dysfunction	4.0	5.6	4.8
13	High Body Mass Index (equal or greater)	1.0	7.1	4.1

14	Previous 3rd or 4th-degree tears	2.5	4.5	3.5
15	Anticipated shoulder dystocia	1.0	5.6	3.3
	Domain 7: Evidence-base practices to minimise adverse events associated with squatting			
16	Hands-on the perineum at the crowning approach	1.8	5.6	4.7
17	Hands off the perineum at the crowning technique	2.3	3.8	3.1
18	Perineal massage using almond oil from 36 gestation weeks	1.4	7.8	4.5

7.3.8 Characteristics of Squatting Positions

The characteristics of each squatting position according to type, key components and factors that influenced its use are summarised in this section.

7.3.8.1 Three Terminologies and Definitions of Squatting Positions

Consensus was achieved on three distinct types of squatting positions, and each was classified as having a different degree of importance by the participants. These were:

(1) full or deep or unsupported squatting,

(2) modified or supported semi-squatting, and

(3) modified partial squatting positions.

All three types have similar requirements in terms of biomechanics (e.g., hyperflexion of the hips), but it was the technique used that affected the measurements of these biomechanical characteristics, which resulted in different classifications of these methods. Each of these squatting positions is described below.

7.3.8.2 **Definition of Full, Deep or Unsupported Squatting Positions**

Various terminologies are used for the full or deep squatting position, which is widely described as a traditional, spontaneous natural squat. It was rated as important with a mean score of 8.9. This type of squat was considered an important and recognised position in the context of childbirth and is listed in Table 27 (domain 1). The definition covers the physical aspects of the posture, the impact on pelvic anatomy, and how this position contributes to the facilitation of the birthing process by creating a more open and accommodating passage for the baby's descent.

7.3.8.3 **Core Features of a Full Squat**

The six core features of unsupported squatting are outlined in this definition.

(1) Hips are unsupported, which permits the buttocks (i.e., sacrum) to flex so that the woman’s weight is lifted off her pelvis, allowing the enlargement of the pelvis to the maximum.

(2) The lumbar spine is bent (i.e., the woman leans forward and has a well-rounded back) or upright (meaning that the third and fifth vertebrae are erect), which allows optimal foetal positioning and engagement.

(3) The hips are hyper-flexed and abducted to enable them to come close to the abdomen.

(4) The knees are fully bent to achieve a flexion angle of 90 degrees or above, and they are placed apart to create space between them.

(5) The woman turns her head downward between her knees.

(6) The feet are placed flat on the floor or tiptoe, while the woman pushes against the floor or a bed in the passive stage of labour.

7.3.8.4 How the Position is Achieved

Figure 54 below illustrates how, in a deep or full squat, the woman's body descends until the top of the thighs falls below the knees (i.e., the knees are higher than the hips). The anterior aspects of the thighs are brought into contact with the chest, the ankles are close to the buttocks, the feet are shoulder-width apart and the woman keeps the position by holding a rope or being supported by a person. In this position, the angle of hip flexion contributes to the full range of motion of the hips, pelvis, spine, and ankle joints, causing the pelvis to tilt in a posterior direction. The thighs and knees are hyper-flexed; hip flexion reaches approximately $\geq$ 90 degrees or more, which brings the bottom closer to the feet. The dorsiflexed position of the ankles is maintained by the feet on tiptoe or flat. The perceived main function of all these characteristics is to bend the baby's body into a cylindrical shape and to narrow the upper part of the pelvis while fully opening the lower part of the pelvis to the maximum. In effect, this lengthens the birth canal.



Figure 54: Images Demonstrating Full or Deep Squatting Positions

7.3.8.5 **Definition of the Supported or Modified Semi-Squatting Positions.**

Semi-squatting is considered a modification of the traditional squatting position, which implies that it is a mechanical not spontaneous position. The definition received the highest ranking for importance, with a mean score of 9.6. The consensus statement on the definition of modified-semi-squatting is found in Table 26, Domain 1. The agreed description of semi-squat clarifies the characteristics of this position during childbirth. The ranking suggests that the participants in this study considered this position to be the most important in the context of childbirth.

Figure 55 shows images that demonstrate this squatting position. The differences between full squatting and semi-squatting were highlighted in this study. It was agreed that in the supported or semi-squat, the woman's weight rests on the thighs rather than the feet, and one or two legs may be raised on a step. In addition, in a supported squat, the woman's feet are much further away from the buttocks than they are in the full squat.

The woman leans forward while her body descends. The hips are placed at a 45-to-90-degree angle to the abdomen and are not as close to the abdomen as they are in the full squat. The knees are semi-flexed (partially bent). This distinguishes semi-squatting from other positions. Some women may have access to a squat bar that is attached to the end of the bed for support, and which helps her them to lean forward and squat over the bed (Figure 55). This position is maintained with assistance, either from a person (partner or doula) and/or equipment such as a birthing stool (Figure 56), water pool, obstetric chair, or bed. It is important to differentiate the parameters of each squatting position and to distinguish a poor from a good squat. Figure 57 shows the woman sitting on her sacrum, which causes pressure on the perineum. This highlights the significance of ensuring that the squatting position is properly executed to avoid discomfort and poor techniques of squatting that might cause harm.

7.3.8.6 Placement of the Sacrum (buttocks)

As the woman squats in this position, her sacrum (the triangular bone at the base of the spine) is positioned in the hole or opening of the seat or bed (Figure 56). This placement of the sacrum is a significant characteristic of the semi-squat that is different from other squat positions. It must be achieved correctly to ensure that pressure on the perineum is relieved (to reduce the likelihood of perineal oedema) and on the sacrum (to allow the lower part of the birth canal, i.e., the pelvic outlet, to open fully or to widen slightly as the baby's head descends). In other words, the woman's weight should be off the sacrum while leaning forward to relieve direct foetal head pressure of the perineal body.

7.3.8.7 Leaning Forward

A woman in a semi-squatting position must lean forward. This position performs a similar function to the crouched position in the full squat as it aligns the baby into an optimal position to enable descent during labour and birth. It also offers benefits such as improved balance and comfort, and it can relieve back pain during labour.



Figure 55: Images Demonstrating Supported Semi- Squatting Positions



Figure 56: Image of a Birthing Stool



Figure 57: Image Demonstrating Inappropriate Sitting on a Birthing Stool

7.3.8.8 Definition of Modified, Partial Squatting Positions

Partial squatting is another modification of the traditional squatting position, it is also defined as a mechanical position. It was rated by the participants in this study as important with a mean score of 6.2, which placed it at a lower ranking than the semi-squat. The participants defined two partial squatting positions, which are explained below. They may be used less often than the full or semi-squatting positions because they are used in cases of labour dystocia, and this limited usage may have affected their ranking scores in the study's findings. Figures 58-60 illustrate partial squatting positions. The purpose, benefits, and variations of these positions are discussed in the context of childbirth, labour dystocia and foetal positioning.

One of the partial squatting definitions involved one leg abducted and flexed while the other leg was kneeling, or the half-squat or knee-squat, in which one knee was more abducted than the other (Figures 58 and 59). The definition of partial squatting is presented in Table 27 domain 2. The other position is like the McRoberts manoeuvre. The statement agreed by the participants explains that the partial squatting position involves hyperflexion (beyond 90 degrees) and abduction of the maternal thighs, bringing them close to the abdomen and chest to simulate a squatting position. However, in the position known as the McRoberts manoeuvre, unlike a traditional squat, the woman's back remains flat on a bed or the floor (Figure 60). The McRoberts manoeuvre is a technique used to alleviate shoulder dystocia during childbirth. It is defined as *'hyperflexion as well as abducting maternal thighs up into the maternal abdomen to simulate a squatting position while the woman's back is flat on a bed or floor.* [(58)] It is called partial squatting because the woman's lumbar spine is horizontal rather than vertical. In this type of partial squatting, the woman's head is positioned between her legs.

7.3.8.9 Descriptions of Partial Squatting

Participants in the study defined partial squatting in a specific manner. It involves one leg being abducted and flexed, while the other leg is kneeling. This position is typically achieved using a footstool, the floor, or a step. According to one participant, *'this position is used when the baby is stuck*'. In other words, this position is often recommended to facilitate foetal descent and engagement through the birth canal, as well as to ensure the correct positioning of the foetal head. The partial squatting position is believed to aid in creating optimal conditions for the birthing process.

Figure 60 introduces another concept known as the 'half-squat' or 'knee-squat'. In this variation, when one hip is flexed, the other hip is more abducted, causing a difference in the positioning of the knees. According to one participant, the half-squat position is often

recommended if labour dystocia is anticipated or diagnosed. The partial squatting position is believed to aid in creating optimal conditions for the birthing process at the cost of maternal discomfort. Therefore, it is maintained for a shorter period than the other squatting positions, depending on the woman's preference and ability.

Figure 58: mage Showing Partial Squat with One Leg



Figure 59: Image Showing Partial Squat with One Leg with a Support Person





Figure 60: Image Showing Partial Squatting on Bed

7.3.9 Definition according to factors that influence the use of squatting during childbirth.

7.3.9.1 Statements that Reached Consensus and those which did not.

The consensus reached in this study revolved around the factors that influenced the utilisation of squatting positions during childbirth, categorised into seven distinct domains: maternal and provider concerns, models of care, environmental, obstetric, organisational, and evidence-based-practice factors. The ideas presented by the expert panel were analysed in terms of their consensus level, and they were categorised into those that reached consensus and those that did not.

7.3.9.2 Factors considered most important for squatting positions.

Table 25 presents five domains with a total of ten ideas that were identified as the most important factors influencing the adoption of squatting positions during childbirth. The consensus among the expert panel was strongest for two maternal, three providers, one model of care, one environmental, and three obstetric factors. These factors scored highly, from 9.0 to 9.5.

7.3.9.3 Factors considered important for squatting positions.

Factors that were agreed to be important by the expert panel numbered 33 and encompassed seven domains. The factors comprised eight maternal, seven provider, three models of care, seven environmental, two obstetric, and six evidence-based-practice influencing factors, and are listed in Table 27. The scoring of these factors ranged from 7.0 to 8.9.

7.3.9.4 Factors that did not reach consensus.

Conversely, the ideas listed in Table 28 did not achieve consensus among the experts. These ideas spanned seven different categories, including maternal, provider, organisational, environmental, and obstetric exclusion criteria, as well as evidence-based practice factors.

Although lacking consensus, these ideas provide valuable insights into the diversity of practice and knowledge among participants regarding squatting positions during childbirth.

7.3.9.5 Targeted population

There was an agreement regarding the population that should be targeted to use squatting positions in childbirth. Table 27 Domain 4 provides a list of inclusion and exclusion criteria for assuming squatting during childbirth. However, there was a lack of consensus on contraindicating factors that were associated with squatting positions, particularly concerning high-risk pregnancies. (see Table 28; Domain 6)

7.3.9.6 Providers that support the use of squatting

Factors that were related to providers that could influence the use of squatting positions were identified in domains 4 of Tables 27 and 28. These factors emphasised the achievement of appropriate education and training, and the confidence and competence of healthcare providers. Junior clinicians might require mentoring and support to develop the necessary skills, while the supply of education and training can enhance familiarity with different techniques for women assuming squatting positions. Consequently, the behaviours of healthcare providers need to be targeted as part of interventions to increase the use of squatting.

7.3.9.7 Additional active components of squatting positions

Domain 3 of Table 27 lists the strategies for the delivery of squatting positions during labour and childbirth. An explicit theory that describes the active components of squatting positions and the mechanisms for delivery of these positions are important factors that can influence the target behaviour. The application of squatting positions can enhance women's comfort, promote effective labour processes, and reduce the incidence of maternal complications.

7.3.9.8 Settings

The agreement was found in Domains 6, 7 and 8 of Table 27 regarding statements about maternity philosophies including environmental factors, models of care, and organisational factors that could either positively or negatively influence the use of squatting positions during childbirth. Additionally, agreed statements on evidence-based practices were recorded in domain 7. These suggested that standardisation of these practices could improve birth outcomes when applied to women assuming squatting positions.

7.3.9.9 Timing of squatting positions

There was an agreement that squatting is more likely to be effective when it is timed appropriately during the processes of pregnancy or childbirth. It was deemed appropriate to consider squatting during pregnancy from 36 gestational weeks onwards, during early labour, 1st, 2nd and 3rd stages of labour. (see Table 27; Domain 3)

7.3.9.10 Duration (dose) of squatting positions

Duration per dose and total duration of squatting exposure were variable relative to the timing of squatting discussed above. The agreed optimal duration of squatting positions during pregnancy, and childbirth ranged from 2 minutes to 2 hours or more. See Table 27 Domain 1 and 3).

7.3.9.10 Outcome measure

There was agreement that the squatting position has a positive effect on various birth outcomes if assumed during pregnancy and childbirth. Numerous outcome measures were considered and are reported in Table 27; Domain 3.

7.4 Discussion

7.4.1 Summary of the main results

This Chapter aimed to explore the opinions of international experts and to reach an agreement regarding the terminologies and parameters relative to types, characteristics, key components, and factors that might influence the use of squatting positions in childbirth. The purpose was to identify the active components of squatting vaginal births that could be replicated and generalised in clinical practice or subsequent RCTs. The objective of this study was unique in its focus on the literature gaps and its demonstration of experts' perspectives on the biological characteristics of each squatting position and between these positions. The opinion-based evidence shows what squatting techniques are, thus providing information for replication in subsequent studies. The final definition, which was accepted by a mean score of 8.9 for full squat, 9.2 for modified semi-squat and 6.5 for partial squat among the participating experts, contains a broad range of components.

Meaningful insights were gained by comparing the terminology definitions with pre-existing definitions. When compared against published literature [58-68] and midwifery textbooks [69, 70], the opinions of the participants in this study showed agreement regarding several features of squatting during childbirth. The participants developed the terminology 'deep' or 'full' to include other terminologies used in the literature, such as 'crouch', 'unsupported', 'unaided' or 'traditional and natural'. [60, 61, 68, 70-74] Similarly, the study identified 'modified' or 'semi' squatting to encompass various terms used in the literature, such as 'parallel', 'half', 'aided', 'partial', 'supported' 'sitting on a stool or ball or chair' 'squat-kneeling' or 'squat-supine squatting'. [60, 74-89] Additional terms that are used to describe squatting in the literature are: standing (unsupported squatting); knee-squat; semi-squat; and modified squatting positions. [60, 74, 75, 77, 79-81, 83] Some positions involve the use of aids to support women's feet, [84, 90] while in

others the feet are not supported. [70, 71, 78, 91] Remarkably, the full squat is recognised as a traditional and natural position, while the other two positions are seen as modifications or variations of traditional squatting positions. This classification and the associated importance ratings may be valuable in guiding clinical practice, research, or decision-making related to maternal positions during childbirth. This information can also be used to better understand the preferences and perspectives of experts and stakeholders in this field. Although the naming of squatting positions is crucial, it should be related to the biomechanical characteristics of the positions.

This study has demonstrated the six main characteristics of squatting positions in childbirth. Three of the characteristics are in line with those described in the literature: crouching of the lumbar spine, hyper-flexing of the thighs and flexing of the knees. Firstly, the top of the spine should be maintained in a vertical or upright position in which the connection of the third and fifth vertebrae is erect. [60, 75, 92] Secondly, the hyperflexion of the woman's thighs and flexing of the knees [76, 78, 93] enables optimal descent of the foetal head. [64, 66, 83, 94-97] Thirdly, the thighs and knees should be flexed at certain degrees. [64, 77] Addressing these features helps with the identification of intervention components, permitting the standardisation of terms as well as the comparison of squatting techniques across studies. Similar observations are reflected in published studies. [98-100]

Moreover, the biomechanical parameters and their classifications that differ between the three types of squatting in childbirth have been demonstrated in this study. These involve the differences in the angles of hip flexion (the angle between trunk and thigh), knee flexion angles (those between the thigh and calf) and ankle dorsiflexion (the angles between the calf and dorsum pedis) in three types of squatting, semi, partial and deep. Full squatting is perceived to show the largest hip, knee, and ankle flexion angles. Likewise, empirical studies in childbirth have shown variants in squatting positions that involve hyperflexion hip, knee, and ankle

flexion in the descent for squatting. [87, 88, 99, 101-103] The classification of these methods offers a pragmatic approach to the evaluation of a woman's squatting abilities during childbirth.

A preliminary framework of the squatting position, categorized by type, key components, target population, and other influencing factors, is presented in Table 29. The strength of this framework lies in its consideration of squatting positions as suitable for practice during pregnancy and childbirth, catering to women with varying obstetric conditions, including both low-risk, medium-risk, and high-risk individuals eligible for vaginal birth in any maternity setting. Additionally, it offers specific recommendations regarding the type and timing of squatting, duration, outcome measures, and other pertinent features relevant to daily practice, service evaluation, and research activities. This information is not only intended to improve the external and internal validity of future research but also has the potential to enhance clinical practice in maternity care.

Table 29: Preliminary framework of squatting position in pregnancy and childbirth from findings of modified Delphi study

Timing of exposure	**Type of exposure**	**Duration of exposure (dose per session in mins)**	**Duration of exposure (total duration)**	**Outcome measures**	**Target population**	**Comments**
Pregnancy ≥ 36 gestation weeks	Full squat	2-3 mins at least 4 times a day	Minimum of 10 mins	• Optimal foetal positioning • Angle of foetal progression in the birth canal • Spontaneous vagina birth, • need of induction and • mode of birth	Any parity Low & high-risk	High risk (squatting without compromising maternal or foetal well-being). Medium risk (managing to squat with their obstetric conditions) Any maternity settings: Home,
	Semi-squat	10-20 mins interval	Minimum of 3 days = 180 mins			
Early labour (as 4 to 36 hours)	Full squat	2-3 mins interval	10 minutes		Any parity Low & high-risk	
	Semi-squat	20 mins interval	Minimum of 4 hrs in 24 hrs			
1st stage of labour (4 to 12 hours)	Full squat	2-3 mins interval	Minimum of 30 mins	• Length of 1st stage • Mode of birth	Any parity	

				• Need analgesia/anaesthesia. • Foetal well-being	Low & high-risk	MLU, OLU, standalone birthing centre.
	Semi-squat	20 mins interval	Minimum of 2 hrs			
2nd stage of labour (30 to 60 mins)	Full squat	2-3 mins interval	Minimum of 30 mins	• Length of 2nd stage • Mode of birth • Intact perineum and perineal trauma • Foetal well-being	Any parity Low & medium risk	Evidence-based practices that might interact with squatting in the 2nd stage to minimum harm were present in table 7.8 domain 6 and 10.
	Semi-squat	20 mins interval	Minimum of 30 mins			
3rd stage of labour (15 to 60 mins)	Full squat	2-3 mins interval	Minimum of 30 mins	• Length of 3rd stage • Mode of birth of placenta & membranes • Post-partum haemorrhage • Maternal satisfaction with intervention	Any parity Low & medium risk	
	Semi-squat	20 mins interval	Minimum of 30 mins			

7.4.2 Strengths and limitations of the study

The study has several strengths that contribute to its significance. The utilisation of consensus development methods, which are recognised within scientific healthcare research, effectively defined the terminologies and parameters of squatting positions during childbirth. The naming and categorisation of squatting positions provided clarity in understanding not only the biomechanical differences among squatting methods but also how these positions might be achieved in childbirth. It is important to note that while the terms for these positions may be like those found in the published literature, the specific categorisation and characteristics of squatting positions were shaped and guided by the perspectives and input of the expert panel. Nonetheless, the feasibility of adopting these methods across diverse maternity settings warrants further exploration.

The main weakness of the study was the potential for selection bias that was associated with the inclusion of a group of experts who shared similar opinions. This is an integral weakness of consensus methodologies. Furthermore, some researchers have criticised Delphi surveys, suggesting that researcher bias can influence the development of themes after the method's brainstorming phase (Round 1). [27, 104] In this study, to mitigate researcher bias, NGT discussions were integrated strategically so that participants in these discussions would analyse the initial Delphi responses. Furthermore, it has been argued that allowing participants to add items to the original list and to comment on the development of individual themes can help to address researcher bias. [104] Incorporation of both quantitative consensus data and qualitative insights enhances the study's trustworthiness and credibility, as advocated by Hasson et al,. [27]

The skewed expert demographics, primarily representing only three European countries and high-income backgrounds, raise questions about the generalisability of the findings to other

cultural contexts. There was limited interest from health- and midwifery-related organisations, which resulted in unequal amounts of input from these stakeholders.

Furthermore, twenty-eight (78%) out of 36 experts in the last Delphi e-survey were recruited from one NHS hospital, while only 8 (22%) out of 36 experts were recruited from other organizations. Recruiting participants mainly from one organisation limited the diversity of perspectives represented in the Delphi panel. Experts from different healthcare settings may have different experiences, perspectives, and practices, which could influence the consensus reached in the Delphi process. Likewise, experts from one organisation may share similar institutional cultures, resources, norms, or biases that could influence their responses and consensus decisions. This implies that while the consensus reached by experts within mainly one institutional setting may be valuable for informing local practices, it may not apply or be generalisable to broader populations or settings with different contexts or healthcare systems. Resolving this limitation requires conducting similar modified Delphi processes with experts from multiple hospitals or other healthcare settings to capture a more diverse range of perspectives and enhance the generalizability of the findings.

Additionally, clinicians and women participants in the study were volunteers, which introduced self-selection bias. [22] All the experts required sufficient English and computer skills to complete the e-surveys. Consequently, relevant people, particularly those from non-English-speaking countries, were underrepresented in the sample. The possibility of selection bias and the need for validation by a larger expert pool are potential areas for improvement.

7.4.3 Implications for clinical practice

7.4.3.1 Developments in the Definition of Squatting Positions

Squatting positions in childbirth have a historical significance. They can be traced back to biblical times when birthing stools or other equipment were used, and they have been modified over the years. [105] In modern obstetrics, the use of the McRoberts manoeuvre as a modified squat position demonstrates that creative advancements in obstetric science can impact childbirth practices. This study has expanded descriptions of the physiological features, and psychological and social health issues, which are crucial for optimising squatting vaginal birth, and it offers a prescription for giving women clear instructions and support in assuming this position in pregnancy and childbirth.

Furthermore, a standardised definition of squatting positions is essential to minimise variability in how the interventions are implemented, allowing evaluation of its rationale, components, and procedures, through clinic audits or surveys. Besides, clinicians could utilise the detailed description of squatting positions in this study to assess its feasibility, suitability, relevance, and potential impact in childbirth and to implement it effectively in real-world settings. Furthermore, reporting squatting positions as illustrated in this study might facilitate an understanding of its mechanism of action, by outlining how the intervention is expected to produce its effects and identify potential causal pathways. However, it would be interesting to know whether different maternity settings might implement squatting methods similar to those demonstrated in the study. This suggests that the contextual differences that influence the application of maternal positions across various healthcare settings should be considered.

7.4.3.2 Regional differences in squatting use

Squatting is becoming increasingly popular in modern childbirth practices among certain European populations (e.g., in France, Germany, Italy and Turkey). [83, 86, 91, 93] Similarly,

squatting holds significance in Asian, African, and Middle Eastern populations due to its cultural relevance in activities beyond childbirth, such as toileting, socialising, working, and religious acts. [106] While a woman might naturally or culturally respond to a particular childbirth position that is most comfortable for her, [76, 77] these positions might not be practically available without proper support, encouragement, and permission from care providers. This emphasises the importance of considering both the comfort and practicality of chosen positions.

7.4.3.3 Providers' Roles and Knowledge

This study highlighted the need for in-depth knowledge of the practice of specific maternal positions. Healthcare providers must practise safely by being knowledgeable and responding appropriately to correct usage, addressing misuse, and being aware of any limitations and potential hazards associated with interventions, including the use of equipment and aids for supporting squatting positions during childbirth. They should be able to assess the appropriateness of these interventions report promptly any concerns through appropriate channels and modify care when necessary to ensure safety. The study is aligned with global healthcare goals such as the Millennium Development Goals. [107] and updated guidelines from the WHO. [4] These goals emphasise the importance of the application of evidence-based information regarding clinical interventions to enhance women's health and well-being. The study's contribution to the development of theoretical and practical evidence-based information is in line with these objectives.

7.4.3.4 Squatting and Obstetric Emergency

This study has revealed that the McRoberts manoeuvre is a mechanical squatting position whereby the thighs are abducted as well as flexed onto maternal abdomen to release the trapped anterior shoulder of the baby. Similarly, it has been urged that in a traditional squatting position

the posterior shoulder of the baby is often pushed over the sacral promontory allowing it to fall into the hollow of the sacrum. [108] By adjusting the mother's posture into a squat position, the shape and angles of her pelvis may provide a better fit for the baby's head shape. [83] This might be due to the changes in pelvic angles and diameters inducing foetal head flexion and anterior rotation, [109] and the forces of gravity and flexibility. [110] Whereby the shoulder or labour dystocia are less likely to get stuck because it can rotate the baby anteriorly.

It is also believed that in the case of shoulder dystocia, manipulative manoeuvres can be performed while the woman is in the squatting position. [111] Reported accounts of deliveries managed in this way describe adequate room along the curve of the sacrum to allow the hand to be inserted up to the wrist. [112, 113] This facilitates manoeuvre to deliver the posterior shoulder or arm in case of shoulder dystocia. The clinician inserts her hand into the vagina making use of the space created by the hollow of the sacrum, flexes the elbow, and sweeps the forearm over the chest to deliver the hand. [111]

7.4.4 Implications for Future Research

7.4.4.1 Postpartum Effect Factors

The study highlights the potential benefits of squatting during labour to enlist the assistance of gravity during foetal descent and to reduce the need for medical interventions. It introduces the concept that shorter durations of labour, optimal foetal positioning, and minimal maternal effort could contribute to the preservation of pelvic floor muscles and the reduction of postpartum discomfort or perineal injury. However, the absence of consensus underlines the complexity of these effects and suggests that further research might be needed to clarify their exact influence on postpartum outcomes.

Reporting a detailed and comprehensive descriptions of squatting vaginal birth in research studies is essential. This transparency enables readers, including researchers, clinicians, and policymakers, to fully understand how the intervention was implemented and allows for critical evaluation of the study's methodology and findings. Transparent reporting also enhances the credibility and trustworthiness of the research, as it enables readers to assess the internal validity and reliability of the study. Transparent reporting of interventions enhances the ethical conduct of research by ensuring that participants are fully informed about the nature of the intervention they are receiving. This promotes informed consent and supports ethical oversight by the research ethics committee. Overall, a clear description or definition of the intervention in research studies is fundamental for ensuring the scientific rigour, reproducibility, interpretability, and ethical conduct of the study. It serves as the foundation upon which researchers can build valid conclusions about the effects of the intervention on the outcomes of interest.

7.4.4.2 Feasibility Study

Before adopting any new squatting methods, a feasibility study should be conducted. This study would assess the viability, practicality, and potential benefits or challenges associated with the implementation of these methods. This step is essential to ensure that new interventions are safe and effective before widespread adoption.

7.4.4.3 Publication and Awareness

Publication of this research is planned. The publication of the findings of this study should increase awareness both nationally and internationally about the development of a consensus definition of squatting positions in childbirth. The aim is to shed light on a topic that lacks a clear blueprint in terms of definitions of maternal positions.

7.5 Conclusion

The modified Delphi e-survey that was conducted as part of this study successfully achieved consensus on 52 statements related to squatting positions during childbirth. The study provides a consensus on three different variations of squatting positions: unsupported, supported, and partial squatting positions. It demonstrates the physical aspects of the posture, the impact on pelvic anatomy and how this position contributes to facilitating the birthing process by creating a more open and accommodating passage for the baby's descent in the birth canal. The study also explains the key mechanisms that promote and inhibit the implementation of squatting during childbirth, highlighting the importance of proper positioning, the role of supportive aids and factors that influence its use in clinical practice.

This study had limitations: it could not address uncertainties about the eligibility of the target population and obstetric factors that could influence the application of squatting positions. Nevertheless, this study represents an important initial step in establishing theoretical clarity through consensus methodology in defining squatting positions during childbirth. It provides a foundation for future research to delve into a comprehensive description of squatting positions and to evaluate the implementation of the agreed-upon definition in practice, education, and RCTs. Further research can contribute to the improvement of the understanding and utilisation of squatting positions in the context of childbirth, ultimately benefiting both healthcare providers and expectant mothers.

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CHAPTER 8

Discussion and Conclusion

8.0 Discussion and Conclusion

8.1 Summary of earlier chapters

In Chapter 1, the concept of evidence-based health care was introduced, with consideration of squatting positions during childbirth. The purpose, objectives and research methods were presented. A thorough and systematic approach was presented regarding the investigation of the effectiveness, biomechanical effects, people's perspectives, and definition of squatting positions during childbirth. The use of various research methods and tools, as well as the consideration of unanswered questions and recommendations, which contributed significantly to the knowledge base in this area, was explained.

Chapter 2 contained an overview of three CSRs. It provided a summary of the effects of upright compared with horizontal positions of mothers on maternal and foetal outcomes during childbirth among women who took or did not take epidural analgesia. Knowledge gaps in the current evidence were identified. The results suggested some benefits when women adopted upright positions during labour and childbirth. However, inconsistencies between studies were highlighted. As a result of these gaps, the overview suggested five new hypotheses, which informed the content of the later chapters.

Chapter 3 synthesised studies of biomechanical characteristics and underlying mechanisms of how squatting influences labour and birth outcomes, compared with other positions. Findings suggested that squatting positions have biomechanical metrics associated with a slight increase in the pelvic dimension, intra-uterine pressure, and intrapartum angle of foetal head progression measurements in the second stage of labour. However, it is uncertain whether these features improve the effectiveness of squatting positions during the second stage of labour on birth outcomes.

In Chapter 4, the potential benefits and harms of squatting were compared with other positions

in the second stage of labour. It contained a report of an SR and meta-analysis based on 37 RCTs and 16 NRSIs. Overall, the duration of birth was significantly shortened by approximately eight minutes in the squatting group versus other positions. A significant reduction in the rates of operative birth and perineal trauma that required suturing was also observed in the squatting group versus other positions. However, there was no difference in the rates of blood loss requiring blood transfusion or in the rates of moderate to severe PPH >1000ml between the squatting and other positions. It was concluded that the use of squatting positions in the second stage of labour was associated with beneficial effects, such as shorter duration of birth, and reduced rates of operative birth and perineal trauma. Furthermore, the need for clear descriptions of squatting interventions in RCTs and NRSIs was indicated.

Chapter 5 described a qualitative SR that addressed people's views and experiences of the barriers to and facilitators of using upright positions in childbirth; this was conducted to complement the evidence emerging from the effectiveness reviews. From 24 qualitative studies, a thematic synthesis was undertaken that resulted in 16 descriptive themes, which were grouped under four analytical themes: recognising different care philosophies, enhancing a positive birth experience, preserving safety, and engaging key stakeholders. The review highlighted that a key barrier to the use of upright positions during childbirth was the medicalisation of childbirth. In contrast, a key facilitator was a midwife-led continuity model of care. It was concluded that a midwife-led model that embraced a woman-centred philosophy could advance the use of upright positions during childbirth.

The purpose of Chapter 6 was to identify moderator variables that interacted with squatting during birth and that had the potential to impact outcomes, to generate hypotheses for consideration in future RCTs. Overall, the findings explained in this chapter suggested that the interaction of squatting during birth by changing from squatting to a horizontal position after crowning reduced the rates of PPH ≥500ml during birth. The data showed a significant

reduction in the duration of labour when the mothers squatted during the active second stage of labour. There was a significant reduction in episiotomy rates compared with the likelihood of sustaining second-degree tears when squatting during birth. Nevertheless, the use of different types of squatting did not modify the effects on the duration of birth, operative birth or perineal trauma that required suturing.

The primary objective of the work described in Chapter 7 was to generate expert consensus and opinion statements on the terminologies and parameters of the definition of squatting vaginal birth using the nominal group technique nested into a Delphi e-survey. There was consensus on three different terminologies for squatting positions – unsupported, supported, and partial squatting. The main parameters of these positions included technical variations such as the depth of flexion of the hips, knees, and ankles, with similar vertical positioning of the lumbar spine and weight of the sacrum but on the thighs or feet. The study also demonstrated various stages of pregnancy and childbirth in which squatting should be applied with respective doses and total durations of exposure. The study suggested key elements that women and healthcare providers consider important when they assume squatting positions during birth. These included the target population, the timing, dose and total duration and outcome measures for consideration of squatting during vaginal birth.

8.2 Implications of the findings of the thesis

Table 30 highlights the pluralistic research approach that was taken in this study. The collective findings of this thesis advance knowledge concerning how research studies are designed and the methodological approaches that underpin the application of squatting positions during the second stage of labour. The work performed for the thesis involved analysis and discussion of several important considerations related to improving the description and consideration of the

effects of squatting position, establishment of education and training, coordinated efforts, and standardisation of practice for delivery of squatting vaginal birth.

The thesis is a comprehensive DPhil study in which various aspects of the effectiveness and implementation of squatting during childbirth have been addressed. A summary of the objectives, research methods, and unanswered questions is presented in each chapter, as well as recommendations for a research protocol (see Table 31).

Table 30: The overall analytical and descriptive data synthesised for the DPhil study.

<table>
<tr><th colspan="5">Overall Empirical Data Included in the DPhil Study</th></tr>
<tr><th colspan="4">Analytical studies</th><th colspan="2">Descriptive studies</th></tr>
<tr><th colspan="4">Examination of aetiology and causal association</th><th>Interpretive approach describing human behaviour</th><th>Opinion based evidence</th></tr>
<tr><td colspan="3">Experimental studies (quantifying the relationship between 2 or more variables; examining effects)</td><td>Observational studies (measures of exposure between 2 or more groups)</td><td>Qualitative studies (views & experiences using any qualitative methods)</td><td>Consensus methods (Delphi e-survey & nominal group technique)</td></tr>
<tr><td rowspan="2">Uncontrolled trials (trials without a control group for comparison)</td><td colspan="2">Controlled trials (trials with a control group for comparison)</td><td rowspan="2">Cohort studies (prospective [PCC] &
retrospective [RCC].
case-control studies [CCS] matched and unmatched.
cross-sectional studies [CSS]</td><td rowspan="2">Research Design: Phenomenology, Grounded Theory, Ethnography, Action research, Case study, Narrative inquiry, Discourse analysis, and Qualitative process evaluation.

Data collection methods: focus groups, interviews, observations, diaries, fieldwork, reflective journals & documents.</td><td>Multi-disciplinary expert participants</td></tr>
<tr><td>Subjects allocated to an intervention or control group but without randomisation</td><td>RCTs (subjects allocated randomly to an intervention or control group)</td><td>Number of experts in the study:
Pilot study = 4
First Delphi = 56
NGT discussions = 23
Final Delphi = 35</td></tr>
<tr><td>Number of uncontrolled trials eligible for the review = none</td><td>Number of controlled studies eligible for the SR = none</td><td>Number of CSRs of RCTs eligible for the overview = 3

Number of RCTs eligible for SR, meta-analysis & subgroup analysis = 37</td><td>Number of observational studies eligible for SRs =
PCC = 12.
RCC = 8.
CCS = 2.
CSS = 8.

Total no. of studies = 30</td><td>Number of qualitative studies eligible for the SR = 22</td><td>Number of primary studies = 1</td></tr>
</table>

Table 31: A sequence of DPhil study objectives and methodological approaches addressing recommendations for future research

Domain	Objectives of each chapter	Research methods	Main findings	Implications to practice
Chapter 2	To generate hypothesis on what is not known about the effectiveness of the upright positions during childbirth	PROSPERO registration, Cochrane standards, R-AMSTAR quality assessment, PRISMA reporting	• A significantly shorter mean duration of 1st and 2nd stages of labour if upright without epidural. • No significant mean difference between positions on the duration of 1st and 2nd stages of labour with epidural. • A significant reduction rate of caesarean section during the 1st stage of labour without epidural if upright, but no significant difference between the 2 groups with epidural. • A significant reduction rate of assisted vaginal birth during the 2nd stage without epidural if upright, but no significant difference between the 2 groups with epidural.	Women without epidural analgesia should be supported in any positions they find comfortable, which can promote but not hinder the physiological progress of labour and birth.
Chapter 3	To assess the biomechanical effects of the squatting position during childbirth.	PROSPERO registration, Cochrane standards; Cochrane ROBINS- 1 Risk	• A significant increase in pelvic transverse diameter reported in 7 studies) if squatting but no significant in 3 studies.	Clinicians should have sufficient knowledge about the biomechanical characteristics of squatting position, to facilitate its application.

		of Bias tool; PRISMA Reporting statement tool	• A significant increase in pelvic outlet diameter reported in 8 studies) if squatting but no significant in 2 studies. • A significant increase in the intra-uterine pressure when squatting compared with lateral and semi-recumbent positions. • A significant increase of angle of foetal head progression with hyperflexion of the hip at 135 degrees	
Chapter 4	To determine the effectiveness of the squatting position during the second stage of labour on maternal and foetal outcomes	PROSPERO registration, MECIR Cochrane standards; Risk of Bias and GRADE tools; TIDieR template; PRISMA reporting	• A significant shorter mean duration of 2nd stage of labour if squatting *(8 minutes shorter)* • A significant reduction rates of perineal trauma requiring suturing if squatting *(5.5% fewer)* • A significant reduction rates of operative births if squatting *(3.0% fewer)* • No significant difference in PPH of 1000mls between the 2 groups. • No significant difference in the need of blood transfusion between the 2 groups. • A significant reduction rates of abnormal FHR pattern if squatting *(4.4% fewer)*	It is not clear whether squatting poses any benefits or risks in childbirth, until prospective research involving squatting in childbirth, require all involved to have the same criteria for the definition and management to ensure validity of the results.

			• No significant difference on the need for admission to NICU between the 2 groups.	
Chapter 5	To explore the views and experiences of women, their families and healthcare providers on delivering and receiving upright/squatting positions during childbirth	Methodological Expectations of Cochrane Intervention Reviews (MECIR) Cochrane standards; Risk of Bias and Grading of Recommendations, Assessment, Development, and Evaluations (GRADE) tool; Effective Practice and Organisation of Care (EPOC) Qualitative Evidence Syntheses protocol & template); Critical Appraisal Skills Programme (CASP) quality assessment tool, Enhancing	**Analytical theme 1: Recognition of different philosophies of maternity care** • Practice shaped by the medication of childbirth. • Practice shaped by midwifery-led care. • Automonous practitioners • Ignoring women's choice **Analytical theme 2: Enhancing a positive birth experience.** • Physiological effects in childbirth • Psychological effects in childbirth • Acknowledging the role of companionship **Analytical theme 3: Preserving safety.** • Safety in a home environment • Appropriateness of upright positions • Approaches to implementation • Potential adverse events • Exposure to upright positions	This QES highlights that a woman-centred approach paves the way for promoting maternal positions other than supine during childbirth.

		Transparency in Reporting the Synthesis Qualitative Research (ENTREQ) reporting.	• Lack of evidence-based clinical guidelines **Analytical theme 4: Engaging key stakeholders** • Informing, engaging, and empowering women • Knowledge and skills development for professionals • Engaging influential stakeholders to initiate behaviour change	
Chapter 6	To identify moderator variables interacting with squatting during birth with the potential to impact different outcomes	Interpretation of subgroup analyses in systematic review tutorial.	• Squatting combined with specific co-interventions reduced the rates of PPH > 500mls. • A significantly shorter duration of 2nd stage of labour was observed during the active phase compared with passive phase, but heterogeneity between studies was no resolved. • Squatting during birth is associated with a greater reduction of episiotomy rates compared to other perineal trauma. • Squatting by type do not modify the effects on the duration and operative births.	This chapter showed the importance of interaction of multi-interventions and evidence-based practices with squatting vaginal birth to improve birth outcomes.

			• No significant subgroup effect when squatting interacted with co-interventions on perineal trauma requiring suturing, operative births and need for analgesia/anaesthesia.	
Chapter 7	To reach a consensus and prioritise statements on the terminologies and parameters of the definition of squatting position and generate key elements that may improve birth outcomes	Modified Delphi study, including NGT nested into 2 Delphi international rounds	**Opinion generated definition of squatting positions:** • **Three classifications** e.g., full, semi-squatting and partial squatting. • **Timing of exposure** i.e., pregnancy from 36 gestation weeks, early, 1st, 2nd and 3rd stages of labour **Duration of exposure (dose) i.e.:** • Pregnancy every 2-10 minutes minimum 3 times a day for 3 days. • Early labour every 2-20 minutes at least for 4 hours • 1st stage of labour every 2-20 for a minimum of 2 hours • 2nd stage of labour every 2-20 minutes for a minimum of 30 minutes • 3rd stage of labour every 2-20 minutes for a minimum of 30 minutes	All components of the intervention (i.e., squatting and control positions) prescriptions should be reported in the methods or adherence to the prescribed intervention in the results. Conducting a cluster RCT with a process evaluation following the Medical Research Council (MRC) framework

			Other factors to be considered: target population, setting, materials, clinicians, barriers and facilitators for the position.	

8.3 Implications for the Characteristics of the Target Population

Empirical evidence continually supports the recommendation that women should adopt any position they find comfortable during childbirth. [1-7] Contrary to this recommendation, the thesis identified inconsistencies in evidence-based publications and international clinical guidelines regarding the adoption of upright positions during childbirth. Factors influencing the use of squatting positions during childbirth are highlighted, including individual pregnancy and medical characteristics, healthcare provider competence, care philosophies, hospital routines, epidural analgesia usage, predicted slow labour, and foetal heart monitoring ability. Maternal preference or comfort is considered secondary to these factors.

The appropriateness of target population characteristics for adopting squatting during birth is emphasised, with the primary aim of producing reliable and reproducible results while minimizing harm and protecting vulnerable individuals. While low-risk women in labour are generally considered suitable for assuming squatting positions, the thesis suggests that contraindications for high-risk women are not absolute due to a lack of evidence. Some studies included in the thesis argue that certain high-risk women, such as those with well-controlled gestational diabetes or planning a vaginal birth after one caesarean section, could still be eligible for assuming upright positions during childbirth. [8, 9] This perspective aligns with broader criteria proposed in certain CSRs, [7] which advocate for the inclusion of various high-risk populations in studies on upright childbirth positions. Likewise, all pregnant women of any parity who are in the second stage of induced or spontaneous labour could be suitable users of any upright position methods. The findings of this thesis suggest that women with Body Mass Index (BMI) >40kg/m^2, Marfan's syndrome, histories of inflammatory joint disease or joint hypermobility syndrome in women with a metal prosthesis should be excluded from this form of vaginal birth, as well as those contra-indicated for vaginal birth. [10-12]

8.4 Implications for Improving the Management of Squatting Vaginal Births.

Sub-optimal reporting of the descriptions of maternal positions, their implementations, and processes to optimise implementation impeded the performance of a meta-analysis of RCTs (see Chapter 4). The review showed that one or a combination of co-intervention practices might improve women's adherence to, and the providers' performance in, the successful use of squatting vaginal birth in RCTs (Chapter 6). Intrapartum co-interventions in the management of the second stage of labour were identified that were aimed at reducing perineal trauma and PPH, particularly when squatting was used as a birthing position. Several care practices for the second stage of labour have been recommended in the international clinical guidelines and the research evidence base. [1-7; 13, 14] Furthermore, some of these practices were found to be essential to influencing the engagement of key stakeholders in the uptake of upright/squatting positions in childbirth (Chapter 5).

8.5 Methodological limitations of systematic reviews

The overall findings of the synthesised evidence should be interpreted with caution because the internal validity of secondary data is considered a limitation. It has been argued that meta-analyses and SRs are often restricted because they involve analysis of secondary data and they are subject to the methodological limitations (e.g., sampling and measurement errors) of the included empirical studies. [15] The current study faced these limitations. The unavailability of data (from eligible studies) due to reporting biases (e.g., publication bias, and selective reporting of outcomes and analyses) and design limitations (i.e., inadequate randomisation, allocation concealment and non-blinding of outcome evaluators) may have caused flaws in the current meta-analytical dataset, despite the measures that were undertaken to minimise their impact. [16] This underlines the fact that the results of SRs are generally restricted by the reporting practices of the research they include. [17]

The included studies lacked high-quality evidence on squatting positions. The key findings were that although squatting may have the potential to improve birth outcomes in low-risk women with very few adverse effects, the existing evidence is insufficient to explain or predict its generalisable benefit. All included RCTs suffered from performance and detection biases, which led to high attrition rates (≥10%) of participants crossing over to the control group. [8, 18-23] This occurrence can result in flawed observed effect estimates. In such studies, contamination bias is predicted, and the sample size in one or both arms of the trial is reduced, which leads to non-statistically significant results when an intention-to-treat analysis is performed. [24, 25] Moreover, this may affect the balance of confounders between the comparative groups in the trial. [26, 27] To resolve these challenges, researchers should carefully consider alternative trial designs, such as cluster RCTs and expertise-based designs, in situations in which blinding, and attrition are significant concerns. The use of such alternative designs can improve the integrity of a study and enhance the reliability of its findings. They are elaborated below.

8.6 Implication for the Application of Woman-Centred Care

The UK National Childbirth Trust [28] and the Action for the Improvement of Maternity Services [29] called for the implementation of women-centred care. Furthermore, the three UK government reports entitled 'Maternity Care in Action', indicated the importance of humanising maternity care services. Since then, several other government reports where stressed the need to reimburse the problems of unnecessary interventions while giving women control over their bodies, e.g., the three C's – Choice, Control and Continuity of care by the Maternity Services Advisory Committee. [30-32] This model of care recognises women's choice and control during pregnancy and childbirth. Winterton Report by the House of Commons Select Health Committee, [33] gave women more control over the decision-making process.

Educating women about their childbirth options is crucial for informed decision-making, and NICE guidance [3] significantly shapes clinical practice by advising healthcare professionals on the best approaches to managing pregnancy and childbirth. This guidance emphasises the benefits of various birthing positions, including squatting, and recommends that women avoid lying flat, opting instead for upright and mobile positions to reduce foetal heart rate abnormalities, episiotomy rates, and improve the birth experience. [3] Effective communication and integration of these recommendations into prenatal care are essential, requiring healthcare providers to be well-trained to discuss these options and address any concerns. Further research, particularly through RCTs, is needed to evaluate the effectiveness and safety of squatting vaginal births. Overall, the implementation of NICE guidance features the importance of personalised, research-informed, and collaborative approaches to prenatal education and childbirth.

The findings from this thesis extend beyond NICE recommendations [3] by advocating for woman-centred care within a flexible antenatal information model to empower women in making informed decisions about upright birthing positions, including squatting. Implementing initiatives like 'midwifery active birth initiatives' during the antenatal period and repeated at the onset of labour is crucial to address individual needs and uncertainties. The thesis proposes multiple strategies: 1) Offering comprehensive antenatal classes that cover different birth positions and their benefits or risks, 2) Facilitating interactive workshops where women can practice various birthing positions with professional guidance, and 3) Enabling peer support groups where experienced mothers share their childbirth experiences, including their use of different birthing positions. These approaches aim to provide consistent information, opportunities for questions, and practical skills, empowering women to make informed choices about their childbirth options.

8.7 Implications for Future Research

The first step to fill the gap in the evidence base is to identify how woman-centred interventions can be implemented to enhance the uptake of upright positions in childbirth. A future segregated mixed-method review is proposed. It would integrate the findings from the qualitative and quantitative evidence syntheses that were generated in this work and would juxtapose them (in a matrix) to look for links, connections, and differences. This was beyond the scope of this project; however, the purpose of such an integration of the quantitative and qualitative findings would be to gain a holistic perspective on how women-centred interventions related to squatting could be implemented in future RCTs. This would identify what, why and how women-centred interventions would match, mismatch, or inform the effectiveness of squatting in quantitative studies.

This work has emphasised the need to conduct robust RCTs, by generating evidence-based squatting protocols and pragmatic study design. The choice of birthing positions and their impact on maternal and neonatal outcomes is a complex and multifaceted issue in maternal care. Hence, a mixed-method study of feasibility integrated with a pilot study is proposed. Such a study would follow the MRC framework. [34] This would ensure that all aspects of the research design conduct and analysis were tested before a large-scale study was performed. A cluster RCT design would be well-suited to address the intricacies of future research on the topic, as it could account for the clustering of practices within healthcare facilities and provide valuable insights that could inform evidence-based care and improve maternal and neonatal outcomes. [35, 36]

A cluster RCT design is particularly relevant in this context for two reasons. Firstly, care practices are often implemented at the hospital or healthcare facility level rather than at the individual patient level. The choice of birthing positions, management protocols for the second stage of labour, and care philosophies are influenced by organisational policies and practices.

Therefore, clusters (hospitals or healthcare facilities) would serve as the unit of randomisation. Secondly, the promotion of birthing positions and normal vaginal birth strategies is influenced by the practices and philosophies of healthcare facilities and their staff. To ensure a fair comparison between different birthing positions, it is crucial to minimise contamination or cross-over of practices between groups.

This thesis provides research questions that future research should address. It highlights the importance of tailoring maternity care practices to the individual needs and circumstances of pregnant women. Section A of Table 32 below shows the research questions that would contribute to more person-centred and equitable maternity care practices regarding squatting positions during childbirth. Section B of the table shows how these research questions would address important aspects of squatting positions during childbirth and their impact on both women and healthcare providers. These research questions underscore the complexity and multifaceted nature of incorporating squatting positions into maternity care. By exploring these aspects, researchers can contribute to a more comprehensive understanding of the implications and feasibility of using squatting positions during childbirth.

Table 32: Proposed research questions with rationale for future research studies

Unanswered research questions	Rationale
Section A – To identify generalisability of the study findings	
How can healthcare providers personalise recommendations regarding squatting positions during childbirth based on an individual woman's characteristics, preferences, and obstetric history?	Personalisation of recommendations can involve a thorough assessment of each woman's medical history, physical capabilities, and preferences. Healthcare providers can use this information to offer guidance on whether squatting positions are suitable for them. This may involve discussions about the potential benefits, harms, and alternatives.
Are there specific screening tools or criteria that can help identify pregnant women who are most likely to benefit from squatting positions during childbirth and who might have contraindications?	Developing screening tools or criteria can assist healthcare providers in making informed recommendations. Research can focus on identifying key factors, such as pelvic anatomy, previous obstetric or medical conditions, or labour progress indicators, that can guide decision-making regarding the use of squatting positions.
What strategies can be employed to ensure that pregnant individuals receive comprehensive information about the potential benefits and harms of squatting positions, allowing them to make informed decisions that align with their unique circumstances and preferences?	Effective communication strategies are essential to ensure that pregnant women are well-informed, by providing an informed choice for them. This might involve providing written materials, one-on-one discussions, and decision aids that outline the advantages and disadvantages of using squatting positions. Tailoring information to an individual's literacy level and language preferences is also crucial.
Are there specific cultural or socio-economic factors that influence the acceptability and feasibility of squatting	Cultural and socio-economic factors can play a significant role in shaping women's preferences and experiences during childbirth. Research can explore these factors and inform healthcare providers about culturally sensitive approaches to discussing and implementing squatting positions, ensuring inclusivity in maternity care.

positions for childbirth among different groups of women, and how can these be considered in clinical practice?	
Section B – To identify the feasibility of the interventions under study	
Have the biological aspects that might modify squatting position responses been excluded?	This question highlights the importance of considering individual variations in physiology and biology that might influence the response to squatting positions. It suggests the need for research that explores how factors such as pelvic anatomy, musculoskeletal health, and hormonal changes during labour might interact or not with squatting positions and their effects on childbirth.
Can women comply with the squatting positions' abilities or activities during childbirth?	This question focuses on the practical aspects of implementing squatting positions. It raises considerations about women's physical capabilities, comfort, and willingness to assume squatting positions during labour. Research in this area can inform the development of strategies to help women use these positions effectively.
Can healthcare providers comply with delivering squatting position requirements?	This question delves into the readiness and ability of healthcare providers to facilitate and support squatting positions during childbirth. It explores whether healthcare professionals have the necessary training, skills, and resources to assist women in using squatting positions and whether there are any barriers to their compliance.
Are likely benefits of squatting methods during birth worth comparing with the potential harms?	This question addresses the critical issue of balancing the potential benefits of squatting positions, such as reduced perineal trauma or shorter labour durations, against any associated harms or costs. Research in this area can help quantify the trade-offs and provide evidence-based guidance for clinical decision-making.

8.8 Implication for Interventions

The experimental groups to be set up in future research on squatting positions during labour should be chosen to focus on varying the types of squatting (full, semi-, or partial), the duration of squatting (continuous or intermittent), and timing (during pregnancy from 36 gestational weeks; first, second or third stage of labour). The semi-recumbent position on the bed is identified as a preferred control arrangement from the evidence that was collected and reviewed for this project. It involves the woman lying on the bed with her legs straight and a slight inclination of the spine (≤30 or 45 degrees), [37, 38] which illustrates biomechanical features that are different from squatting. Other control groups that could be used would undergo labour in supine, lithotomy, or dorsal positions. The use of these control groups would help researchers evaluate the benefits and drawbacks of squatting positions compared with more traditional birthing positions in a controlled and systematic manner.

8.9 Implications for the Application of the TIDieR Framework in Future RCTs

The considerations regarding research project designs and interventions to be studied demonstrate the need for future research to consider recommendations regarding the TIDieR framework. [39] A modified nine-item checklist was developed by MK based on the TIDieR checklist (see Table 33). It is customised to cover issues specific to studies that evaluate squatting vaginal birth. This checklist is intended to ensure that researchers provide clear and comprehensive descriptions of interventions (i.e., squatting compared with semi-recumbent positions), healthcare providers and service users and the implementation processes for the ultimate replicability of the interventions. It is to cover essential domains for reporting interventions, including setting, recipient, provider, procedure, materials, intensity, schedule, and missing information on study interventions. [39] These elements are essential for both research and clinical practice in the field of maternal care. While not validated in this project

due to resource and time constraints, this checklist could be a valuable tool for future studies. A forthcoming study might consider validating the checklist through discussions among researchers, using qualitative methods such as focus groups or the Delphi technique. This collaborative approach could help to refine the checklist for practical use.

Table 33: Proposed framework for reporting squatting during childbirth in RCTs

Maternal positions in childbirth description checklist for RCTs		
Setting	Is it clear where the intervention was delivered?	Yes □ No□
	Hospital Based Midwifery-led unit	Yes □ No□
	Obstetric-led unit	Yes □ No□
	Stand-alone midwifery-led unit	Yes □ No□
	Mixed Obstetric and Midwifery-led unit	Yes □ No□
Recipient	Is it clear who is receiving the intervention?	Yes □ No□
	Low-risk labouring women	Yes □ No□
	Medium risk or other labouring women	Yes □ No□
	Primigravidae	Yes □ No□
	Multigravida (maximum of 5 previous birth)	Yes □ No□
Provider	Is it clear who delivered the intervention?	Yes □ No□
	Small team of midwives (minimum 4 midwives)	Yes □ No□

	Midwives, obstetrician, or other clinicians	Yes □ No□
Procedure	Is the procedure (including the sequencing of the technique) of the intervention sufficiently clear to allow replication?	Yes □ No□
	Full squatting position (a brief description of this position with demonstrations) *Brief description – unsupported squatting crouching position, with the weight of the pelvis while hips abducted and flexed at an angle ≥ 90^0, with feet flat or on tiptoe when pushing on the floor or bed in the passive stage. In this position, the woman's knees are apart while leaning forward with her back well-rounded and bringing her buttocks closer to the heels, whereas the head is facing down between her knees'* Some demonstration images shown in Figure 8.4 of Chapter 8.	Yes □ No□
	Supported squatting position (a brief description of this position with demonstrations) ef description – '*Semi-abducting and flexing of the thighs exceeding 70^0 degrees when using a supportive aid to maintain one squat position with assistance and distribution of a woman's weight. The woman's body descents down sitting on the equipment such as a birthing stool, water pool, obstetric chair or bed', while 'semi flexing the hips and knees by permitting the legs to bend at 90^0 degrees', and 'placing her sacrum in the hole of the seat', 'with lumber spine leaning forward whereby the head is in alignment with semi-flexed knees, with her weight taken by the thighs but off the sacrum ', 'the thighs are in a straight horizontal line parallel to the floor with the top of the knees', placing the feet flat such that the heals come to rest on the floor or equipment and the buttocks are away from the feet.'* (i.e., this definition of squatting is highlighted in Chapter 7).	Yes □ No□

	Semi-recumbent position (a brief description of this position with demonstrations) *Brief description – 'The line between the third and fifth lumbar vertebrae is more horizontal than vertical with the truck tilted backwards at an angle of 30 degrees, that is the elevation of the headrest is at 30^0.'* Demonstrations are to be provided before the study.	Yes □ No□
	Frequency of contractions before randomisation □ 0 □ 2 – 5 minutes □ ≥ 6 minutes	Yes □ /No □ Yes □ /No □ Yes □ /No □
	Duration of contractions before randomisation □ 0– 25 seconds long □ 20 – 40 seconds long □ >40 seconds long	Yes □ /No □ Yes □ /No □ Yes □ /No □
	Non-pharmacological pain relief before randomisation	Yes □ /No □
	Assessment of optimal foetal head positioning before randomisation (abdominal and vaginal examinations)	Yes □ /No □
	Findings of Abdominal Examination Recorded: The measure of symphyseal fundal height ≥ 37 gestation weeks Foetal longitudinal lie Cephalic Presentation	Yes □ /No □ Yes □ /No □

	Foetal engagement 5/5 palpable	Yes □ /No □
	4/5 palpable	Yes □ /No □
	3/5 palpable	Yes □ /No □
	2/5 palpable	Yes □ /No □
	1/5 palpable	Yes □ /No □
	Foetal movement	Yes □ /No □
	Foetal heart sounds	Yes □ /No □
	Any other abdominal finding	Yes □ /No □
	If yes, please state……	Yes □ /No □
	Assessing the positioning of a foetal skull by vaginal examination before randomisation	Yes □ /No □
	Foetal head High/mobile	Yes □ /No □
	Foetal head -2 or -1 above ischial spines	Yes □ /No □
	Foetal head at the ischial spines	Yes □ /No □
	Foetal head +1 or +2 below ischial spines	Yes □ /No □
	Foetal head membranes are intact.	Yes □ /No □
	Any additional findings	Yes □ /No □
	If yes, please state……	Yes □ /No □
	Conclusion of vaginal examination:	
	Foetal head □ fixed or □ mobile	

	Foetal head □ flexed or □ extended	Yes □ /No □
Materials	Are the physical or informational materials used adequately described?	Yes □ No□
	Formal education and training, or other support needed for clinicians	Yes □ No□
	Providing information to a pregnant woman	Yes □ No□
	Effective communication at the onset of labour and 2nd stages of labour between clinicians and women	Yes □ No□
	Defining the boundaries of competence, accessibility of any materials or hand-outs	Yes □ No□
	Clinical policies and procedures to guide midwives in delivering the interventions	Yes □ No□ N/A□
Intensity	Is the dose or duration of individual positioning of the intervention clear?	Yes □ No□ N/A□
	oup 1 – Full squatting – flexible pelvis, sacrum-free vertical lumber spine at least at ≥ 90 degrees (i.e., angle or positioning of the spine to improve the pelvis dimensions) es per session (i.e., Intermittent during contractions may vary – every, please tick all appropriate: □ 2 to 5 minutes □ 6 to 10 minutes □ 10 to 20 minutes □ ≥ 21 minutes	Yes □ No□ N/A□

	A total number of intervals (to measure total dose of squatting) – …… The estimated total amount of squatting exposure …….	
	Group 2 – Supported squatting – flexible pelvis, sacrum free from equipment, vertical lumber spine at least at ≤90 degrees. Option 1 – Assuming supported squatting continuously during the 1st or 2nd or 3rd stages of labour – with and without contractions Option 2 – Assuming supported squatting intermittent during contractions may vary, please tick all appropriate: □ 2 to 5 minutes □ 6 to 10 minutes □ 10 to 20 minutes □ ≥ 21 minutes The total number of intervals – …… The estimated total amount of squatting exposure …….	Yes □ No□ N/A□ Yes □ No□ Yes □ No□ Yes □ No□ Yes □ No□ Yes □ No□
	Group 3 – Semi-recumbent – Fixed pelvis on the bed (elevating the maximum at 30 degrees and can walk to the toilet) Option 1 – Continuous – with and without contractions Option 2 – Intermittent with or without contractions may vary: □ 2 to 5 minutes □ 6 to 10 minutes	Yes □ No□ Yes □ No□ Yes □ No□ Yes □ No□

	□ 10 to 20 minutes □ ≥ 21 minutes The total number of intervals – …… The estimated total amount of semi-recumbent exposure …….	Yes □ No□ Yes □ No□ Yes □ No□
Schedule	Is the schedule (interval, frequency, or timing) of the intervention clear?	Yes □ No□
	Time of commencing of allocated position for all participants at Latent first stage of labour (from ≥8 cm) Passive second stage of labour Active second stage of labour	Yes □ No□ Yes □ No□ Yes □ No□ Yes □ No□
	Time of termination of allocated position for all at the crowning of the foetal head, then change to any horizontal position	Yes □ No□
Patient-Reported Experience and Outcome Measures	Are the patient experience and outcome measured analyses of those receiving the intervention (women's perceptions) reported six weeks after birth?	Yes □ No□
	Scores for the patient-related quality of life are generated from the ability of the individual to function in five dimensions.	Yes □ No□

	Mobility 1. □ No problems walking about 2. □ Some problems walking about 3. □ Confined to bed	
	Pain/discomfort 1. □ No pain or discomfort 2. □ Moderate pain or discomfort 3. □ Extreme pain or discomfort	Yes □ No□
	Self-care 1. □ No problems with self-care 2. □ Some problems washing or dressing 3. □ Unable to wash or dress self	Yes □ No□
	Anxiety/depression 1. □Not anxious or depressed	Yes □ No□

	2. □Moderately anxious or depressed 3. □Extremely anxious or depressed	
	Usual activities (Work, study, housework, leisure activities) 1. □ No problems in performing usual activities 2. □Some problems in performing usual activities 3. □ Unable to perform usual activities Each of the five dimensions used has three levels – no problem, some problems, and major problems – making a total of 243 possible health states, adapted from *Phillips & Thompson (2009)*	Yes □ No□
Missing	Is there anything else missing from the description of the intervention?	Yes □ No□

8.10 Conclusion

The work performed for this thesis has contributed significantly to an improved understanding of the use of squatting positions during the second stage of labour. Through its integration of quantitative and qualitative data, consideration of various perspectives, and performance of statistical and meta-synthesis analyses, the study advances knowledge in this area to inform clinical practice and research. The thesis is organised into chapters that are focused on specific aspects of the topic, such as efficiency, effectiveness, acceptability, appropriateness, and consensus development of the definition of squatting positions. The chapters present detailed analyses and findings that are related to each aspect.

This study illustrates that to enhance the probability of effective intervention, the development of maternal positions (upright and horizontal) should incorporate synthesise all the relevant evidence base, develop appropriate theories, and then test them through feasibility and/or pilot studies before moving on to exploratory and then definitive evaluation. Denying labouring women some upright positions is not an option. However, it is every healthcare professional's responsibility to maximise women's options of upright positions in childbirth by identifying evidence-based practices that are to improve birth outcomes.

This final chapter provides a vision for the preparation of a future cluster RCT on squatting vaginal birth. It is recommended that future research be performed that involves a full-cluster RCT following the MRC framework for the development and evaluation of complex interventions. In addition, the guidance of the TIDieR and CONSORT statement extension frameworks should be followed, integrated with qualitative components to capture stakeholder views and to offer recommendations on squatting and semi-recumbent approaches in various maternity settings.

8.11 References

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APPENDICES

Appendix 1: Included CSRs

1- Gupta JK, Sood A, Hofmeyr GJ, Vogel JP. Position in the second stage of labour for women without epidural anaesthesia. Cochrane Collaboration: Cochrane Database of Systematic Reviews, 2017: Issue 5 Art No: CD002006.pub4, DOI: 101002/14651858; https://doi.org//10.1002/14651858. [cited in April 2017]; https://wwwcochranelibrarycom/.

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Appendix 2: References of excluded CSRs and Cochrane Clinical Answers

1) Cluver C AU: Novikova N AU: Hofmeyr GJ AU: Hall DR TI: Maternal position during caesarean section for preventing maternal and neonatal complications SO: Cochrane Database of Systematic Reviews, 2013 DOI: 10.1002/14651858.CD007623.pub3 US: https://doi.org//10.1002/14651858.

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Appendix 3: Table of Summary findings of meta-analyses with contradicting direction of effect sizes on squatting positions in Gupta et al Cochrane Review:

Outcome	**Intervention: Squatting vs supine**	**Analysis (RR with 95% CI) & N=RCTs & Level of Evidence (very low; low; moderate; high; Not reported (NR)**	**Results**
Episiotomy	Main analysis	0.75 (0.61, 0.92): n of RCTs – 17: Evidence - NR	Significant
	Squatting using birth cushion	0.99 (0.71, 1.36): n of RCTs – 1: Evidence – NR	Non-significant
	Squatting using birth stool	0.88 (0.72, 0.92): n of RCTs – 7: Evidence – NR	Significant
	Squatting using birth chair	0.82 (0.68, 0.99): n of RCTs – 5: Evidence – NR	Significant
Second degree tears	Main analysis	1.20 (1.00, 1.44): n of RCTs – 18: Evidence – Low	Significant
	Squatting using birth cushion	0.72 (0.54, 0.97: n of RCTs – 2: Evidence – NR	Non- significant
	Squatting using birth stool	1.34 (0.79, 2.27): n of RCTs – 7: Evidence – NR	Non- significant
	Squatting using birth chair	1.37 (1.18, 1.59): n of RCTs – 5: Evidence – NR	Significant
Duration of Second stage of labour	Main analysis	MD -6.16 (-9.74, -2.59): n of RCTs – 19: Evidence- very low	Significant
	Squatting using birth cushion	MD -10.64 (-20.15, -1.12): n of RCTs – 3: Evidence- NR	Significant
	Squatting using birth stool	MD -0.57 (-3.83, 2.68): n of RCTs – 4: Evidence- NR	
	Squatting using birth chair	MD -2.63 (-7.03, 1.77): n of RCTs – 9: Evidence- NR	Non- significant
			Non- significant
Assisted births	Main analysis	0.75 (0.66, 0.86): n of RCTs – 21: evidence – Moderate	Significant
	Squatting using birth cushion	0.50 (0.32, 0.78): n of RCTs – 2: evidence – NR	Significant
	Squatting using birth stool	0.77 (0.58, 1.01): n of RCTs – 8: evidence – NR	Non- significant
	Squatting using birth chair	0.91 (0.643, 1.30): n of RCTs – 8: evidence – NR	Non- significant
Blood loss >500mls	Main analysis	1.48 (1.10, 1.98): n of RCTs – 15: Evidence – Moderate	Significant
	Squatting using birth cushion	1.00 (0.58, 1.88): n of RCTs – 2: Evidence – NR	Non-significant
	Squatting using birth stool	1.54 (1.05, 2.26): n of RCTs – 7: Evidence – NR	Significant
	Squatting using birth chair	1.48 (0.83, 2.38): n of RCTs – 4: Evidence – NR	Non-significant

Appendix 4: Studies excluded from this Review:

1. Mendez-Bauer C AJ GRC, Menendez A, Lavilla M, Izquierdo F et al. Effects of standing position on spontaeous uterine contractility and other aspects of labor. Journal of Perinatal Medicine. 1975;3:89-100. Exclude standing with supine

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Appendix 5: Table of the Risk of Bias using (ROBINS-I) assessment tool

STUDY ID & YEAR OF PUBLICATION	SELECTION BIAS (BASED ON RANDOMISATION AND ALLOCATION CONCELLMENT)	CONFOUNDING BIAS (COMPARABILITY OF COHORTS ON THE BASIS OF THE DESIGN OR ANALYSIS)	CLASSIFICATION OF INTERVENTION BIAS (TYPE, DURATION, DEFINITION(S), INTENSITY, TIMING)	CLASSIFICATION OF INTERVENTION BIAS (CO-INTERVENTION – GUIDELINE, EDUCATION, TRAINING AND CLINICAL EXPERIENCE
1.BUHIMSCHI 2001	Prospective Cohort Study Each participant was her own control (NRS) Each participant was her own control. Serious risk of bias	Objective measurement tool IUP measured with sensor-tip catheter connected to a recording of contractions for 15 minutes. Moderate Risk of Bias	McRoberts manoeuvre was defined as a sharp flexion of a woman's hips (hyper-flexed) by 135 degrees, while dorsal was defined as legs placed in stirrups flexed at 90 degrees. Moderate Risk of Bias	No information Unclear Risk of Bias
2.DESSEAUVRE 2019	Prospective Cross-over section study Each participant serves as her own control (non-randomised) Serious risk of bias	Objective measurement tool – average parameters for the pelvis, lumbar spine and thighs on hip flexion, hip abduction, lumber curve. Moderate Risk of Bias	Squatting birth position that are tiptoes and with feet flat. Unclear Risk of Bias	No information Unclear Risk of Bias
DESSEAUVRE 2019	Prospective Cohort Study: convenient sampling	Optoelectronic system and lumber curve measure system, Modified jobbins's extensometer, Epionics SPINE system Moderate Risk of Bias	The effect of hip flexion and abduction on the flexion of the pelvic inlet plane (pelvic inlet/spine angle) and on the lordosis. Optimal position is for which the pelvic inlet forms an angle of 90 degrees with the spine, with a lumbar curve of 0 degree. static supine position (5 seconds of data acquisition) with different angles of hip flexion (0°/30°/60°/90°/110°/ maximum hip flexion) and abduction	No information Unclear Risk of Bias

			(30°/60°/maximum hip abduction) Moderate Risk of Bias	
3.GHERNMAN 2000	Prospective Cohort study: Convenient sampling, consecutive women eligible for the study (NRS) Serious risk of bias	Objective measurement tool X-ray Pelvimetry Moderate Risk of Bias	McRoberts' position was defined as hyper-flexing of the woman's legs by 45 degrees. Unclear Risk of Bias	No information Unclear Risk of Bias
4.GUPTA 1991	Cross-over prospective study; (NRS) Each participant serving as their own control. Serious Risk of Bias	Objective measurement tool Xray reports Moderate Risk of Bias	The 'full' squat position defined as supporting the body weight by hyper-flexing the hips and knees on flatly positioned feet such that the heels come to rest on the ground as opposed to the partial squat, where the body weight is taken by the balls of the feet. Squatting on a purpose-built stool with horizontal bars on upright supports, but weight bearing was through the legs. The image of squatting was provided in the article. Moderate Risk of Bias	No information Unclear Risk of Bias
5.HEMMERICH 2018 (A)	Cohort Prospective; Study Groups Selected from Same Population Serious Risk of Bias	Objective measurement – MRI Xray Moderate Risk of Bias	Squatting was defined as deep squat position with hip flexed and buttocks resting on heels, the woman in labour would rest for approximately two seconds using either sling hanging from the ceiling or stability bar to help support herself. Moderate information about description of intervention was provided. Moderate Risk of Bias	No information Unclear Risk of Bias

6.HEMMERIC 2018 (B)	Cohort Prospective; NRS Convenient sampling, Serious Risk of Bias	Objective measurement – MRI Xray report Moderate Risk of Bias	Moderate information about description of intervention was provided. Moderate Risk of Bias	No information Unclear Risk of Bias
7.HEMMERIC 2019	Cohort Prospective: NRS, Convenient sampling, Serious Risk of Bias	Objective measurement – MRI Xray reports Moderate Risk of Bias	Intervention status was moderately defined. Moderate Risk of Bias	No information Unclear Risk of Bias
8.LILFORD 1989	Cross-over section; NRS; Each participant serving as own control Convenient sampling, Serious Risk of Bais	Objective measurement tool – Firm Xray reports Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
9.MICHEL 2002	Cross-over sectional study; NRS; participants serving as their own control. Serious Risk of Bias	Objective measurement tool – MRI Xray reports Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
10.REITTER 2014	Cross-over sectional study; Non-randomised; Convenient sampling, Serious Risk of Bias	Objective measurement tool – MRI Xray reports Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
11. ROBERTS 1980	No information Unclear Risk of Bias	IUP was measured using a vaginal balloon. Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
D12.RUSSELL 1969	Cross-over sectional study; NRS; participants serving as their own control; Convenient sampling, Serious Risk of Bias	Pelvic measurements Objective measurement tool Xray reports. Moderate Risk of Bias	Supine position was defined as lying flat while squatting was defined as sitting while leaning forward with the thighs abducted as well as flexed. Moderate Risk of Bias	No information Unclear Risk of Bias
Zimerman et al (2018)	Observational study Serious Risk of Bias	Intrapartum angle of progression (assessment of the foetal head descent (head direction angle of	McRoberts Manoeuvre is defined as tension and movement at the sacroiliac joints with maternal hip flexion results	No information Unclear Risk of Bias

		middle line & progression distance) during the second stage of labour. Moderate Risk of Bias	in posterior pelvic tilt and cephalad displacement (hip hyperflexion at 135^0 degree) Hip extended = -10^0 degree. Lying flat = 0^0 degree. Knee flexed = 45^0 degree Moderate Risk of Bias	

Appendix 6: Assessing the Risk of Bias using (ROBINS-I) assessment tool

STUDY ID	DEVIATIONS FROM INTENDED INTERVENTION BIAS IN ABILITY TO BLIND WOMEN AND CLINICAL STAFF FROM INTERVENTION (PERFORMANCE BIAS) BUT THEIR IMPACT ON THE OUTCOME IS EXPECTED TO BE SLIGHT.	MISSING DATA BIAS ATTRITION BIAS (WITHDRAWAL, DROPOUTS, PROTOCOL DEVIATIONS)	SELECTION OF THE REPORTING RESULTS BIAS (EVIDENCE OF PRE-REGISTERED PROTOCOL TO EXAMINE REPORTED OUTCOME CORRESPOND TO INTENDED OUTCOMES, ANALYSIS AND SUBGROUPS)	MEASUREMENT OF OUTCOME BIAS BLINDING OF OUTCOME ASSESSOR (DETECTION BIAS)	OTHER BIASES (SAMPLE SIZE CALCULATION)
1.BUHIMSCHI 2001	Serious Risk of Bias	No withdrawals were reported Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
2.DESSEAUVRE 2019	Serious Risk of Bias	No withdrawals were reported Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias.	No information Unclear Risk of Bias
3.DESSEAUVRE 2019	Serious Risk of Bias	No withdrawals were reported Moderate Risk of Bias	Full protocol is available Moderate Risk of Bias	No information Unclear Risk of Bias	Sample size calculation Moderate Risk of Bias
4.GHERNMAN 2000	Obstetric providers were masked Moderate Risk of Bias	2 post withdrawals due to inability to assess the pelvic Moderate Risk of Bias	No information Unclear Risk of Bias	Obstetric providers were blinded to results of pelvimetry Moderate Risk of Bias	No information Unclear Risk of Bias
5.GUPTA 1991	Serious Risk of Bias	No loss to follow up Moderate Risk of Bias	No information Unclear Risk of Bias	Out of 4 assessors, 3 were blinded Moderate Risk of Bias	No information Unclear Risk of Bias
6.HEMMERICH 2018(A)	Serious Risk of Bias	No loss to follow up	No information	No information	No information

		Moderate Risk of Bias	Unclear Risk of Bias	Unclear Risk of Bias	Unclear Risk of Bias
7.HEMMERICH 2018(B)	Serious Risk of Bias	No loss to follow up Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
9.HEMMERICH 2019	Serious Risk of Bias	No loss to follow up Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
10.LILFORD 1989	Serious Risk of Bias	No loss to follow up Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
11.MICHEL 2002	Serious Risk of Bias	No loss to follow up Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
10.REITTER 2014	Serious Risk of Bias	No loss to follow up Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
12. ROBERTS 1908	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
13.RUSSELL 1969	Serious Risk of Bias	No loss to follow up Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias
14.ZIMERMAN 2018	Serious Risk of Bias	No loss to follow up Moderate Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias	No information Unclear Risk of Bias

Appendix 7: Table of Characteristics of included RCTs

Comparison: Squatting positions during the second stage of labour without epidural analgesia.

Settings: Brazil, Finland, India, Iran, New Zealand, Nova Scotia, Pakistan, Palestine, Sweden, South Africa, Taiwan, Turkey, United Kingdom (UK) and United States of America (USA)

AUTHOR AND YEAR OF PUBLICATION	INTERVENTIONS (STUDY & CONTROL GROUPS)	INCLUSION & EXCLUSION CRITERIA;	TYPE AND DATES OF STUDY; COUNTRY OF ORIGIN;	DESCRIPTION OF THE INTERVENTION	OUTCOMES	NUMBER OF PARTICIPANTS &PARITY
1. Allahbadia 1992; India	Squat on delivery bed vs Supine	Inclusion: All women had full term (37 weeks completed) gestation; adequate pelvis; vertex presentation. Exclusions: medical, surgical or obstetric complications.	RCT, January 1990 to December 1990;	Brief name: physiological position with adduction and flexion of the hip causing the separation of ischial tuberosities and increase in the bituberous diameter, gravity aids the expulsive efforts, placental transfusion and prevents supine hypotension syndrome. Why: birth is easier for women in squatting position due to expulsive direction and same muscle used for defaecation are used for expulsive of the foetus. Enlarges the dimensions of pelvic outlet and enables bearing down to the greatest advantage. Materials/training: unclear Who provided: nurse/midwives? Mode of delivery (full/ modified): squatting on the delivery bed. Where: (Hospital/ midwifery led): hospital Frequency: Duration of exposure: all the length of 2nd stage Intensity (if provided): unclear. Optimal timing: second stage of labour Tailoring: unclear	Duration 1st & 2nd of labour; Mode of birth - Spontaneous vaginal, assisted and caesarean births, Perineal trauma: 1st, 2nd, 3rd degree tears; lacerations, paraurethral tears; extension of episiotomy, cervical tears Foetal outcomes: perineal mortality & morbidity; birth injuries; Apgar scores > 5 at birth	200 Mixed 100 women in each group

				Modifications: unclear How well (adherence or fidelity): unclear Strategies to improve adherence: unclear		
2.Altman 2007 Sweden	Sitting Vs Kneeling/ Cushion	Inclusion criteria: Primiparous subjects with a normal pregnancy, singleton fetus in cephalic presentation, and spontaneous labour in gestation week 37–42 entered the trial when admitted to the hospital delivery ward.	RCT April 1998 and September 1999.	Brief name: kneeling position, leaning towards the head of the delivery bed or a cushion, or to a sitting position in the delivery bed, with the head of the bed raised at least 60 degrees from horizontal. For randomization to be complete, the assigned delivery position was to be maintained until the foetus crowned. Why: increase pelvic dimensions, beneficial effects on uterine contractility, shortens the duration of labour, no need of perineal protection Materials/training: unclear Who provided: unclear? Mode of delivery (full/ modified): modified (sitting on the bed) Where: (Hospital/ midwifery led): Hospital Frequency: unclear Duration of exposure: fully dilation until crowning of the foetal head. Intensity (if provided): Optimal timing: fully dilated and retracted cervix with occiput internal rotation complete Tailoring: unclear Modifications: unclear How well (adherence or fidelity) Strategies to improve adherence: unclear.	Perineal integrity - intact, 1st, 2nd, 3rd and 4th degree tears, episiotomy Caesarean section rates Blood loss >1000mls Manual removal of placenta; Augmentation; Duration of labour; need for analgesia; Apgar scores <7 at 5	271 Primiparous women 138 in experimental & 133 in control groups
3.Amiri 2012. Iran (online Publication in Arabic)	Squatting vs Kneeling & Lithotomy	The inclusion criteria were set as women being. primiparous and singleton, within the gestational age of 37-42 weeks	RCT, in 2009-2010	Brief name: squatting Why: unclear Materials/training: unclear Who provided: nurse/midwives? Mode of delivery (full/ modified): full. Where: (Hospital/ midwifery led): hospital Frequency: unclear	Duration of second stage (between full dilation & effacement until the crowning of vertex) Perineal trauma Apgar score	160 Primiparous women Lithotomy = 52 Squatting = 53 Kneeling = 55 (outcome reported

				Duration of exposure: unclear Intensity (if provided): unclear. Optimal timing: second stage Tailoring: unclear Modifications: unclear How well (adherence or fidelity): unclear Strategies to improve adherence: unclear.		on 50 – lithotomy; 49 – squatting; & 55 kneeling groups
4. Azhari 2011	Sitting vs Kneeling and Supine	Inclusion criteria: 42 weeks of pregnancy, single foetus, cephalic presentation, intact membranes, lack of infection of medical and midwifery, lack of foetal anomaly ultrasound proved by cervical dilation 3 to 5 cm. Exclusion criteria: women in the first stage or second stage of labour with fetal distress, fetal macrosomia and women, who because of his illness, were unable to get into certain positions.	RCT, in 2011 to 2012.	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: unclear Modifications: unclear How well (adherence or fidelity) Strategies to improve adherence:	Pain intensity before and after intervention. Duration of second stage of labour.	Nulliparous women 30 participant per group
5.Beall 2003 USA	McRobert Vs Usual care	Inclusion criteria: foetal weight >3800gs; anticipated normal vaginal birth. Exclusion: caesarean section, multiple	June 1997 and April 2001	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency:	Head-to-body delivery time Head-to-body time >60min Admission to NICU Birth injuries Shoulder dystocia	185 women 90 experimental group 95 usual care

		pregnancy, non-cephalic présentation		Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Newborn birth injury Admission to NICU APGAR scores at 5 min.	
6.Bhardway 1994; India	Squat on birth cushion vs Lithotomy	All women had full-term (> 36 weeks completed) gestation; vertex presentation. No medical, surgical or obstetric complications. Exclusion criteria: high-risk pregnancies; previous caesarean sections; epilepsy; hypertension; jaundice in pregnancy; malaria; heart disease; diabetes; rhesus factor negative; postmaturity (> 40 weeks); other than vertex presentation; antepartum haemorrhage; severe anaemia; cephalopelvic disproportion; premature labour; late registration in labour;	RCT, dates not stated	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Duration of 2nd & 3rd stage of labour, Mode of delivery, blood loss estimated visually, Maternal & foetal complications Foetal distress	617 Mixed (294 Experimental group = 136 primips; 158 multip Control group = 323; 148 primip; 175 multip)

		those who refused to squat.				
7.Bomfim-Hyppolito 1998; Brazil	Sitting (maternal back is vertical at 60 degrees with feet & legs bent at 90 degrees) vs Lying on the birth table	Included women with a singleton pregnancy at term with a vertex presentation. Exclusions: women who preferred other birthing positions or who changed their minds during labour; foetal weight - less than 2500 g or heavier than 4000 g; women needing episiotomy and operative births (assisted & caesarean)	Quasi-randomised controlled trial; dates not stated	Brief name: unclear Why: upright can shorten duration of labour Materials/training: unclear Who provided: unclear Mode of delivery (full/ modified): modified (sitting) Where: (Hospital/ midwifery led): hospital Frequency: unclear Duration of exposure: unclear Intensity (if provided): unclear Optimal timing: Duration of the second stage and of expulsion of the placenta, vulvo vaginal and perineal lacerations, Tailoring: unclear Modifications: unclear How well (adherence or fidelity) unclear Strategies to improve adherence: unclear	Blood loss, Changes in haemoglobin and haematocrit measured before birth, during labour and 24 hours after birth, Duration of second stage of labour, Incidence of vulvo-perineal lacerations, Apgars at 1 & 5 minutes	248 Nulliparous (127 experimental & 121 in control group)
8. Chang 2011 Taiwan	Sitting (with knees flexed) Vs Supine position	Inclusion criteria: nulliparous women, 38-42 weeks gestation; > 18 years; Primigravidae; cephalic presentation; absence of major obstetric or medical pregnancy complications; singleton pregnancy; no foetal conditions; ability to speak, read and write in Chinese. Exclusion criteria:	Quasi-experimental study; September 2004 to January 2005;	Brief name: Yes Why: upright positions improves the efficiency of the uterus to the benefit of both mother and baby Materials/training: Written protocol for experimental but control group received standard care. Who provided: researcher for experimental group only, Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Hospital on labour ward Frequency: Duration of exposure: 2nd stage of labour to the crowning of the baby. Intensity (if provided): unclear	Duration of second stage (minutes) Pain (Visual Analogue Scale) Fatigue (level one to four hours after birth) APGAR scores at 1 and 5 mins	66 Nulliparous (33 in each group)

		caesarean section. Training for women: prenatal antenatal classes		Optimal timing: active second stage of labour Tailoring: encouraged to push 3 to 4 times per a contraction, pushing period of 4 to 6 mins. Modifications: the head of the bed elevated to 30^0 and the knees bent so that place the woman in a face-up position. Spontaneous pushing method. How well (adherence or fidelity): 100% compliance rate Strategies to improve adherence:		
9.Cottrell 1988; USA	Birth chair vs Delivery bed	55 primiparous women; Inclusion criteria: Spontaneous labour, 37-41 weeks gestation, normal pregnancy and labour	A prospective quasi-experimental design; dates not staged	Brief name: squatting using chair Why: upright position may held to avoid gravid of uterus compress the inferior vena cava, improve blood flow to the heart & increase cardiac output and improve BP Materials/training: investigators prepared nurses Who provided: nurse Mode of delivery (full/ modified): sitting on chair Where: (Hospital/ midwifery led): hospital Frequency: unclear Duration of exposure: onset of 2^{nd} stage to birth Intensity (if provided): upright angle of $>45^0$ Optimal timing: unclear Tailoring: Valsalva (forced) pushing for 5 mins (holding breath & nurse instructed to push i.e. curves back, tilts pelvis, chin to chest or throws head back and arches back) Modifications: sitting at an angle 30^0 to 75^0 How well (adherence or fidelity): 100% Strategies to improve adherence: unclear	Duration of second stage of labour Need for instrumental birth Maternal blood loss Postdelivery haemotocrit and haemoglobin Frequency of episiotomy and laceration Frequency of perineal swelling and haemorrhoids	55 Nulliparous (33 in experimental & 22 in control group).

10.Crowley 1991; Ireland in UK	E-Z obstetric chair vs Bed care	Only nulliparous women; 34 weeks' gestation; Singleton pregnancies; Vertex presentation; Induced and augmented women were included. Exclusion: Epidural anaesthesia.	RCT; March 1984 to June 1985;	Brief name: unclear Why: improve expulsive phase of labour, reduce the need for operative vaginal birth and decrease perineal trauma Materials/training: Who provided: midwives? Mode of delivery (full/ modified): modified on birth EZ chair (midwives were free to adjust height & angle of the chair, according to her preference and that of the woman Where: (Hospital/ midwifery led): hospital Frequency: unclear Duration of exposure: unclear Intensity (if provided): unclear. Optimal timing: second stage of labour Tailoring: unclear Modifications: unclear How well (adherence or fidelity) Strategies to improve adherence: Notes: Midwives were free to manage birth in whatever methods they felt to be appropriate.	Maternal experience and satisfaction of second stage of labour, Use of analgesia/ anaesthesia, Mode of birth, Perineal trauma, Postpartum haemorrhage, Neonatal condition, Apgar scores and Admission to NICU	1250 Nulliparous (634 in experimental and 596 in control group)
11. Dani 2015 India	Squatting group (using a plastic stool to rest in between contractions) vs Dorsal position	Inclusion criteria: maternal age 18-37 years; low-risks pregnant women; full term >37 & <41 weeks pregnant, mixed parity, 18-37 years, second stage of labour Exclusion criteria: high risk pregnancy i.e. pre-term birth, foetal distress in the 1st stage; PROM >12 hours; multiple	RCT, dates not stated	**Brief name:** Squatting position on the labour table with hand bars for support and back support was provided by the birth attendant. Dorsal position on delivery table for delivery as per standard care. Why: Sacroiliac joints move up by gliding movement in squatting position; abduction of hip which widens the pelvic outlet. squatting opens the pelvis by 30% more as compared to lying down position. Coccyx can move freely in squatting position which also aids in widening the pelvic outlet. Gravity also helps great role in decent of the baby's head. The lengthening of gluteus muscle, hamstring muscle, quadriceps and calf muscle which	Maternal outcomes - Episiotomy; 1st, 2nd, 3rd, and 4th degree tears, assisted vaginal births; LSCS, episiotomy extended, retained placenta, need of oxytocin in second stage, PPH, maternal satisfaction. Foetal outcomes - foetal distress, admission to NICU, birth injury	200 patients mixed parity (primigravida = 59 women; multiparous women = 141)

		pregnancy, congenital foetal malformation, severe PIH; Severe anaemia; heart disease; congenital malformed fetus; mal-position and macrosomia>3.5 kgs		helps in better pushing down efforts. Better bearing down and pushing down efforts and duration is shortened; inferior vena cava compression is minimal in squatting position hence foeto-placental circulation is better and chances of foetal distress is less. Materials/training: unclear Who provided: birth attendant? Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: unclear Duration of exposure: unclear Intensity (if provided): unclear. Optimal timing: Second stage of labour, no further information given. Tailoring: unclear Modifications: unclear How well (adherence or fidelity) Women were given plastic stool to rest in between the uterine contractions. Strategies to improve adherence: Women delivered the baby in the same position.		
12.De Jonge 1997; **South Africa**	Step stool Vs Supine & bed care	Full-term pregnancy (37 weeks completed) gestation; Singleton pregnancies; Vertex presentation. Exclusions: contraindications for normal vaginal delivery medical, surgical or obstetric complications;	RCT, 1 May 1995 to 1st September 1996,	Brief name: Squatting on a step stool Why: many women wish to assume squatting, western women find it difficult to adopt squatting. Aids such as chair or stool may be used for support. Materials/training: 2 obstetricians and 2 senior midwives reviews the various types of squatting. Who provided: midwives? Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: intermittently squatting during	Maternal experience and satisfaction of second stage of labour, Pain, use of analgesia, Duration of the 2nd stage of labour, mode of birth, Perineal trauma, Blood loss, Abnormal foetal heart rate patterns.	517 Mixed (257 study participants: 107 primigravidae, 150 multi-gravidae. 260 control participants: 115 primigravidae, 145 multi-gravidae.

		epidural anaesthesia.		contractions, sitting back between contractions Duration of exposure: all the duration of second stage of labour until after placenta delivered. Intensity (if provided): Optimal timing: beginning of the 2nd stage. Tailoring: Modifications: How well (adherence or fidelity): 100% adherence Strategies to improve adherence: Helper supported women on both sides. Midwife knelt on the mattress in front of her, supporting her perineum if necessary or performed episiotomy if necessary. Note: women needed to be supported by 2 companions during contractions and need to relax between contractions. To allow perineal access, squatting should not be on the floor. Stool was covered with foam rubber and placed against a wall. Maternal weight and downward pressure are supported by thighs and not buttocks and perineum.		
13. Ganapathy 2012; India	Supported sitting vs Supine & lithotomy & lying flat on the back	Inclusion: normal low risk women, 38-42 gestation weeks, spontaneous onset of labour, single vertex fetus; anterior position, adequate pelvis presenting; at least 5 minimum antenatal check-ups. Exclusions: Obstetric, medical and surgical,	RCT, April 2008 to September 2009,	Brief name: unclear Why: Lying down during birth hampers with normal physiological process going against gravity. Squatting can eliminate the need for most common interventions or complications in childbirth. Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: unclear Duration of exposure: unclear Intensity (if provided): back elevated at 60^0	Spontaneous bearing down Duration of 2nd & 3rd stage. Frequency, strength of the uterine contractions Maternal BP Mode of birth Estimated blood loss. Abnormal FHR patterns Intensity of labour pain (VAS) Apgar score at 1 & 5 mins	200 Nulliparous (100 in each group)

		gynaecological, psychiatric risk factors; maternal and foetal complications in pregnancy & labour.		angle to assume upright sitting position. Optimal timing: 2nd stage of labour Tailoring: unclear Modifications: unclear How well (adherence or fidelity) Strategies to improve adherence:	Maternal birth experience (postpartum questionnaire)	
14.Gardosi 1989a; England, UK	Squatting using a birth cushion placed on the floor vs. Conventional position	Inclusion: spontaneous vaginal and induction of labour; singleton cephalic presentation, antenatal risk factors. Exclusion: epidural analgesia; elective & emergency caesarean births; premature labour; antenatal risk factors vaginal breech; late admission in labour.	Quasi-experimental design, dates not stated.	Brief name: modified squatting using a cushion placed on the bed, back supported by a fully raised head of the bed. woman's weight is mostly supported by her thighs rather than feet, so the position is maintained without effort. Also used on the floor Why: women requested to use upright positions Materials/training: unclear Who provided: 21 midwives fully trained some with previous experience of supporting birth in upright positions, but all using semi-recumbent position? Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: at least 50% of the duration of active, bearing down stage Intensity (if provided): Optimal timing: second stage of labour Tailoring: Modifications: use of cushion for squatting How well (adherence or fidelity) Strategies to improve adherence: birth cushion to allow women to adopt a supported squatting position.	Duration of the 2nd stage of labour, Mode of birth (spontaneous vaginal, instrumental, and caesarean births), Perineal trauma (1st, 2nd degree & labial tears and episiotomies. Estimated blood loss >500mls. Foetal outcomes – APGAR scores <7 at 1 & 5 and Perinatal deaths.	427 Nulliparous (218 in Experimental & 209 in control groups)
15.Gardosi 1989b; England, UK	Squatting, kneeling, sitting upright	Maternal age 16 – 35 years; Full-term (37 weeks completed)	Quasi-experimental design; dates not	Brief name: Physiological positions Why: gravity, lessened risk of aorto-caval compression, improved alignment of the foetus	Duration of second stage of labour, mode of birth	151 Nulliparous (73 in experimental and

	or standing vs Conventional semi-recumbent or lateral positions	gestation. Maternal age between 16-35 years. Singleton pregnancies. No contraindications for normal vaginal delivery. Vertex presentation. Induced and spontaneous labours were included. Exclusion: medical, surgical or obstetric complications. Had no epidural anaesthesia.	stated	for passage through the pelvis, stronger and more efficient uterine contractions, radiological evidence of larger antero-posterior and transverse pelvic outlet diameters, resulting in the total outlet area in squatting. Materials/training: unclear Who provided: 18 midwives, most midwives with little experience with upright positions. Mode of delivery (full/ modified): Full squat & sitting. Where: (Hospital/ midwifery led): Hospital Frequency: unclear Duration of exposure: unclear Intensity (if provided): unclear. Optimal timing: active 2nd stage, when the woman started to feel the urge to push (bearing down effort) Tailoring: unclear Modifications: unclear How well (adherence or fidelity): 49% loss to follow up Strategies to improve adherence: unclear Squatting was difficult to maintain, then they started with a new group of midwives to use birth cushion which facilitates a supported squatting position on the delivery bed. Moving women from recumbent to upright positions was often perceived to be beneficial when there was slow progress.	(spontaneous vaginal; instrumental and caesarean birth), Perineal trauma, Blood loss estimated visually.	78 in control)
16.Gupta 1989; England, UK	Squatting vs Conventional recumbent position	Women had full-term (37 weeks completed) gestation. Singleton pregnancies. Vertex presentation. Adequate pelvis. Exclusions:	RCT, dates not stated	Brief name: upright posture with abducted thighs Why: women have preferences in alterative birth positions. Squatting prevent caval compression, increase dimension of the pelvic outlet, increase force of gravity and thereby facilitate maternal expulsive effort Materials/training: Women in squatting group	Duration of the 2nd stage of labour, mode of birth, Perineal trauma, Blood loss Apgar score at 1 minute	114 Nulliparous (67 in experimental & 47 in control)

		contraindications for normal vaginal delivery; medical, surgical or obstetric complications.		attended a special parentcraft class at 30wks, physiotherapist supervised special leg exercise which continued daily until birth. Who provided: midwives Mode of delivery (full/ modified): full Where: (Hospital/ midwifery led): hospital Frequency: intermittent Duration of exposure: active birth to crowing of the foetal head Intensity (if provided): Optimal timing: active 2nd stage of labour: full cervical dilation with a desire to push Tailoring: unclear Modifications: unclear How well (adherence or fidelity) Strategies to improve adherence: supported in squatting position by partners and midwives Able to recline on bean bags during their rest period between contraction. Changed to semi-recumbent at the crowining of the foetus head to allow good access of the perineum and enable the midwife in the management of the perineum.		
17.Hemminki 1986; Finland	Obstetric chair vs Horizontal, Lying on their backs less than 45 degrees	Inclusion: Exclusion: 35 weeks gestation or less; small for dates fetus; breech presentation; twins; concomitant serious disease; planned caesarean births, imitate births, women with a strong desire to use the chair or referred to the delivery ward.	RCT; October 1982 – April 1983;	Brief name: unclear Why: Materials/training: birth chair not unclear Who provided: 3 midwives had experience of using chair, most had to learn during the trial. Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): non-teaching hospital Frequency: unclear Duration of exposure: mean length of stay on the chair was 49 minutes Intensity (if provided): adjustable back from 45^0 - 90^0 on the chair the back was maintained	Mode of birth	175 Mixed (88 experimental and 87 in control groups)

				at 60 to $70^0$from the horizontal. Optimal timing: cervical dilation of 8cm Tailoring: unclear Modifications: unclear How well (adherence or fidelity) 14% (12/88 delivered in the bed) Strategies to improve adherence: hand and leg supports Note: Three midwives with experience with the chair did not ask women to push and the baby was breathed out.		
18.Hillan 1984; Glasgow UK	E-Z obstetric chair vs Lying in bed	All women had singleton pregnancies, at 37-42 weeks' gestation, were of mixed parity with a cephalic presentation, either in induced or spontaneous labour.	RCT, dates not stated	Brief name: birth in chair Why: unclear Materials/training: unclear Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: unclear Duration of exposure: unclear Intensity (if provided): Optimal timing: second stage Tailoring: unclear Modifications: unclear How well (adherence or fidelity): Strategies to improve adherence:	Duration of the 1st & 2nd stage of labour, mode of birth, Use of analgesia, Blood loss, Perineal trauma,	500 Nulliparous (250 participants in each group)
19. Hofmeyr 2018 South Africa	Squatting or crouching and Kneeling Vs recumbent/ supine position	Inclusion criteria: Equal or > 18years old; Nulliparous women; Gestational age equal > 35 weeks; Singleton pregnancy anticipated vaginal birth; Cephalic foetal presentation; Baby's heartbeat	RCT, 12 March 2015 to 11 of August 2017;	Brief name: squatting or crouching Why: unclear Materials/training: unclear Who provided: midwife or doctor Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Teaching hospital in South Africa (multi-centre) Midwifery-led and obstetric led units and Hospital Frequency: unclear Duration of exposure: 20 minutes in the	Primary outcome: Duration of second stage of labour (in mins) Secondary outcomes: Maternal outcomes Spontaneous cephalic birth; Need of Augmentation in the 1st & 2nd stages of labour; Operative births; Need of	1,158 Nulliparous (Group 1 - GAP in upright = 388 Group 2- Upright position = 386 Group 3- Recumbent/supine = 384)

		detected; Exclusions: No chronic medical conditions, including heart disease, epilepsy, hypertension, diabetes mellitus and renal disease; No obstetric complications, including hypertensive disorders of pregnancy, cephalo-pelvic disproportion, antepartum heamorrhage, intra-uterine growth restriction, foetal distress, intra-amniotic infection		position Intensity (if provided): Optimal timing: second stage of labour Tailoring: unclear Modifications: At the foetal crowning of the head, providers could choose to move the woman to a recumbent position for the birth, if required. How well (adherence or fidelity): unclear Strategies to improve adherence: unclear	analgesia & anaesthesia, perineal trauma – 2nd & 3rd degree tears & episiotomy; maternal discomfort in labour. Foetal outcomes: Cord blood pH <7.2; Apgar score at 5 mins; Admission to NICU; Neonatal injury, adverse events and encephalopathy; Neonatal death.	
20.Jahanfar 2004; Iran	Sitting on stool vs Lithotomy	Multiparous women with singleton uncomplicated pregnancies gestation 38-42 weeks; Number in each group was 50; Exclusions: Newborn <2.5kgs or >4kgs, History of PPH, Dystocia, Uterus over distention such as twin pregnancy or polyhydramnios,	Quasi-Experimental study; dates not stated	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Length of 2nd and 3rd stage of labour, Blood loss, Apgar score at 1 & 5 minutes	100 Multiparous (50 in each group)

		High blood pressure, Placenta abruption, Abnormal placenta attachment or using painkillers during labour, Need of episiotomy, Dysfunctional uterus during the first stage of labour, Manual placental removal and episiotomies.				
21.Liddell 1985; New Zealand	Birthing chair vs Supine	All women had 38 - 42 weeks singleton pregnancies. Both induced and spontaneous labours.	RCT, dates not stated	Brief name: unclear Why: efficient uterine contraction Materials/training: the use of chair was demonstrated to women Who provided: midwives Mode of delivery (full/ modified): birth chair with a hole in the middle to access perineum Where: (Hospital/ midwifery led): Frequency: unclear Duration of exposure: unclear Intensity (if provided):unclear Optimal timing: second stage of labour Tailoring: unclear Modifications: unclear How well (adherence or fidelity) Strategies to improve adherence: footrests chair raised or lowered and fully adjustable to lithotomy position Note: There are several theoretical advantages to assuming an upright posture in the second stage of labour. The force of gravity in the upright position may alone be equivalent to a continuous uterine	Epidural, opioids analgesia, Duration of 1st and 2nd stage of labour, Mode of birth, Perineal trauma, Foetal distress, Apgar scores	56 Nulliparous (27 in experimental & 21 controls)

				contractile force of 30- 40 mmHg. The anatomical forces acting the pelvis, when the trunk is vertical, and the thighs abducted. A combination of the weight of the trunk acting through the spine and the upward thrust of the femora acting as levers on the innominate bones may enlarge the outlet of the pelvis by as much as 28%. Such observations lend observational support to the anthropological evidence that the upright posture may be the most favourable for delivery.		
22. Lin 2018 Taiwan	Squatting with ankle supports Full squatting, Vs Semi-recumbent groups	Inclusion criteria: 38–42 weeks of gestation, older than 18 years, no major obstetric or medical pregnancy complications based on the prenatal check chart, a singleton pregnancy, primiparous, normal extremities and ability to adopt the squatting position, and ability to speak, read, and write Chinese. Exclusions Use of epidural anaesthesia, were overweight (> 200 kg), or underwent an emergency caesarean	RCT, January 29, 2015, to June 25, 2015,	Brief name: Unsupported Squatting with ankle supports displayed the best balance, the lowest exerted force on the rectus femoris and tibialis anterior muscles, and the lowest load force on the tibialis anterior muscle during a forward shift in bodyweight. Thus, the ankle supports were shown as effective in reducing load on the calves and perceived soreness. Why: anatomical studies have shown that the vertical position increases the diameter measurements of the pelvic inlet and outlet, maintains the angle of the pelvis at 90°–120°, aids foetal descent into the pelvic outlet, facilitates the process of foetal descent and stabilization, and enhances overall delivery success. Materials/training: 3-day natural childbirth workshop Who provided: experimental group care for by the researcher midwife (with 20yrs experience) Mode of delivery (full/ modified): Full squat Where: (Hospital/ midwifery led): Hospital Frequency:	Duration of second stage of labour Pushing experience Labour Pain, Duration of Pushing (i.e., Duration of active pushing to crowning Duration of active pushing to delivery)	174 primiparous 58 per group.

		section.		Duration of exposure: active second stage until the crowning of the foetal head. Intensity (if provided): Optimal timing: active second stage of labour Tailoring: passive second stage Modifications: Use of ankle support, How well (adherence or fidelity): set on the hospital bed mattress, hold onto the bed rails, both to maintain balance and to facilitate pushing. Strategies to improve adherence: Use of ankle support		
23. Matthew 2012				Brief name: squatting on the birthing ball Why: they should move the hips in a circular motion. This allows the baby's head to press against the cervix, which promotes dilation, move down in the pelvis faster Materials/training: unclear Who provided: unclear Mode of delivery (full/ modified): full Where: (Hospital/ midwifery led): two hospitals Frequency: unclear Duration of exposure: 1st and 2nd stages of labour Intensity (if provided): Optimal timing: from 3cm dilation to birth Tailoring: unclear Modifications: unclear How well (adherence or fidelity): unclear Strategies to improve adherence: unclear		
24.Marttila 1983; Finland	Birth chair vs Bed care	Inclusion: uncomplicated pregnancy; Spontaneous labours.	RCT, dates not stated	Brief name: half sitting at 50^0delivery chair vs supine Why: pelvic measures may be larger in squatting compared with supine	Duration of 2nd stage of labour i.e. passive and active; perineal trauma; Instrumental births,	100 Mixed (60 primiparous and 40 multiparous)

		augmented labours. 38-42 weeks' gestation. Singleton, pregnancies.		Materials/training: unclear Who provided: unclear Mode of delivery (full/ modified): modified squatting Where: (Hospital/ midwifery led): unclear Frequency: unclear Duration of exposure: full dilation to birth Intensity (if provided): half sitting at 50^0 Optimal timing: Fully dilated Tailoring: unclear Modifications: squatting using a delivery chair How well (adherence or fidelity): 100% Strategies to improve adherence: unclear	Abnormal foetal heart rate.	50 women in each group

25.Moralogiu 2017; Turkey	Experimental group - Squatting position using bars Control group - Supine lithotomy modified to 45 degree of semi-fowler	Inclusion criteria: Nulliparous women, singleton live cephalic presentation, 37 and 42 weeks pregnant, active labour. Exclusions: Epidural analgesia, history of uterine scarring or pregnancies complicated i.e. foetal congenital malformations, gestational diabetes, hypertension or chronic illness or complicated labour in the first stage (LSCS	RCT, December 2013 to May 2014,	Brief name: Full squatting using bars, while her weight is on her feet, knees bent; Supine patient lying on her back , modified to 45 degree of semi-fowler. Why: increase pelvic dimensions, more efficient contractions, reduced risk of aortocaval compression and improvement of acid-base outcomes in newborns Materials/training: unclear Who provided: midwives Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: squatting for 5 minutes at 10 minutes interval, squatting whenever she feels a strong urge to push during contraction Duration of exposure: during active stage until crowning of the vertex Intensity (if provided): maternal weight on the feet and knees bent (no more information) Optimal timing: The complete opening of the	Primary outcome: Duration of 2nd stage of labour; and 3rd stage of labour: Secondary outcomes: Spontaneous labour; Augmentation of labour with oxytocin Second degree tears; Experience of pain during second stage VAS 1-5; Haemoglobin before birth <10; Haemoglobin after birth <10; Admission to NICU	Nulliparous women (51 participants in each group)

		or maternal fever).		cervix until delivery Tailoring: unclear Modifications: using bars, How well (adherence or fidelity); no loss to follow up Strategies to improve adherence: squatting intermittently with a strong urge to push when contracting until crowning of the vertex.		
26.Nasir 2007 Palestine	Squatting vs Supine	Gestation more than 37 weeks in active labour with cephalic presentation. Excluded patients with multiple gestation, malpresentation, previous scar, maternal fever and prenatal diagnosed foetal malformation.	Quasi-randomised controlled trial;	Brief name: Squatting is a position adopted during defecation. Why: unclear Materials/training: unclear Who provided: unclear Mode of delivery (full/ modified): full Where: (Hospital/ midwifery led): Hospital Frequency: unclear Duration of exposure: unclear Intensity (if provided): unclear Optimal timing: second stage of labour until placenta is delivered Tailoring: unclear Modifications: unclear How well (adherence or fidelity) unclear Strategies to improve adherence: unclear	Episiotomy rate Extension of episiotomy Para-urethral tears 2nd and 3rd degree tears Shoulder dystocia Retained placenta Postpartum haemorrhage	200 Mixed (100 participants in each group
27. Phumdoung 2010 Thailand	Modified squat position - PSU birthing bed with or without holding a squat bar Vs Lithotomy	Inclusion criteria: primiparous; married; aged 18 to 35 years; receiving antenatal care for at least the second trimester; 38 to 42 weeks' gestation; Normal FHR patterns (120 to 160 beats per min); estimated foetal	RCT, April 2007 to August 2009,	Brief name: Group1; PSU locked-upright position knee-to-chest; Group2: PSU locked-upright position lithotomy position: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: unclear Duration of exposure: Participants remained in the same position until birth	**Primary outcome:** Duration of second stage of labour **Secondary outcomes:** Pain sensation and distress Maternal comfort during second-stage labour among primiparous women. Mode of birth (vaginal or caesarean	320 nulliparous Intervention group: Group 2 = 80. Group 3 = 80. Group 4 = 80. (Subjects in Groups 2, 3 and 4 had the head of the birth table raised 45º to 60°)

	position	weight of 2.5 – 4Kg; Exclusions: prolonged latent or active phases; and maternal or foetal health complications.		Intensity (if provided): Optimal timing: Second stage of labour after cervical dilation of 10 cms or full dilation. Tailoring: unclear Modifications: unclear How well (adherence or fidelity): unclear Strategies to improve adherence: unclear	section); Augmentation of labour; need of analgesic drug; and maternal complication in the second stage of labour.	Control: Group 1= 80
28. Phumdoung 2013 Thailand	Modified squat position - PSU birthing bed with or without holding a squat bar Vs Usual bed care (supine)	Inclusions: maternal age 17-35 years; 37-42weeks gestation; foetal vertex presentation; foetal weight 2.5 to 4kgs; and able to read & write Thai. Exclusions: Anaemia; hypertension; asthma; an infection; a bleeding disorder; a history or presence of psychological problems; foetal distress and cord prolapse.	RCT, dates not stated	Brief name: Prince of Songkla University Locked – upright position similar to squatting position in a lying position. PSU birthing bed without a holding bar; usual birthing bed with head elevated 45-60 degrees. Usual birth bed with head elevated 15 degrees Why: unclear Materials/training: unclear Who provided: midwives Mode of delivery (full/ modified): full & modified Where: (Hospital/ midwifery led): Frequency: Duration of exposure: unclear Intensity (if provided): unclear Optimal timing: Active second stage of labour Tailoring: Modifications: Using PSU bed with holding bars How well (adherence or fidelity): supported squatting Strategies to improve adherence: Supporting need for squatting position using towel secured to an immovable bar or object to maintain balance and facilitate effective pushing, enhancing the abdominal muscles in expulsive efforts	Primary outcome: Duration of the second stage of labour Secondary outcome: Pain (sensation and distress) & maternal comfort.	240 nulliparous Study group 1 = 60 & group 2 = 60 Control group 3 = 60 & 4 = 60.
29. Racinet 1999; France	Squatting vs	Ability to assume a squat position	Randomised design defined as	Brief name: squatting Why: unclear	Duration of second stage Cord arterial pH	239 Mixed (120 in

	Lithotomy		Zelen; dates not staged	Materials/training: unclear Who provided: midwives Mode of delivery (full/ modified): full Where: (Hospital/ midwifery led): hospital Frequency: unclear Duration of exposure: unclear Intensity (if provided): unclear Optimal timing: second stage of labour Tailoring: unclear Modifications: unclear How well (adherence or fidelity): unclear Strategies to improve adherence: unclear	Apgar scores at 1 & 5 minutes Method of delivery Perineal trauma Blood loss Women's perceptions about birth positions	experimental and 119 controls)
30.Radkey 1991; Nova Scotia	Upright/ squatting vs Horizontal Inclination less than 45 degrees	Inclusion: nulliparous women no more details specified	Randomised design defined as Zelen, dates not stated	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Duration of second stage Duration of active phase of 2nd stage of labour Mode of birth	197 Nulliparous 56 in experimental; 53 in control
31. Sekhavat 2009 Iran	Sitting Vs Lithotomy	Inclusion criteria: nulliparity pregnancy, full-term, singleton, normal 1st stage of labour, cephalic presentation with no contraindications to vaginal birth.	RCT, 2005 to 2006,	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided):	Duration of second stage of labour, perinea trauma and Apgar at 5 minutes.	110 nulliparous (55 participants in each)

		Exclusion criteria: foetal distress in the 1st stage of labour, fixed foetal abnormalities by ultrasound, especially in the head, view posterior occipital stable, foetal macrosomia, limitations for the use of sustain positions in labour due to illness.		Tailoring: Optimal timing: Modifications: How well (adherence or fidelity) Strategies to improve adherence:		
32.Stewart 1989; England, in UK	Obstetric chair vs Wedged dorsal position	Inclusions: normal labouring women with a singleton and cephalic presentation; spontaneous labour at 37-42 weeks gestation; Exclusions: augmentation & epidural analgesia	RCT, May 1984 to March 1986;	Brief name: Yes, features of the chair provided Birth chair is designed to provide greater flexibility for the position, and support the perineum during birth. Why: squatting position have several benefits, the sagittal diameter of the pelvic outlet is increased, helping to overcome minor degrees of cephalopelvic disproportion; gravity aid the downward pressure of the expulsive forces o uterine contractions and the abdominal musculature; reduce pressure of uterus on the vena cava reducing the likehood of abnormal FHR patterns. Materials/training: unclear Who provided: experienced midwives and 80% by research midwife. Mode of delivery (full/ modified): modified Where: (Hospital/ midwifery led): labour ward in hospital Frequency: unclear	Use of analgesia/anaesthesia Duration of 1st, 2nd and 3rd stage of labour Mode of birth Perineal trauma Postpartum haemorrhage Apgar scores <7 at 1 minute Cord blood gas Maternal comfort	304 Mixed (157 experimental & 147 controls [187 parous & 117 nulliparous)

				Duration of exposure: no restriction given Intensity (if provided): maintained at 15-20^0recline from the upright Optimal timing: from late 1st stage Tailoring: unclear Modifications: movable head rest, side and hand support to provide comfort, no hole in the seat to have maximum support for the perineum up to the time of birth. Hinged flap can then be opened up to provide access to perineum to facilitate control of the birth my midwives. Convertible chair in case of emergency, How well (adherence or fidelity): >10 loss to follow up Strategies to improve adherence: Research midwife and experience midwives attended birth		
33. Thies-Lagergren 2011 Sweden	Birth seat vs Kneeling, standing and horizontal	Inclusion criteria - Nulliparous women, Singleton pregnancy, at term 37-41+6 weeks pregnant, vertex presentation, spontaneous labour, BMI >30, gestation diabetic women not in the need of medical treatment; VBAC, induced because of PROM	RCT, November 2006 to 2009;	Brief name: Yes Why: to determine mode and duration of birth Materials/training: DVD on the use of birth seat Who provided: midwives Mode of delivery (full/ modified): modified squatting Where: (Hospital/ midwifery led): 2 hospital on labour ward Frequency: unclear Duration of exposure: unclear Intensity (if provided): unclear Optimal timing: second stage of labour Tailoring: unclear	Primary outcome: Need of oxytocin in 2nd stage of labour; Secondary outcomes: Duration of labour (mins) - 1st, 2nd and 3rd stage; Augmentation of labour 1st stage of labour; Mode of birth - Instrumental vaginal birth, operative and spontaneous vaginal birth;	1020 Nulliparous 510 women in each group

		Exclusions; any medical diagnosis		Modifications: squatting on a birthing seat How well (adherence or fidelity): (224) over 10% loss to control group. Strategies to improve adherence: unclear	Need of analgesia/ anaesthesia - Epidural analgesia; Perineal trauma: 1st, 2nd, 3rd degree tears and Episiotomy; Perineal edema; Postpartum haemorrhage (Hb) levels 0-499; 500-999mls;1000-1499mls; and >1500mls; Need of Blood transfusion Manual removal of placenta: Foetal outcomes: Foetal macrosomia, APGAR scores <7 at 5 mins; Cord pH and transfer to NICU	
34.Turner 1986; England, UK	E-Z birth chair vs Bed care	Inclusion: full-term maturity greater than 36 weeks gestation; Singleton pregnancies; cephalic presentation; Induced and spontaneous labours & women needing epidural anaesthesia were included. Exclusions: mothers who had strong preference for using chair or bed	RCT, dates not stated	Brief name: upright position in birth chair Why: avoids caval compression and supine hypotension, improve foetal oxygenation, the use of gravity may shorten 2nd stage of labour Materials/training: Who provided: midwives Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: unclear Duration of exposure: second stage until placenta delivered Intensity (if provided): birth in chair conducted with chair tilted back to an angle of 40^0, to allow midwives good access conducting birth. Optimal timing: second stage Tailoring: unclear Modifications: unclear How well (adherence or fidelity) Strategies to improve adherence: Birth EZ	Duration of 2nd stage of labour Mode of birth Perineal trauma Postpartum haemorrhage Perinatal deaths	636 mixed parity; 226 study participants & 313 control subjects (348 parous & 288 nulliparous women)

				chair is made of high impact plastic with moulded leg supports and foot rests.		
35. Valiani 2016 Iran	Squatting positions – Arm 1 – full squat; Arm 2 – birth chair Vs Lithotomy	Inclusion: nulliparity; 37-43 weeks gestation; singleton pregnancy; normal first stage of labour; cephalic presentation. Exclusion: Abnormal FHR pattern in the 1st stage of labour; estimated birth weight of 4kgs; PROM >12 hours, slow 1st stage; maternal fatigue in the 1st stage; medical complications; joint problems; mental and neurologic disorders, augmentation of oxytocin, short perineum	RCT, 2010 to 2011,	Brief name: sitting on the labour chair in such a way that her lumbar spines were completely straight and the hip and knee joints were at the same level. Squatting position, the woman was sitting on her feet so that her sole was in touch with the floor and the knee joints were higher than the hips. Why: unclear Materials/training: unclear Who provided: unclear Mode of delivery (full/ modified): full and modified Where: (Hospital/ midwifery led): in 2 Hospitals Frequency: continuous Duration of exposure: unclear Intensity (if provided): straight lumber spine with hip and knee joints at the same level. weight on her feet, knees joints higher than the hips. Optimal timing: from 8cm dilation, latent and active second stage of labour. Tailoring: unclear Modifications: using a chair How well (adherence or fidelity): unclear Strategies to improve adherence: unclear	Duration of latent & active second stage of labour; duration of 3rd and 4th stage of labour; Pain severity (VAS & PPI)	96 nulliparous women: 32 participants in each arm.
36.Waldenstrom 1991; Sweden	Birth stool vs Semi-recumbent	Inclusion: Singleton and twin pregnancies were included of mixed parity; gestation not stated in paper. No contra-indications	RCT, dates not stated	Brief name: Squatting is a sitting position with the feet firmly on the floor but is more erect than is usual with other birthing chairs. Why: inconsistent result, Materials/training: Who provided: midwifery care Mode of delivery (full/ modified): modified	Pain Maternal satisfaction Duration of birth Mode of birth Perineal trauma Postpartum haemorrhage Apgar scores	294 Mixed (148 participants in each group)

		to normal vaginal delivery. Vertex and breech presentations were included; Foetal distress was an exclusion criterion; women with medical conditions were eligible. Exclusions: women who did not understand Swedish		squatting Where: (Hospital/ midwifery led): hospital Frequency: intermittent or continuous according to women preference, stand or move around between contractions Duration of exposure: Intensity (if provided): Optimal timing: second stage of labour Tailoring: unclear Modifications: unclear How well (adherence or fidelity): unclear Strategies to improve adherence: women using a stool, her partner or husband supports her back and, in this way, play an active part in the birth of their baby. **Note: several reasons for the variations in the average duration of sitting in the chair and different designs of birthing chair, with its back at a variety of angles from the horizontal**.	Admission to NICU Maternal and paternal satisfactory	
37.Zaibunnisa 2015; Pakistan	Squatting vs Lithotomy	Inclusion: all women booked/un-booked with term pregnancy >37 & less than 40 weeks gestation; spontaneous labour; cephalic presentation. Exclusion: mal-presentation, multiple pregnancy, antepartum haemorrhage, previous surgery (caesarean, myomectomy) and	RCT, 5 October 2011 to 05 April 2012,	Brief name: Squatting Why: use of gravitational force to assist bearing down effort, productive uterine contractions, less aortocaval, intrauterine foetal cord compression, less need for episiotomy, requires less oxytocin, good perineal access. Materials/training: unclear Who provided: midwives Mode of delivery (full/ modified): full squat Where: (Hospital/ midwifery led): hospital Frequency: Duration of exposure: unclear Intensity (if provided): unclear Optimal timing: second stage of labour Tailoring: unclear Modifications: unclear	Perineal tears Periurethral tear Extended episiotomy Instrumental births Caesarean section Primary postpartum haemorrhage	302 Mixed 151 – squatting 151 - lithotomy

		antenatally diagnosed foetal anomalies.		How well (adherence or fidelity) Strategies to improve adherence: unclear Notes: Unsupported squatting is difficult to maintain during labour and birth, it is also tiring or uncomfortable for women but once women adopted the squatting position, they were uneasy to lie down on delivery table as it was much easier for women to push in this posture due to effect of gravity. Shortens labour helps to reduce maternal fatigue. Providers should be creative to facilitate the needs of women during the second stage of labour. (art and science of midwifery) **Squatting requires less bearing down effort, while stretches perineum naturally.**		

Appendix 8: Table of Characteristics of NRSIs included in the SR

Details of 16 Non-randomised studies (6 prospective, 8 retrospective cohorts, 2 case-controlled study)

Comparison: Squatting positions during the second stage of labour without epidural analgesia.

Settings: Australia, Austria, Brazil, Canada, Germany, Italy, Mexico, Netherlands, Sweden, Switzerland, UK and USA

Study ID country of origin	Interventions & Number of subjects	Inclusions and Exclusions	Type of study; Length of Follow-up	Description of the intervention	Outcomes	Confounding factors controlled for
1.Bodner-Alder 2003 Austria	Squatting (n= 307); Supine (n= 307) 88 nulliparous & 222 parous women	Restricted sample of women with uncomplicated pregnancy, uncomplicated first and second stage of labour, gestational age >37 weeks, a normal sized fetus (2.5 and 4Kg) and cephalic presentation. Exclusions: Women with medical or obstetric risk factors, epidural analgesia.	Case-control Matched 1997 to 2002; 6yrs & 0 months	Brief name: Why: Materials/training (for providers/women): Care provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Duration of 1st & 2nd stage of labour; Perineal lacerations: Intact, 1st, 2nd, 3rd & 4th degree tears; vaginal & labial trauma, episiotomy; Use of oxytocin Use of analgesia Postpartum haemorrhage >500mls APGAR score at 1 and 5 minutes Cord pH Perineal tears were categorised using the traditional definitions of first, second, and third-degree tears	next parity-matched normal spontaneous vaginal delivery
2.Dahlen 2012	Squatting (n= 193)	Inclusion criteria: mixed parity; low	Cohort Retrospectiv	Brief name: unclear Why: unclear	Perineal trauma (intact; 1st to 4th degree tears,	Birth positions; foetal birth weight

Australia	Birth stool (n= 582) All-fours/kneeling (n= 2,936) Standing (n= 458) Lateral (n=321) Semi-recumbent (n=730) Missing (n= 105)	risk women gave birth in the birth centre; water birth; six birthing positions; transferred to hospital after birth for postnatal complications. Exclusions: woman transferred to hospital in labour.	e January 1996 to April 2008; 12yrs & 4 months	Materials/training: unclear Who provided: trained midwives Mode of delivery (fu ll/ modified): full & modified Where: (Hospital/ midwifery led): midwifery led Frequency :unclear Duration of exposure: Intensity (if provided): unclear Tailoring: unclear Optimal timing: second stage Modifications: unclear How well (adherence or fidelity): unclear Strategies to improve adherence: unclear	episiotomy; labial/vaginal tears/graze; postpartum haemorrhage; mode of birth; Shoulder dystocia; Use of oxytocin for 3rd stage, need for analgesia Physiological or active 3rd stage of labour; Apgar scores at 5 mins.	>4Kgs, nulliparity; prolonged second stage of labour >120 mins; and skilled birth attendant
3.De Jonge 2007 Netherland	Sitting (on birth stool) (n= 119) Semi-sitting (n= 605) Lithotomy (n= 922)	Inclusion criteria – mixed parity;	Cohort Retrospectiv e (secondary analysis of da ta from a large RCT); 1st May to 1st September 1996; 4months	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Perineal trauma – intact; postpartum haemorrhage [minor = >500 – 1000mls; moderate > 1000mls to 1500mls; severe >1500mls	Maternal age; ethnicity; parity; length of 2nd stage of labour >60 mins; duration of 3rd stage > 30mins; foetal birth weight; active vs physiological management of 3rd stage of labour.
4.Elvander 2015 Sweden	Semi-recumbent (n=45,402); Standing (n= 1119) Birth seat (n= 10163)	Inclusion criteria – mixed parity; singleton pregnancy, spontaneous vaginal births, VBAC	Cohort Retrospectiv e 1st of January 2008 to 22nd October 2014; 6 yrs	Brief name: squatting and birth seat Why: such as effects of gravity, stronger uterine contractions, maternal satisfaction and feeling of control. Inconsistent findings have also been reported for the association between birth position and OASIS Materials/training: unclear	Obstetric anal sphincter injury (OASIS)	Maternal age, induction of labour, use of epidural analgesia (EDA), oxytocin augmentation, duration of second

	Squatting (n= 832) All fours (n= 678) Knee (n= 10187) Lithotomy (n= 20180) Lateral (n=18868) Supine (n= 4978) Missing (n= 749) Primigravidae (n= 44,942); Multiparous women (n= 65, 486),	Excluded criteria - caesarean & assisted births, preterm births (≤36 completed weeks), Need for episiotomy; mal-presentations, and stillbirths.	& 10 months	Who provided: Midwives Mode of delivery (full/ modified): Full and modified Where: (Hospital/ midwifery led): all maternity facilities (hospital and community) Frequency: unclear Duration of exposure: unclear Intensity (if provided): unclear Optimal timing: second stage of labour Tailoring: unclear Modifications: unclear How well (adherence or fidelity): 614 (1.1%) less than 10% loss to follow up. Strategies to improve adherence: unclear		stage, head circumference, presentation, birth weight, and hospital delivery unit. Data on maternal weight and height for calculation of body mass index (BMI)
5.Gizzo 2014 Italy	Group 1- Squatting; Sitting (on chair, bed, birth ball) All fours; Standing (supported by partner, chair or bed) (n= 156) Group 2- Supine & Lateral (n=69)	Inclusion criteria: Nulliparity, uncomplicated pregnancies, singleton, cephalic presentation, before or at the onset of labour, Maternal age >18 years, BMI 18 to 30Kg/m, occiput foetal position at the labour onset confirmed by ultrasound and information about intrapartum	Cohort Prospective January 2013 to December 2013; 1yr & 0 months	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Primary outcomes: 1 - Duration of 1st and 2nd stages of labour, 2 - Type of birth (assisted birth, spontaneous birth and caesarean birth) 3 - Neonatal wellbeing (APGAR scores >7 at 5 mins and cord pH at birth (normal 7.2mmol) Secondary outcomes: 1 - Foetal head rotation rate from OP to OA, 2 - Best alternative position 3 - Perineal integrity - episiotomy, 1st and 2nd degree tears	Maternal age; gestational age at birth; Body Mass Index (BMI); Intra-labour pain score; length of 1st stage of labour; occiput posterior position at the onset of labour; persistent occiput posterior position at birth

		analgesia administration. Exclusion Criteria - Previous caesarean birth, OA presentation after manipulation, labour induction and augmentation.			4 - Shoulder dystocia	
6.Golay 1993 USA	Squatting (no. of cases =200) Semi-recumbent; lateral; lithotomy (no. of control = 100)	Exclusion criteria: insufficient data on labour and birth; caesarean birth	Case control Matched January 1979 and October 1984; 5yrs & 10 months	Brief name: the squatting position (upright, with abducted thighs and spine curved forward, supported on each side by a nurse or support person Why: increases the diameter of the pelvic outlet by as much as 0.5 to 2.0 prevent supine hypotensive syndrome, enlist the forces of gravity, increase the bearing-down urge, and bring about the proper alignment of the foetus inthe birth canal to facilitate Delivery. Materials/training: squatting was a routine practice for ten years before the study. Pregnant women were encouraged to practice squatting daily to strengthen them legs and become accustomed to the flexed-thigh stance. Who provided: one Dr and four nurse/midwife Mode of delivery (full/ modified): full Where: (Hospital/ midwifery led): hospital Frequency: intermittent Duration of exposure: Intensity (if provided): Optimal timing: second stage of labour Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence: During	Length of 1st, 2nd and 3rd stages of labour Mode of delivery Augmentation and oxytocin induction Perineal integrity Maternal and foetal well-being	Parity, previous vaginal & operative births, pelvic adequacy & type, initial & 36 weeks haematocrit, weight gain during pregnancy, cigarette smoking, marital status, race, insurance & source of finance, pre-mature rupture of membranes, fever during labour & birth, foetal position at onset of labour, frequency of pre-eclampsia.

				contractions, the side-rail of the bed or another person could be used for support. By the time delivery was imminent, most women had returned to the bed, which was broken, with the seat raised about 12 inches above the foot. The head ofthe bed was put fully upright. Between contractions the woman could lean back, stretch out her legs, and relax; during contractions she squatted down on the lower part of the bed with feet apart, thighs abducted and flexed,		
7.Gottvall 2007 Sweden	Squatting (n= 236) Birth stool (n= 190) Semi-recumbent (n= 347) Lateral (n= 1018) Supine (n= 1087) Lithotomy (n= 2701) Kneeling/all fours (n=1488) Standing (n= 147) Sitting (n= 5366) Missing (n= 202)	Inclusion: mixed parity; normal vaginal birth. 12, 782 women met the inclusion criteria Exclusion: assisted births	Cohort Retrospective April 2002 - December 2005; 3yrs & 4 months	Brief name: squatting upright on the birthing stool supported by partner from behind. Squatting is a natural position, Why: effect on 3rd and 4th degree tears, effect of gravity, more efficient uterine contraction, less compression on vena cava, less pain delivery, a reduction of abnormal FHR pattern, shorter 2nd stage Materials/training: unclear Who provided: midwives Mode of delivery (full/ modified): Full and modified Where: (Hospital/ midwifery led): teaching hospital Frequency: unclear Duration of exposure: late second stage of labour Intensity (if provided): unclear Optimal timing: active second stage of labour Tailoring: unclear Modifications: unclear How well (adherence or fidelity): unclear Strategies to improve adherence: unclear	3rd and 4th degree tears (OASIS)	Parity, maternal age, length of gestation, induction of labour, augmentation of labour, epidural anaesthesia, no pain relief (pharmacological or nonpharmacological), episiotomy (mediolateral or midline), length of second stage of labour and maternal position.
8.Haslinger 2014	Squatting (on a stool) (n= 138)	Inclusion criteria (≥ 34 weeks of	Cohort Retrospectiv	Brief name: Why:	3rd and 4th degree tears (OASIS)	Maternal age, parity, gestational

Switzerland	Kneeling (n= 429); Semi-recumbent & lateral (n= 5031) Water (n= 228)	gestation, singleton pregnancy, vaginal delivery, cephalic presentation). 7832 women met the inclusion criteria Exclusion criteria - vaginal-operative deliveries [vacuum and forceps, pressure on the uterine fundus, and incomplete documentation or unplanned childbirth at home with subsequent treatment at our hospital.	e November 2004 and August 2011 6yrs & 10 months.	Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:		age at delivery, maternal position at delivery, performance of episiotomy (mediolateral, mid-line), delivery-related perineal trauma, infant birth weight, infant head circumference, occurrence of shoulder dystocia, and foetal occipito-posterior position.
9.Jander 2001 Sweden	Squatting on a low chair (n = 26) Lithotomy (n = 184) Kneeling (n = 30) Lateral (n = 63) semi-recumbent (n = 111) Standing (n= 2)	Unmatched control - with no 3rd or 4th degree tears compared with cases who sustained 3rd & 4th degree tears	Unmatched case control Retrospective 1st of January 1995 to 31st of December 1996; 2yrs 0 months	Brief name: squatting on a lower chair Why: unclear Materials/training: unclear Who provided: midwives Mode of delivery (full/ modified): modified Where: (Hospital/ midwifery led): Frequency: Duration of exposure: unclear Intensity (if provided): unclear Optimal timing: active second stage Tailoring: unclear Modifications: unclear How well (adherence or fidelity): unclear Strategies to improve adherence: Unclear	3rd and 4th degree tears (OASIS)	Maternal age >35 years; Nulliparity; previous sphincter rupture; Birth weight >4.0kg; Instrument births; medio-lateral or median episiotomy; induction of labour; epidural analgesia; foetal mal-position, shoulder dystocia; breech presentation; BMI >28; post-term

						delivery >294 days.
10.Lydon-Rochelle 1995 Mexico	Group 1- Lithotomy with legs flexed in stirrups (n= 194) Group 2 – Semi-squat with knees flexed (n= 796) Group 3 – Alternative positions - full squatting, standing, lateral sims or hands and knees (n= 194)	Inclusion criteria - Women who had spontaneous vaginal birth; Mixed parity Exclusion criteria not stated	Cohort Retrospective January 1991- June 1993; 2yrs & 6 months	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Episiotomy Lacerations - requiring suturing Perineal management - compresses, lubricant, support and massage Use of epidural analgesia Foetal distress	Maternal age; ethnicity; birth weight; parity
11.Sabatino 2010 Brazil	Group 1- Squatting (n=25) Group 2 – Squatting/supine (n=15) Group 3- Horizontal (n= 25) (for Blood loss outcome) Group 1 – Squatting (n=581) Group 2 – horizontal (n=	Mixed parity	Cohort Prospective	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Blood loss >500mls Apgar score >6 at 1 minute	Not specified

	8810) [APGAR score outcome)					
12.Serati 2015 Italy	Study group – Squatting (n= 296) Control group – Supine & lateral (n=360) 656 women	656 nulliparous women, singleton at term, spontaneous onset of labour or an induced labour for post-term pregnancy and spontaneous delivery. Exclusion criteria - presence of urinary symptoms before birth, caesarean section or assisted births and twin pregnancy.	Cohort Prospective January 2014 to July 2014 7 months	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Postpartum urinary incontinence	Maternal age; gestational age; BMI; prolonged first stage >12 hrs; prolonged 2nd stage >2 hrs; nulliparity; epidural analgesia; episiotomy; 3rd & 4th degree tears; foetal macrosomia;
13.Soong 2005 Australia	Semi-recumbent (n=2,476) Lateral (n=550) Supine (n=50) Lithotomy (n=27) Kneeling (n=54) All fours (n=371) Squatting (n=47) Standing (n=153) 3728 women	Inclusion criteria – spontaneous vaginal birth; gestational age between 36-41 weeks; Exclusion criteria – tears not requiring suturing; mal-presentations; multiple pregnancy	Cohort Prospective 1 June 1999 to 31 March 2002; 2yrs 9 months	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Perineal trauma requiring suturing	Maternal age, nulliparity, maternal position at the time of birth, accoucheur, flexion of the head, reginal anaesthesia, previous perineal trauma, birthweight, type and degree of perineal trauma, need for suture of the trauma, and estimated blood loss.

14.Terry 2006 USA	Study group; Squatting; Sitting; Kneeling (n= 98) Control group – supine (n= 100) 198 women	Inclusion criteria: mixed parity, 37 weeks of gestation, spontaneous or induced singleton pregnancy, spontaneous vaginal birth and cephalic presentation. Exclusion criteria: Congenital malformation, diabetes mellitus, pregnancy-induced hypertension, or use of epidural anaesthesia	Cohort Prospective June 1997 to October 1998 1yr & 4 months	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Perineal integrity: Episiotomy and laceration Estimated blood loss Foetal position at birth; Infant birth weight Length of 1st and 2nd stage of labour Maternal postpartum hematocrit Vulvar oedema (graded 1 to 4)	Not specified

15.Willemijn 2016 Netherland	Upright group - Sitting – on Birth stool/ birth chair Kneeling/hands & knees, standing Horizontal group - Supine & lateral Group 1 – horizontal (n= 901) Group 2 – upright & horizontal at birth (n= 144) Group 3 – Sitting on birth stool/chair (n= 151) (1,196 women)	Inclusion criteria - low risk women, women birthing in primary midwifery care, at home or in hospital Exclusion criteria - women referred to obstetrician during labour	Cohort Prospective October 2005 to December 2007. 2yrs & 3 months	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity) Strategies to improve adherence:	Perineal integrity: Intact perineal - no sutures required 1st and 2nd degree tears 3rd & 4th degree tear (involving the anal sphincter) Episiotomy Labia tear	Maternal age, parity, ethnicity, duration of second stage of labour and birth weight
16.Wheaton 2012 USA	Squatting (n= 83) Birth stool (n= 99) McRoberts (n= 35) Semi-recumbent (n=260) Lateral (n= 74) Supine (n= 34) Hands & knees (n= 127)	788 mixed parity Inclusion and exclusion criteria not specified.	Cohort Retrospective 2004	Brief name: Why: Materials/training: Who provided: Mode of delivery (full/ modified): Where: (Hospital/ midwifery led): Frequency: Duration of exposure: Intensity (if provided): Optimal timing: Tailoring: Modifications: How well (adherence or fidelity)	Perineal outcome: Intact; 1st, 2nd, 3rd and 4th degree tears;	Confounders were not accounted for

	Standing (n= 25) (788 women)			Strategies to improve adherence:		

Appendix 9 - Characteristics of excluded RCTs

Study	Reason for exclusion
1.Boyle et al 2002	Wrong intervention - Intervention eligible for the study: walking, kneeling or standing vs immobile for women using epidural analgesia
2.Calvo Aguilar 2013	Description of vertical position not clear
3.Drabral et al 2014	Wrong interventions - Study comparing kneeling with supine positions in the second stage of labour
4.Brocklehurst 2017	Women using epidural analgesia, also not clear whether interventions included squatting positions
5.Nagoetta et al 1997	Intervention in the first stage of labour: period of intervention not specified. Comparative groups: walking vs not walking
6.Downe et al, 2004	Intervention eligible for the study: Supported sitting legs not in flexed vs lateral position women using epidural analgesia
7.Golara et al 2002	Intervention eligible for the study: Standing or walking vs in bed or chairwomen using epidural analgesia
8.Karraz et al 2003	Intervention eligible for the study: Walking, sitting in a chair or recline in a semi-supine or lateral position women using epidural analgesia
9.Vallejo et al 2001	Intervention eligible for the study: Walking or sitting in chair vs in bed, recumbent or lateral position women using epidural analgesia
10.Andrews 1990	Intervention included various types of upright positions e.g. squatting, kneeling, standing, ambulating and sitting. Data on squatting was analysed together with other positions.
11. Chan 1963	Data collection and analysis included another upright position. Sitting in the chair and bed
12.Caldeyro-Barcia 1960	Examining standing and horizontal position in the first stage of labour
13.Arbitto 1985	Wrong intervention - Squatting position not considered in this study
14.Brement 2007	Wrong intervention - Comparing lateral and dorsal positions
15.Liu YC.1986	Definition of upright position not clear.
16.Suwanakam 1988	Wrong intervention – comparing semi-recumbent and supine positions

Appendix 10- Characteristics of excluded NRSs studies

Study	Reason for exclusion
1.Albers et al 1996	Squatting data measured with other upright positions
Chen 1987	Sitting position not defined
2.Da Silva et al 2012	No classification of upright positions

3.Gareberg (104)et al 1994	The study examined two methods of Squatting (unsupported) versus another squatting (supported) position
4.Knauth & Haloburgo 1986	The purpose of the study was to evaluate two different pushing technique using obstetric chair
5.Mayberry et al, 2003	Evaluation of squatting with other upright positions compared with horizontal positions in women using epidural analgesia
6.Nodine & Roberts 1987	Squatting data was not measured due to small sample size
7.Roberts and Kriz 1984	Upright positions excluded squatting
8.Smith et al, 2013	Squatting data measured with other upright positions
9.Shorten et al 2002; 10.Edqvist 2016; 11.Maheux-Lacroix 2012	Insufficient data lead authors contacted with no reply.

Appendix 11: Table of modified Cochrane Risk of Bias for Cohort Studies, Case-control Studies and Cross-over Section

STUDY ID & YEAR OF PUBLICATION	*RANDOM SEQUENCE GENERATION*	*BLINDING OF RANDOMISATION*	*BLINDING OF WOMEN AND CLINICAL STAFF (PERFORMANCE BIAS)*	*BLINDING OF OUTCOME ASSESSOR (DETECTION BIAS)*	*ATTRITION BIAS (WITHDRAWAL, DROPOUTS, PROTOCOL DEVIATIONS)*	*SELECTIVE REPORTING (REPORTING BIAS)*
BODNER-ALDER 2003	Matched Case-control High Risk	Not mentioned High Risk	No description assumed unblinded High Risk	No description assumed unblinded High Risk	None Low Risk	No evidence of protocol registration; unclear Risk
DAHLEN 2012	Retrospective cohort study Non-randomised study (NRS) High Risk	Not mentioned High Risk	No description assumed unblinded	No description Assumed unblinded	Loss to follow-up =2.5% Low Risk	No evidence of protocol registration; unclear Risk
DE JONGE 2007	Retrospective cohort NRS High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	No description Unclear Risk	No evidence of protocol registration; unclear Risk
ELVANDER 2015	Retrospective cohort study NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to follow up 0.6%; Low Risk	No evidence of protocol registration; unclear Risk
GIZZO 2014	Prospective Cohort study; NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to follow up not reported; Unclear RoB	No evidence of protocol registration; unclear Risk
GOLAY 1993	Nonconcurrent cohort study; Matched case- control;	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	No loss to follow-up Low Risk	No evidence of protocol registration; unclear Risk
GUPTA 1991	Cross-over prospective study; NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded High Risk	Four assessors; Three assessors blinded Low Risk	No loss to follow-up Low Risk	No evidence of protocol registration; Unclear Risk
GOTTVALL 2007	Retrospective cohort study NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to follow up = 1.6% Low RoB	No evidence of protocol registration; unclear Risk
HASLINGER 2014	Retrospective cohort study NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to Follow up not reported Unclear RoB	No evidence of protocol registration; unclear Risk

HEMMERICH 2018	Cohort Prospective; NRS High Risk	Not mentioned High Risk	No description Assumed unblinded High Risk	No description assumed unblinded High Risk	No loss to follow up Low Risk	No evidence of study protocol registration; Unclear Risk
JANDER 2001	Retrospective cohort study NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to Follow up not reported Unclear Risk	No evidence of protocol registration; unclear Risk
LILFORD 1989	Cross-over section; NRS; High Risk	Not mentioned High Risk	Participants were not blinded; High Risk	No described Assumed unblinded; High Risk	Loss to follow up not reported Unclear Risk	No evidence of protocol registration; Unclear Risk
LYDON-ROCHELLE 1995	Retrospective cohort study NRS; High RoB	Not mentioned High Risk	No description Assumed unblinded; High Risk	No description Assumed unblinded; High Risk	Loss to Follow up not reported Unclear quality	No evidence of protocol registration; unclear Risk
MICHEL 2002	Cross-over sectional study; Non-randomised; High Risk	Not mentioned High Risk	No description Assumed unblinded; High Risk	No description Assumed unblinded; High Risk	Complete data low risk	No evidence of protocol registration; Unclear Risk
REITTER 2014	Cross-over sectional study; Non-randomised; High Risk	Not mentioned High Risk	No description Assumed unblinded; High Risk	No description Assumed unblinded; High Risk	Complete data low risk	No evidence of protocol registration; Unclear Risk
RUSSELL 1969	Cross-over sectional study; Non-randomised; High Risk	High Risk	No description Assumed unblinded; High Risk	No description Assumed unblinded; High Risk	Complete data low risk	No evidence of protocol registration; Unclear Risk
SABATION 2010	Prospective cohort study; NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to Follow up not reported Unclear quality	No evidence of protocol registration; unclear Risk
SERATI 2015	Prospective cohort study; NRS; High Risk	Not mentioned HIgh Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to Follow up not reported Unclear quality	No evidence of protocol registration; unclear Risk
SOONG 2005	Prospective cohort study; NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to Follow up not reported Unclear quality	No evidence of protocol registration; unclear Risk
TERRY 2006	Prospective cohort study; NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to Follow up not reported Unclear quality	No evidence of protocol registration; unclear Risk

WARMINK-PERDIJIK 2016	Prospective cohort study; NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to Follow up not reported Unclear quality	No evidence of protocol registration; unclear Risk
WHEATON 2012	Retrospective cohort study NRS; High Risk	Not mentioned High Risk	No description Assumed unblinded	No description Assumed unblinded	Loss to Follow up not reported Unclear quality	No evidence of protocol registration; unclear Risk

Appendix 12: Quality assessment of Cohorts and Cross-sectional studies using Modified Cochrane Risk of Bias addition assessment for non-randomised studies *(rating of quality high, low and very low quality)*

STUDY ID	REPRESENTATIVENESS OF THE EXPOSED COHORT	SELECTION OF THE NON-EXPOSED COHORT	ASCERTAINMENT OF EXPOSURE/ DATA COLLECTION METHOD	COMPARABILITY OF COHORTS ON THE BASIS OF THE DESIGN OR ANALYSIS	INTERVENTION – PROPORTION OF PARTICIPANTS RECEIVED INTERVENTION
DAHLEN 2012	Somewhat controlled criteria Low Risk	Drawn from same community Low Risk	Secure record- hand written (clinical records) Low Risk	Most important factors adjusted for. Low Risk	Squatting & stool = 775 (14.8%) Control = 4445 (85.6%); Skewed sample sizes between groups High Risk
DE JONGE 2007	Controlled inclusion criteria High Risk	Controls drawn from same source of population Low Risk	Secondary analysis of RCT Low Risk	Some important factors adjusted for Low quality	Squatting = 119 (6.7%); Controls 1646 (93.3%) Skewed sample sizes High Risk
ELVANDER 2015	Somewhat controlled criteria Low Risk	Study groups selected from same source of population. Low Risk	Maternal & foetal data was obtained from obstetric electronic database	Most important factors adjusted for. Low Risk	Squatting = 10995 (2.1%) Controls = 506412 (97.9%) Skewed sample sizes High Risk
GIZZO 2014	Controlled inclusion criteria High Risk	Study groups selected from same source of population. Low Risk	Data was collected from electronic service; labour partogram & midwifery records; Low Risk	Most important factors adjusted for. Low Risk	Squatting = 156 (69.3%) Controls = 69 (30.7%) Skewed sample sizes High Risk
GOTTVALL 2007	Broad inclusion criteria Low Risk	Study groups selected from same source of population. Low Risk	Data recorded by midwives on pregnancy, labour & birth was collected from computer; Low Risk	Most important factors adjusted for. Low Risk	Squatting & stool = 416 Control = 12805 Skewed sample sizes High Risk
GUPTA 1991	Broad inclusion criteria Low Rsk	Cross-over, participants serving as their own control; Low Risk	X-ray reports Low Risk	Most important factors adjusted for. Low Risk	Cross-over study 63 women 5th or 6th week following a caesarean birth Low Risk
HASLINGER 2014	Broad inclusion criteria Low Rsk	Study groups selected from same source of population.	Patient data was obtained from	Most important factors adjusted for.	Squatting on stool = 138 (2.4%) Control = 5688 (97.6%)

		Low Risk	electronic database; low Risk	Low Risk	Skewed sample sizes High Risk
HEMMERICH 2018	Broad inclusion criteria; Low Risk	Study groups selected from same source of population. Low Risk	MRI x-ray; Low Risk	Most important factors adjusted for. Low Risk	Very small sample 2 cases and 3 controls
JANDER 2001	Broad inclusion criteria Low Risk	Study groups selected from same source of population. Low Risk	Routinely recorded delivery data from a database; Low Risk	Most important factors adjusted for. Low Risk	Squatting = 26 (6.3%) Control = 390 (93.7%) Skewed sample sizes High Risk discrimination
LILFORD 1989	No information Unclear Risk	Each participant serving as own control Low Risk	Prospective firm X-ray reports; Low Risk	Important factors adjusted for Low Risk	Even sample sizes 43 women one week following a caesarean birth Low Risk
LYDON-ROCHELLE 1995	Somewhat restricted inclusion criteria Low Risk	Study groups selected from same source of population. Low Risk	Data recorded using the Nurse-Midwifery Clinical Data Set; Low Risk	Some important factors adjusted for High Risk	Squatting & Semi-squat = 990 (83.6%) Control Lithotomy = 194 (16.4%) Skewed sample sizes High Risk
MICHEL 2002	Broad inclusion criteria Low Risk	Cross-over, participants serving as their own control; Low Risk	MRI x-ray Low Risk	Most important factors adjusted for. Low Risk	Cross-over 35 multiparous 25 nulliparous; non-pregnant women Low Risk
SABATINO 2010	Broad inclusion criteria Low Risk	Can't tell Unclear Risk	Can't tell Unclear Risk	No description Unclear Risk	Group 1 = squatting 35; control = 25 Group 2 = squatting 581; Control = 8810 Skewed sample sizes; High Risk
REITTER 2014	Broad inclusion criteria Low Risk	Cross-over, participants serving as their own control; Low Risk	MRI x-ray reports Low Risk	Most important factors adjusted for. Low Risk	Cross-over study 100 women (50 pregnant & 50 non-pregnant) Low Risk
RUSSELL 1969	Broad inclusion criteria Low Risk	Cross-over, participants serving as their own control; Low Risk	X-ray reports Low Risk	Most important factors adjusted for. Low Risk	Cross-over study 96 antenatal women 47 six weeks postnatal women Low Risk
SERATI 2015	Somewhat restricted inclusion criteria Low Risk	Drawn from same community; Low Risk	Women answered questionnaire after birth & 12 wks postnatal via telephone interviews; Low Risk	Most important factors adjusted for. Low Risk	Squatting = 296 (45.1%); Control = 360 (54.9%); Somewhat equal sample size; Low Risk
SOONG 2005	Somewhat restricted inclusion criteria Low Risk	Study groups selected from same source of population. Low Risk	Data collected from obstetric & midwifery database; Low Risk	Most important factors adjusted for. Low Risk	Squatting = 47 (1.3%) Other 3681 ((T= 98.7%) Skewed sample sizes High Risk
TERRY 2006	Somewhat restricted inclusion criteria	Study groups selected from same source of population.	Summery sheets completed by providers following each birth	Confounders controlled for not stated	Squatting = 98 (49.5%) Other = 100 (50.5%)

	Low quality	Low Risk	Low Risk	High Risk	Even proportion of sample sizes Low Risk
WARMINK-PERDIJIK 2016	Somewhat restricted inclusion criteria; High Risk	Study groups selected from same source of population. Low Risk	Data recorded by student midwives; Low Risk	Same important confounders controlled for; Low Risk	Squatting & stools = 295 (24.7%) Other positions = 901 (75.3%) Skewed sample sizes High Risk
WHEATON 2012	Inclusion criteria not described Unclear R	Study groups selected from same source of population. Low Risk	Data was collected from electronic dataset; Low Risk	Confounders were not accounted for High Risk	Full squatting & birth stools = 217 (29.4%) Other positions = 520 (70.5%) Skewed sample sizes High Risk

Appendix 13: An Updated QES Review Protocol

Title: A qualitative evidence synthesis on factors that influence the use of upright position in childbirth among service users and healthcare providers: A systematic qualitative evidence synthesis protocol.

No Abstract for this qualitative evidence synthesis protocol

Background of the review

In recent decades, the development of a systematic review methodology for synthesising qualitative studies, including within Cochrane, has advanced. [(1)] Qualitative syntheses are research approaches that can provide extensive data on how people view, experience, interpret and act upon health care interventions and what emerges during the interaction between service users and providers. Campbell *et al.* [(2)] suggest that qualitative synthesis aims 'to achieve greater understanding and attain a level of conceptual or theoretical development beyond any individual empirical study.'

The Cochrane Qualitative and Implementation Methods Group has identified more than 500 qualitative reviews. [(3, 4)] Although three Cochrane reviews have evaluated the effectiveness of maternal positions during childbirth, none of these considered qualitative research evidence. [(5-7)] On the other hand, there have been two previous non-Cochrane qualitative reviews related to this topic. Firstly, Green *et al.* led a qualitative synthesis to explore midwives' influence on childbirth positions. [(8)] The second review aimed to identify the barriers that midwives face, which hinder them from effectively promoting upright positions

during the second stage of labour. [9] Both reviews were limited to high-income country studies and views among midwives only. They were published outside the context of effectiveness reviews (i.e., were not integrated with a quantitative review).

A critical exploration of key stakeholder perceptions on the factors that influence the use of birthing positions can help identify core aspects for pregnant women and clinicians that are essential in developing, delivering, and receiving care in childbirth. In particular, a national policy in the United Kingdom recommends a comprehensive model of personalised care approaches in health services. [10] Hence, people's needs, preferences and experiences about the appropriateness, acceptability and feasibility of practices or interventions should be central to decision-making about their care. The qualitative review described in this chapter aimed to address the following overarching question:

- What are the perspectives and experiences of women, their partners, and healthcare providers regarding the barriers to and facilitators of using upright or squatting positions in childbirth?

Study objectives

- To identify factors facilitating or hindering the use or implementation of upright positions during childbirth among women, their partners and healthcare providers.
- To explore people's views and experiences on the factors influencing their choice of upright/squatting positions in childbirth.

Methodology

This systematic qualitative review was based on the methodology described in Chapter 20 of the Cochrane Handbook [11] and conducted following the Cochrane Effective Practice and

Organisation of Care (EPOC) Group Qualitative Evidence Syntheses guidance. [4, 12] A research protocol was followed to ensure robustness and transparency. The protocol for this qualitative synthesis was first registered on PROSPERO (CRD42014014255) on 15 October 2014. It was updated on 5 April 2022. Reporting of this review followed the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) statement. [13]

Criteria for inclusion and exclusion

Sample/participants

Qualitative studies will eligible if they explored key stakeholders' views and experiences. The key stakeholders will be those involved in developing (e.g., researchers, clinical specialists or leaders, managers, policymakers, clinical facilitators), receiving or observing (e.g., women and any supporting person such as partners, friends, and family members), and delivering or affected by the intervention in any country (i.e., midwives, doctors, doulas, obstetric nurses, traditional (no formal training) birth attendants [TBA]). The review will explore differences in the perspectives of various key groups regarding the barriers and facilitators of using upright positions.

Phenomenon of interest

The phenomenon of interest in this review will be factors that influence the provision of care on squatting positions supported (with person or equipment) and unsupported (with no aid, equipment, or person) in the first or second stages of labour. The review will focus on any immediate, short, or long-term physical, emotional, and social views, and experiences of key stakeholders. In the absence of research studies exploring people's perspectives on squatting positions, and to provide comprehensive data on the topic, studies exploring

participants' perspectives on using other upright positions, such as all fours, kneeling, standing, and different positions, will be included.

Types of study design

This review considered study designs including ethnography, phenomenology, grounded theory, action research, case study, narrative inquiry, appreciative inquiry, discourse analysis, and qualitative process evaluation, as outlined by Ring et al. [12] Following the EPOC guidance, [12] mixed methods studies were eligible if the qualitative component was easily distinguished from the quantitative part. Study abstracts that included the study's aim using a qualitative method, including the study population, findings, and recommendations, will be eligible for this review. Abstracts will be included only if the study added important insights not found in full text published articles.

Evaluation

This review included qualitative studies investigating details of people's views and experiences to identify their understanding and perceptions of the need, acceptability, appropriateness, and other factors influencing the implementation of upright positions during childbirth. [14] [15] The concepts to be considered included values, beliefs, preferences, perceptions, attitudes, feelings, perspectives, and opinions. |Human experiences is to include training, education, knowledge, skills, uptake, research, policy development, and audits.

5.3.6 Research type

Eligible studies would have used one or more qualitative approach for data collection (such as focus groups, semi-structured or unstructured interviews, observation, diaries, fieldwork,

reflective journals, and documents). [11] They also would have used a qualitative approach to analyse data (e.g., content, thematic, framework, narrative, constant comparison, and discourse analysis). [27-30]

Published qualitative studies limited to English were eligible for this review. Qualitative studies will be eligible if they were conducted before an effectiveness study, as part of the intervention design process, conducted alongside or within an effectiveness study (e.g., process evaluations), or conducted after completion of an effectiveness study but with the same groups of participants. [12] These studies are described as 'trial siblings'.[16] Furthermore, studies will be included if they were 'unrelated' (i.e., qualitative research conducted outside the context of an effectiveness study). [16, 17] Questionnaires that had responses to open-ended questions analysed using a qualitative approach (e.g., thematic analysis, Delphi studies) will be eligible. However, studies will be excluded if they used qualitative methods but did not investigate data using qualitative analysis methods (e.g., open-ended survey questions where the response data were analysed using descriptive statistics only).

Literature search strategy

In collaboration with a medical librarian (MM), a systematic search strategy will be developed using a combination of Medical Subject Headings (MeSH) and controlled vocabulary to identify peer-reviewed articles relevant to the review topic. Database sources reflected the scope and topic of the review. The search strategy will be conducted to identify studies meeting the inclusion criteria with no limits on the country of origin, language or date of publication. The following electronic databases will be searched to identify relevant studies:

- MEDLINE (PubMed) In-Process & Other Non-Indexed Citations, MEDLINE Daily, and MEDLINE (1946 to 25 February 2022)
- Embase Classic + Embase (1947 to 25 February 2022)
- OvidSP (up to 19 March 2020)
- Midwives Information & Resource Service (MIDIRS) (searched from 1985 to 19 March 2020)
- PsycINFO (1966 to 19 March 2020)
- OvidSP (searched up to 19 March 2020)
- POPLINE, K4Health (1827 to 19 March 2020)
- CINAHL (Cumulative Index to Nursing and Allied Health Literature) (1977 to 25 February 2022),
- ProQuest Dissertations and Theses (1861 to 19 March 2020)
- Web of Science Conference Proceedings Citation index, ISI Web of Knowledge (1990 to 19 March 2020)
- World Health Organization Reproductive Health Library (up to 19 March 2020)
- World Health Organization Global Health Library for WHO databases (Regional Indexes) (up to 19 March 2020)

Additional search for 'Grey literature' (that is ongoing and unpublished studies) was sought through searching established Grey Literature in Europe (http://www.opengrey.eu/), OpenSINGLE, which provides access to all the former SIGLE records, new data added by EAGLE members and information from Greynet (opensigle.inist.fr), the Open University dedicated grey literature site (http://library.open.ac.uk/resources/reports.html) and the Dutch based GreyNet

(Grey Literature Network Service, http://www.greynet.org/). In addition, we will search the following grey literature sources:

- Dissertation Abstracts
- ERIC database
- GrayLit Network
- Networked Digital Library of Theses

These databases will be chosen because it is anticipated that they would provide the highest yield of relevant results based on preliminary, exploratory searches.

Additional articles were sought by using snowballing to search for relevant literature in a systematic manner. Snowballing refers to using the reference lists of a paper or the citations to the paper to identify additional papers. This method has been recommended by qualitative methodologists**.** [24; 61; 71] The search will be updated at least every 12 months until the completion of the qualitative synthesis. The search aimed to generate a comprehensive list of both published and unpublished primary research studies which may be suitable to answer the research questions posed in the SR. Identification of relevant literature by a thorough unbiased search strategy is critical.

Language translation

The review team are fluent in English only. For titles and abstracts in any other languages, an initial translation through open-source software (Google Translate) will be carried out. If the translation indicates inclusion, or if the translation is inadequate to decide, the article in full text will be retrieved. MK will search for members of Cochrane networks or other networks who are fluent in language other than English to assist us in assessing the full text of the paper for inclusion. If this cannot be done for a paper in a particular language, this

paper will be listed as a 'study awaiting classification' in order to ensure transparency in the review process.

Sampling of studies

Qualitative evidence synthesis aims for variation in concepts rather than an exhaustive sample, and large amounts of study data can impair the quality of the analysis. A selection of a sample of studies will be considered if more than 40 studies are eligible for inclusion. It has been demonstrated that by familiarise and immerse in the study data and context, large numbers of studies can prevent us from carrying out a thorough analysis that explores and explains a phenomenon comprehensively. [4] Hence, a purposive sampling approach will be applied to ensure maximum heterogenous sampling with intention of extracting the largest possible variation within the eligible studies. [18] For example, considering studies by setting (e.g., country income level (high-income or low- and middle-income settings)); by timing of care (e.g., first, second or third stage of labour); and by the thematic focus of the study (e.g. education and training, specialist providers, model of care). This approach has been proven to profitable in two other qualitative evidence reviews [3, 19], and can help deal with large quantities of data that could potentially impair the quality of analysis. [20]

The search teams will be informed by the inclusion criteria framework provided above. Each study will be selected based on their direct relevance addressing the contextual factors important to answer the review question. Once all eligible studies have been identified and full texts have been extracted, MK will assess whether the number or the type of qualitative data is likely to represent a problem for the analysis and will consider selecting a sample of studies.

Data extraction

A standardised data extraction form will be developed by MK and extract the following data.

- The extracted data set will include study characteristics (i.e. first author of the study, aim or objectives of the study, study setting, country of origin, year of publication, bibliographic information, any explanatory models, funding).
- Cadre of health worker (e.g., nurse-midwife, doctor, midwife, or other cadre identified as the health provider), description of the provision of care for women using squatting or other upright position will be extracted (content of care).
- Participant characteristics (i.e., age, ethnicity, type of subjects such as postnatal women, their families). To be eligible, participants should have used upright or squatting positions during childbirth, the description of receiving care as experienced by women & their families and their perceptions of the positions are essential and will be extracted.
- Each study characteristics: information about how the study was designed and conducted (i.e., data collection and analysis methods, reflexology, ethical approval and any relevant tables, figures or images) is also essential to provide the basis for methodological quality assessment of each study.
- Data describing the views, experiences, and behaviour of health workers when providing and women receiving childbirth. The authors of the eligible studies were regarded as 'informants' rather than the participants in these studies. The authors' interpretations, presented for example through themes and categories, will hence characterise the data. The authors' interpretations will be primarily collected from the results sections of each paper, the discussion sections, and these too will be extracted when relevant and when well supported by data.

- The main findings will constitute key analytical themes or categories, meaning emerging from the analysis, participant quotations, author's interpretations of their data, negatives or positives and comparative themes), concepts or concise summaries of findings obtained from results or finding sections and conclusions. Any themes or category-level evidence related to the barriers and facilitators of using upright position were extracted, irrespective of how simple or complex of its development, adhered to the same approach as that of Marston & King [21]; Noyes & Popay [22], Jordan et al. [23]

MK review author will extract the data, and ST discussed the methods for the data extraction to ensure that all relevant data has been extracted.

Assessing the methodological limitations of included studies

An inclusion criterion of this review is that a study must have used qualitative methods for both data collection and data analysis. This criterion constitutes a basic quality threshold. In addition, one review author (MK) will independently assess methodological limitations for each study using an adaptation of the Critical Appraisal Skills Programme (CASP) tool. [24, 25] The methodological limitations will be assessed according to the following domains.

1. Are the setting(s) and context described adequately?
2. Is the sampling strategy described, and is this appropriate?
3. Is the data collection strategy described and justified?
4. Is the data analysis described, and is this appropriate?
5. Are the claims made/findings supported by sufficient evidence?
6. Is there evidence of reflexivity?
7. Does the study demonstrate sensitivity to ethical concerns?
8. Any other concerns?

One review author will apply the criteria to each included study, and discussions and verified the data extraction process will be made with ST. No studies will be excluded on the basis of our assessment of methodological limitations, but this information will be utilised to assess our confidence in the review findings.

Synthesis of qualitative evidence

Data synthesis

Several meta-synthesis methods bring together qualitative data. These methods include (but are not limited to) a meta-ethnographic approach, meta-study, content analysis, formal grounded theory, cross-study analysis, and thematic synthesis. [26, 27] Thematic synthesis was relevant for this review for several reasons. First, it is one of the most commonly used qualitative evidence synthesis methods because it can address many topics and questions. According to Flemming et al, 'Like thematic analysis, thematic synthesis seeks to explore a range of people's views, expectations, opinions, knowledge, experience or values from a set of qualitative data that can provide a robust description of the phenomenon.' [28]

Thematic synthesis methods enable new insights, interpretations, and theories to be developed from primary studies. [29] Like grounded theory, thematic synthesis text is coded line by line, [30] and the development of codes support the creation of descriptive themes from primary study data. [31] Thematic synthesis also draws on meta-ethnography, which moves beyond the content of primary studies and offers novel interpretations by synthesising findings across studies. According to Noyes *et al.* [32], this can allow for a new understanding, including hypotheses for future studies and potentially explaining the results of effectiveness reviews.

Thematic synthesis is also considered appropriate for this review to capture and organize people's in-depth views and experiences related to the review's objectives regarding the subjective interpretation of acceptability, need appropriateness, and implementation factors. [14] Its methods can incorporate 'thick' and 'thin' data (e.g., open-ended qualitative survey) to produce descriptive themes into more in-depth analytic themes through an inductive approach to coding. [14] Thematic synthesis is a suitable method to be used by novice qualitative reviewers. [28]

A thematic synthesis approach will be employed manually as described by Thomas and Harden. [14] Thematic synthesis develops and organises findings into themes using inductive and 'constant comparison' methods drawing conclusions in systematic reviews. [14] Thematic synthesis is one of several approaches recommended by the Cochrane Qualitative Review Methods Group [32-34] and is an appropriate synthesis method for exploring questions about people's perspectives and experiences. [35] The synthesis will comprise three steps line-by-line coding of the texted, developing descriptive themes and then, developing analytical themes.

Thematic synthesis will involve three stages of analysis (all three stages will be applied to all included qualitative studies). These include the free line-by-line coding of the findings of primary studies; the organisation of these 'free codes' into related areas to construct 'descriptive' themes; and the development of 'analytical' themes which overlap to some degree. [14] First, the data connect to people's views and experiences are coded. A coding frame will be developed comprising codes derived from the data. After an initial familiarisation with and immersion in the articles, a line-by-line coding of the findings of the articles will be conducted. These 'data-driven codes will facilitate the translation of

findings from one study to another. A selection of at least two articles that will be considered highly relevant to the review question, will be used as a starting point to build a coding list. 'Line-by-line' coding will be conducted according to the content and meaning of the relevant findings of this article. Subsequently, by formulating the 'free' codes, develop an initial coding list, and check this list on two additional articles to determine if and how well the concepts translate from one study to another. Hence, generating a preliminary coding framework. Coding will be carried out by the first reviewer (MK), the process will be verified by ST.

The remaining studies then will be coded using line-by-line preliminary coding framework, adding new codes as necessary. Relevant findings, reported anywhere in the primary qualitative studies, will be coded. If new codes arise during the analysis process, MK will revisit articles already coded to determine if the new codes apply or not. This process will continue until data are extracted from all of the included articles. MK will discuss with ST this process, who will verify the process of the data coding for a sample of articles. ST will highlight if additional or modify codes are necessary. Disparities or discrepancies in coding will be resolved through discussion or in consultation with IA and MC if necessary; the coding frame will be adjusted recommended by ST, IA, MC.

In the second stage of analysis, differences and similarities between codes will be identified. Codes will be grouped into 'descriptive themes' that capture and describe patterns in the data across studies. Each theme will be entered as columns into a table, and coded data from each study will illustrate the themes in rows, to facilitate similarities and differences within and between studies, as part of the constant comparison analytic process. [31, 36] Memos will be used as part of the analysis process and may be included in the summary table where

clarity may be required about the interpretation of a piece of evidence. [37] The aim of this table is to establish themes with explanatory data and capture comparisons within the data where possible. This is to show how themes are produced but also show deviation of findings in each theme, where it pertains. MK will then independently work together to explore similarities and differences between the codes, condense and merge codes of similar content, and organise similar codes into 'descriptive themes. Then a narrative summary of the descriptive themes will be developed. From the descriptive themes 'analytical themes' will then be generated.

The third stage of thematic synthesis will involve the development of analytic themes. While the generation of descriptive themes remains 'close' to the primary studies, the purpose of analytical themes review is to 'going beyond' the primary reported data by synthesising findings across included studies and interpreting their meaning in relation to our review research questions. In another words, the analytic themes are to address the review question directly and potentially yield interpretive explanations or hypotheses. Analytical themes will provide narrative descriptions of each theme by moving between the descriptive themes, their constituent codes, and relevant individual study findings. The analytical themes will be presented and discussed with ST for feedback and final refinement. Discussion and re-working of the themes will until reach consensus. Finally, the 3 stages of thematic synthesis will provide an overall account of current understandings of people's views and experiences of the factors influencing the delivery, development and receiving of upright positions during childbirth.

Review author reflexivity

In keeping with quality standards for the conduct and reporting of qualitative research, a reflexive stance when conducting this review will be maintained. The views and beliefs of the primary reviewer (MK) will be considered on how they influenced the scope of this review, the review methods, our interpretation of the data, and the findings from our synthesis.

MK worked a registered practicing midwife employed by East Kent NHS Hospitals University Foundation Trust. MK have support women using both upright, including squatting and horizontal positions during childbirth. She has worked primarily in different clinical settings including consultant led hospital, standalone birthing centre, midwifery led unit and community midwifery. In these roles, she has obtained varying degrees of experience having worked in different maternity settings and have seen how this influenced her own motivation and ability to provide women-centred care. She is therefore sympathetic to the challenges experienced by healthcare providers in these kinds of settings. She is also of the opinion that discussions about improving the quality and up take of upright positions in childbirth should adequately reflect on and consider the system-level factors that determine the available care in a particular setting.

Ethics and dissemination

This review is a secondary research study, drawing on data that are available published articles and does not need to undergo a formal ethical review for approval. Dissemination of this review findings will be achieved through publication in a peer-reviewed journal.

Discussion

Several systematic reviews have evaluated the effectiveness of using upright and squatting positions during childbirth reporting about maternal, foetal and neonatal outcomes. Most of these reviews together with the World Health Organisation guideline indicates that women should be allowed to use the positions of their choice they found most comfortable.[5-7, 38] However, there is substantial evidence demonstrating the restriction for using upright positions during labour and birth among women, their families and healthcare providers.[39-44] This review is to synthesis qualitative evidence on people's views and experiences about the factors that influence the implementation of upright/squatting positions during childbirth. This is to assist our understanding on the perspectives, behaviours, and interactions of people receiving and delivering this positions during labour and birth. [14, 35] Synthesising qualitative evidence can allow an exploration of comparisons between similarities and differences across contexts and better understanding of how upright childbirth positions' structure and components may influence health and well-being outcomes. This type of review means that the reviewer is to provide their interpretation of the original authors' interpretation of their participants' views, thereby producing 'third order' constructs (i.e. combining the participants' findings and author's interpretation to provide new insight). [45] Bringing multiple qualitative studies into a review makes the best use of available evidence on a topic, can be used to increase the transferability of findings, informs the findings of an effective review, and can identify gaps in knowledge and areas for further primary research. Therefore, this synthesis will be followed by a mixed method systematic review of qualitative and quantitative studies, whereby analytical themes will be used to inform data extraction and synthesis of RCTs and NRSIs on the research topic.

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Appendix 14: Data extraction standardised form for qualitative research

Heading	Subheading	Questions to guide data extraction	Notes for the Reviewer to Complete
General factors	Bibliographic details		Journal article Report Book chapter Other
	Name of author(s)	*Number of the Authors*	Yes No Unclear
	Typology	Review (systematic or narrative)? Primary research? Case studies or descriptive accounts?	Systematic review Narrative review Primary Research Case studies Descriptive account
	Participants	Evidence from service users, carers, policy, academics, researchers or practitioner	Evidence from (define category)
	Geographical area	Country of origin	
	Study aims	What were the study's aims and purpose?	
	Key findings	What are the key study findings?	
	Author's conclusion	Draw together brief comments on the study as a whole and its strengths and weaknesses. Is further work required? What are its implications for policy, practice and theory, if any?	
	Sample:	Does the study report on the views and experience of service users? Does the study report on the views and	Users Carers Professionals

	Service users' and providers' perspective	experiences of carers? How were they involved in the study (e.g. as advisors for the research, in the design and execution of the study, in dissemination)?	Advisors Design Dissemination Participants
	Phenomenon of interest		
Ethical standards		Was ethical committee approval obtained? Was informed consent obtained? Does the study address ethical issues adequately? Has confidentiality been maintained?	Ethical approval: Yes No Informed consent: Yes No Unclear Ethical issues addressed: Yes No Unclear Confidentiality maintained: Yes No Unclear
Purpose of the article	Aims	Are the aims and purpose of the study clearly stated?	Yes No Unclear
Setting	Area & care setting	What is the geographical and care setting for the study?	Urban Rural Semi-urban Semi-rural Mixed
	Rationale	What is the rationale and appropriateness for this choice?	
	Detail	Is there sufficient detail about the setting?	Yes No Unclear
	Timing	Over what period did the data collection take place?	
Sample	Inclusion criteria	Who was included in the study?	
	Exclusion criteria	Who was excluded from the study?	
	Selection	How was the sample selected? Were there any factors that influenced how	

		the sample was selected (e.g. access, timescale issues)?	
	Size	What is the size of the sample and groups comprising the study?	
	Appropriateness	Is the sample appropriate in terms of its ability to meet the aims of the study, the depth of data that it is enables to be collected, and its breadth?	Yes No Unclear
Data collection and analysis	Methods	What data collection methods were used? Was the data collection adequately described and rigorously conducted?	Interview Focus group Observation Mixed methods Yes No Unclear
	Role of researcher	What is the role of the researcher within the setting? Are there any potential conflicts of interest?	
	Fieldwork	Is the process of fieldwork adequately described?	Yes No Unclear
	Data analysis approach	How are the data analysed? How adequate is the description of the data analysis? Is adequate evidence provided to support the analysis (e.g. use of original data, iterative analysis, efforts to establish validity and reliability)? Is the study set in context in terms of findings and relevant theory?	
	Researcher's potential bias	Are the researcher's /researchers' own position, assumptions and possible biases outlined? Indicate how they	

		could affect the study in terms of analysis and interpretation of the data.	
	Reflexivity	Are the findings substantiated by the data and has consideration been given to any limitations of the methods or data that may have affected the results?	Yes No Unclear
Outcomes		What outcome measures were adopted? What was the impact of the study for (a) service users (b) family (c) practitioners (d) organisation responsible for service.	
Findings	Themes	Key themes identified in the study (1st order interpretations)	
		Author explanations of the key themes (2nd order interpretations)	
		Data extracts related to the key themes	
	Conclusions		
Policy and practice	Generalisability	To what extent are the study findings generalisable? What is the country of study? How applicable are the study findings to the system in the UK? Are the conclusions justified?	
	Implications for practice	What are the implications for practice?	
	Implications for research	What are the implications for research?	
	Links to other references to be followed up	List any links to other references that should be followed up	

Decisions	Name of the second reviewer		
	Agreement with reviewer		

Appendix 15: References to included studies.

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Appendix 17: Table of the characteristics of included studies in a qualitative evidence synthesis

Author/year of publication/ country of origin	Aim of the Study	Setting	Type & number of participates	Research Design & Data collection	Qualitative data analysis employed	Findings
Afsana & Rashid [64] Bangladesh	To determine how to improve existing health centre services and create a new service delivery model.	Consultant-led	Four physicians and seven female paramedics	used a qualitative approach using in-depth interviews, participant observation, focus groups, and informal discussions.	Not stated	1- Healthcare providers were reported as being inflexible or unwilling to implement alternative delivery positions even though women preferred these interventions. 2- Women labouring and birthing routinely lying on the bed
Badejoko et al [65] Nigeria	This study was conducted to compare the knowledge, attitude and experience regarding childbirth positions between antenatal clinic attendees in the southwest and northwest Nigeria.	Consultant-led	19 Midwives	Mixed methods Qualitative semi-structured interviews	Framework approach with Thematic analysis	1- Supine is the only position we have trained to use and have observed. 2- Kneeling and Some midwives have observed squatting for women birthing at home, not in a hospital. 3- Due to providers' opinions and lack of experience in delivering in upright positions, women in antenatal classes are taught only supine positions. 4- All participating midwives expressed the need for training, re-orientation and re-training of skilled birth attendants on the supporting labouring women to use of non-supine positions
Coppen R	To compare whether the provision of 'focussed' information was superior to	Mixed Maternity Units	66 midwives	Mixed methods Systematic review; Survey	Thematic analysis - line-by-line coding	1) Women expectation 2) Traditional influence /bed as focus 3) Midwife's influence 4) Lack of education/awareness

	'general' information in terms of knowledge, satisfaction, decision-conflict and improved decision-making.			– open and closed questionnaire; double-blind RCT		5) Use of analgesia/monitors 6) Media/friends influence 7) Education sessions for women 8) Difficulties women had in decision-making 9) Unpredictability of labour on decision-making.
De Jonge & Lagro-Janseen [45] Netherlands	To gain insight into the influence on women's use of birthing positions and into the labour experiences of women in relation to the birthing positions	Mixed units	20 women	**Mixed methods** Qualitative and Semi-structured interviews	Coding categories and emerging themes. Not clear	1) Midwives' advice in labour is the most influencing factor in birthing positions. 2) Effects on labour experience 3) Effects on post-partum health 4) Need for information – women value antenatal preparation. 5) Supine used in an anticipation of quick birth to enable more controlled birth. 6) Women most familiar with supine regardless of ethnicity
De Jonge et al [49] The Netherlands	To explore views of midwives on women's positions during the second stage of labour	Mixed units	Purposive sample 31 midwives divided in 6 groups	Qualitative 6 Focus groups	Codes and themes; Thachuk's models (not clear)	1) Midwives practising informed consent corresponded to supporting birth in supine positions vs midwives practising informed choice compared to supporting non-supine birth positions. 2) Most experience supporting non-supine birth was using birth stool – ordinary in the Netherlands. 3) Midwives' comfort limits their support for women in non-supine positions. 4) Midwives are more likely to support women in alternative positions if a woman expresses a strong desire for non-supine childbirth. 5) Need for midwives to take control if obstetrically indicated, or women are not proactive in decision-making
Diorgu et al [43] Nigeria	To explore the perceptions and experiences of some Nigerian obstetricians regarding	Consultant led	8 Obstetricians	Two focus groups	Thematic analysis	1) 'Entrenched practice', 'Lithotomy was accepted routine care for women. 2) Lack of insight into evidence.'

	maternal birthing position and perineal trauma following childbirth. Secondly, to gain insights into whether obstetricians' clinical decisions and practice were influenced by research evidence.				Six-stage thematic framework, Braun and Clarke's (2006)	3) Embracing woman-centred care.' 4) Perineal trauma, 'professional dominance'.
Gayeski et al [47] **Brazil**	To better understand postpartum women's perceptions regarding their experiences in vertical and horizontal deliveries and identify positive and negative aspects of each position.	Consultant-led	10 women	Semi-structured interviews	Thematic content analysis	**Positive aspects of squating positions** 1) Greater comfort, more manageable & faster to expulse baby. 2) Freedom of movement 3) Reduction of the expulsive effort 4) Favours women's participation 5) Labour is faster due to gravity and strong contractions. **Negative aspects of upright** 1) Discomfort 2) Lack of obstetric intervention-episiotomy 3) Horizontal generates security
Gholitabar 2009	An exploratory study to develop knowledge of the likely factors or conditions that have positive or negative influence on women's choice of birth positions in labour and birth.	Consultant-led unit Birthing centre	33 antenatal women 14 postnatal women Total = 47 women	Unstructured interviews	Grounded theory: Thematic analysis defined by Glaser (1995), Strauss and Corbin (1998)	1) Evironment 2) Power 3) Support 4) Decision-making
Hunter [50] **USA**	To focus the examination on the mother–doula relationship during the birth experience.	Consultant-led	9 doulas and 9 women	Observations, materials and interviews	Ethnographic analysis (no	'**Holding the space' in birth'** 1- Companion support in labour enables the use of upright positions.

					reference was provided)	
James [63] **South Africa**	To explore and describe the experiences of multiparous labouring women on their use of the birthing ball to encourage the choice of vaginal births.	Mixed model	12 women	In-depth unstructured interviews Participant observation	The data analysis spiral method is not precise.	**Advantages of the birth ball in labour** 1- Relieving pain and promoting relaxation & comfort. 2- Promote mobility during labour. 3- They decreased active pushing during birth. 4- Increased contractions resulted in a quicker birth. 5- Reduced fear and anxiety 6- Promote satisfaction with labour experience. 7- Empowering women by allowing them to feel in control of their labour
Jiregnna (2021)	To explore the perception of women toward child birthing positions among women in the postnatal unit at Jimma Medical Center, Jimma town, Ethiopia 2020.	Hospital	10 women 4 midwives 1 Doctor	In-depth interview A phenomenology method	Thematic analysis	1- Women's lack of awareness about birth positions, 2- Women's passivity to respect their decision-making on their position of preference, 3- Health care professionals' knowledge and skill gaps on alternative childbirth positions.
Johansson [60] **Sweden**	To investigate how maternal birth position during the second stage of labour may influence a father's childbirth experience.	Consultant-led	221 fathers (110 participated in the qualitative study)	Mixed method Qualitative data – open-ended questions	Content analysis	**Midwives' ability to be professional** a) Professional attentiveness b) Obstetrical competence of professionals c) The organisation of midwifery care **The birth process impact**

						a) The overall experience of the birth process b) An upright birth position mainly was regarded as positive. c) Being prepared to participate **Author's interpretive explanation** 1- The impact of an upright position 2- Midwives' ability to participate. 3- Being prepared to participate
Khresheh& Barclay [51] **Jordan**	To evaluate whether labour support from a female relative affected duration of labor, use of pharmacologic pain relief, mode of birth, and woman's postpartum perception of the birth experience.	Consultant-led	107 women	Semi-structured interviews	Not clear	**Provision of physical support** 1- Companion support in labour enables the use of an upright position in the labour
Lindgren et al [61] **Sweden**	To describe the practice of midwives in home birth settings with the focus on the occurrence of perineal injuries.	Midwifery led	20 midwives	Open-ended interviews	Content analysis	Advantage of upright 1- It relaxes the woman, and her pelvic floor relaxes too. 2- Comfortable
Lugina et al [42] **Tanzania (linked with Smith 2004)**	Exploration of barriers and facilitators to implement evidence-based procedures on birthing positions from providers perspective and women's documented preferences and satisfaction of care To evaluate the impact of an educational intervention to	Consultant led	5 Obstetricians 48 midwives 1154 women – exist interviews) Traditional birth attendants – number not stated Doctors = 55	**Mixed methods** Qualitative & Quantitative Semi-structured in-depth interviews; 5 focus groups **Mixed methods**	Framework approach analysis	**Benefits and barriers to birthing positions** 1) Mobility during labour 2) Birthing positioning during labour 3) Providers' awareness of women's preferred birthing positions. 4) Providing informed choice to women 5) Lack of expertise on supporting upright positions. 6) Obstetric factors can influence the use of upright position e.g. slow labour **Strategies to improve uptake of upright position in clinical practice**

	introduce evidence-based obstetric care principles and encourage mobility during labour in government hospitals in Dar es Salaam.		Midwives = 56	Qualitative and Quantitative Exit interviews Semi-structured Focus groups		1- Education and training can change clinical practice by empowering providers with adequate knowledge. 2- It improves awareness of the benefits and willingness to encourage women to be mobile. 3- They are using other methods to promote evidence-based practice in clinical, e.g., the involvement of policymakers and opinion leaders to champion such strategies among their peers. 4- We are developing mechanisms to overcome barriers to practice change. 5- I am developing an evidence-based guideline for childbirth care involving policymakers, practitioners and managers.
Mselle & Eustance [48] **Tanzania**	To explore the perceptions and experiences of mothers and nurse-midwives regarding the use of the supine birthing position. More so, why the supine position is used more frequently during childbirth than other positions even though the evidence discourages it.	Consultant-led units	23 participants 16 women 7 nurse/midwives	5 Focus group and semi-structured interviews	Content analysis	**Why use supine positions?** 1- Women adopted the supine as instructed by midwives. 2- Women experience alternative positions. 3- Midwives commonly decide birthing positions for labouring women. **4-** Supine is the best-known birthing position
Mushtari & Hamnawozada[66] **Afghanistan**	The aim of the study was to explore health care providers' perceptions on birthing positions and the possibility to improve evidence-based variety in birthing positions in 2 busy hospitals	Consultant-led	30 doctors and midwives (number of each cluster not specified)	Focus groups	Not stated	**Disadvantages of upright** - Difficult to manage and cause lacerations. - Unhygienic to give birth in sitting/squatting positions. **Recommendations** Need of education for health care providers.

						Advocate for resources and facilities suitable for promoting alternative birth positions
Musie (2021) South Africa	To explore and describe factors hindering midwives' utilisation of alternative birth positions during labour at a selected public hospital.	Hospital	20 Midwives	Face-to-face semi-structured interviews Purposive sampling	eight stages of Tesch's method of data analysis	
Nieuwenhuijze et al [53] **Netherlands**	To investigate by exploring how maternity care providers communicate with women during the second stage of labour regarding birthing positions	Midwifery led	Midwives and women in the 2nd stage of labour	Qualitative Unstructured audio recording of conversations Nested in (Nieuwenhuijze 2014) RCT	Deductive content analysis	Communication themes identified to styles of communication used by providers has an impact on women's choice of birthing positions e.g. 1) Listening to women 2) Encouragement 3) Information 4) Offering choices 5) Use of a range of Communication Styles of support (directive, support directive & support)
Pettersson et al. [67] **Mozambique**	To explore midwives' perceptions of factors obstructing or facilitating their ability to provide quality perinatal care at a central labour ward.	Consultant-led unit	There were sixteen midwives from the labour ward, including one auxiliary nurse midwife, one regular midwife, and 14 with maternal/infant health training.	In-depth interviews	Grounded theory technique (technique not mentioned)	1-Health provider inflexibility in allowing labouring women to assume their preferred birthing positions.
Priddis et al. (69) **Australia**	To explore how physiological birthing positioning is facilitated by midwives and experienced by women in two	Midwifery led units	Ten women (5 birth centres &	Face-to-face interviews with women	Thematic analysis	1) Being upright and leaning forward – its natural 2) Juggling instinct and fear 3) Midwives and women's juggling instinct

	main settings in New South Wales in Australia **Objectives:** investigate midwives ' perceptions & understanding of physiological birth positioning & the strategies midwives use to facilitate this in the two main birth settings; Explore the way women perceive physiological birth positioning and its impact on the birth experience in the two main birth settings; Identify key facilitators & barriers to implementing physiological birth positioning in the two main birth settings.		5 delivery suites) 10 Midwives (5 birth centres & 5 delivery wards)	Observation and recording of labour positions. Focus groups with midwives		and fear. - Birth centre associated with increase in upright positions. - Women and midwives report upright and forward leaning positions are natural – instinctive. - Midwives who are flexible and creative with equipment and examinations support birth position choice - Fear more dominant in delivery ward vs instinct more dominant in birth centre equates to midwives' expectation to 'do' or to 'be' in order to protect women.
Somers-Smith [62] United Kingdom	To gain an in- depth perspective of both the women's expectations and experiences of support, as well as the male partner's thoughts and feelings concerning his role as a supporter.	Consultant-led units	13 couples Husbands & women	Qualitative design – semi-structured interviews	An ethnographic approach	**Physical supporting role** 1- Companion support in labour, enabling the use of upright positions.
Sycharen et al [68] Laios	To explore why rural women in particular so seldom give birth at health facilitates gaining insight into how cultural and social traditions influence childbirth practices	Mixed units	12 women 8 husbands 8 grandmothers	Eight focus groups In-depth interviews	Content analysis	Perceived advantages of home births 1) the upright position was one of the factors to opt for a home birth

	and factors that might affect the decision-making process about where to give birth					
Zang et al [52] China	To explore midwives' perceptions on assisting women in upright positions during the second stage of labour in the context of China	4 hospitals 2 maternity and 2 general hospitals	17 midwives	Semi-structured interviews Convenience and purposive sampling method	Content analysis	Three themes emerged: 1- Safety and availability 2- Unclear method of implementation 3- lack of knowledge of the potential risks and precautions.

Appendix 18: Questions included in the modified CASP.

1 Was the context described?
2 Was the sampling strategy appropriate and described?
3 Was the data collection strategy appropriate and described?
4 Is there evidence of researcher reflexivity?
5 Have ethical issues been taken into consideration?
6 Was the data analysis appropriate and described?
7 Did evidence support the findings?
8 Overall assessment of methodological limitations

Critical Appraisal Skills Programme (CASP) tool: Quality Assessment of Included Qualitative Studies

Author/year	***Was the context described?***	***Was the sampling strategy appropriate and described?***	***Was the data collection strategy appropriate and described?***	***Was the role of the researcher/ reflexivity described?***	***Have ethical issues been considered?***	***Was the data analysis appropriate and described?***	***Were the findings supported by the evidence?***	***Overall assessment***
Afsana [64]	Yes	Yes	Yes	No	Yes	Unclear no details of how data was analysed	Yes	Serious concern
Badejoko [65]	Yes	Yes	Yes	No	Yes	Yes	Yes	Minor concern
De Jonge [45]	Yes	Yes	Yes	Yes, midwives giving care collected data, it	Yes	Partial - limited description of data analysis	Yes	Minor concern

				was acknowledged how this could lead to introduce bias.				
De Jonge [49]	Yes	Yes	Yes	Two midwifery researchers together with a psychologist collected data, the influence of midwives on data collection and analysis was not mentioned	Yes	Partial - limited description of data analysis	Yes	Minor concern
Diorgu [43]	Yes	Yes	Yes	No	Yes	Yes	Yes	Minor concern
Gayeski [47]	Yes	Yes	Yes	No	Yes	Yes	Yes	Minor concern
Hunter [50]	Yes	Yes	Yes	No	Partial - mentions IRB approval but unclear consent process	Yes	Yes	Moderate concern
James [63]	Yes	Yes	Yes	Partial - researchers described as midwives as	Yes	Yes	Yes	Minor concern

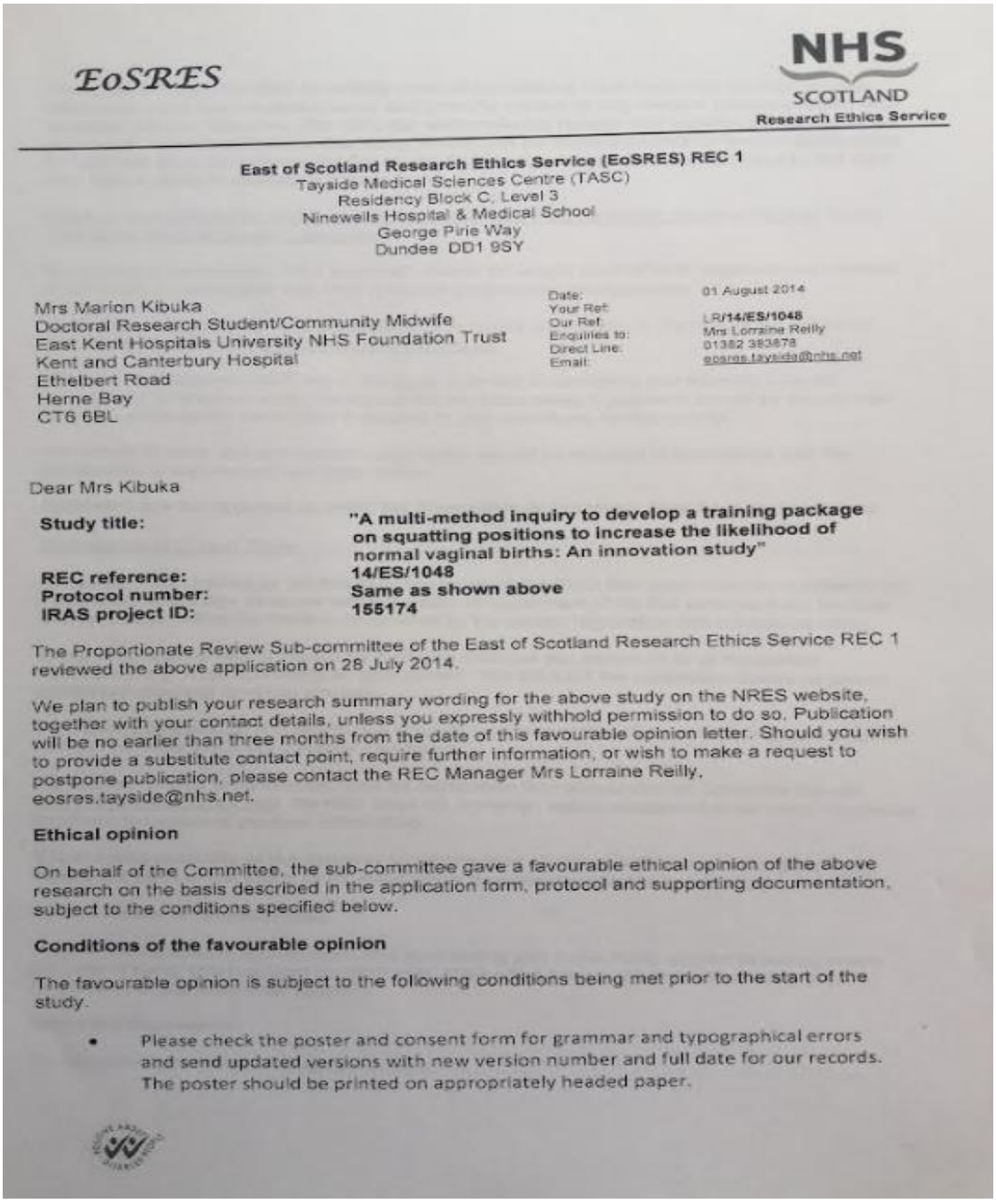
				gatekeepers but no discussion on how this might influence data collection or analysis				
Johansson [60]	Yes	Yes	Yes	No	Yes	Yes	Partial - limited qualitative data presented	Moderate concern
Khresheh & Barclay [51]	Yes	Yes	Yes	No	Yes	Partial - limited description of data analysis	Partial - limited qualitative data presented	Serious concern
Lindgren [61]	Yes	Yes	Yes	Midwives collected the data but no discussion how this might influence the data collection or analysis.	Yes	Yes	Partial - limited qualitative data presented	Moderate concern
Lugina [42]	Yes	Yes	Yes	Partial - researchers described as midwives not working on labour ward but no discussion on how this might influence data	Yes	Yes	Yes	Minor concern

				collection or analysis				
Mselle [48]	Yes	Yes	Yes	No	Yes	Yes	Yes	Minor concern
Mushtari [66]	Yes	Partial	Not clear	Not clear	Not clear	Not clear	Not clear	Serious concern (limited information in abstract)
Nieuwenhuijze [53]	Yes	Yes	Yes	Partial - researchers described that the audio recording was stated by a nurse but no discussion on how this might influence data collection or analysis	Yes	Yes	Yes	Minor concern
Pettersson [67]	Yes	Yes	Yes	No	Yes	Yes	Partial - limited qualitative data presented	Moderate concern
Priddis [69]	Yes	Yes	Yes	Midwives were asked to complete a structured data collection form but no	Yes	Yes	Yes	Minor concerns

				discussion on how this might influence data collection or analysis				
Smith [70]	Yes	Yes	Yes	Partial - researchers described as midwives not working on labour ward but no discussion on how this might influence data collection or analysis	Yes	Yes	Yes	Minor concern
Somers-Smith [62]	Yes	Yes	Yes	No	Yes	Yes	Partial - limited qualitative data presented	Moderate concern
Sycharen [68]	Yes	Yes	Yes	No	Yes	Yes	Partial - limited qualitative data presented	Moderate concern

Appendix 19:

Ethical approval through the East of Scotland Research Ethics Service (EoSRES)



EoSRES

NHS SCOTLAND
Research Ethics Service

East of Scotland Research Ethics Service (EoSRES) REC 1
Tayside Medical Sciences Centre (TASC)
Residency Block C, Level 3
Ninewells Hospital & Medical School
George Pirie Way
Dundee DD1 9SY

Mrs Marion Kibuka
Doctoral Research Student/Community Midwife
East Kent Hospitals University NHS Foundation Trust
Kent and Canterbury Hospital
Ethelbert Road
Herne Bay
CT6 6BL

Date: 01 August 2014
Your Ref:
Our Ref: LR/14/ES/1048
Enquiries to: Mrs Lorraine Reilly
Direct Line: 01382 383878
Email: eosres.tayside@nhs.net

Dear Mrs Kibuka

Study title: **"A multi-method inquiry to develop a training package on squatting positions to increase the likelihood of normal vaginal births: An innovation study"**

REC reference: **14/ES/1048**
Protocol number: **Same as shown above**
IRAS project ID: **155174**

The Proportionate Review Sub-committee of the East of Scotland Research Ethics Service REC 1 reviewed the above application on 28 July 2014.

We plan to publish your research summary wording for the above study on the NRES website, together with your contact details, unless you expressly withhold permission to do so. Publication will be no earlier than three months from the date of this favourable opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to make a request to postpone publication, please contact the REC Manager Mrs Lorraine Reilly, eosres.tayside@nhs.net.

Ethical opinion

On behalf of the Committee, the sub-committee gave a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

- Please check the poster and consent form for grammar and typographical errors and send updated versions with new version number and full date for our records. The poster should be printed on appropriately headed paper.

You should notify the REC in writing once all conditions have been met (except for site approvals from host organisations) and provide copies of any revised documentation with updated version numbers. The REC will acknowledge receipt and provide a final list of the approved documentation for the study, which can be made available to host organisations to facilitate their permission for the study. Failure to provide the final versions to the REC may cause delay in obtaining permissions.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission ("R&D approval") should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations.

Registration of Clinical Trials

All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database within 6 weeks of recruitment of the first participant (for medical device studies, within the timeline determined by the current registration and publication trees).

There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g. when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.

To ensure transparency in research, we strongly recommend that all research is registered but for non-clinical trials this is not currently mandatory.

If a sponsor wishes to contest the need for registration they should contact Catherine Blewett (cathenneblewett@nhs.net), the HRA does not, however, expect exceptions to be made. Guidance on where to register is provided within IRAS.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion").

Approved documents

The documents reviewed and approved were:

Document	Version	Date
Copies of advertisement materials for research participants [Copies of Adverts]		
Covering letter on headed paper		02 July 2014
GP/consultant information sheets or letters		02 July 2014
Interview schedules or topic guides for participants [Topic guides for participants]		
IRAS Checklist XML [Checklist_17072014]		17 July 2014
Letter from sponsor		27 May 2014
Letters of invitation to participant [Participant letter]		
Non-validated questionnaire [Questionnaire]		
Participant consent form [Consent form]		
Participant information sheet (PIS) [PI-SI]		
REC Application Form [REC_Form_17072014]		16 July 2014
Referee's report or other scientific critique report		01 September 2013
Research protocol or project proposal [First Version]	1	21 March 2014
Summary CV for Chief Investigator (CI) [CV for CI]		
Summary CV for student [Student CV]		
Summary CV for supervisor (student research) [CV FOR STUDENT SUPERVISORS]		

Membership of the Proportionate Review Sub-Committee

The members of the Sub-Committee who took part in the review are listed on the attached sheet.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The HRA website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use

East of Scotland Research Ethics Service REC 1

Attendance at PRS Sub-Committee of the REC meeting on 28 July 2014

Committee Members:

Name	Profession	Present	Notes
Dr Carol Macmillan	Consultant Anaesthetist	Yes	Chair
Mrs Shona Carson	Clinical Trials Pharmacist	Yes	
Mr John Macleod	Retired	Yes	

Also in attendance:

Name	Position (or reason for attending)
Mrs Lorraine Reilly	Senior Co-ordinator

Written comments received from:

Name	Position
Dr Carol Macmillan	Consultant Anaesthetist, Chair
Mrs Shona Carson	Clinical Trials Pharmacist
Mr John Macleod	Retired

the feedback form available on the HRA website http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance/

We are pleased to welcome researchers and R & D staff at our NRES committee members' training days – see details at http://www.hra.nhs.uk/hra-training/

With the Committee's best wishes for the success of this project.

14/ES/1048:	***Please quote this number on all correspondence***

Yours sincerely

pp
Dr Carol Macmillan
Chair

eosres.tayside@nhs.net

Enclosures: List of names and professions of members who took part in the review
"After ethical review – guidance for researchers"

Copy to: Dr Art Ationu

Appendix 20:

TITLE PAGE

SUPPORTING DOCUMENTS FOR THE RESEARCH PROPOSAL

DPHIL IN EVIDENCE-BASED HEALTH CARE

RESEARCH TITLE:

"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth".

By

MARION KIBUKA

(MSc, BSc, RM, RGN)

PRIMARY ACADEMIC SUPERVISOR

Professor MIKE CLARKE

CO-SUPERVISOR ACADEMIC SUPERVISOR

Dr Valerie Smith

CO-SUPERVISOR ACADEMIC SUPERVISOR

Dr Eve Hutton

CLINICAL SUPERVISOR

JULIE PEARCE

Third Version

21/03/2014

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East Kent Hospitals University NHS
NHS Foundation Trust

PROTECT PRIVATE: Curriculum Vitae Template

Research Title: ***"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth"***

Personal Information:

Name (including title): Mrs Marion Kibuka

Current Research Organisation: Department of Continuing Education, University of Oxford

Proposed Research Organisation (where research is to take place): Prospective institutions are: East Kent Hospitals University NHS Foundation Trust and Medway Maritime Hospital

Dates (month/year) From	To	Universities/colleges attended	Subjects read and examinations taken	Degree with details of the class of honours,
07/10/2012	Present	University of Oxford	Pre-Doctorate (Part-time) Evidence-based Health Care (EBHC)	N/A
01/09/2001	30/09/2005	University of Oxford	MSc in (Research) EBHC	Merit
08/01/1998	23/08/1999	Anglia Polytechnic University	BSc (HONS) in Pre-Registration Midwifery Programme	Upper Second 2:1
06/01/1992	30/03/1995	South Bank University	Registered General Nursing	Level 1 Nursing course

Pre-Doctoral

Have you registered for your DPhil: *(tick as appropriate)*	Yes	√

If Yes, the date registered (month and year):	07 October 2012	
Is this full-time: *(tick as appropriate)*		No
If N, what % of the time? (12/11/12 to 31/08/14) (2 days a week – 15 hours	1320 hours	

Employment History: Provide details of your employment in chronological date order (most recent first) and include your present position in the table below:

Dates (month/year) From	To	**Name of organisation and position held.** Please include your salary with the details for your current position	**Type of appointment e.g. permanent, fixed-term, full-time, part-time etc**
17/03/2003	Present	East Kent Hospitals University NHS Foundation Trust	Community Midwife Full-time (Band 6 - £34,189 per year)
24/08/1999	13/02/2003	Basildon and Thurrock NHS Trust	Midwife, Full-time
08/01/1998	23/08/1999	Basildon and Thurrock NHS Trust	Student Midwife Full-time
01/02/1997	06/01/1998	Essex County Council	Residential Care Coordinator, Full-time
31/01/1997	03/04/1995	Forest Health Care Trust	Staff Nurse Full-time
06/01/1992	30/03/1995	Redbridge Health Care Authority	Student Nurse

Date (month/year)	**Professional Membership**
31/03/2014	Nursing and Midwifery Council
01/09/2001 to present	Kellogg College (University of Oxford)
01/1992 to Present	Royal College of Nursing
23/08/2013 to Present	Royal College of Midwifery

Career Profile

a) Pre-doctoral midwife with a range of experience in research methodology (e.g., developing, assessing, analysing and reporting of systematic reviews), able to work both independently (e.g. completed MSc thesis within the time limit given; publisher or Cochrane Protocol; co-publisher of a Cochrane Review and as a supportive team member in midwifery (e.g. community midwife; hospital midwife)

b) Experience in quantitative research design e.g., undertaking RCT systematic review using Rev-Man software for statistical analysis.

c) Able to rapidly incorporate the information, summarise and draw conclusions, e.g., MSc thesis on maternal positions during childbirth and Cochrane review during childbirth.

d) Confident in presenting to both technical and less-skilled audiences e.g., pregnant women workshops, teaching and assessing student midwives, and PowerPoint presentations.

e) Thrives on new intellectual challenges e.g., the DPhil programme

f) Qualified midwife for fourteen years with community and hospital experience; main experiences include being the leader of antenatal education, promoting home births for ten years (e.g., gained extensive experience caring for women who choose to squat during labour and birth) and evidence-based practice, detecting, supporting & advocating for high risk and low-risk pregnant women.

Communication Skills

a) Presenting research results at local scientific meetings (up to 50 people)
b) Preparing MSc thesis (10,000 words)
c) Publishing scientific papers in high-quality journals e.g., the online Cochrane Database of Systematic Reviews

Publications

Kemp E, Kingswood CJ, Kibuka, M, Thornton JG. Position in the second stage of labour for women with epidural anaesthesia. *Cochrane Database of Systematic Reviews* 2013, Issue 1. Art. No.: CD008070. DOI: 10.1002/14651858.CD008070.pub2.

Kibuka M, Kingswood CJ, Thornton JG. Position in the second stage of labour for women with epidural anaesthesia. Cochrane Database of Systematic Reviews 2009; (Protocol)

Kibuka M, A systematic review of randomised controlled trials on the effects of upright versus neutral maternal positions during the first and second stage of labour with epidural analgesia on operative delivery, length of labour and other maternal & foetal outcomes, Sept 2005 (Partially published MSc thesis).

Academic and Clinical Supervisors

Primary supervisor: Professor Mike Clarke, Director of Medical Research Council Methodology (HUB), Centre for Public Health, Institute of Clinical Sciences, Block B Queens University Belfast, Royal Victoria Hospital, Grosvenor Road, Belfast BT12 6BJ, Northern Ireland: Email Address: m.clarke@qub.ac.uk

Co-Supervisor: Dr . Valerie Smith, Lecturer in Midwifery/Research Fellow, School of Nursing and Midwifery, Trinity College Dublin, 24 D'Olier Street, Dublin 2, Email Address: smith1@tcd.ie

Co-Supervisor: Dr Eve Hutton, Head of Occupational Therapy (Children, Young People and Safety Families), First Floor Offices, Buckland Hospital, Coombe Valley Road, Dover, Kent, CT17 0HD, and Email Address: eve.hutton@nhs.net

Clinical Supervisor: Mrs Julie Pearce, Chief Nurse, Division of Clinical Quality, Patient and Operations, East Kent Hospitals University NHS Foundation Trust, Kent and Canterbury Hospital, Ethelbert Road, Kent, CT1 3NG, Email: juliepearce@nhs.net

East Kent Hospitals University NHS
NHS Foundation Trust

Recommendations of the III Approval Committee:
Approved by:_____
Approved date:_____

Research Title:
"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth"

For Midwives

Participant Information Sheet for Nominal Group Technique

My name is Marion Kibuka. I am a postgraduate student undertaking a doctorate in the Evidence-Based Health Care programme at the University of Oxford. As part of this programme, I am developing and validating an accessible, evidence-based package on squatting positions during pregnancy and childbirth. The project will use several ways to answer the research questions. One of the methods is to have a structured group discussion of 'experts' in midwifery that will provide a detailed examination of the research problem. I am writing to you because you have been selected as an 'expert' midwife to look after women who choose to squat during the second stage of labour.

Study Title:

"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth"

Invitation

You are invited to take part in a research study. Before you decide, you need to understand why the research is being done and what it will involve. Please take the time to read the following information carefully and discuss it with others if you wish. If there is anything that you are not clear on or would like more information on, please contact me at the email address provided below.

Thank you for reading this.

What are the objectives of the study?

The researcher is looking for 'experts' in midwifery with theoretical knowledge and/or clinical experience in looking after women who use squatting positions during labour and birth. The objective of the study is to develop a consensus judgment on:

Definition of squatting positions:
Please provide your definitions of squatting positions during labour and birth.

Key Elements of squatting positions:

List all the key elements that you believe best describe squatting positions during labour and birth. This could include details about how it is applied, delivery methods, and any relevant equipment.

Barriers to using squatting positions:
Identify and list all the factors that you consider vital for hindering the use of squatting positions during labour and birth. This may include obstetrical, cultural, personal, organisational, or other factors.

Facilitators for using squatting positions:
List all the factors that you believe are the most important in facilitating the use of squatting positions during labour and birth. This could encompass maternity care practices, support from healthcare providers, or women preferences.

Additional comments:
Please provide any additional comments or insights you have regarding the use of squatting positions during birth. This can include personal experiences, observations, or any other relevant information.

Why have I chosen you?

You have been chosen because you are a qualified midwife and an 'expert' in clinical midwifery practice.

What will I have to do if I take part?

If you agree to take part, you will be asked to join a Nominal Group meeting at the postgraduate centre at Kent and Canterbury Hospital. The Nominal Group technique (NGT) is a structured face-to-face group session to achieve group consensus and action planning focused on the research topic. This is a controlled small group meeting facilitated by an experienced facilitator to ensure democracy during the NGT discussion among the participants. The panel will consist of 5-9 participants per group and will be conducted in a structured form following up to seven stages. In the discussion, every participant is given an equal chance to contribute to answering the research questions. For the first stage, the facilitator will explain the purpose and specific steps of the NGT discussion. She will present the research questions by reading and writing them on the board so all participants can refer to the same questions. In the second stage, you will be asked independently and privately to record a list of ideas and opinions relating to the research questions. In the third stage, ideas will be recorded on a flip chart in a round-robin feedback session. The fourth stage will require group members to engage in a discussion to clarify and categorise different ideas to obtain a list of opinions. During the fifth stage, each participant will independently rank the different options. The sixth stage will be the final discussion of the ranked items, where the group will clarify, revise, and change their lists as they wish. The group decision is based on the consensus achieved during this final ranking process. In the seventh stage, all participants will review the final individual ranking and group consensus (agreement) with the most important items to include in the training package. Each participant will engage in one discussion session of a maximum 4-hour duration. Please note that some of the questions will relate to your personal history and experiences in clinical practice.

Do I need to prepare for the discussion?

It is not mandatory to prepare for the discussion. However, the researcher will provide an unbiased summary of the literature on published evidence two weeks before the NGT meeting. You can also prepare for the meeting by reading your selected published literature on squatting positions. In addition, you are allowed to write down any notes to bring with you to the meeting (e.g., case scenarios or notes from published evidence or your own).

Will I be paid for participating in the study?

Yes, you will be paid a band six hourly rate (£141.95 per day). Funding will include the time spent preparing for the study.

What are the possible disadvantages and risks of taking part?

There are no risks to taking part in this study. The only disadvantage will be the time required to attend the NGT meeting. The discussion process will provide an opportunity to talk about your own experiences (good or bad), and, in some instances, this may be upsetting.

What are the possible benefits of taking part?

You are unlikely to benefit directly from taking part in this study. However, some participants may find it helpful to be allowed to share their views and experiences regarding the intrapartum care they provide to women. Your experience and knowledge will be shared in a consensus manner with other professionals. They will contribute to improving midwives' skills and confidence in managing the second stage of labour for women who choose to squat. In addition, the information you provide will help to develop one accessible, evidence-based document on squatting positions during birth for future use in maternity services.

Do I have to take part?

No, **taking part is voluntary**. If you don't want to participate, you do not have to give a reason, and no pressure will be put on you to try and change your mind. You can pull out of the discussion at any time. Please note, that if you choose not to participate or withdraw during the discussion, this will **not** affect you in any way.

If I agree to take part, what happens to what I say?

All the information you give us **will be confidential** and used for this study only. The data will be collected and stored following the Data Protection Act 1998 and disposed of securely. The information will be used in a way that will not allow you to be identified individually. No one will be able to link any information provided to you.

The NGT discussion seven stages will be discussed further with all the midwives who would like to participate in the study.

What happens after the study?

Once the study is complete, the researcher will write a thesis detailing the views and thoughts of those interviewed and any recommendations for change arising from these interviews. This information will be made available to health professionals through publication in health service journals but will not identify you in any way. You will receive a summary of the findings if you wish.

Who is organising the study?

This study is being conducted as part of a doctoral course at the University of

Oxford is supervised by Professor Mike Clarke, Director of Medical Research Council Methodology (HUB), Dr Valerie Smith, Lecturer in Midwifery/Research Fellow and Dr Eve Hutton, Head of Occupational Therapy. Further details about the researcher and her supervisors are provided below.

Who has reviewed the study?

This study has been approved by NHS Regional Ethics Committee and the

Department of Continuing Education, Ethics Committee at the University of Oxford.

What do I do now?

Think about the information on this sheet and ask me if you are not sure about anything. If you agree to take part, sign the consent form. The consent form will be kept safe by the researcher with all other research data

information. If, after the discussion, you want any more information about the study, please do not hesitate to contact me my email: marion.kibuba@kellogg.ox.ac.uk

If you feel upset after the discussion and need help dealing with your feelings, you must talk to someone right away.

The contact details for the person to talk to are:
Name: _____

If you require further information or wish to discuss any aspects of this study, please contact:

Researcher: Marion Kibuka, Doctoral Student in Evidence-Based Health Care, University of Oxford, Continuing Education Department, Rewley House, I Wellington

Square, Oxford, Oxfordshire, OX1 2JA: Email address: marion.kibuka@kellogg.ox.ac.uk

Academic and Clinical Supervisors

Primary supervisor: Professor Mike Clarke, Director of Medical Research Council Methodology (HUB), Centre for Public Health, Institute of Clinical Sciences, Block B Queens University Belfast, Royal Victoria Hospital, Grosvenor Road, Belfast BT12 6BJ, Northern Ireland: Email Address: m.clarke@qub.ac.uk

Co-Supervisor: Dr . Valerie Smith, Lecturer in Midwifery/Research Fellow, School of Nursing and Midwifery, Trinity College Dublin, 24 D'Olier Street, Dublin 2, Republic of Ireland. Email Address: smith1@tcd.ie

Co-Supervisor: Dr Eve Hutton, Head of Occupational Therapy (Children, Young People safety Families), First Floor Offices, Buckland Hospital, Coombe Valley Road, Dover, Kent, CT17 0HD, and Email Address: eve.hutton@nhs.net

Clinical Supervisor: Mrs Julie Pearce, Chief Nurse, Division of Clinical Quality, Patient and Operations, East Kent Hospitals University NHS Foundation Trust, Kent and Canterbury Hospital, Ethelbert Road, Kent, CT1 3NG, Email: juliepearce@nhs.net

Thank you for taking the time to read this information sheet. If you return the attached form, you will be contacted shortly by the researcher. If you agree to participate in the study, you will be given a copy of this information sheet and a signed consent form to keep.

East Kent Hospitals University NHS
NHS Foundation Trust

Recommendations of the III Approval Committee:
Approved by:_____
Approved date:_____

Participant Information Sheet for Nominal Group Technique

For Women

My name is Marion Kibuka. I am a midwife and a postgraduate research student undertaking a doctorate in the Evidence-Based Health Care programme at the University of Oxford. I am working on a project that intends to develop a training package on squatting positions during pregnancy and childbirth. The reason I am doing this is that, currently, there is no structured method for informing midwives in these positions. By developing and validating structured training, midwives will be helped the increase the skills required to support women achieve normal labour and birth. The project will use several ways to answer the research questions. One of these ways is to produce a structured group discussion to assess consumers' (women as users of maternity services) perspectives on views and experiences of squatting positions during the second stage of labour. This will provide a detailed examination of the research problem. The reason I am writing to you is that you have been selected as one of the women who adopted squatting position(s) during the second stage of labour.

Study Title

"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth"

Invitation

You are invited to take part in a research study. Before you decide, you need to understand why the research is being done and what it will involve. Please read the following information carefully and discuss it with others if you wish. If there is anything that you are not clear on or if you would like more information, please contact me at the email address provided below. Take time to consider whether or not you wish to take part.

Thank you for reading this.

What are the objectives of the study?

The researcher is looking for 'experts' in midwifery with clinical experience looking after women who use squatting positions during labour and birth. The objective of the study is to develop a consensus judgment on:

Definition of squatting positions:
Please provide your definitions of squatting positions during labour and birth.

Key Elements of squatting positions:
List all the key elements that you believe best describe squatting positions during labour and birth. This could include details about how it is applied, delivery methods, and any relevant equipment.

Barriers to using squatting positions:
Identify and list all the factors that you consider vital for hindering the use of squatting positions during labour and birth. This may include obstetrical, cultural, personal, organisational, or other factors.

Facilitators for using squatting positions:
List all the factors that you believe are the most important in facilitating the use of squatting positions during labour and birth. This could encompass maternity care practices, support from healthcare providers, or women preferences.

Additional comments:
Please provide any additional comments or insights you have regarding the use of squatting positions during birth. This can include personal experiences, observations, or any other relevant information.

Why have I chosen you?

You have been chosen because of your experience adopting a squatting position during the second stage of labour. We would like to hear your views and personal preferences, and priority for care.

What will I have to do if I take part?

If you agree to take part, you will be asked to join a Nominal Group meeting which will take place at Kent and Canterbury Hospital. The Nominal Group Technique (NGT) is a structured face-to-face group discussion to achieve group agreement and action planning on squatting positions during childbirth. This is a controlled small group meeting facilitated by an experienced moderator to ensure democracy during the NGT discussion among the participants. The panel consist of 3-8 participants per group and will be conducted in a structured form of seven stages. In the discussion, every participant is given an equal chance to contribute to answering the research questions. For the first stage, the facilitator will explain the purpose and specific steps of the NGT discussion. She will present the research questions by reading and writing them on a board so all participants can refer to the same questions. In the second stage, you will be asked independently and privately to record a list of ideas and opinions relating to the research questions. In the third stage, ideas will be recorded on a flip chart in a round-robin feedback session. In the fourth stage, you will engage in a discussion to clarify and categorise different ideas to obtain a list of opinions. During the fifth stage, you will independently rank the other options in order of importance. The sixth stage will be the final discussion of the ranked items, where you can clarify, revise, and change your lists. The group decision is based on consensus (agreement) achieved during this final ranking process. Each participant will engage in one session of discussion, which will take no longer than approximately four hours. Please note that some of the questions will relate to your personal history and experiences of labour and birth.

Do I need to prepare for the discussion?

It is You don't have to prepare the discussion. However, you can write down any notes about your experiences and bring these notes with you to the meeting. In addition, the researcher can provide a summary of the published literature two weeks before the NGT meeting. You can also prepare for the NGT by reading information on squatting positions.

Will I be paid for participating in the study?

You will be paid petrol money (or other travel expenses) and childcare expenses if necessary.

What are the possible disadvantages and risks of taking part?

There are no risks to taking part in this study. The only disadvantage will be the time required to attend the NGT meeting. The discussion process will provide an opportunity to talk about your own experiences, and, in some instances, this may be upsetting.

What are the possible benefits of taking part?

You are unlikely to benefit directly from taking part in this study. However, some participants may find it helpful to be allowed to share their views and experiences regarding childbirth. The information from this study may support midwives to improve their skills and confidence in looking after women who squat during labour and birth. In addition, this study may enhance consideration of women's views and opinions for developing evidence-based information on squatting positions.

Do I have to take part?

No, **taking part is voluntary**. If you don't want to participate, you do not have to give a reason, and no pressure will be put on you to try and change your mind. You can withdraw from the discussion at any time. Please note, if you choose not to participate or withdraw during the NGT discussion, this will **not** affect you at all in any w

f I agree to take part, what happens to what I say?

All the information you give us **will be confidential** and used for this study only. The data will be collected and stored following the Data Protection Act 1998 and will be disposed of securely. The information will be used in a way that will not allow you to be identified individually. No one will be able to link any information provided to you.

What happens after the study?

Once the study is complete, the researcher will write a thesis detailing the views and experiences of women in the group. This information will be made available to health professionals through publication in health service journals but will not identify you in any way. You will receive a summary of the findings if you wish.

Who is organising the study?

This study is being conducted as part of a doctoral course at the University of

Oxford and is being supervised by Professor Mike Clarke, Director of Medical Research Council Methodology (HUB), Dr Valerie Smith, Lecturer in Midwifery/Research Fellow; Dr Eve Hutton, Head of Occupational Therapy; and Mrs Julie Pearce, Chief Nurse, Division of Clinical Quality, Patient and Operations. Further details about the researcher and her supervisors are provided below.

Who has reviewed the study?

This study has been approved by NHS Regional Ethics Committee and the

Department of Continuing Education, Ethics Committee at the University of Oxford.

What do I do now?

Think about the information on this sheet and ask me if you are unsure about anything. If you agree to take part, please sign the consent form. The consent form will be kept safe by the researcher with all other research data information. If, after the discussion, you want any more information about the study, please do not hesitate to contact me my email: marion.kibuba@kellogg.ox.ac.uk

If you feel upset after the discussion and need help dealing with your feelings, you must talk to someone immediately.

The contact details for the person to talk to are:
Name: _____

If you require further information or wish to discuss any aspects of this study, please contact:

Researcher: Marion Kibuka, Doctorate in Evidence-Based Health Care, University of Oxford, Continuing Education Department, Rewley House, I Wellington Square, Oxford, Oxfordshire, OX1 2JA: Email address: marion.kibuka@kellogg.ox.ac.uk

Academic and Clinical Supervisors

Primary supervisor: Professor Mike Clarke, Director of Medical Research Council Methodology (HUB), Centre for Public Health, Institute of Clinical Sciences, Block B Queens University Belfast, Royal Victoria Hospital, Grosvenor Road, Belfast BT12 6BJ, Northern Ireland: Email Address: m.clarke@qub.ac.uk

Co-Supervisor: Dr . Valerie Smith, Lecturer in Midwifery/Research Fellow, School of Nursing and Midwifery, Trinity College Dublin, 24 D'Olier Street, Dublin 2, Email Address: smith1@tcd.ie

Co-Supervisor: Dr Eve Hutton, Head of Occupational Therapy (Children, Young People safety Families), First Floor Offices, Buckland Hospital, Coombe Valley Road, Dover, Kent, CT17 0HD, and Email Address: eve.hutton@nhs.net

Clinical Supervisor: Mrs Julie Pearce, Chief Nurse, Division of Clinical Quality, Patient and Operations, East Kent Hospitals University NHS Foundation Trust, Kent and Canterbury Hospital, Ethelbert Road, Kent, CT1 3NG, Email: juliepearce@nhs.net

Thank you for taking the time to read this information sheet. If you return the attached form, you will be contacted shortly by the researcher. If you agree to participate in the study, you will be given a copy of this information sheet and a signed consent form to keep.

East Kent Hospitals University NHS
NHS Foundation Trust

Recommendations of the III Approval Committee:
Approved by:_____
Approved date:_____

Participant Information Sheet for Delphi Survey

Study Title:

"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth"

You are invited to participate in a questionnaire survey exploring your knowledge and/or experiences on the factors that facilitate or hinder the use of squatting positions during pregancy and childbirth. The study aims to develop a consensus judgment from experts on the definition(s), types, and factors affecting the care for women adopting squatting positions at any stage of pregnancy and childbirth to inform an evidence-based package. You will be asked to complete three different questionnaires. The first questionnaire will have open-ended questions where you will have an opportunity to write as many answers as possible you think are essential for the research questions. The second questionnaire will include summary feedback from all experts and a new questionnaire generated from the first-round survey.

Participation in this study is voluntary, and you are under no obligation to take part in this study. You are free to withdraw at any point before the questionnaire (you may destroy the questionnaire if you wish). All data collected will be kept confidential and used for research purposes only. The consent forms will be kept separate from the questionnaires. Please briefly examine the questionnaire before signing this consent form.

There are no trick questions in this survey. There are no right or wrong answers. Your name or identifying characteristics will not be available to anyone other than the researcher and her supervisors.

Once the study is complete, the researcher will write a thesis detailing the views and experiences of the multi-disciplinary panel consensus of opinions on squatting positions. This information will be made available to health professionals through publication in health service journals but will not identify you in any way. You will receive a summary of the findings if you wish.

This study is being conducted as part of a doctorate in Evidence-Based Health Care at the University of Oxford. It is being supervised by Professor Mike Clarke, Director of Medical Research Council Methodology (HUB), Dr Valerie Smith, Lecturer in Midwifery/Research Fellow, Dr Eve Hutton, Head of Occupational Therapy and Mrs Julie Pearce, Chief Nurse, Division of Clinical Quality, Patient and Operations. Further details about the researcher and her supervisors are provided below.

This study has been approved by NHS Regional Ethics Committee and the

Department of Continuing Education, Ethics Committee at the University of Oxford.

If you have any questions, you may contact me on:

Researcher: Marion Kibuka, Doctoral Student in Evidence-Based Health Care, University of Oxford, Continuing Education Department, Rewley House, I Wellington

Square, Oxford, Oxfordshire, OX1 2JA: Email address: marion.kibuka@kellogg.ox.ac.uk

Primary supervisor: Professor Mike Clarke, Director of Medical Research Council Methodology (HUB), Centre for Public Health, Institute of Clinical Sciences, Block B Queens University Belfast, Royal Victoria Hospital, Grosvenor Road, Belfast BT12 6BJ, Northern Ireland: Email Address: m.clarke@qub.ac.uk

Co-Supervisor: Dr . Valerie Smith, Lecturer in Midwifery/Research Fellow, School of Nursing and Midwifery, Trinity College Dublin, 24 D'Olier Street, Dublin 2, Email Address: smith1@tcd.ie

Co-Supervisor: Dr Eve Hutton, Head of Occupational Therapy (Children, Young People safety Families), First Floor Offices, Buckland Hospital, Coombe Valley Road, Dover, Kent, CT17 0HD, and Email Address: eve.hutton@nhs.net

Clinical Supervisor: Mrs Julie Pearce, Chief Nurse, Division of Clinical Quality, Patient and Operations, East Kent Hospitals University NHS Foundation Trust, Kent and Canterbury Hospital, Ethelbert Road, Kent, CT1 3NG, Email: juliepearce@nhs.net

East Kent Hospitals University NHS
NHS Foundation Trust

Recommendations of the III Approval Committee:
Approved by: _____
Approved date: _____

Participant Invitation Letter

East Kent Hospitals University NHS Foundation Trust
Kent and Canterbury Hospital
Ethelbert Road
Canterbury
Kent
CT1 3NG

Dear …….

This letter is to invite you to participate in a research study on maternal positions during childbirth.

The title of the study is:

"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth"

This study aims to explore the lived experience and/or knowledge of midwives on their views of squatting positions during the second stage of labour. Potential risks and benefits of squatting positions during pregnancy and childbirth are published in professional and peer-reviewed journals. However, there has not been a comprehensive study of the evidence which balances the benefits against the risks of this intervention during labour and birth. Furthermore, there is no accessible single document providing effective practices that can eliminate suspected risk factors and maximise the benefits of squatting positions for normal birth. The study's purpose is to explore your knowledge and/or experience on the factors that facilitate or hinder the use of squatting positions during the pregnancy, labour or birth. You will be able to share your experience in a small group discussion of 'experts' in midwifery on the topic. The group discussion aims to reach a consensus on various aspects of the study. These are listed in the attached information pack for participants of the study.

You have been chosen because you are a qualified midwife with experience looking after pregnant women who decide to squat during childbirth. We plan to conduct four NGT group discussions with six participants in each group. We hope to include 24 clinical midwives with various experiences to ensure in-depth knowledge and expertise are acquired for the study.

Enclosed with this letter is an 'information sheet' giving more detail about the study.

I would be grateful if you could read this information and return your response form in the envelope provided if you wish to participate in the study. You can also use this form if you require further information before deciding.

Thank you for your time

Marion Kibuka (Chief Investigator and Registered Midwife)

RGN, RM, BSc, MSc

East Kent Hospitals University NHS
NHS Foundation Trust

Recommendations of the III Approval Committee:
Approved by: _____
Approved date: _____

Delphi/NGT Participant Recruitment Email

Study title: ***"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth"***

If you have read the information sheet and would like to participate in the study, please complete the details below and return this form in the stamped addressed envelope **(or email the researcher directly).**

Thank you for your interest in participating in this study. Your involvement is vital to identifying the factors that will enable women to adopt evidence-based positions in childbirth. By completing this form, you permit the researcher to contact you about participation in this study. Your details will remain confidential.

Name ……

Email address ……

Job title ……..

Organisation/company ……..

Age: ……..

Gender: ……..

Which occupational group best describes your current role?

□ Obstetrician □ Lecturer (midwife)

□ Head of Midwifery □ Consultant Midwife

□ Risk manager (Midwife) □ Matron (Midwife)

□ Community Midwife □ MLU midwife

□ Labour room midwife □ Band 7 Midwife

□ Band 6 Midwife □ Band 5 Midwife

□ Researcher □ Other: ……

Work Telephone …… Mobile …… (if preferred)

Work Email Address: ……..

East Kent Hospitals University NHS
NHS Foundation Trust

Recommendations of the III Approval Committee:
Approved by:_____
Approved data:_____

Appendix 17.7

Participant Consent Form **Study Design: Nominal Group Technique**

Centre number: Study number:

Participant Identification number for this study:

Title of Study

"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth"

Consent to Participate in a Research Study

Principal Investigator: Marion Kibuka, Doctoral Research Student.
Department of Continuing Education, University of Oxford

Researcher Marion Kibuka, a student at the University of Oxford in the Department of Continuing Education, invites you to be part of a research project that she will conduct to complete the requirements for an advanced degree. She is supervised by several professionals who have different roles in overseeing the study. These are:

Primary Supervisor: Professor Mike Clarke;
Co-supervisor: Dr Valerie Smith;
Co-supervisor: Dr Eve Hutton; and
Clinical supervisor: Mrs Julie Pearce

The project examines maternal positions during childbirth. The purpose of the study is to determine the factors that hinder or facilitate squatting positions during pregnancy and childbirth. The information you provide will contribute to developing an evidence-based knowledge on squatting positions during pregnancy and childbirt, to combine into one document. The study is funded by ----------. We are asking you to participate because we want to generate a consensus (agreement) on the most important evidence required by clinicians during the management of care women who choose to squat. To the researcher, there has not been a study of this kind in the past. Therefore, we are looking for strategies which can promote effective practices for the management of care in women who squat.

Description of your involvement
If you agree to take part in the research study, you will be asked to participate in one nominal group session [NGT] (similar to focus group meetings) at the postgraduate centre at Kent and Canterbury Hospital. We will invite 5 to 9 people to meet together to discuss their experiences and opinions about squatting positions during the pregnancy and childbirth. The discussion topics will include six different questions. **A member of the research team will help guide the discussion.** The NGT group will last about four hours and we will videotape the discussion to make sure that it is recorded accurately. You must agree to be videotaped to participate in the NGT group.

Benefits
While you may not receive a direct benefit from participating in this research, some people find sharing their stories to be a valuable experience. We hope that this study will contribute to the improvement of professional and social support systems for those who provide care to others.

Risks and discomforts
Answering questions or talking with others about past experiences of assisting birth in a squatting position can be difficult. You may choose not to answer any discussion questions and you can stop your participation in the NGT group at any time. The facilitator will have a list of local agencies that can provide you with additional information or support if you are interested.

All NGT group members are asked to respect the privacy of other group members. You may tell others that you were in an NGT group and the general topic of the discussion, but the actual names and stories of other participants should not be repeated.

Compensation
You will be paid £18:90 per hour for participating in the NGT group session. If you leave before the focus group ends, you will receive £7:00. You will need to pay for your travel and parking expenses.

Confidentiality

The researcher plans to publish the results of this study, but any information that would identify you or any other group member will not be included. To keep your information safe, the videotape of the NGT group will be placed in a locked file cabinet until a written word-for-word copy of the discussion has been created. The researcher will enter study data on a password-protected computer and use special coding to protect the information. To preserve confidentiality, your real name will not be used in the written copy of the discussion. The researcher intends to keep this study data and the videotapes for future research on squatting positions during childbirth.

There are some reasons why people other than the researchers may need to see the information you provided as part of the study. This includes organisations responsible for ensuring that the research is done safely and correctly, including the University of Oxford, NHS Trusts hosting the survey, or the study funding bodies, the Department of Health. Because this study explores lived experiences, if you tell us something that makes us believe that you or others have been or may be physically harmed, we may report that information to the appropriate agencies.

Voluntary nature of the study
Participating in this study is entirely voluntary. Even if you decide to participate now, you may change your mind and stop anytime. You may choose not to answer a focus group question for any reason.

Contact information
If you have questions about this research, including questions about the scheduling of the NGT group or any other issue regarding the study, you can contact:

Researcher: Marion Kibuka, Doctoral Student in Evidence-Based Health Care, University of Oxford, Continuing Education Department, Rewley House, I Wellington Square, Oxford, Oxfordshire, OX1 2JA: Email address: marion.kibuka@kellogg.ox.ac.uk

Primary supervisor: Professor Mike Clarke, Director of Medical Research Council Methodology (HUB), Centre for Public Health, Institute of Clinical Sciences, Block B Queens University Belfast, Royal Victoria Hospital, Grosvenor Road, Belfast BT12 6BJ, Northern Ireland: Email Address: m.clarke@qub.ac.uk

Co-Supervisor: Dr Valerie Smith, Lecturer in Midwifery/Research Fellow, School of Nursing and Midwifery, Trinity College Dublin, 24 D'Olier Street, Dublin 2, Email Address: smith1@tcd.ie

Co-Supervisor: Dr Eve Hutton, Head of Occupational Therapy (Children, Young People, safety Families), First Floor Offices, Buckland Hospital, Coombe Valley Road, Dover, Kent, CT17 0HD, and Email Address: eve.hutton@nhs.net

Clinical Supervisor: Mrs Julie Pearce, Chief Nurse, Division of Clinical Quality, Patient and Operations, East Kent Hospitals University NHS Foundation Trust, Kent and Canterbury Hospital, Ethelbert Road, Kent, CT1 3NG, Email: juliepearce@nhs.net

Consent
By signing this document, you agree to be in the study. You will be given a copy of this document for your records, and one copy will be kept with the study records. Be sure that questions you have about the study have been answered and that you understand what you are being asked to do. You may contact the researcher if you think of a question later.

I agree to participate in the study. As part of my consent, I agree to be videotaped.

_____ _____
Participant's Signature Date

_____ _____

Researcher's Signature Date

East Kent Hospitals University NHS
NHS Foundation Trust

Recommendations of the III Approval Committee:
Approved by:_____
Approved data:_____

Participant Consent Form **Study Design:** Delphi Technique

Centre number: Study number:

Participant Identification number for this study:

Title of Study

"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth"

Researcher Marion Kibuka, a doctoral student at the University of Oxford in the Department of Continuing Education, invites you to part in a research project that she is conducting to complete the requirements for an advanced degree. She is supervised by several professionals who have different roles in overseeing the research study. These are:

Primary Supervisor: Professor Mike Clarke;
Co-supervisor: Dr Valerie Smith;
Co-supervisor: Dr Eve Hutton; and
Clinical supervisor: Mrs Julie Pearce

If you agree to participate in the research study, you will be asked to complete an online Delphi survey about maternal positions during childbirth. We expect this survey to take 30 minutes to complete. Some of the survey questions ask about assisting birth in the squatting positions, and these may be distressing for you as you think about your experiences. If you need to talk to someone about these feelings, please contact: "the researcher or her supervisor as per the details below.

While you may not receive any direct benefit from participating, we hope that this study will contribute to the improvement of social support systems for those who provide care to others.

The researcher will not be able to link your survey responses to you. The survey software has been set so that no identifying information is captured. We may publish the results of this study but will not include any information that would identify you.

Participating in this study is entirely voluntary. Even if you decide to participate now, you may change your mind and stop anytime. You may choose not to answer an individual question, or you may skip any section of the survey. Simply click "Next" at the bottom of the survey page to move to the next question. However, it will benefit the study if you complete all items in the survey.

If you have questions about this research study, you can contact:

Researcher: Marion Kibuka, Doctoral Student in Evidence-Based Health Care, University of Oxford, Continuing Education Department, Rewley House, I Wellington Square, Oxford, Oxfordshire, OX1 2JA: Email address: marion.kibuka@kellogg.ox.ac.uk

Academic and Clinical Supervisors

Primary supervisor: Professor Mike Clarke, Email Address: m.clarke@qub.ac.uk

Co-Supervisor: Dr . Valerie Smith, Email Address: smith1@tcd.ie

Co-Supervisor: Dr Eve Hutton, Email Address: eve.hutton@nhs.net

Clinical Supervisor: Mrs Julie Pearce, Email: juliepearce@nhs.net

If you have questions about your rights as a research participant, please contact the **University of Oxford Research Review Board (address and telephone numbers) to be confirmed.**

By clicking on "Yes, I agree to participate", you are consenting to participate in this research survey.

Yes ☐

If you do not wish to participate, select "No, I do not wish to participate" to exit the survey

No ☐

Page 23

'Interested in a squat study?'

Study Title: *"An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth"*

The objective of the study: To generate a consensus judgement from healthcare providers on the factors that facilitate or hinder the use of squatting positions during the pregnancy and childbirth.

Description of the Study: Participants are invited to join a group discussion of 5 to 9 'expert' panels, called Nominal Group Technique (NGT). Each participant will be given an equal chance of discussing their views, experience and/or knowledge about squatting positions during childbirth. Each discussion will take approximately 4 hours.

Eligibility: All qualified midwives who have clinical experience and/or knowledge of assisting birth in a squatting maternal position. A total of 24 midwives are required for this study.

Reimbursement: Participants will be reimbursed at an hourly rate of £18:90 (band 6 midwife's rate). Payment is for reimbursement of time and not a reward for participating in the study.

(*If the study is funded)*

Further information: If you require any further information please do not hesitate to contact the researcher or academic and clinical supervisors.

Researcher: Marion Kibuka, Email: marion.kibuba@kellogg.ox.ac.uk
Primary supervisor: Professor Mike Clarke, Email: m.clarke@qub.ac.uk

Co-Supervisor: Dr . Valerie Smith, Email: smith1@tcd.ie

Co-Supervisor: Dr Eve Hutton, Email: eve.hutton@nhs.net

Clinical Supervisor: Mrs Julie Pearce, Email: juliepearce@nhs.net

Poster for Recruiting Midwives

Page 24

‘Interested in a squat study?’

Study Title: “*An investigation involving multiple systematic reviews and a Delphi study of the effects and definition of the squatting position in childbirth*”

The objective of the study: To generate a consensus judgement from women's perspectives on the factors that facilitate or hinder the use of squatting positions during the pregnancy and childbirth.

Description of the Study: Participants are invited to join a group discussion of 5 to 9 ‘expert’ panels, called Nominal Group Technique (NGT). Each participant will be given an equal chance of discussing their views, opinion and experience of squatting positions during childbirth. Each discussion will take approximately 4 hours.

Eligibility: All women with a history of adopting squatting position(s) during childbirth, whether you had a good or bad experience. A total of 12 women are required for this study.

Reimbursement: Participants will be reimbursed by an hourly rate of £15:00. Payment is for reimbursement of time and not a reward for participating in the study.

(*If the study is funded)*

Further information: If you require any further information please do not hesitate to contact the researcher or academic and clinical supervisors.

Researcher: Marion Kibuka, Email: marion.kibuba@kellogg.ox.ac.uk
Primarily supervisor: Professor Mike Clarke, Email: m.clarke@qub.ac.uk

Co-Supervisor: Dr . Valerie Smith, Email: smith1@tcd.ie

Co-Supervisor: Dr Eve Hutton, Email: eve.hutton@nhs.net

Clinical Supervisor: Mrs Julie Pearce, Email: juliepearce@nhs.net

Poster for Recruiting Women

March 26, 2014

Name of Chair

IRAS (NHS Ethical Committee)

Address

Dear Name:

Enclosed please find the protocol and consent form for the study, "*Squat Study*" I have also enclosed a copy of the University of Oxford Review Board's approval, dated …….., 2014.

I propose to conduct a Nominal Group Technique discussion with frontline midwives and women with a history of choosing to squat during the second stage of labour. In addition, I intend to conduct an international Delphi survey with practitioners and academic professionals in midwifery and professionals in related health disciplines to investigate the factors that hinder or facilitate the acceptability, applicability, and suitability of squatting positions during the passive and active second stage of labour (PASSOL). I will also conduct a systematic review of squatting positions during labour and birth. This is an innovative study with the overall aim of developing and validating a training package on squatting positions during PASSOL. There is evidence to suggest that training health care professionals in core skills such as squatting during childbirth can improve midwifery competencies and increase the uptake of this intervention.

I have met with both project supervisors and other professionals on several occasions to discuss this project. I have received official approval for the project from both the East Kent Hospitals University NHS Foundation Trust and Medway NHS Foundation Trust.

Currently, this study has been funded on a part-time contract from 09 September 2012 to 14 November 2014 by the Health Education for Kent, Surrey and Sussex, Third Floor Red Wing Crawley Hospital, West Green Drive, Crawley West Sussex, RH11 7DH. Currently, I apply for this funding every year.

I have scheduled to start data collection for this project in September 2014. I will appreciate your informed review and approval of the enclosed material. If you have any questions or concerns, please contact me at the email address: mkibuka@nhs.net.

I am looking forward to your comments and approval.

Yours Sincerely,

Marion Kibuka, Principal Investigator (RGN, RN, BSc, MSc)

Prof. Mike Clarke (Primary Project Supervisor)

Dr Valerie Smith (Co-Supervisor)

Dr Eve Hutton (Co-Supervisor)

Mrs Julie Pearce (Clinical Supervisor)

Appendix 21

TITLE PAGE

RESEARCH PROPOSAL FOR A DPhil IN EVIDENCE-BASED HEALTH CARE

Name of the Research:
Squat Study

RESEARCH TITLE:

"Consensus development of the definition of the squatting position in childbirth: A Delphi and Nominal Group Discussions"

By
MARION KIBUKA
(MSc, BSc, RM, RGN)

PRIMARY ACADEMIC SUPERVISOR
Professor MIKE CLARKE

CO-SUPERVISOR ACADEMIC SUPERVISOR

Dr VALERIE SMITH

CLINICAL SUPERVISOR
JULIE PEARCE

FIRST Version
21/03/2014

Background of the Study

Squatting is when a labouring woman is sitting in a crouching position while her thighs are abducted and flexed, with her weight off the pelvis and the main axis of the body greater than 60 degrees from horizontal [(78)]. This definition is fundamental for this project. For decades, there has been controversy around whether being upright (sitting, squatting, kneeling, standing, walking, hands & knees, knees to chest, birth stool, balls and chairs) or lying down (lateral, semi-recumbent, recumbent, lithotomy, supine) have advantages for the woman in childbirth [(72, 79)]. Since 1963, empirical evidence on the influence of different positions in childbirth on maternal and foetal outcomes has been continually emerging but consistent with poor quality [1].

For many aspects of healthcare, meta-analyses of prospective RCTs remain the best method to obtain evidence about the value of an intervention. It is the only research method that allows researchers to balance known and possibly unknown confounders that may affect research outcomes [(80)]. In addition, the strong internal validity and usefulness of the RCTs design lie in its supremacy in offering a reliable association between cause and effect.

According to Wells and colleagues [(81)], the reader of the study article needs to be able to understand and define the cause of the effect. There is a potential for the cause to be the intervention itself, fundamentals of the healthcare context within which the intervention is being carried out, the methods used in research procedure in the clinical practice or a mixture of all three [(82)]. Therefore, the process of how the intervention is implemented may influence the observed outcomes. In these SRs causal inferences can be undermined by flaws in the study design, data collection and analysis of primary studies and leading to type1 error (under or overestimation of the true intervention effect).

Currently, there are several systematic reviews of randomised controlled trials (RCTs) that evaluate different maternal positions for women in labour and birth [(83)]**.** Overall evidence of these review findings was rated low using the GRADE tool. One of the main reasons for the low confidence level in the findings is the considerable variation in the position interventions women received and how these positions were described. There is a lack of consensus on the description of interventions, and very little is known about the mechanisms that distinguish different types of maternal positions in childbirth.

Empirical studies have reported various squatting positions which are broadly categorised as being either unsupported/unaided/full/deep/traditional or supported/aided/modified/semi or partial squatting positions [27, 29, 31-36]. Different terms which have been used for describing squatting are: standing (unsupported squatting); sitting (supported squatting with chair/cushion/stool/ball; knee-squat; semi-squat; full squat; modified squatting positions [27, 29, 31-34, 36], with some using aids to support women's feet [37, 42] while others the feet are not supported [30, 43].

According to Glasziou [84], failure to describe interventions adequately in a trial may result in the incorrect use of these interventions or not used at all. Multifaceted interventions such as maternal positions necessitate completeness and accurate published description for researchers and other healthcare professionals to assess the generalizability of findings, synthesise literature, design future trials, determine the feasibility of interventions and develop intervention standards.

Subsequently, understanding how complex interventions work is important in producing robust research. Yet in RCT studies evaluating the effectiveness of these interventions, the complexity of these interventions has been widely accepted with little understanding of their active parts. Consequently, to improve future RCTs assessing the effectiveness of squatting in childbirth, it is essential to develop a theoretical framework of what this intervention is.

Research question

Definition of squatting positions:

Please provide your definitions of squatting positions during labour and birth.

Key Elements of squatting positions:

List all the key elements that you believe best describe squatting positions during labour and birth. This could include details about how it is applied, delivery methods, and any relevant equipment.

Barriers to using squatting positions:

Identify and list all the factors that you consider vital for hindering the use of squatting positions during labour and birth. This may include obstetrical, cultural, personal, organisational, or other factors.

Facilitators for using squatting positions:

List all the factors that you believe are the most important in facilitating the use of squatting positions during labour and birth. This could encompass maternity care practices, support from healthcare providers, or women preferences.

Additional comments:

Please provide any additional comments or insights you have regarding the use of squatting positions during birth. This can include personal experiences, observations, or any other relevant information.

Overview of Objectives of the Study

To identify and prioritise the most important key elements to generate a clear description of squatting derived from consensus statements through an interactive, online Delphi survey in conjunction with Nominal Group Technique (NGT) discussions involving women, midwives, obstetricians, and other health professionals.

Methodology

It has been stated that in systematic approaches indicator selection relies directly on the compiled synthesised available evidence, complemented when necessary with expert opinion [2, 85]. Experts will use their lived experiences and examine the evidence to reach a consensus. Systematic methods enhance decision-making [15]; facilitate the development of quality care or review criteria for areas where the evidence alone is insufficient [2] or controversy exists [3, 4] and synthesize accumulated expert opinion. Among these methods, systematic reviews, NGT and the Delphi technique have been widely used for quality-care development in healthcare. According to May and colleagues [1], a theoretical framework for describing complex interventions should be formed by three kinds of conceptual work. These are accurate descriptions, systematic explanations and knowledge claims. A rapid consensus is required from a panel of experts to develop an accurate description by

providing a set of definitions that enable the identification, differentiation and codification of the qualities and properties of cases and classes of phenomena [1].

Recruitment and Selection of Consensus Development Methods Participants

Identifying the Experts

NGT and Delphi Technique are group decision mechanisms requiring qualified experts who have a deep understanding of the issues. They are designed to acquire expert group face-to-face meetings and communication process that aims at conducting detailed examinations and discussions of a specific issue for goal setting, identification and/or prioritisation of a problem and conceptualisation or framework development for the training program. One of the most critical components of consensus development methods is the selection of qualified experts since it is their opinions upon which the output of the study is based [8-10]. These are the individuals with knowledge and experience in the field of childbirth about the substantive area of research, who will engage within the inquiry process and be able to articulate judgements. In coalition with the detailed guidelines on how to solicit qualified experts provided by Delbecq and colleagues [23], the study will use a multiple-step iterative strategy to identify the experts. They described a rigorous procedure whose purpose is to ensure the identification of relevant experts and allowed them to participate in the study.

Panel Structure:

Consensus development subjects will be trained and competent within the specialised area of childbirth. The researcher will need to closely examine and consider the qualifications and experiences (clinical and personal) of study subjects and select using a systematic process Jones and Twiss [86] four components are critical for identifying "expertise": knowledge and experience with the issues under investigation; capacity and willingness to participate; sufficient time to participate in the Delphi; and, effective communication skills [87]. Ludwig [88] also recommended, "A solicitation of nominations of well-known and respected individuals from the members within the target groups of experts". These will include opinion leaders [23], authors of research evidence [89, 90]; frontline midwives [91]; pregnant women [23, 92] and other stakeholders with various interests related to the target issue or research problem. The authors made it clear that they can be applied to the both NGT and Delphi technique approaches [11].

This will be the first step which will divide the experts into several different panels. In this case, four relevant classes of experts have important and valuable knowledge about maternal positions in labour and birth: academics, practitioners, researchers service users and professional organisations.

Step 1: Prepare a Knowledge Resource Nomination Worksheet (KRNW)

The purpose of the Knowledge Resource Nomination Worksheet has been described by Okoli and Pawlowski [11] as a structured framework used to categorise the experts before identifying them, to prevent overlooking any important class of experts.

Step 2: Populating the KRNW with names

After the KRNW is completed, a multi-disciplinary panel was generated. Then a stratified sampling technique was used to identify a diverse range of experts that included two stratums for NGT and Delphi Technique.

Step 3: First-round contacts—Nominations for additional experts

The researcher contacted various identified experts and ask them to nominate others for inclusion on the list (snowball sampling strategy). The first round of contacts aims primarily at extending the KRNW to ensure that many various experts can be accessed.

Step 4: Ranking experts by the level of qualifications

At this step, the researcher will obtain basic biographical information for every expert on the list to determine the qualifications they possess to make them experts.

Step 5: Inviting experts to the study

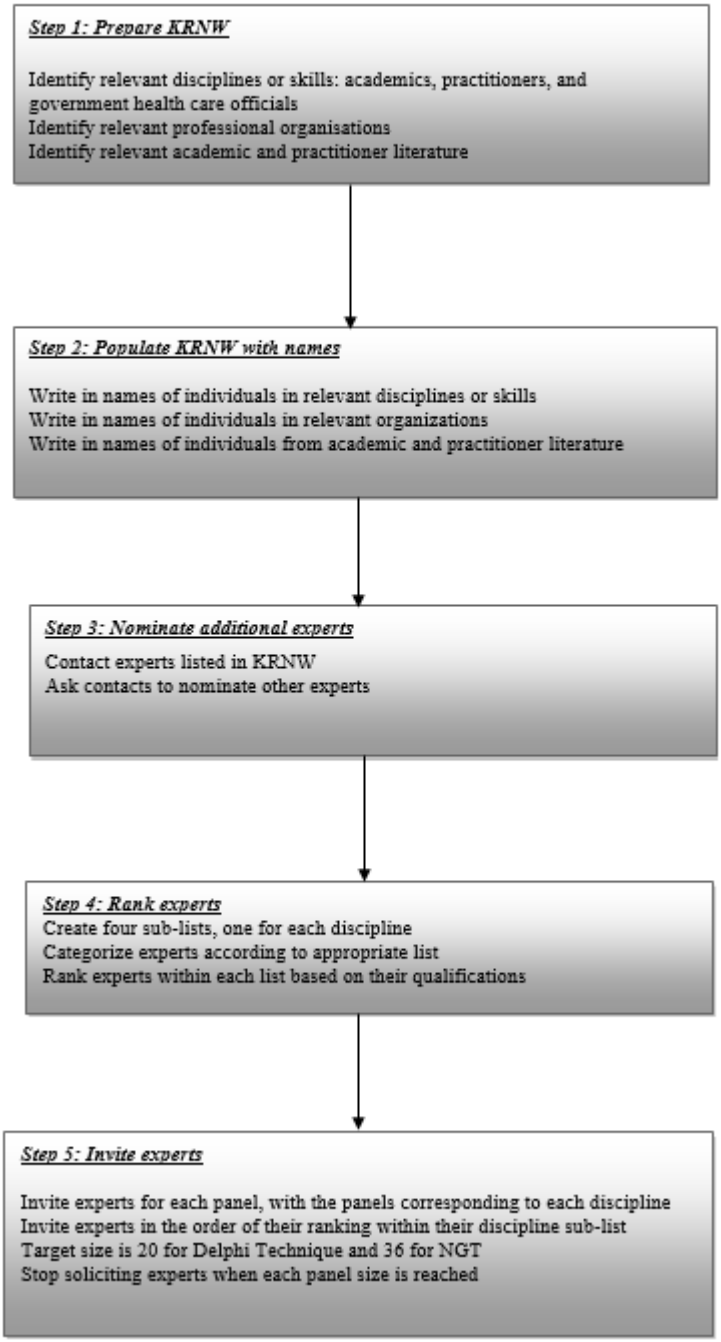
Based on the rankings, one panel will be created for each of the four clusters. Again, the target panel size will depend on the method of the inquiry which is the NGT or Delphi Technique. Choosing the maximum number provides a buffer in case of attrition, even though participant drop-out tends to be very low when respondents have verbally assured their participation [11].

The experts will be identified via the internet e.g. Google, Cochrane Library and PubMed searches on the subject, through personal networks of the researcher and recommendations selected opinion leaders. The expert

panels for the Delphi survey will be invited by email and personal contact and all will be asked to include demographic, information from their own experience or knowledge in the process. The invited experts will be asked to suggest colleagues who may be interested in participating in the study. Three reminders will be sent to the non-respondents.

Each expert will be contacted, and an explanation will be made about the subject of the study and the procedures required for it, including the commitment required. For the NGT study, panellists will commit to attending at least 4 hours (maximum of 7.5 hours for midwives) face to face discussions led by a facilitator; for the Delphi Technique, the panellists will complete 15-to-30-minute questionnaires and return them within two weeks of receipt, for a total of one hour over three months. The researcher will impose a limit of three questionnaires so as not to tax the participants, and yet give them an honest appraisal of their time commitment.

Summary of Procedure for Selecting Experts of the Study (adapted from Okoli and Pawlowski [38])



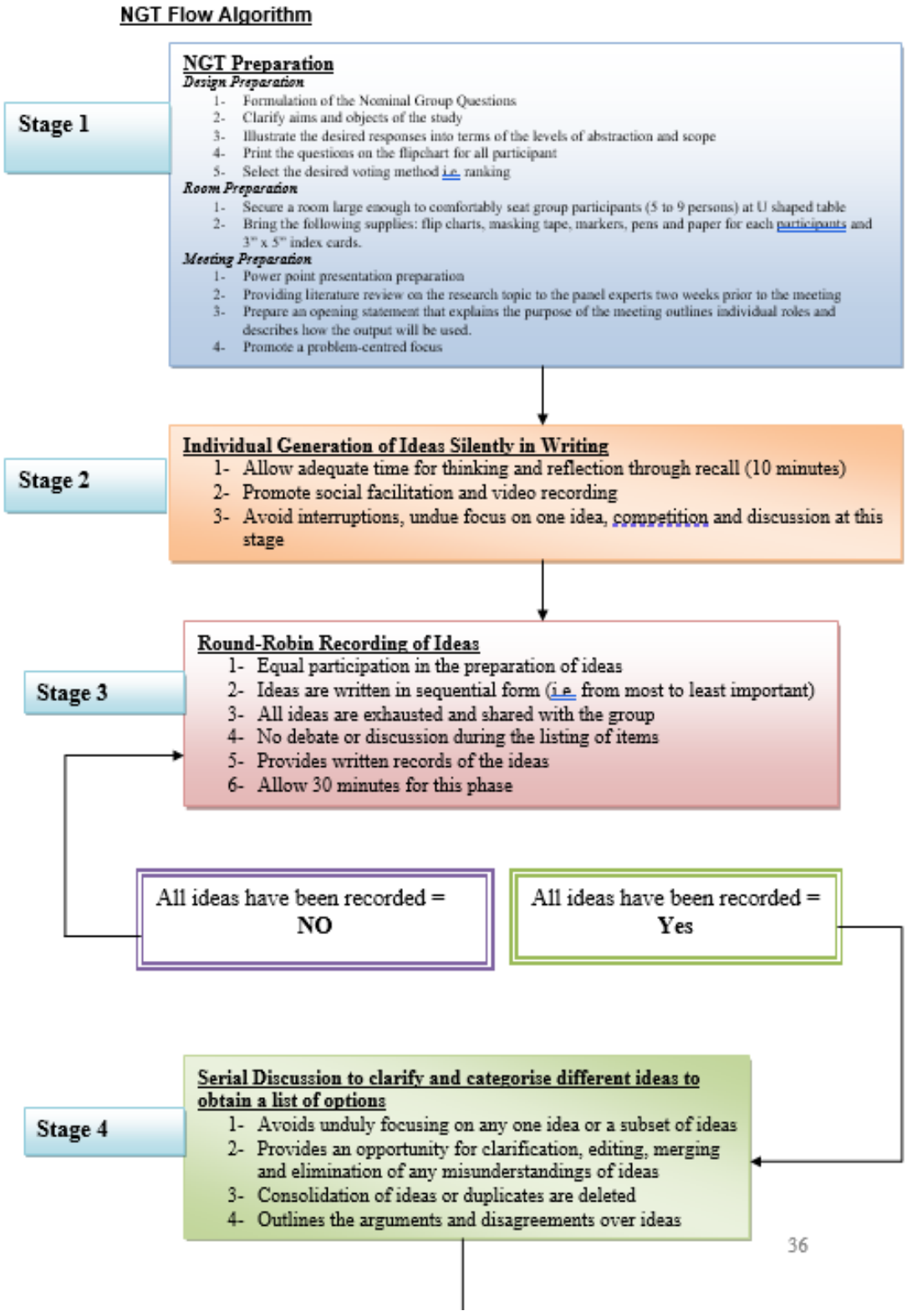
Nominal Group Technique

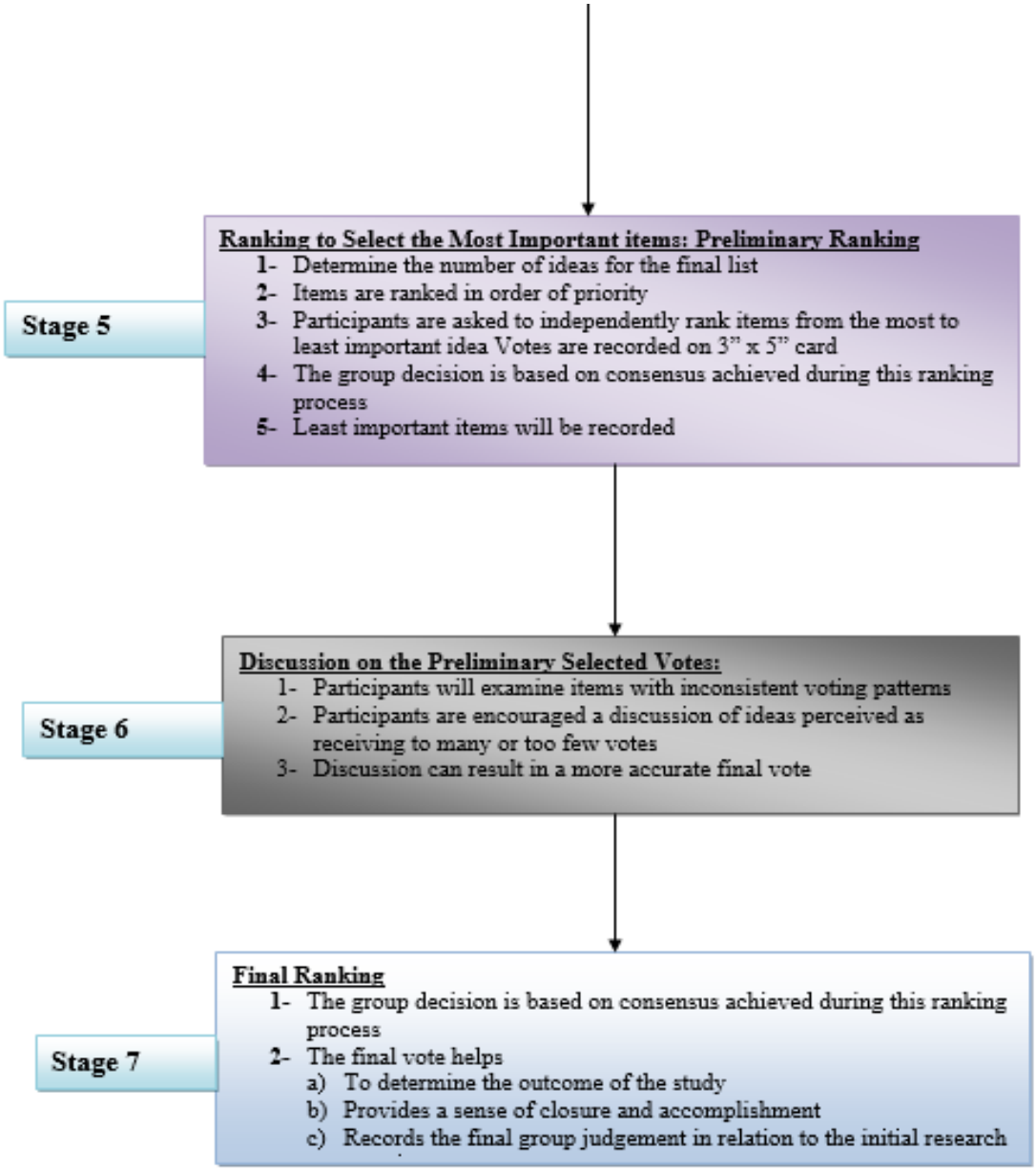
Nominal Group Technique (NGT) is a structured method generating data from group discussions that encourage contributions from everyone[41]. The Nominal Group Technique will be utilised to explore different perspectives and reach a consensus from clinical midwives and women on the factors that facilitate and hinder the acceptability, applicability and suitability of squatting positions during childbirth to inform the training package. Professional participants will include midwives with experience in supporting women adopting squatting position(s) during the second stage. User participants will be women who adopted squatting during childbirth.

Nominal Group Technique (NGT) will select professional participants who will include 24 midwives with experience supporting women adopting squatting position(s) during the second stage of labour. User Participant 12 will be about women's experience of adopting squatting during the second stage of labour. The ideal Nominal Group Technique (NGT) sample size will be 6-12 participants [(16)]. Six nominal groups will be conducted with 6 participants in each from two different maternity NHS Trusts (East Kent Hospitals University NHS Foundation Trust; Medway Maritime NHS Trust). Each workshop will last for 3 hours making a total of 18 hours approximately 2 days. This sample size has been recommended as the ideal size because a bigger size will have no additional benefit as they. After all, participation becomes more unequal [(16, 17)].

The groups will be purposively selected to represent as diverse a range of experiences and views as possible [(16)]. The group discussions will be designed to follow the same NGT process 5 steps as listed by Delbecq & Van der Ven [(23)]. This is a structured method for data generation. The discussion will be recorded on a flip chart, notes taken and a video recording/audiotape that will be transcribed. NGT discussions will be facilitated using an independent facilitator to reduce the risk of the researcher influencing the agenda too much, reducing bias [(23)]. The NGT will create two types of data. The first is the written ideas and prioritization, validated by the group as part of the process. The second is the wider discussion generating and clarifying the ideas. This second type of data will be transcribed and a content analysis using Oxford Web-Line software. Qualitative (generation of ideas) and quantitative (ranking of ideas) data will be subjected to systematic analysis with independent cross-checks by NGT subjects to increase trustworthiness. Information from each workshop was finally converted into a structured Round 2 e-survey by the researcher.

The timeline for collecting and analysing the NGT data will be two months (the 01st of September to the 31st of Oct, 2015).





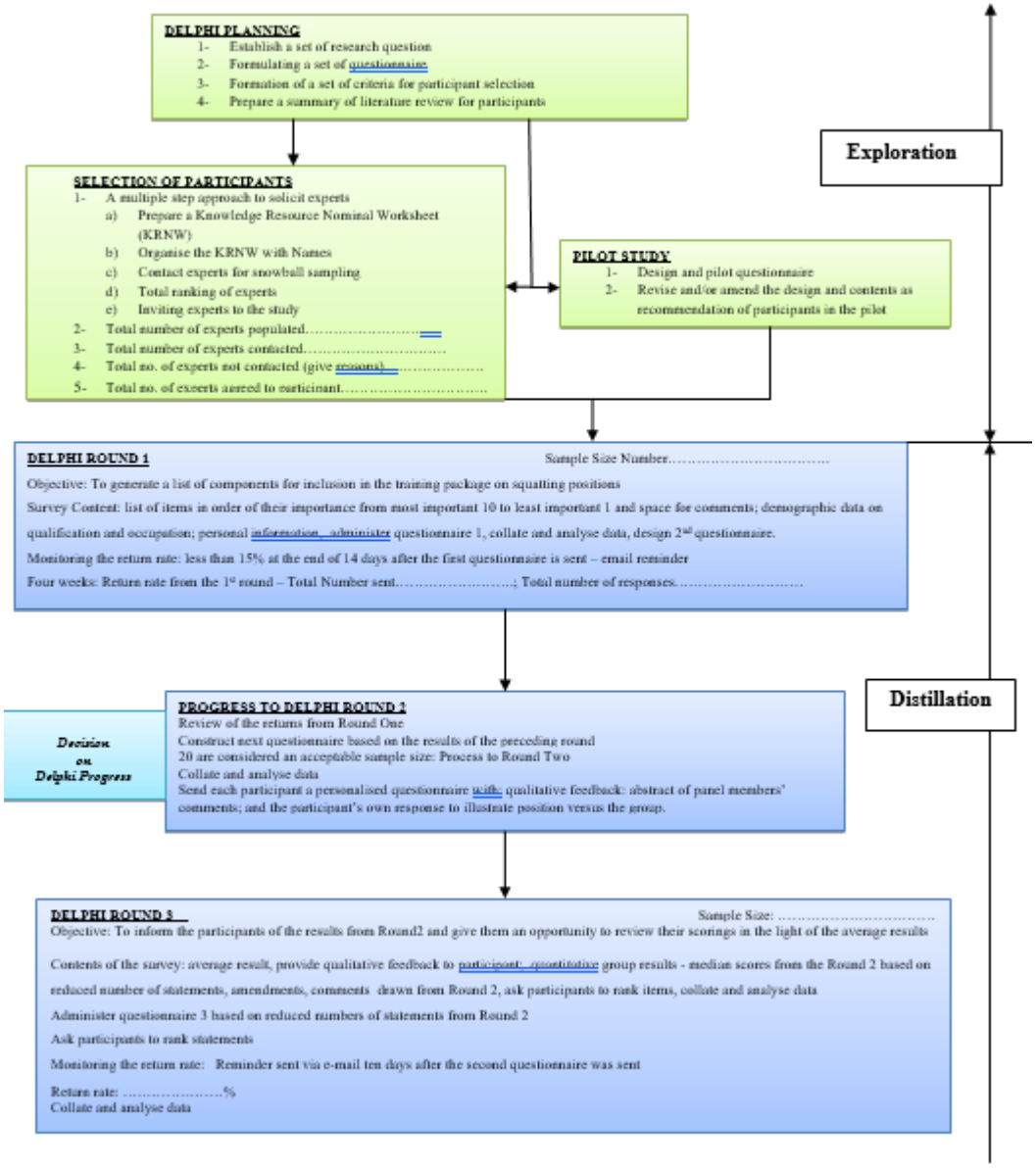
Delphi Technique

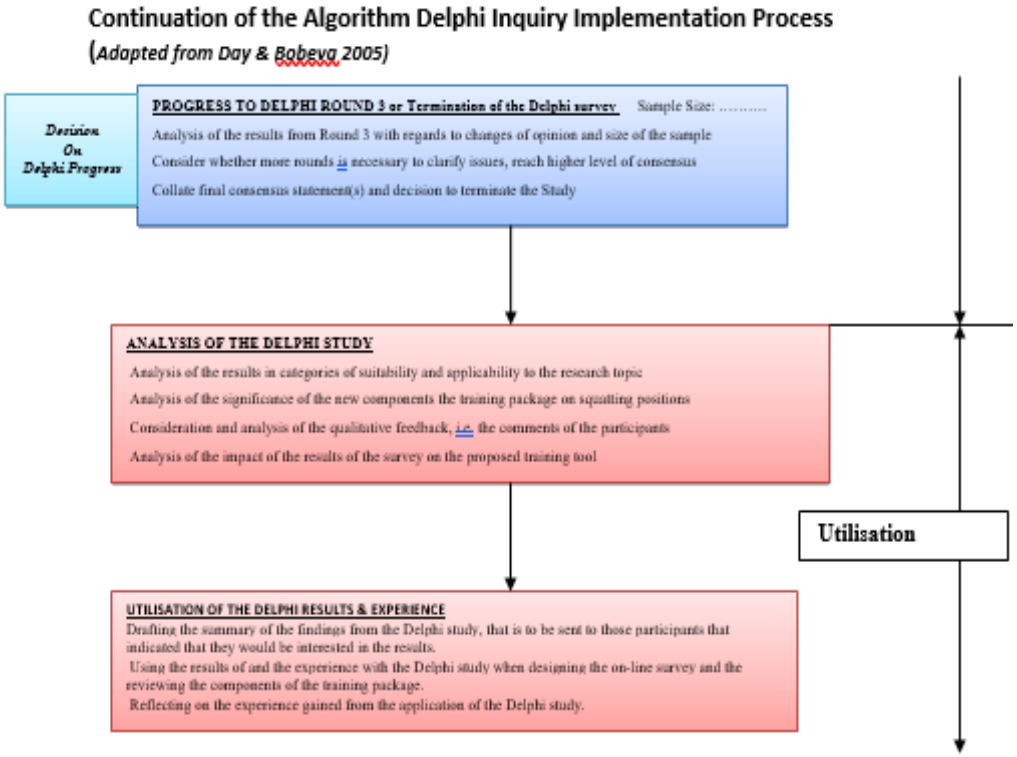
The Delphi method will gather a consensus of views and experiences, from a wider multi-disciplinary panel, on maternal positions during labour. This is to allow a national and international synthesis of ideas from the 'experts'.

It is pragmatic that the selection of subjects is one of the keystones in the entire process because it directly relates to the quality of the results generated[37, 45, 46, 47]. The Delphi participants will meet four expertise requirements which are: knowledge and experience with the issue under investigation; capacity and willingness to the participant; sufficient time to participate in the Delphi; and effective communication skills[48]. Therefore, a purposive sample is necessary together with the help of these project supervisors to identify the initial group of experts and may use the snowball sampling technique to generate subsequent participants (Hartman and Baldwin 1995. In addition, in alignment with the guidelines of Del becqu and colleagues [(23)], the study will use a multiple-step iterative approach to identify the experts. To enhance the credibility and widespread acceptance of the training tool, subject selection will reflect the full range of key characteristics of the population from which the participants will be drawn. These will include participants from UK national organisations such Royal College of Midwives, professionals with experience in training and development skills in midwifery or related disciplines, obstetricians, and international midwifery researchers and academics.

Data collection – The majority of researchers suggest that three iterations are often sufficient to collect the information to reach a consensus in most cases[(16, 23)]. The data collection technique will follow the structured process as stated by Chia-Chien[45]. Typically, questionnaires will be sent via emails to participants; the questions will be initially broad and open-ended and seek individual responses. The open-ended responses are then analysed to generate a series of statements (closed-ended questionnaires), which are compiled into another questionnaire and sent back to the individual participants who are asked to rank their agreement with each. Delphi studies typically involve three rounds or more if the sample is heterogeneous [(16)], but the number needed will depend on the research question and time available[56].

Algorithm of Delphi Inquiry Implementation





Sample Size

As mentioned above, a purposive sample is necessary together to identify the initial group of experts and may use the snowball sampling technique to generate subsequent participants [16]. The strategy for this study is to recruit as many experts as possible until 15 – 20 participants agree to take part in the study. This is the sample size required to reach a valid and reliable consensus judgment [16].

Data Collection

The design of the data collection instrument is critical for the Delphi technique process. Most researchers suggest that three iterations are often sufficient to collect the information to reach a consensus, if the sample is heterogeneous [3, 16, 18, 20, 93, 94]. The data collection technique will follow the structured process stated by Chia-Chie [20]. In the first round, the panel members will be provided with a list of themes and cues that summarize the items gathered from NGT discussions.

The timing of the questionnaires has a significant impact on the stability of the results and the response rate. For this study, each questionnaire will be given three weeks maximum time of return. Reminders will be sent 14 days after the questionnaire sent date. A wide time gap is undesirable as it allows for more changes in an individual's circumstances, knowledge and situational context and it might limit the response rate.

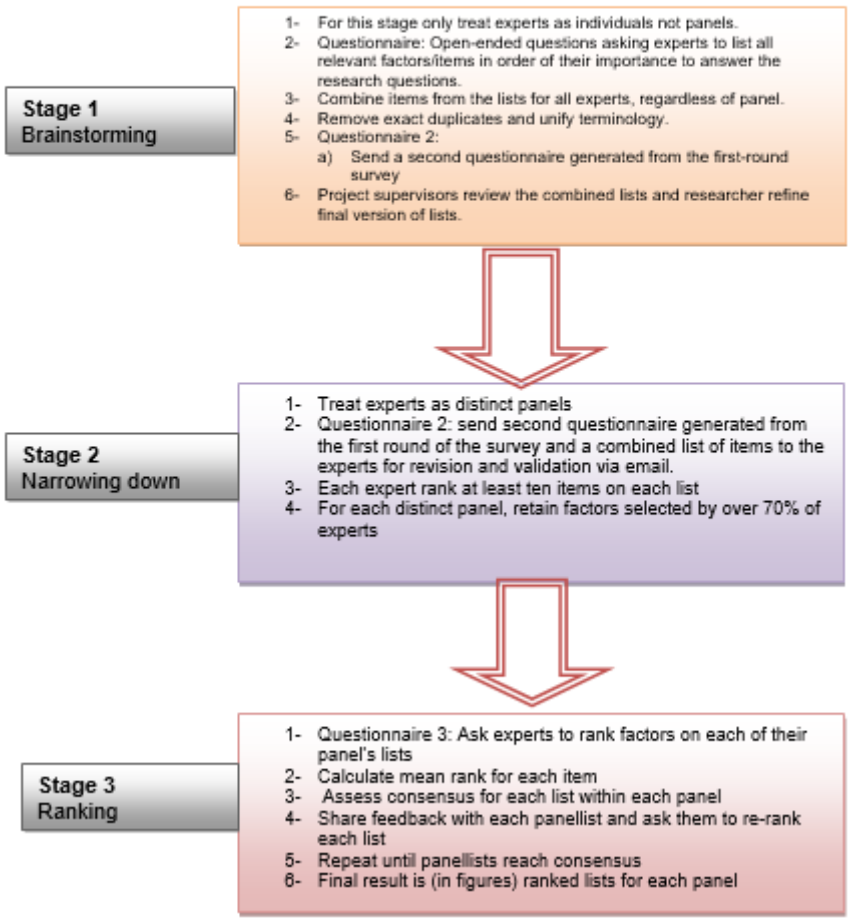
A mechanism for Administering the Questionnaire

The Delphi questionnaires will be administered using E-mail. The advantage of this 'rapid' media is that they speed up the turnaround time between questionnaires. Each E-mail to collect data will take about a month for participants in the study to fill out and return a questionnaire immediately for analysis, before the next one could be sent out [(11)] (01st of November 2014 – 31st of January, 2015). The researcher will not send out the next questionnaire until all the results from the participants are in. Three versions of questionnaires will be designed for this study. The administration of the questionnaire will follow the procedure for 'ranking-type' Delphi studies outlined by Schmidt and colleagues [(95)]. This involves three general steps 1) Brainstorming for important features; 2) narrowing down the original list to the most important ones; and 3) ranking the list of important factors [(17)]; [See diagram below – A summary of Delphi Technique Process]).

Weakness of the Delphi Method

Although the researcher can minimise the workload for the Delphi participants, it is often a considerable amount of work, which is likely to affect the method's acceptability [(96)]. Response rates can be low and often decrease as the rounds progress [(97)]. A considerable effort is needed beforehand to get professionals to 'buy in' to the process. Furthermore, it may be pragmatic to select a participant who has an interest and involvement in the question being explored [(15)]. This method is also complemented with the use of Nominal Group Technique discussion.

Delphi study administration process (Adapted from Day and Bobeva 2005)



Qualitative Analysis of NGT and Delphi Technique

A qualitative thematic analysis Framework' and a systematic classification process will be used to analyse the written documents or transcription of recorded verbal communication. The study will use QSR NVivo 9 software for coding and categorisation of NGT group discussion and Delphi transcripts. The analysis will identify patterns or similar ideas relevant to participants' experiences and perspectives related to the research questions.

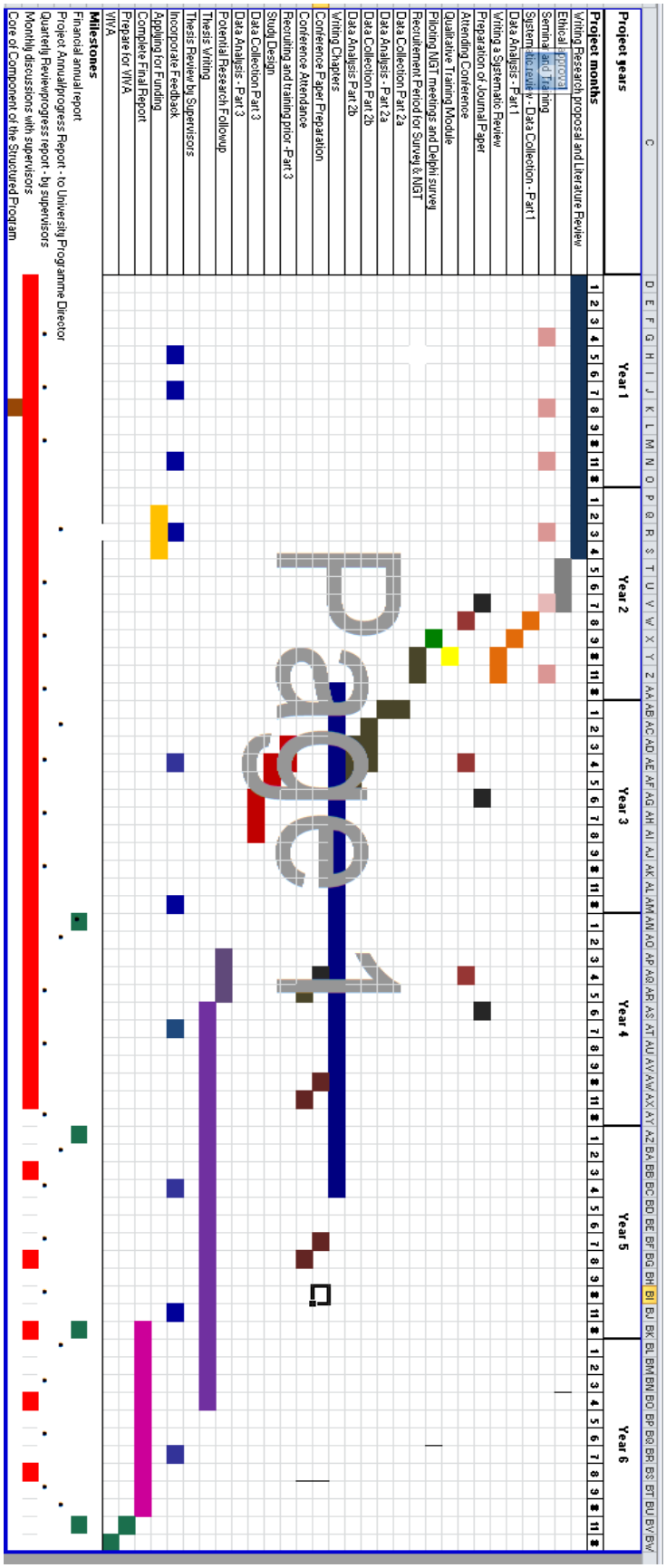
Ethical Implications of the study

The research will incorporate both the collection and analysis of qualitative and quantitative data from human subjects to answer the research questions. This will involve NHS employees and service users (pregnant women). Therefore, the study is subject to ethical review, and legal and NHS implications.

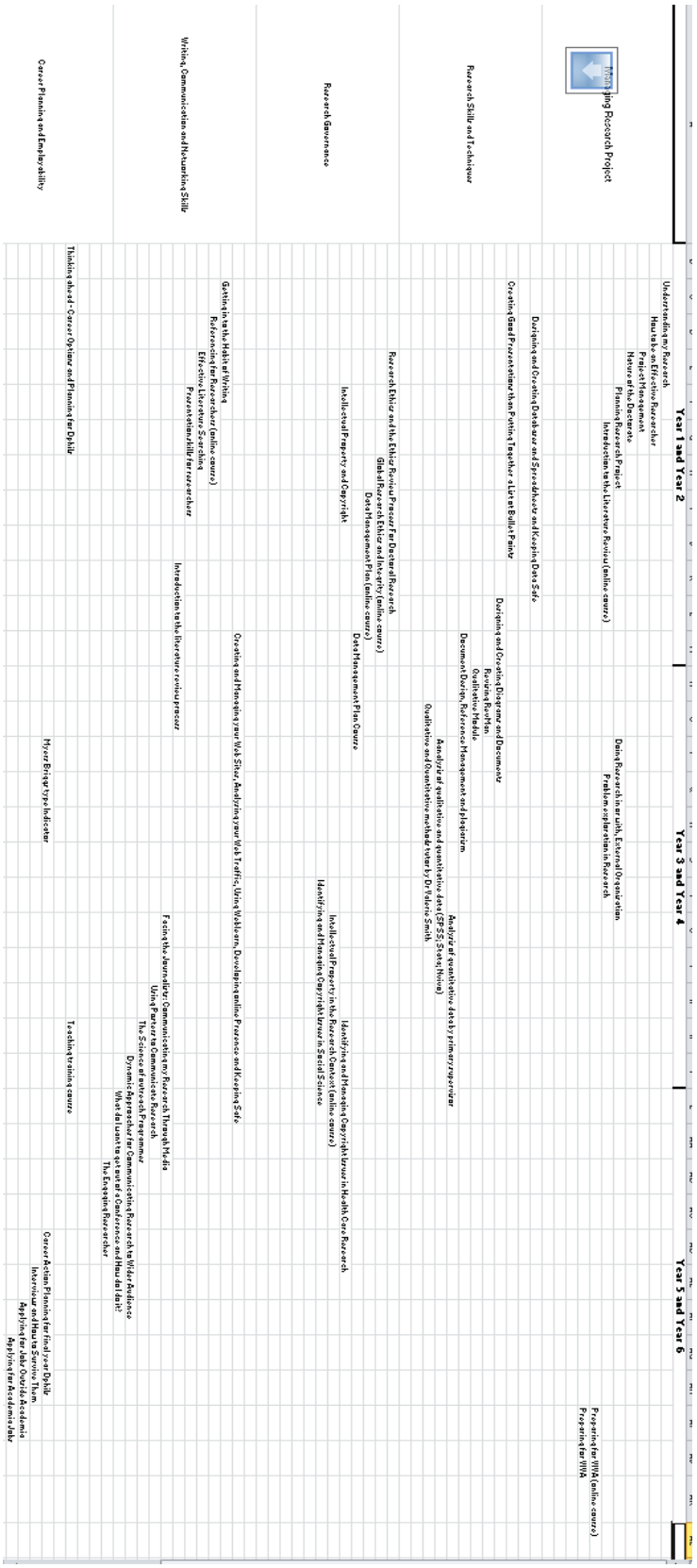
The following will be considered to protect the human subjects' rights: voluntary, informed consent; treated as autonomous agents; the right to end participation in research at any time; and protection from physical, mental and emotional harm.

The study will be conducted in full compliance with the current revision of the Declaration of Helsinki (last amended October 2008) and with relevant regulations and with the Medical Research Council (MRC) guidelines for Good Clinical Practice (GCP) which are based on International Conference on Harmonisation (ICH) Guidelines for GCP (CPMP/ICH/135/95) July 1996.

Appendix 1: Timeline for the Study – Version 1 - Completed on 03rd of February 2014



Research Training and Development Plan (Version 1 – Completed on 22nd of January 2014



Appendix 22

Women's Delphi e-Survey Round 1 Responses for NGT discussion

N.B. The document was printed and distributed to NGT participants on the day of the discussion, together with their survey responses.

Questions asked:

What is your definition of a squatting position during birth?

On a scale of 1 (poor) to 10 (excellent) how would you rate the usefulness of squatting position during childbirth?

Would you recommend a squatting position during birth to other pregnant women?

Definition of squatting positions:

Please provide your definitions of squatting positions during labour and birth.

Key Elements of squatting positions:

List all the key elements that you believe best describe squatting positions during labour and birth. This could include details about how it is applied, delivery methods, and any relevant equipment. (for example, how long you managed to squat, how often between your contractions, the support you received from your partner or any other person, and any other important factors)

Barriers to using squatting positions:

Identify and list all the factors that you consider vital for hindering the use of squatting positions during the birth of your baby. This may include obstetrical, cultural, personal, organisational, or other factors.

Facilitators for using squatting positions:

List all the factors that you believe are the most important in facilitating the use of squatting positions during labour and birth. This could encompass maternity care practices, support from healthcare providers, or women preferences.

Additional comments:

Please provide any additional comments or insights you have regarding the use of squatting positions during birth. This can include personal experiences, observations, or any other relevant information.

The consensus was set at a weighted mean of 6 or 60% agreement for scores of 1-5 or 10 to 50% as less important; 6-8 or 60 to 89% as important; 9-10 or 90 to 100% as most important.

Women	**Description of squatting positions**
	-
1- On a scale of 1 (poor) to 10 (excellent) how would you rate the usefulness of squatting position during childbirth?	Scored 1 to 5 = 2 women Scored 6 to 10 = 11 women Comments: 1. I have never seen childbirth in this position 2. I experienced it, and it worked for me. The moment I set myself in a squatting position, the baby came out straight away, for which I was about to use an epidural; thanks, the squatting position helped me avoid an epidural. It was all my husband's ideas that encouraged me to use this position. 3. It was the most successful position for me once I reached the end of the pushing phase. 4. Using squatting was easier delivery than my first (on my back). Instinct was also kicking in and telling me to push back further. 5. I recommend squatting in the birthing pool rather than just squatting. 6. I found it extremely helpful and believe it was the reason I could have natural childbirth with just gas and air after a caesarean section the year before.

	(6 participants)
g) Would you recommend a squatting position during birth to other pregnant women?	Yes = 12 women No = 1 woman 1. I found squatting in water particularly helpful for reducing pain and as a pushing position. But it did not help me to squat on a birthing ball during early labour. 2. I would categorically recommend it 100% 3. It was the most successful position for me once I reached the end of the pushing phase. 4. I had mentioned it to a couple of friends as an option when we were talking about their imminent childbirth. 5. I learnt the squat position by accident during my second childbirth experience at home whilst anxiously waiting for my husband to pick me up and take me to the hospital. **(5 participants)**
Research questions	**Participants' comments**
h) What aspects (if any) of the squatting position during the birth of your baby were particularly useful/helpful?	1. I found being in a squatting position helpful as it allowed me to use the correct muscles without too much exercise and made pushing easy. 2. Do not know 3. It relieved some pressure sensation, allowing more flex to the expensive passage. 4. I had my first baby at a Birth Centre. I felt that squatting using a birth stool helped my baby to come down faster. On arrival, the Midwife did what she called an internal to check my baby. She then told me the baby was not engaged well in the pelvic area. However, I was in the first stage of labour. She advised me to sit on the birth stool supported by pillows while leaning forward and resting my head on the bed with pillows again. I was told that if the baby does not engage well after 2-3 hours, I will be transferred to the hospital. After 3 hours, I was rechecked and told that I would start pushing if my body told me to do so. When I felt that I needed to push the baby, the Midwife told me to push gently if I felt strong urges to push or not to push if I did not have to. I think I pushed my baby within 30 minutes. I had a tiny tear which healed quickly. 5. The Midwife knew what she was doing. I had no backache; I could sleep for a little while. It was easier for me to push my baby; I could tell my friends about this position 6. It felt more comfortable and natural than sitting, standing, or kneeling. Whilst submerged in the birthing pool, the water and the squatting position seemed to help the baby to descend faster and prepare for pushing. This position maximises the use of gravity as an aid to natural birth. In my experience, pushing and delivering lying on a bed was more labour-intensive than squatting in water. 7. The pushing stage where I used a poll to support my muscles for defecation to expel the baby. 8. Feeling like I was in an active position. Using my arms on wall bars for safety and stability

	9. I recalled a friend saying,' it's like having a big poo; use these same muscles.' Words from midwives and books that say 'bear down' didn't mean anything to me and sounded mystical. Though giddy on gas and air, I recall instinct kicking in. My Midwife was fantastic - "What position would you like to do now, mother". She allowed me to listen to my own body. I was hoping for a C-section, so I hadn't planned for a natural delivery or read any books. Honestly, I didn't think a natural birth was something I could do. I also did not feel the urge to push - until I got into the squat. This was also when my waters broke. I hung my arms around my partner's neck for support and squatted on the bed. I was told the baby was 'back-to-back' afterwards, which can be more painful, but I had a great birth which was borderline pleasurable! It only tore a little and did not need any stitches - though this may be because I laboured at home in the bath for several hours, which could have softened the skin. 10. - The squatting position allowed me, in the latter stages of labour, to feel that the baby was in a good position for me, pushing him out more quickly. I used a birthing stool which helped keep me in this position and enabled my baby to be successfully delivered. 11. - Encouragement and support by health professionals - Prior knowledge and advice of the squatting position - Demonstrations on how squatting can be achieved before childbirth, this could be in pre-natal classes or antenatal period - Squatting being provided as a viable option alongside other methods - Choice 12. - At the beginning of labour, I felt the need to sit on the toilet, and I found that very comforting and helpful in alleviating my pain. In the advanced stages of labour, I found it very comfortable to squat in the birthing pool; this is where I eventually gave birth to my baby. 13. - Relief of pressure during contractions, help with the pushing where I felt that my body was working WITH me to get the baby out. On my back, I was wasting energy not pushing through my bum. When I finally understood what I had to do, I was exhausted. Squatting automatically made me push correctly. 14. Put simply, it's what our bodies are designed to do when having a baby 15. I had a caesarean for my first baby, and for my second baby, I sat on the toilet and felt comfortable, had the baby on the toilet at home. 16. you have to get into squatting to know it is comfortable, when you see pictures you think it takes a lot of energy. 17. I instantly felt it was the right position for me, did not need to push for long 18. It was my first baby, I did not know how to push the baby. I was able to push in the right direction, it is the right position I would recommend any woman to use. **(18 participants)**
i) What aspects (if any) of the squatting	1. Several medical staff around me were trying to get me to stay on the bed and put my legs in stirrups, but

	position during the birth of your baby were NOT useful/helpful?	I declined. They did not seem to want me to use the squatting position. I am unsure if this was due to a lack of training or competency or just that the squatting position was not convenient for the staff or there were simply ignorant. 2. Do not know 3. Tiring on the legs during the peak of the contraction 4. Before my baby, I did not know enough about this position; I followed what the Midwife said. 5. At times I grew so tired that my husband had to bear my weight to keep me upright in the squatting position. It was hard work for him. 6. During the birth of my first child, each time I attempted the squatting position, it sent shooting pains up my thighs and back, and I could not use it. 7. Unsupported squatting position. 8. It could be challenging to hold the gas and air mouthpiece. I was okay, as I was using a partner for support and could still carry it, but if gripping my knees, it could be difficult. 9. I did not consider any aspects of the position unhelpful 10. Negative attitude and being discouraged by the health professionals on squatting position, being made to lie down flat on a bed - not being allowed to move about as you get ready to move into different positions such as squatting - straps on the legs - Lack of knowing squatting position - Not being given the option of squatting - Squatting is seen as primitive in some cultures - previous caesarean section 11. I did not try this, but I did not 'fancy' just squatting on the floor, fearing that it would be too difficult and require too much energy. 12. Lying on my back during contractions whilst hooked to a monitor. 13. The poor attitude among some midwives, 14. Not knowing that positioning is very crucial in childbirth until this study 15. You cannot go to the toilet lying flat, it is the same with having a baby, I do not know whether this view can be considered 16. I had a severe vaginal tear, I pushed lying flat for a long time, then was asked to use the stool. I pushed hard and felt straight away the baby was coming from my backside. One midwife asked me to change position but did not bother. 17. I was not in this position long and my baby came out, I did not get to know much 18. I was left too long on the bed before they asked to squat, I feel I should have used the position earlier than later. (18 participants)
j)	What improvements would you recommend to midwives to support women who use squatting positions during birth?	1- Information on all various birthing positions at the initial meetings with the Midwife to include squatting Discussion in prenatal classes, Support by medical staff during birth General support in support groups/family friends to be encouraged 2- Do not know 3- More aids were offered to hold onto. 4- They need to inform women about different positions they can use before and during childbirth. They also knew the

	advantages and disadvantages of using different positions when having a baby. 5- Extra handles or floats are available in birthing pools to support a maintained squatting position. 6- I think they should support and encourage women to use this position before the use of an epidural, for it is possible to use gas and air throughout because squatting easily increases the baby's movement. In other words, it spreads up the process, or the baby comes out so quickly. On the other hand, it might be slightly different for another woman. 7- Training and experience sharing and adequate planning. 8- Make sure mum is balanced well and supported. Hold the gas and air to her if needed. Say 'push back further, into your bottom'. "Use the same muscles as you are having a large poo. It will feel like the baby coming out of your bottom, rather than your vagina - this is normal, and as it should be." 9- I cannot think of any improvements I would suggest based on my experience 10- Improving knowledge for pregnant or in labour women on squatting Improving health care professionals' attitude on squatting position 11- Whilst in labour, the Midwife, went away from the birthing pool. I found it more reassuring when she was closer to the birthing pool, as I knew I was being helped. 12- Advise women to try it. Start in a kneeling position with your head on the bed, and wide legs, then progress to a squat. This is how I stumbled across the squat. 13- midwives should give pregnant women adequate information before birth 14- women need to know all the birth positions options to choose from 15- I have said what I needed to say 16- we need information about positioning when we are pregnant not in labour, it is too late I think. you are in pain and someone tells you things you are hearing for the first time it is not easy. 17- I resisted moving from the bed for a long time and my baby was not coming until I was told to be transferred to the hospital. Then I sat on the stool the baby come. **(17 participants)**
k) Write any other comments about the squatting position during birth.	1- My personal view and experience are that squatting, for some reason, does not seem to be encouraged by staff; they do not seem to have the confidence to support this position. 2- None. 3- It made the process a lot quicker and less stressful it was the natural position I wanted to be in that my body just drove me to go into when my baby was stuck in my hip cavity and had a lot of moulding. 4- I felt that the squatting position when having my baby worked well because I wanted to have my baby at Canterbury Birth Centre. My birth plan did not work for this birth; however, being my first baby, I felt I had to listen to the Midwife. 5- I would have found it harder to use this position on the floor, and I would have been concerned about the baby going too close to the floor upon delivery. It is in an excellent position when used with water or over a mat or bed. I think it is safest used with the assistance of a vigilant and supportive birthing partner.

	6- Generally, squatting speeds up the process; it encourages the baby's movements, reducing labour time. 7- Giving birth is a natural event, and so is the squatting position, mothers should be supported in using the approach in case the medical personnel is well trained. It also increases choices for service users. 8- I sometimes wonder if the position is unsuitable for the pelvic floor, which might make me think twice about using the position too much next time, maybe only right at the end if needed. 9- I squatted facing the side of the bed, but the bars at the top helped grab onto it. The top of the bed may need to be raised to a 'sat up' 10- p' position to enable a decent squat. 11- I felt I needed more encouragement to squat during labour from the Midwife assisting me. 12- Useful in water and out of water. It can sound and feel 'unnatural' until you try it. Women in active labour would be willing to try anything. I was able to swing from one side to another as well. **(12 participants)**

Appendix 23

Healthcare Provider's Delphi e-Survey Round 1 Responses for NGT discussion.

N.B. The document was printed and distributed to NGT participants on the day of the discussion, together with their survey responses.

Participants were asked to list:

Definition of squatting positions:

Please provide your definitions of squatting positions during labour and birth.

Key Elements of squatting positions:

List all the key elements that you believe best describe squatting positions during labour and birth. This could include details about how it is applied, delivery methods, and any relevant equipment. (for example, how long you managed to squat, how often between your contractions, the support you received from your partner or any other person, and any other important factors)

Barriers to using squatting positions:

Identify and list all the factors that you consider vital for hindering the use of squatting positions during the birth of your baby. This may include obstetrical, cultural, personal, organisational, or other factors.

Facilitators for using squatting positions:

List all the factors that you believe are the most important in facilitating the use of squatting positions during labour and birth. This could encompass maternity care practices, support from healthcare providers, or women preferences.

Additional comments:

Please provide any additional comments or insights you have regarding the use of squatting positions during birth. This can include personal experiences, observations, or any other relevant information.

The consensus was set at a weighted mean of 6 or 60% agreement for scores of 1-5 or 10 to 50% as less important; 6-8 or 60 to 89% as important; 9-10 or 90 to 100% as most important.

Each item is ranked based on a Likert-type response (i.e. from 10 most important to 1 least important). The Delphi survey will be analysed using a Nominal Group Technique discussion (NGT).	
Healthcare professional's response **Healthcare provider participants** **Education – Doctorate level – 4; MSc in midwifery – 7; BSc in midwifery – 11; Diploma in midwifery – 3.**	
Feel free to list any definition of squatting position in your opinion	
1- I would demonstrate to the client as opposed to describe 2- Supported squatting when birthing partners support the weight of the woman under her arms. The feet are often not flat when squatting and pushing. But in a 'tip toe' position. The feet will be flat in the passive second stage but in the 'tip toe' during active pushing. 3- Supported squatting where the partner is behind the woman and takes the weight of her body with his arms 4- Sitting in a crouching position, with knees bent and buttocks near the heals 5- The same as no.9 but with a birthing partner sitting on a chair behind her, supporting her arm from behind with their arms under her armpits and taking some of her weight. 6- It can be where a woman is in the kneeling position and then during a contraction squat backwards. 7- I miss the definition that the woman in a squatting position can also be supported by another person (e.g., her partner) who is sitting behind her. This person either used arms or knees to give the woman support. 8- It increases the pelvis exit because of the help from gravity and because the sacrum becomes pushed and is flexible, giving the pelvis more space and room. 9- Supported squatting May also be supported by a partner or bar 10- Standing supported semi-squat 11- McRoberts' Manoeuvre involves flexing as well as abducting maternal thighs up into the maternal abdomen simulating the squatting position, partial squatting position because the woman's spine is horizontal other than vertical 12- Crouch down between your partner's legs and lean against him, using his knees for support. 13- Sitting position on the stool while the back was supported by a wall 14- Squatting position the patient crouches during contraction and then recuperate during relaxation. Sitting position when the pregnant woman is sitting on a bed, on a chair or a birthing ball. 15- Modified squatting position most of her weight being taken by the thighs rather than the feet, so the position can be maintained without effort. 16- Sitting in bed supported by a person or on a birthing stool or similar birthing aid. supporting persons, supporting the woman on both sides. 17- Full squatting is a sitting position by tilting the truck backwards at an angle of 30^0 degrees to the vertical. It is achieved by supporting the body weight by hyper-flexing the hips and knees on flat feet such that the heels come to rest on the ground. In a partial squat, the body weight is taken by the balls of the feet	***17***
List 'ALL' types of squatting position(s)	
1- Squatting with support, e.g., partner sitting on a chair behind, supporting under the arms, squatting holding over a birthing ball on a birthing ball, stool, or birthing chair. 2- Supported Unsupported with stool/bed without a stool. 3- Supported squatting by another person or an object, i.e., a chair/ table/ bars. Usually being leant on with arms Supported squat, squat supported at the legs/thigh, i.e., with birthing stool. In unsupported squats, a woman's weight is supporting her own feet.	20

4- Sitting on a birthing stool either supported or unsupported by a birth partner, kneeling squat. 5- Supported Unsupported Birth Stool Delivery bed (semi-recumbent pushing against bars) Leg raised on a step 6- Supported squat between partners legs squatting in the pool using sides to support birthing stool 7- Supported using birthing partners to support weight under arms or edge of the pool in water birth Birthing stool CUB Toilet Floor Birthing couch 8- if a woman has used exercises during pregnancy to help with squatting on her partner taking weight from behind the woman on the bed facing the back of the bed holding on to the back 9- Squatting in the pool, on the bed, supported squat by a partner, birthing stool squat, 10- Unsupported squat - woman squats on the floor, bed or in the pool. Supported by a partner - either sitting on the chair or standing, maybe with support from the wall. Supported squatting using equipment such as a sling, chair, or bed. Birthing stool. 11- Standing sitting on the birth stool hanging over the bed, etc. supported squatting with the person behind the woman supported squatting using the obstetric bed with a squat bar supported squatting using the birth shell (baarschelp) unsupported squatting 12- Birth stool, on obstetrics bed, with support as a table, with ropes 13- Supported squat. Unsupported squat 14- Supported, partner, bar, stool, ball etc. standing, supported semi squat unsupported, woman's bodyweight 15- Unsupported squat supported squat 16- Deep squat, bottom below knees squat, knees in line with the bottom 17- Women squatting freely i.e. without any support from another or equipment Supported squat i.e. with support from another or using equipment 18- flexing of the thighs and knees 19- Squatting on the floor with legs up, using a squatting bar for support 20- weight of the body is on the feet but the knees and hips are bent	
Please, provide a list/details of ALL of the factors which you consider hindering the use of squatting positions during the passive and active second stage of labour (PASSOL).	
1- Need a degree of physical fitness before using the position, can't move around, need a strong partner, difficult to visualise the perineum, plays havoc on the midwives back, can put stress on the perineum, as can increase the urge to push, can be tiring position, need a good squat position or could get tight muscles e.g., toes calves' thighs, 2- Epidural analgesia Woman's flexibility high BMI Space, maternal tiredness Midwife! 3- Inadequate preparation of squatting muscles. It is difficult to maintain a squatting position unaided for a prolonged period. The use of medical equipment hinders access to good squatting positions. Lack of supportive equipment, rails, variogram etc. not available in high-risk areas. 4- Most women are not fit/flexible enough to squat indefinitely for the duration of their second stage. I suggest they practice during their pregnancy. Regular yoga can help with this. Maternal request. Maternal exhaustion. Maternal raised BMI. Difficulty auscultation of the foetal heart. Difficulty on the part of the midwife to work around the position adopted by the woman i.e., unfit, inflexible midwife. Fear on the part of the midwife that she cannot see the perineum as easily as if the woman was semi-recumbent and fear that the woman might then tear badly. The still pervading notion backed up by tv programs like 'One born every minute' is that women 'should' give birth on their backs. Hospital rooms are not set up to facilitate swatting positions. 5- Lack of equipment to support squat i.e., obstetric chairs/ stools Fatigue of woman in 2nd stage. Lack of physical strength of a woman to support squat, particularly in the leg. Culturally women expect not to deliver in a squatting position but	25

instead feel they should be birthing supported on a bed. Birth is not often presented this way in the media. 6- Maternal health conditions, high-risk women, obesity, trust policies, culture, experience, 7- lack of education. Doctors fear blame in cases where things go wrong. lack of confidence 8- Maternal BMI and mobility stamina discomfort pethidine PGP 9- Maternal mental state Maternal tiredness Maternal fitness levels Family support Availability of aids Confidence of midwife Manual handling issues for midwife BMI It's an association with increased perineal trauma and bleeding 10- maternal exhaustion raised BMI maternal disability 11- Dense epidural without the option of squat bars on obstetric beds. Maternal fatigue Midwives not confident in upright birth. Breech presentation. Poor antenatal education on active birth Poor midwife/mother relationship Birthing room environment Lack of equipment 12- tiredness pain woman out of control pelvic girdle pain 13- BMI, the flexibility of the woman, epidural analgesia, Pethidine causing sedation, a woman not willing to try squatting position, continuous monitoring needing to be in a semi-recumbent to keep contact, pain and fear in the woman, midwives used to other portions. 14- Midwife's or woman's expectations - media usually shows birthing women in a semi-recumbent position. Partner's attitude. Bed in the centre of the room, especially when the room is small, full of other equipment or has no other aids to mobilising and remaining upright in labour. Lack of forethought or practice of upright positions - leg muscles tire quickly. Pharmacological analgesia. Fatigue. 15- Hospital setting: when it is too clinical, bed dominantly present, too open access to other people Home setting: nothing hinders the use Care provider: lack of confidence, possibly physical constraints although these can be handled with adjustment (e.g. using the obstetric bed in the hospital, or a small (yoga) stool for the care provider to sit on Woman: some woman are not comfortable although small variation often helps Epidural can hinder, with a little bit of imagination much more is possible than women and care providers often think 16- I don't think it makes any difference 17- The need to practice well before the EDD and to be aware of their fitness and being overweight could be detrimental. Also the risk of brachial nerve damage, for women squatting for a long period of time. 18- Stress factor, to the midwives on duty, number of mothers in labour, non-motivated mothers, maternal and foetal stress 19- Monitoring cables. intravenous lines, epidurals - caregiver preferences - institutional policies and procedures - small, cluttered, or over-crowded birth rooms 20- Prolonged process, macrosomia, bad presentation of foetus, maternal request, and discomfort. The mother is not motivated. 21- Maternal preference, midwife preference, lack of support aids, and lack of midwife confidence in supporting women using the squat position during birth. 22- Tiring position for most women to maintain may be difficult to auscultate the foetal heart Emergence of presenting part not visible to woman May be painful for women with SPD and may not be advisable for women with chronic back problems or disc lesions? Due to over flexion of back attitude/influence/belief of woman/family or birth attendant. 23- Fatigue women are not used to squatting and having to practice during pregnancy to be able to hold this position for any length of time 24- Staff attitude CTG culture 25- Reluctance from women Reluctance from midwives Lack of midwife knowledge	
Please, provide a list or details of the factors which you consider most facilitate squatting position during the passive and active second stage of labour (PASSOL).	
1- Gravity, progress, instinctive, popular, easy to do in a small area, a partner can be supportive, preparation previously	24

2- Maternal request Space Previous experience of that position. Partner support Midwife experience 3- The willingness of midwives to mentally support. Equipment available to enhance the squatting mother maintains the squat position. Fit well, mother. 4- Healthy, fit low-risk woman (although many high-risk women could be encouraged to give birth in a squatting position too). Encouraging supportive midwives. Encouraging a supportive birth partner. Encouraging supportive doula. An empowered woman who believes in her innate ability to birth her baby. Good antenatal preparation education for birth. Midwife-led units tend to have rooms better equipped for women to give birth squatting. Understanding on the part of the woman and the midwife of the benefits of squatting to give birth. 5- Good general physical fitness and strength of woman, Support of partner Environment with good equipment/facilities that facilitate squatting position 6- Environment, experience, and support from the seniors. Knowledge of successes of squatting births with no complications. 7- Midwife support birth partners support maternal mobility environment water. 8- Midwife and mother confidence 9- good equipment in the room, i.e., bars, stools, mats etc. mobile women large area to move around in a adopt different positions 10- Trusting relationship between midwife and mother Good facilities that allow space for upright birth and adopting positions well-trained midwife's Good antenatal preparation for birth. the 11- control helps a woman to concentrate opens up the pelvis allows decent gravity 12- The belief of midwives is the effectiveness, a woman who has trust and is willing to try different positions, antenatal teaching of the effectiveness of good positions such as squatting, the flexibility of the woman and midwife, a woman listening and in control of her labour. 13- An environment which offers alternatives to labouring on the bed – e.g., bean bag, ball, sling, birthing couch, or birthing stool. A midwife who is skilled at offering alternative positions and encourages the woman to move around, maybe walking between contractions and squatting during contractions. Birthing pool available - less tiring and easier to remain upright with the buoyancy in water. The partner who is willing to take an active part in labour. Antenatal education includes suggestions for alternative positions in labour. 14- Freedom to move around Home or home-like private environment facilities that help to use different positions: birthing chair, etc. Supportive people are those who are willing to facilitate and help to adapt to different positions. 15- Maternal choice. maternal BMI 16- Actively engaged with the birth process, in more control in fairly strange surroundings and when ready to push the squatting position the mother hopefully should feel fully involved. 17- Relaxed midwives, motivated patients, and personnel 18- woman's knowledge and preference - caregiver knowledge and preference 19- Motivated mother, weak contraction, tiredness, to gain more power and to increase self-control 20- Maternal preference, midwife preference especially with slow progress in the late first/second stage, antenatal education. 21- Supportive strong partner Supportive midwife Availability of ball, stool, toilet, bar, bean bag etc appropriate environment Belief that it helps with malposition 22- Women desire to use this position Women able to maintain this position during labour woman understand the advantages and the disadvantages midwives understand, and have the ability to be able to facilitate squatting 23- Midwife-led unit midwives happy with their practice 24- Education of women and midwives Space Equipment Support for women who want to squat	

Appendix 24:

Final Delphi e-Survey completed by 25 Healthcare Providers

Squatting positions during pregnancy and childbirth

Public ad-hoc group for squatting positions in pregnancy and childbirth

Survey Results

Started: 9th March 2015

Ended: 31st March 2015

Reply rate: 25 / --

Web-learn Online Survey Tool

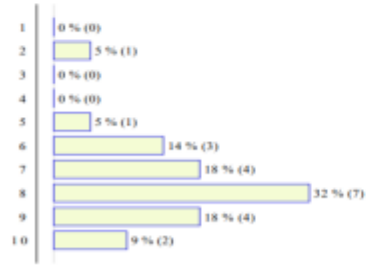
Squatting positions during pregnancy and childbirth

Section 1 seeks your judgement on the definition of squatting positions. Section 2 seeks your judgement on the opinion about the type(s) of squatting positions. Section 3 and 4 seeks your judgement on the key components for implementation and factors that influence the use of squatting positions during childbirth. Section 5 seeks your judgement on literature-based definitions of squatting. This questionnaire is using a numerical rating scale from 1 to 10, where 1 is your least important judgement and 10 is your most important judgement. For each statement in each section, please click on the circle which most accurately reflects your response. These statements were derived from the on-line Delphi e-survey completed by 56 experts and four Nominal Group Technique discussions. Consensus will be reached if a statement scores a weighted mean of 6 and above. The questionnaire will take you approximately 60 minutes or less to complete. On completion, please press the save button.

Thank you very much indeed for taking part in this study.

2- Definition of partial squatting

Squatting when one leg is abducted and flexed, and the other leg is kneeling, which is usually achieved using a footstool, floor or a step. Hyper-flexion as well as abducting maternal thighs up into the maternal abdomen simulates the squatting position while the woman's back is flat on to a bed or floor (McRoberts). This is a partial squatting position because the woman's spine is horizontal, not vertical.

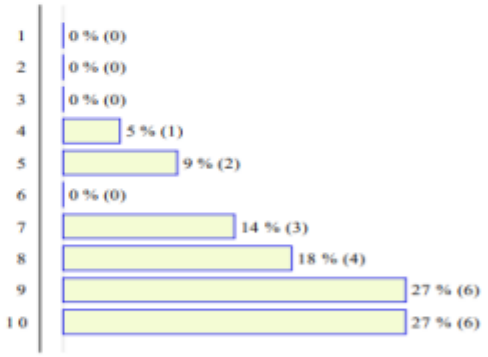


Number of answers: 22
Weighted mean: 7.5

Section 1: Definition of squatting positions

1- Definition of Full, deep or unsupported squatting

Unsupported squatting is when a woman adopts a crouching position, when her weight is off the pelvis with hips come close to the abdomen (i.e., abduction of the hips) and the knees fully bent (flexed) at an angle ≥ 90^0, with feet flat or on tiptoe when pushing on the ground or bed in the passive stage. In this position, the woman's knees are apart while leaning forward with her back well-rounded and bringing her buttocks closer to the heels, whereas the head is facing down between her knees. When squatting, the upper part of the pelvis (i.e., length of the true conjugate) is reduced, while the lower part of the birth canal (i.e., pelvic outlet) is fully open or slightly widens by the descending baby's head. The lowest part of the bottom called the coccyx moves upwards and backwards expanding a little, allowing the enlargement of the anteroposterior and transverse diameters of the pelvic outlet when the baby's head descends through the birth canal. Furthermore, there is even pressure on the vagina from the head of the baby which stretches the perineal muscle naturally, increase pressure in the pelvic cavity making it easier to push with minimal muscular effort leading to optimum relaxation of the pelvic floor and vaginal muscle. Unsupported squatting position - a woman can squat on the bed or on the floor for every few minutes during the expulsive phase, once she has finished pushing, she can sit back to rest her legs on the bed or chair. The woman crouches intermittently for 2-3 mins during a contraction, for 30 mins to 2 hrs in the 1st stage, & 10 to 30 minutes in the 2nd and 3rd stages of labour, to promote squatting abilities.



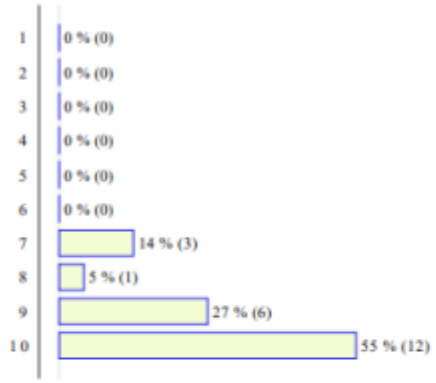
Number of answers: 22
Weighted mean: 8:23

Comments:

- First sentence is most relevant. The other sentences are not a definition but a description of the consequences.

Number of comments: 1

3. **Definition of supported squatting**
Supported squatting is when hips come closer to the abdomen at 45 to 90 degrees (i.e., semi-abducting of the hips) while the knees are partially bent (semi-flexing the knees) with a supportive aid to maintain one squat position with assistance and distributing a woman's weight. In this position, the woman is assisted by a person (caregiver, partner, or doula) or equipment such as a birthing stool, water pool, obstetric chair, or bed. In semi-squatting, a woman rests her body weight on her thighs, placing her bottom (i.e., sacrum) in the hole of the seat (obstetric chair or birth stool or obstetric bed), relieving the weight of her body from her bottom. One or two legs are raised on a step.



Number of answers: 22
Weighted mean: 9.23

SECTION 2: Types of squatting positions

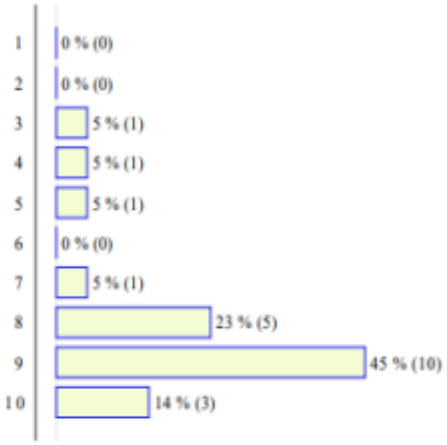
4. **Types of squatting positions: Please tick all that apply – those you tick are the most important statements and those which you do not tick are the least important)**



Number of answers: 82
Weighted mean: 2.5

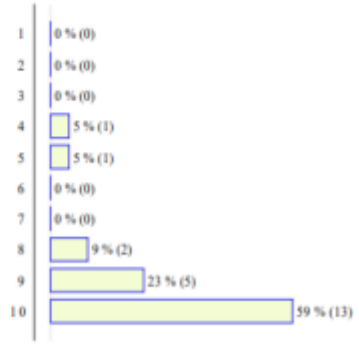
SECTION 3: Key components of squatting positions

5. **Women can squat during pregnancy at 36 to 41 weeks, dose 20 minutes 3x a day, total exposure = minimum of 3 days a week.**



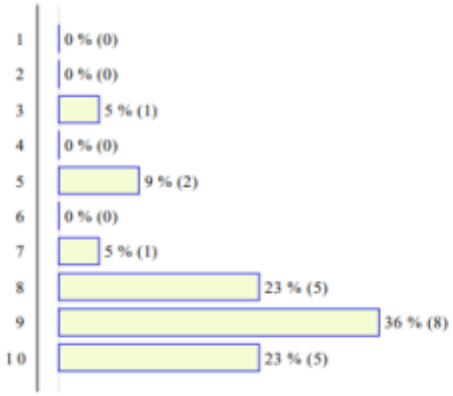
Number of answers: 22
Weighted mean: 8.14

6. **Women can squat in early labour, dose of 20 minutes 3x a day, total exposure of minimum of 4 hours.**



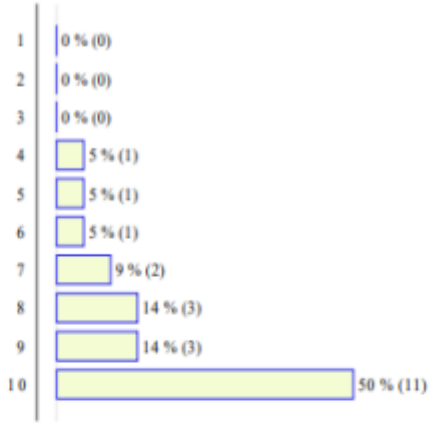
Number of answers: 22
Weighted mean: 9.09

7. **Women can squat during the 1st stage of labour (approx. 6 to 12 hours), dose 10 to 20 minutes, total exposure = 2 or more hours. Frequency of exposure is dependent on individual woman.**



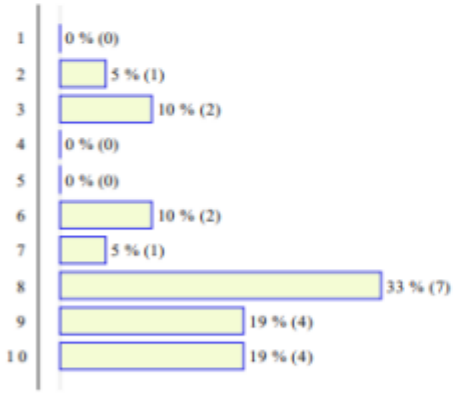
Number of answers: 22
Weighted mean: 8.27

8. **Women can squat in the 2nd stage of labour (30 to 60 mins), dose 10 to 20 minutes, total exposure = minimum of 30 mins. Frequency of exposure is dependent on individual woman.**



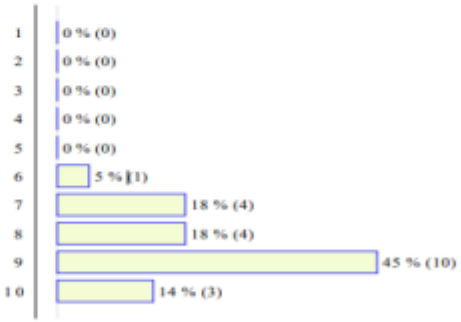
Nmuber of answers: 22
Weighted mean: 8.64

9. **Women can squat during the 3rd stage of labour (15 to 30 mins), dose 10 to 30 minutes, total exposure = minimum of 30 minutes. Frequency of exposure is dependent on individual woman.**



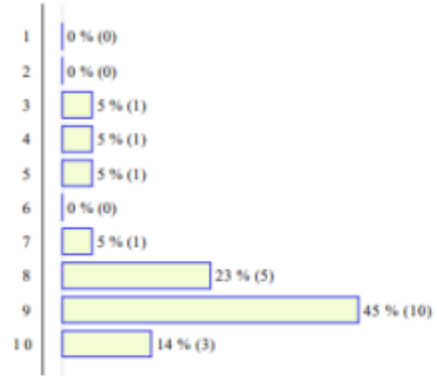
Number of answers: 22
Weighted mean: 8.27

10. **Important outcomes for evaluation if squatting during pregnancy and in early labour, include optimal foetal positioning in the pelvis resulting into optimal angle of the foetal progression through the birth canal, length of early labour, spontaneous vaginal birth, need of induction of labour and mode of birth.**



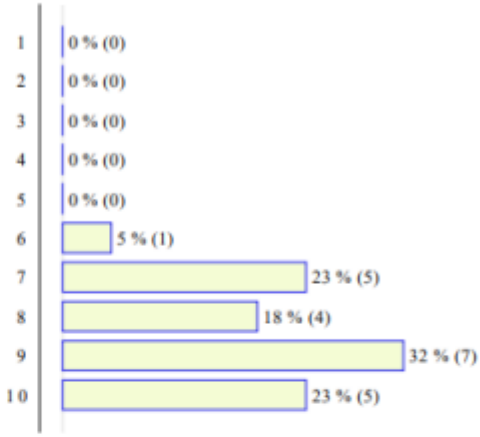
Number of answers: 22
Weighted mean: 8.45

11. Important outcomes for evaluation if squatting during the 1st stage of labour, including length of labour, mode of birth, the need of pain relief and foetal well-being.



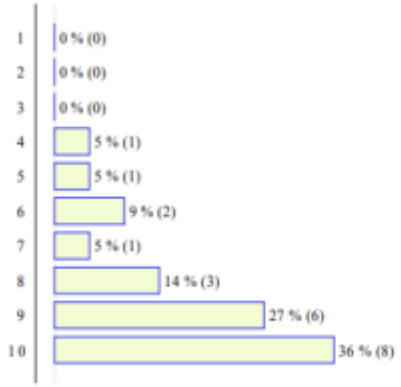
Number of answers: 22
Weighted mean: 8.14

12. Important outcomes for evaluation if squatting during the 2nd stage of labour, including length of birth, mode of birth, intact perineum and perineal trauma requiring suturing, and foetal well-being.



Number of answers: 22
Weighted mean: 8.47

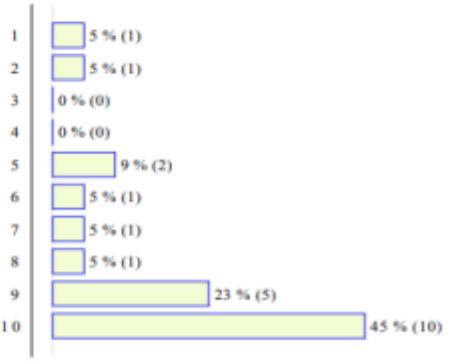
13. Important outcomes for evaluation if squatting during the 3rd stage of labour, including length of 3rd stage, mode of birth, postpartum haemorrhage, maternal satisfaction with intervention.



Number of answers: 22
Weighted mean: 8.45

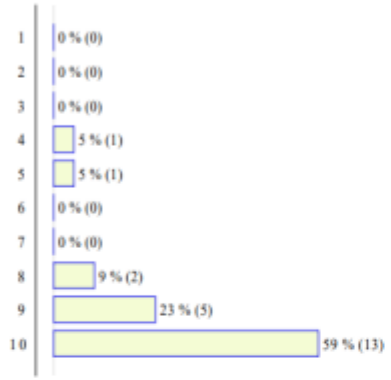
SECTION 4: Factors that facilitate the use of squatting during pregnancy and childbirth.

14. Information and advice given by the midwife is far from the most important factor that influence the choice of birth positions during pregnancy and childbirth.



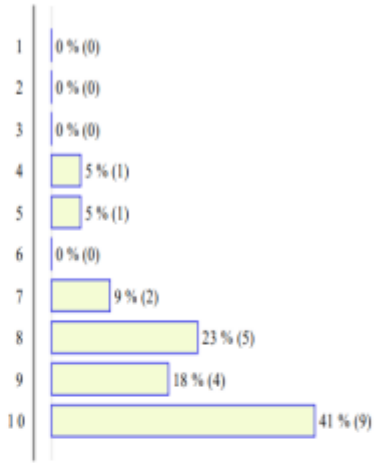
Number of answers: 22
Weighted mean: 8.44

15. **Environment factor are important where a woman gives birth in a room that can be similar to a home-like environment, encourage a number of position changes and the use of squatting/upright positioning aids such as birthing balls, cushions, bean bags, floor mats, squatting bars or ropes, birthing stools and water-poor with handles and floats, with assistance from the midwife and birthing partner.**



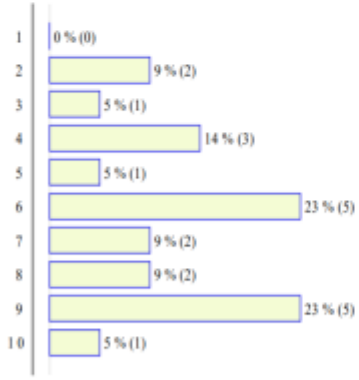
Number of answers: 22
Weighted mean: 9.09

16. **Maternity led units (MLU) tend to have rooms that are better equipped to facilitate women giving birth in upright including squatting positions.**



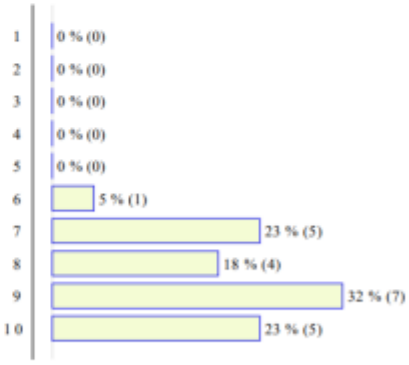
Number of answers: 22
Weighted mean: 8.59

17. **May require less use of pain relief medication and epidural analgesia.**



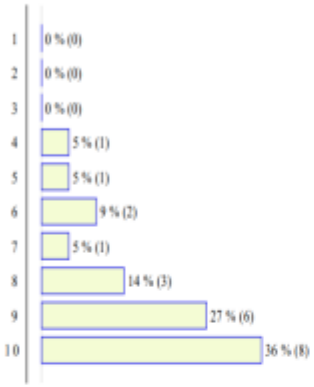
Number of answers: 22
Weighted mean: 6.32

18. **Allows the use of the right muscles necessitating minimal effort to bear down or no use of maternal effort.**



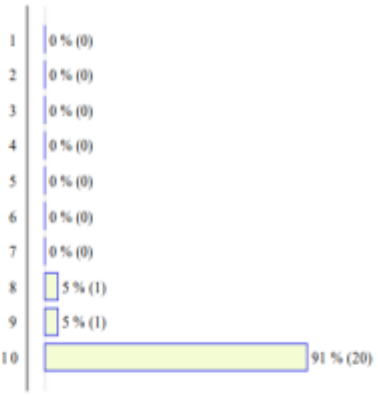
Number of answers: 22
Weighted mean: 8.45

19. Squatting is suitable for women classified as low-risk, but there is no contraindication for women with medium or high-risk factors eligible for a vaginal birth, including previous x1 caesarean section for a vaginal birth, well-controlled gestational diabetes, and low-dose epidural anesthesia.



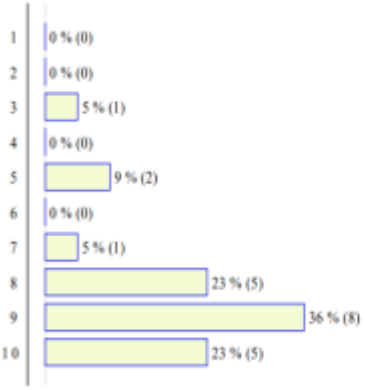
Number of answers: 22
Weighted mean: 8.54

20. Labouring women 's preferences and cultural issues should be identified and respected.



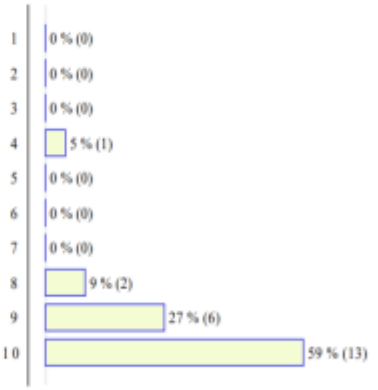
Number of answers: 22
Weighted mean: 9.86

21. Women's choice of maternal position can increase women's feeling of being in control leading to increased satisfaction and a positive birth experience.



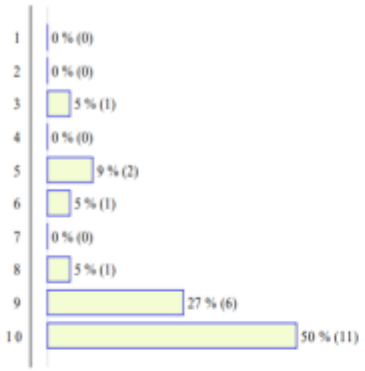
Number of answers: 22
Weighted mean: 8.27

22. Midwives' confidence and competence are fundamental factors for assisting women using squatting positions during childbirth.



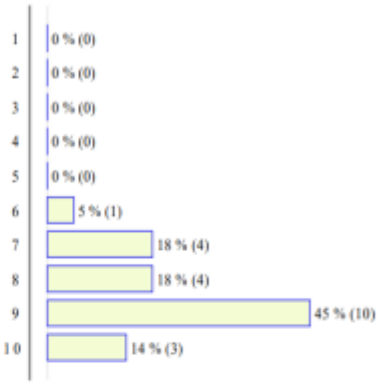
Number of answers: 22
Weighted mean: 9.27

23. **Women should be supported to squat freely supporting them to find the most comfortable or bearable options, where it does not impair the speed of dilation of the cervix or expulsive of the foetus and/or compromise maternal or foetal well-being.**



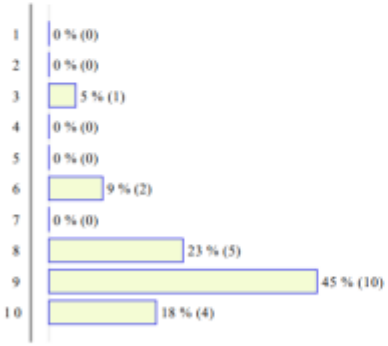
Number of answers: 22
Weighted mean: 8.68

24. **Squatting position appears to be an alternative option in anticipation of labour dystocia. This may be due to its function of maximum gravity and enlarged dimensions of the pelvis outlet in facilitation of a normal vaginal birth.**



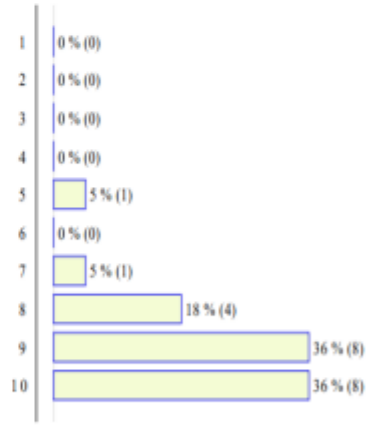
Number of answers: 22
Weighted mean: 8.45

25. **When squatting women should be empowered to use minimal expulsive force to allow a good control of the descending foetal head, at the crowning (i.e., avoiding precipitous expulsion) to minimise potential risk of perineal trauma.**



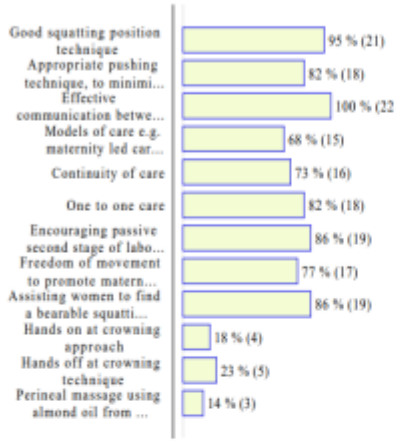
Number of answers: 22
Weighted mean: 8.41

26. **A good understanding of the benefits and methods of care that alleviate harm when squatting for both women and clinicians.**



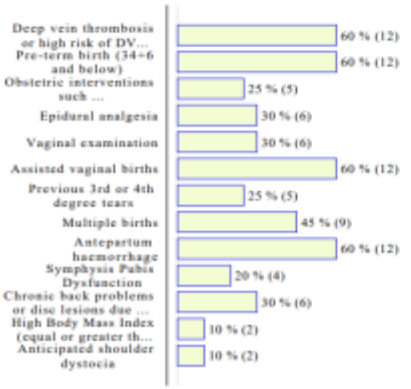
Number of answers: 22
Weighted mean: 8.91

27. The following evidence-based practices are crucial when implementing squatting positions during childbirth to maximise potential benefits and minimise harm. (Please tick all that apply – those you tick are the most important statements and those which you do not tick are the least important)



Number of answers: 177
Weighted mean: 5.32

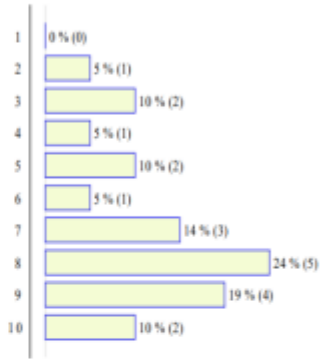
29. Any health dysfunction e.g., medical, surgical, obstetric or orthopaedic diseases must be considered. Squatting positions can be contraindicated for some high-risk women. (Please tick all that apply – those you tick are the most important statements and those which you do not tick are the least important).



Number of answers: 93
Weighted mean: 5.89

Section 4: Factors that hinders the use of squatting positions in childbirth

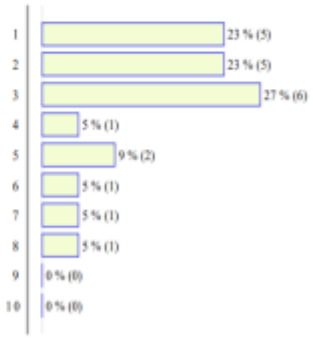
28. Women are encouraged to lie down on the bed because this is the most convenient and comfortable position for clinicians to perform a vaginal examination, best access to the perineum, easier to assist birth, monitor the foetal heart rate and carry out other obstetric procedures.



Number of answers: 21
Weighted mean: 6.9

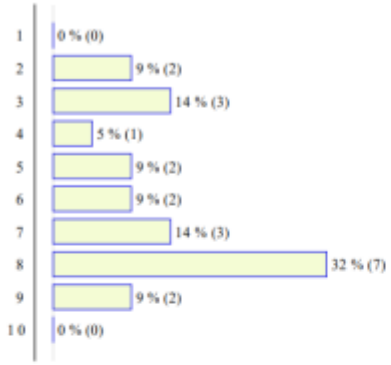
Maintaining a squatting position during childbirth may have the following barriers:

30. Unable to visualise the perineum during birth which may increase the risk of 3rd and 4th degree vaginal tears.



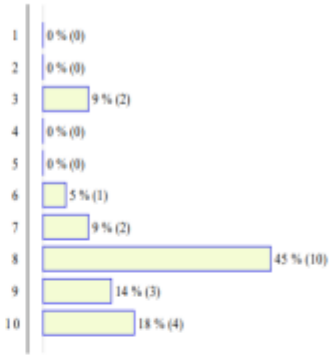
Number of answers: 22
Weighted mean: 3.09

31. It can be difficult for a birthing partner to support a woman to use full squatting as labour intensive.



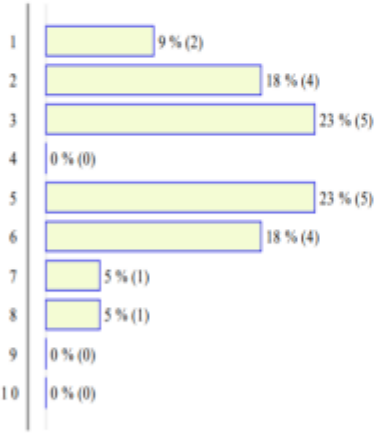
Number of answers: 22
Weighted mean: 6.09

32. It can be stressful and difficult for women to maintain unsupported squatting position thought labour or birth.



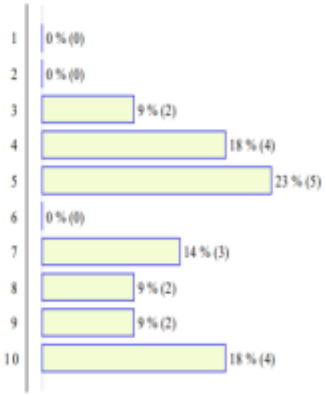
Number of answers: 22
Weighted mean: 7.86

33. More likely to have blood loss greater that 500mls with the need for blood transfusion.



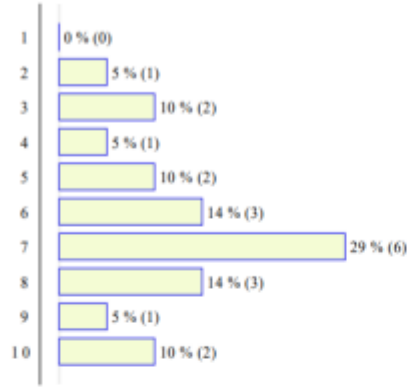
Number of answers: 22
Weighted mean: 4.05

34. Lack of good preparation program(s) for pregnant women on how to use some upright positions including squatting positions during birth.



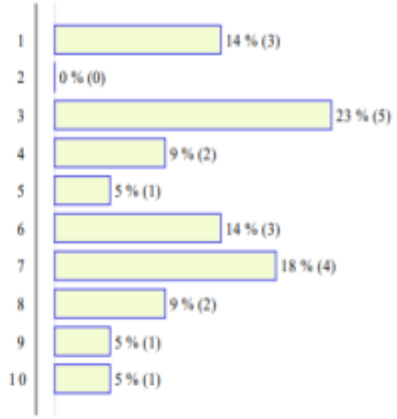
Number of answers: 22
Weighted mean: 6.45

35. Women's poor physical health, unfit and inflexibility.



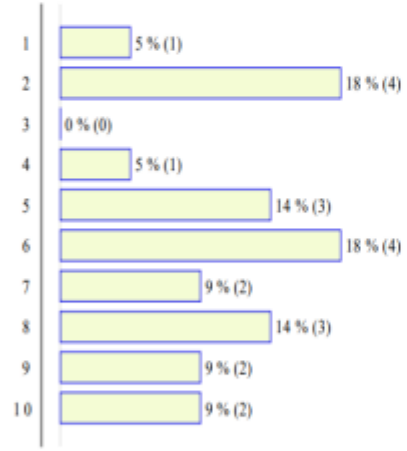
Number of answers: 21
Weighted mean: 6.43

35. Maternal fatigue/exhaustion in the second stage of labour.



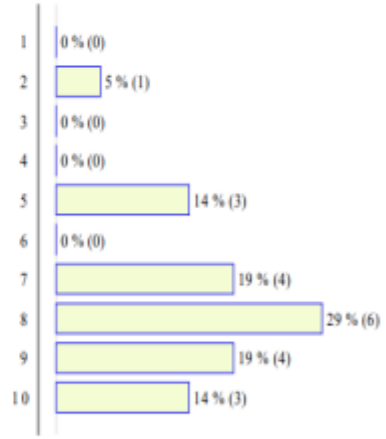
Number of answers: 22
Weighted mean: 5.09

36. Midwife's poor physical health, unfit, and inflexibility.



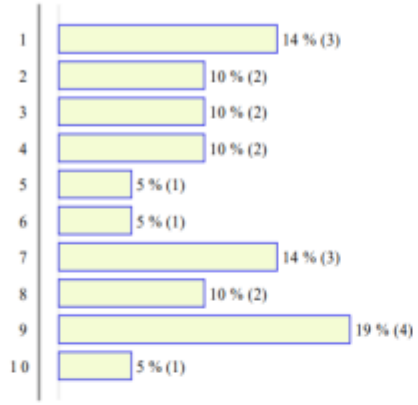
Number of answers: 22
Weighted mean: 5.82

37. Poor attitude/influence/lack of motivation/ beliefs of clinicians, women, partner and family members.



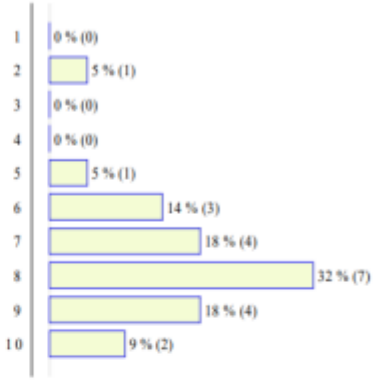
Number of answers: 21
Weighted mean: 7.57

38. Culturally, women expect not to give birth in a squatting position instead feel they should be birthing on an obstetric bed.



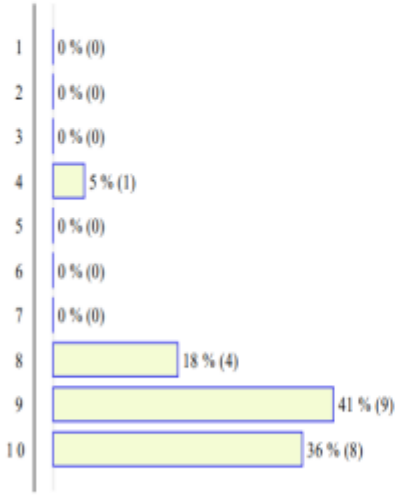
Number of answers: 21
Weighted mean: 5.48

39. The pervading notion often supported in the media (e.g., TV programs like 'one born every minute') that women 'should' give birth on their backs.



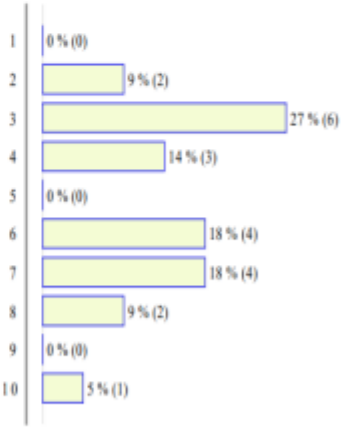
Number of answers: 22
Weighted mean: 5.48

40. Some clinicians are unfamiliar in assisting birth using squatting positions.



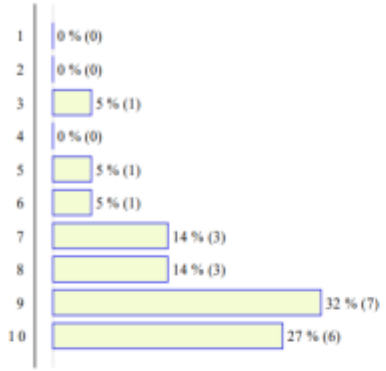
Number of answers: 21
Weighted mean: 8.95

41. Lack of organisational policies and evidence-based research, that demonstrates a clear pathway for conducting birth using alternative positions. (i.e., available policies encourage the use of upright positions but lack description of these positions so they cannot be delivery appropriately).



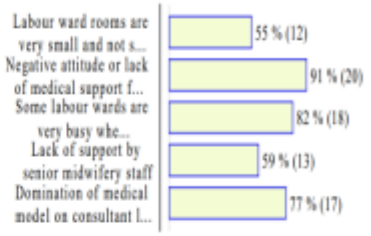
Number of answers: 21
Weighted mean: 5.09

42. Lack of formal midwifery training and education on squatting/upright and other positions.



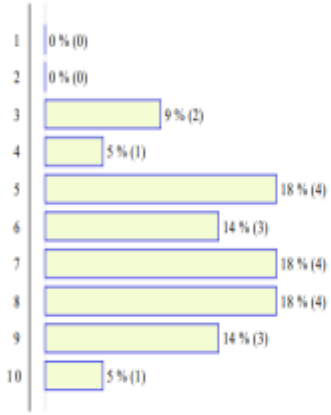
Number of answers: 21
Weighted mean: 8.27

43. Medical model of care: (please, tick all that apply – those you tick are the most important statements and those which you do not tick are the least important).



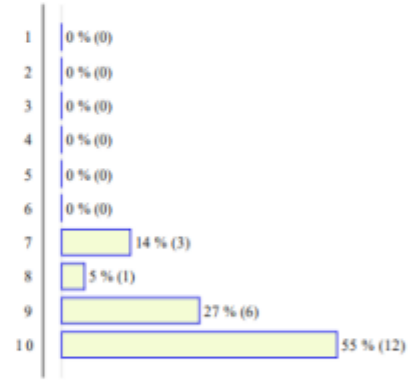
Number of answers: 80
Weighted mean: 3.04

44. Possibility of midwife's physical constraints e.g., back problem, manual handling issues.



Number of answers: 22
Weighted mean: 6.59

45. On a scale of 1 (Poor) to 10 (Excellent), how would you rate the usefulness of squatting position during childbirth?

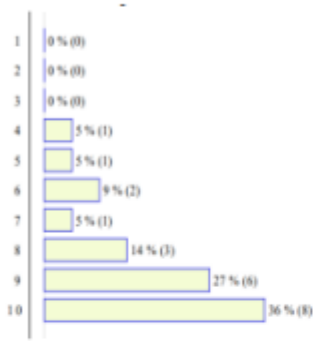


Number of answers: 22
Weighted mean: 9.25

Comments: • with regard to question 15: unclear, what is the definition of maternity led unit? compared to what? to hospital (score 7) or to home (score 4) question 28: this is unclear, in the real-world women are often encouraged to lie down for these reasons (score 8), but these are not legitimate reasons (score 2). question 39: unclear, this depends on if you mean unsupported or also include supported squatting. Overall contraindications are never absolute, but unsupported squatting seems less advisable for deep vein problems. I miss a possible contraindication: history of postpartum haemorrhage. • Need better antenatal advice and encouragement to use alternate positions. • I ASSESS EACH INDIVIDUAL WOMAN AS TO WHETHER I PUT MY HANDS-ON OR NOT AS THE HEAD IS CROWNING • Hand on and off depends on a woman preference and midwives' clinical judgement • all midwives should be able to assist women in any squatting position in any environment i.e. even in a small labour ward room, provided mother and baby are not compromised. There is lack of knowledge regarding contraindication associated squatting position. • Question 31: not unless there are special circumstances • I think women should be encouraged to use alternate positions even those who are classified as high risk, but are planning to have a vaginal birth. Also, more flexibility in movement of women when they have to have continuous foetal heart monitoring. • Midwives particularly in the labour ward setting are unfamiliar with squatting positions and fearful assist women. Many have never used a birthing stool and rarely use a supportive squat to aid descent with preference for lithotomy. Number of comments: 8	

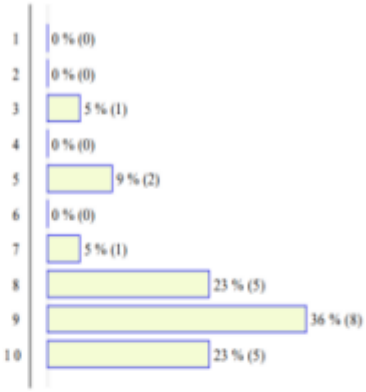
SECTION 5: Literature-based definitions of squatting positions in pregnancy and childbirth.

Statement 1- Supported squatting – a woman rests her body weight on her thighs, placing her bottom (sacrum) in the hole of the seat (obstetric chair or birth stool or obstetric bed), relieving the weight of her body from her bottom (sacrum).



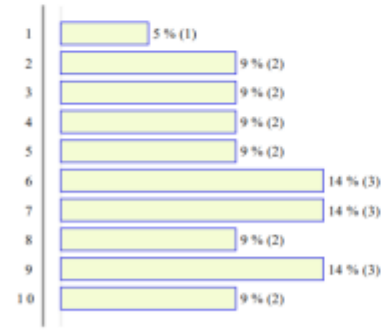
Number of answers: 22
Weighted mean: 8.32

Statement 2- Unsupported squatting – a woman's buttocks and thighs support her weight with her knees bent, her feet flat on the bed or floor or in the water pool.



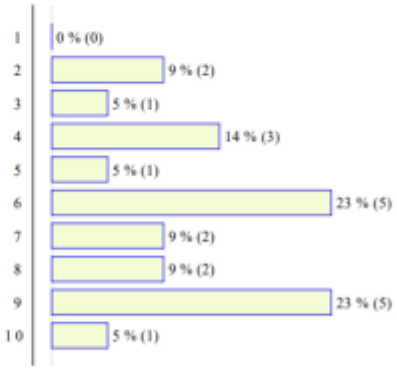
Number of answers: 22
Weighted mean: 8.27

Statement 3- Squatting is where the curved part of the top of the hip (i.e., iliac crest) moves inwards as though the upper portion of the hip bone and pelvis (i.e., the ilium) were being squeezed together. The bottom (i.e., sacrum) moves downwards and forward, reducing the upper part of the pelvis (i.e., true conjugate). In summary, the upper part of the birth canal (pelvis brim) is reduced, enlarging slightly the lower part of the birth canal (i.e., transverse and pelvis outlet).



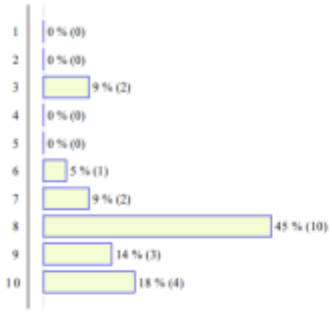
Number of answers: 22
Weighted mean: 5.95

Statement 4- Squatting is one of the upright sitting positions without using a backrest, or the backrest of the obstetric bed is raised higher than 85 to 90 degrees.



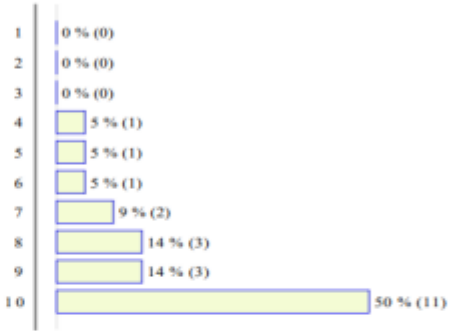
Number of answers: 22
Weighted mean: 6.29

Statement 5- Squatting is the birth position that allows the enlargement of the measurements of the bottom level of the pelvis bone called the pelvic outlet and enables it to bear down to the most significant advantage.



Number of answers: 22
Weighted mean: 7.76

Statement 6 - Squatting is an upright position with shoulders above the pelvis; the movement of the leg coming closer to the abdomen (i.e., thighs are abducted) with knees bent (i.e., flexed = the limit is the calf pushing onto the back of the thigh), which causes a separation of the lower part of the pelvis sitting bone called ischial tuberosities and an increase in the bottom or final level of the pelvis (that baby descends and rotates through during birth) called pelvic outlet diameter by as much as 28% compared with the recumbent position.



Number of answers: 22
Weighted mean: 8.64

Appendix 9 - Characteristics of excluded RCTs

Study	Reason for exclusion
1.Boyle et al 2002	Wrong intervention - Intervention eligible for the study: walking, kneeling or standing vs immobile for women using epidural analgesia
2.Calvo Aguilar 2013	Description of vertical position not clear
3.Drabral et al 2014	Wrong interventions - Study comparing kneeling with supine positions in the second stage of labour
4.Brocklehurst 2017	Women using epidural analgesia, also not clear whether interventions included squatting positions
5.Nagoetta et al 1997	Intervention in the first stage of labour: period of intervention not specified. Comparative groups: walking vs not walking
6.Downe et al, 2004	Intervention eligible for the study: Supported sitting legs not in flexed vs lateral position women using epidural analgesia
7.Golara et al 2002	Intervention eligible for the study: Standing or walking vs in bed or chairwomen using epidural analgesia
8.Karraz et al 2003	Intervention eligible for the study: Walking, sitting in a chair or recline in a semi-supine or lateral position women using epidural analgesia
9.Vallejo et al 2001	Intervention eligible for the study: Walking or sitting in chair vs in bed, recumbent or lateral position women using epidural analgesia
10.Andrews 1990	Intervention included various types of upright positions e.g. squatting, kneeling, standing, ambulating and sitting. Data on squatting was analysed together with other positions.
11. Chan 1963	Data collection and analysis included another upright position. Sitting in the chair and bed
12.Caldeyro-Barcia 1960	Examining standing and horizontal position in the first stage of labour
13.Arbitto 1985	Wrong intervention - Squatting position not considered in this study
14.Brement 2007	Wrong intervention - Comparing lateral and dorsal positions
15.Liu YC.1986	Definition of upright position not clear.
16.Suwanakam 1988	Wrong intervention – comparing semi-recumbent and supine positions

Appendix 10- Characteristics of excluded NRSs studies

Study	Reason for exclusion
1.Albers et al 1996	Squatting data measured with other upright positions
Chen 1987	Sitting position not defined
2.Da Silva et al 2012	No classification of upright positions

3.Gareberg (104)et al 1994	The study examined two methods of Squatting (unsupported) versus another squatting (supported) position
4.Knauth & Haloburgo 1986	The purpose of the study was to evaluate two different pushing technique using obstetric chair
5.Mayberry et al, 2003	Evaluation of squatting with other upright positions compared with horizontal positions in women using epidural analgesia
6.Nodine & Roberts 1987	Squatting data was not measured due to small sample size
7.Roberts and Kriz 1984	Upright positions excluded squatting
8.Smith et al, 2013	Squatting data measured with other upright positions
9.Shorten et al 2002; 10.Edqvist 2016; 11.Maheux-Lacroix 2012	Insufficient data lead authors contacted with no reply.