Explaining determinants, impact on breastfeeding, and trends over time of prelacteal feeding practice in Indonesia: a mixed methods study

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ABSTRACT

Background

Prelacteal feeding (PLF) is any feed other than breastmilk given to newborns within the first few days of birth and/or before breastfeeding is established. PLF has been recognised as one of the challenges to optimal breastfeeding, hence the World Health Organisation (WHO) recommends against it unless medically indicated. In Indonesia, breastfeeding practice is gradually improving, yet PLF prevalence is higher than the global average. However, research about PLF from Indonesia is limited. Moreover, existing literature showed that type of PLF varies across settings, but most studies analysed it as a single entity. This thesis aims to explain the determinants, impact on breastfeeding, and trends over time of PLF practice in Indonesia, overall and by different type.

Methods

My thesis used a mixed methods approach. The quantitative components used the Indonesia Demographic and Health Surveys (IDHS) datasets from 2002, 2007, 2012, and 2017. The qualitative component used in-depth interviews with Indonesian health professionals to understand the role of the health care service in preventing inappropriate PLF practice.

Results

The PLF prevalence in Indonesia decreased from 68% in 2002 to 45% in 2017. The most common PLF types were formula, honey, water, and other milk. Some determinants of PLF varied by type and sometimes showed opposite directions of association. Higher wealth quintiles, first child, and caesarean birth especially at a private facility were consistent determinants for prelacteal formula and other milk in most survey years. In contrast, home birth was a determinant for prelacteal honey and water. Meanwhile, any PLF, particularly

formula and other milk, were consistently associated with shorter duration of any breastfeeding and non-exclusive breastfeeding at 0-6 months. However, these associations were not consistent for prelacteal honey and water. Interviews with health professionals revealed complexity in PLF practice, where definition, justification, and consequences for giving PLF were sometimes unclear. Health facilities, particularly the health professionals, played a crucial role in reducing inappropriate PLF, although this depended on the health professional skills, services available, and influences from the mother's families. The decrease in PLF practice in recent years was reported to be largely contributed to by Indonesia's breastfeeding laws and mothers' increasing commitment to breastfeeding. Nevertheless, remaining challenges include lack of acknowledgment and support towards addressing breastfeeding difficulties in the first days.

Conclusion

PLF is a complex challenge to breastfeeding that is often overlooked in Indonesia, a country where breastfeeding is culturally favoured and protected by law. PLF is not a single entity, hence identifying vulnerable groups and circumstances for different PLF types is helpful for health professionals in preventing inappropriate PLF practice. Information about the impact on breastfeeding of different PLF types is often not clarified, together with information about options to address potential breastfeeding difficulties. My DPhil thesis findings support current recommendations to avoid PLF without medical indications. However, discussion about the risks and benefits of PLF in relation to breastfeeding difficulties in the first days and ways to overcome them deserves more attention.

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“It takes a village to raise a mother, especially if she is pursuing a PhD.”

I could not come up with an original quote to sum up my DPhil journey, which happened to begin in the first few years of motherhood. So, I modified a famous old proverb to remind myself that doing a PhD while raising a small child in the middle of a pandemic is not something I could have casually done without the help from others. I am dedicating this page to express my deepest gratitude to the amazing people who have become my ‘village’.

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STATEMENT OF CONTRIBUTION TO WORK

I, Lhuri Dwianti Rahmartani, confirm that the work presented in this thesis is my own.

For the quantitative component, I developed the research proposal, accessed the IDHS datasets, cleaned the data, wrote the Stata code, analysed the data, and wrote the relevant thesis chapters. My supervisors Professor Maria Quigley and Associate Professor Claire Carson advised me on the conceptualisation, study design, statistical analysis, interpretation of the thesis findings, as well as writing and language for my overall thesis, particularly the quantitative components. They also co-authored a peer-reviewed paper I published during my DPhil study. They both have consented me to include material from the paper in my thesis.

For the qualitative component of my thesis, For the qualitative component, I designed the study protocol and survey instruments, gained the necessary ethical approvals, recruited the participants, conducted the interviews, transcribed the data, translated the transcripts, analysed the data, and wrote the relevant thesis chapters. I also specifically received expert input from my advisor Dr Jenny McLeish, who is an experienced qualitative researcher with a specialty in the UK maternity services. She advised me on the philosophical orientation, conceptualisation, independent coding, thematic analysis, as well as writing and language in Chapter 8 and Chapter 9.

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STATEMENT OF THE COVID-19 PANDEMIC'S IMPACT ON THE DPHIL STUDY

I started my DPhil in Michaelmas 2018 and planned to complete my study in three years as covered by my initial funding. However, several adjustments had to be made and delays were inevitable due to the COVID-19 pandemic that begun in the UK in early 2020. The pandemic caused disruption in both my research and personal life.

Substantial changes of the methods in the qualitative study had to be made, in which I initially intended to do in-person interviews. The process of changing the methods from in-person to online interviews meant additional time required to rewrite study protocols and adjust them to adhere to information security policy regarding videoconferencing software that was different between the local ethic committees in Indonesia and in the University of Oxford.

The pandemic also prevented the inclusion of study participants who could not be interviewed online. Moreover, the interviews took place during the second half of 2021, when Indonesia was badly hit by the second wave of COVID-19. During these months, health facilities in Indonesia were close to, if not collapsing. Many health care workers were directly affected by COVID illness or bereavement, and the impact on the health care system meant that most were also extremely busy at work. There were times when my 'candidate' participants were affected by one of these events, and it was only appropriate to approach another participant and/or wait until they were ready to be interviewed, resulting in significant delays in the recruitment.

Furthermore, the delay in my study progress was largely due to the unforeseeable additional childcare responsibilities when schools in England were closed for almost six

months to most children during multiple lockdowns in early 2020 and 2021. I had to dedicate a large part of my time to provide remote learning support for my son who was in Reception (2020) and Year 1 (2021). Furthermore, there were times of intense psychological stress caused by the fact that the majority of my family in Indonesia were ill with COVID-19, especially during the months when my husband had to be in Indonesia to take care of his parents.

All these circumstances contributed to delays in my study progress. Nevertheless, I am grateful that I received a lot of support from my sponsor, supervisors, friends, and family. I also acknowledge that the online interviews partly compensated the time and cost needed for travel. With all the support during such a strange time, I managed to submit before the end of my fourth year, the maximum study period stipulated by the University of Oxford.

LIST OF ABBREVIATIONS AND KEY TERMS

ABM	The Academy of Breastfeeding Medicine
AIDS	Acquired immunodeficiency syndrome
AIMI	*Asosiasi Ibu Menyusui Indonesia* (Indonesian Breastfeeding Mothers' Association)
ANC	Antenatal care
aOR	Adjusted Odds Ratio
aPR	Adjusted Prevalence Ratio
B.C.	Before Christ
BF	Breastfeeding
BFHI	Baby-friendly Hospital Initiative
BF	Breastfeeding
BPJS	*Badan Penyelenggara Jaminan Sosial (*usually meant *BPJS Kesehatan)*, Social Security Agency of Health
CI	Confidence interval
CMPA	Cow milk protein allergy
'Current' EBF	Exclusive breastfeeding in the last 24 hours prior interview, defined as still breastfeeding and not giving anything other food or drink in the last 24 hours prior interview
DHS	Demographic and Health Survey
EBF	Exclusive breastfeeding
EBF2D	Exclusively breastfed for the first two days after birth
EIBF	Early initiation of breastfeeding
ENF	Early neaonatal food/feed/feeding
EU	European Union
HCW	Health care worker
HIV	Human immunodeficiency virus
HR	Hazard ratio
hr	Hour
IBI	*Ikatan Bidan Indonesia* (Indonesian Midwifery Association)
IDAI	*Ikatan Dokter Anak Indonesia* (Indonesian Paediatrics Society),
IDHS	Indonesia Demographic and Health Survey
ITU	International Telecommunication Union
IYCF	Infant and young child feeding

MA	Meta-analysis
MCH	Maternal and child health
MICS	Multiple Indicator Complex Survey
MoH	Ministry of Health
NA	Not available
NEC	Necrotising enterocolitis
NICU	Neonatal intensive care unit
NS	Not significant
OR	Odds ratio
PCOS	Polycystic ovary syndrome
PLF	Prelacteal feeding
PNC	Postnatal care
PPS	Probability proportional to size
PR	Prevalence ratio
Riskesdas	*Riset Kesehatan Dasar* (Basic Health Survey)
SBA	Skilled
SR	Systematic review
TBA	Traditional birth attendant
UK	The United Kingdom
UNICEF	The United Nations Children's Fund
WHO	The World Health Organisation

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1 INTRODUCTION

1.1 Topic and scope

My DPhil thesis is about prelacteal feeding (PLF) practice in Indonesia. The research presented here examines the prevalence and determinants of the various types of PLF as well as how they affect breastfeeding outcomes. It also describes how PLF practices have changed in Indonesia over the past two decades.

There are several ways to define PLF, but in general PLF refers to any food or drink other than breastmilk given to a newborn within the first few days after birth and/or before breastfeeding starts (1-3). There are various types of PLF, such as infant formula milk, animal or plant-based milk, honey, butter, and many others which differ by geographic region. The reasons and justification for giving PLF vary widely. These include, but are not limited to, temporary medical indications, religious reasons, cultural traditions, and breastmilk insufficiency (whether actual or perceived). Depending on the context and reference, PLF might be either necessary or inappropriate.

When breastfeeding is the mother's intended or preferred infant feeding option, PLF is rarely necessary, and the World Health Organisation (WHO) recommends that it should be avoided unless there is medical indication (4). There are very few medical justifications for giving PLF, and under those circumstances only infant formula is considered an acceptable form of PLF (4, 5). However, as described earlier, PLF practices are not limited to formula and there are a wide range of types of PLF given to newborns by their mother or wider families. One of the reasons the WHO recommends against giving PLF without medical indication (2) is because existing studies have shown detrimental impacts of PLF on breastfeeding, particularly by disrupting the positive feedback mechanism of milk production (3). This thesis acknowledges that PLF is also associated with other health risks

such as infection and allergies but the thesis scope about the impacts of PLF is restricted to those related to breastfeeding.

1.2 Rationale for this research

Breastfeeding is one of the best interventions to improve child health while also providing significant health benefits for the mothers (3, 6). The WHO recommends that children are breastfed exclusively for six months and continue to be breastfed until two years or beyond (3, 4). These are viewed as optimal breastfeeding behaviours and many countries are attempting to achieve or maintain these practices in a high proportion of mothers. There are various challenges to optimal breastfeeding and PLF is known to be one of them.

Nevertheless, there is a long history of PLF in many parts of the world. Indonesia, my home country, is among the nations with the highest prevalence of PLF (7). According to the Indonesia Demographic Health Surveys (IDHS), nearly half of all newborn babies in Indonesia received some form of PLF in 2017. On the other hand, Indonesia does not rank the lowest in terms of breastfeeding indicators, but there continues to be room for improvement in the infant feeding practice and the need for evidence from the relevant setting.

According to the current report from United Nations Children's Fund (UNICEF) the percentage of exclusive breastfeeding (EBF) and continued breastfeeding among children at 12-23 months in 2017 in Indonesia was 51% and 69% respectively, which were slightly above the most recent global average (44% and 65%, respectively) (8). However, although mothers usually breastfeed for nearly two years (1, 9-12), the percentage of continued breastfeeding at 12-23 months kept decreasing from 74% in 2002 to 67% in 2017 (8). Moreover, the EBF percentage has been fluctuating in the past three decades and the current figure (51%, 2017) was not much higher than in 1991 (47%) (8). Considering the

high prevalence of PLF, it is crucial to have a deeper understanding about PLF practice in Indonesia, especially about factors associated with higher risk of giving PLF, how PLF impacts breastfeeding, and how these have changed over time.

Epidemiological research on PLF from Indonesia is particularly scarce. Existing studies about PLF in Indonesia were usually conducted in a small sample from geographically limited areas (13-15), and therefore do not represent the practice across the whole nation. Indonesia is a large country with a heterogeneous population of 271 million (16, 17) and an epidemiological study on PLF at the national scale is needed. Studies on PLF determinants using Demographic Health Surveys (DHS) datasets from various countries, especially from Africa, had been published (18-21), but to my knowledge when I started my DPhil, nobody had done so with the Indonesia DHS (IDHS). In addition to the large sample size and representativeness of the study population, DHS is free to use, easily accessible to public, and available over a series of years. Making use of such data is a good practice in public health research, which tends to be underutilised and not well recognised in Indonesia.

Furthermore, while many studies from other countries have identified PLF as one entity, very few looked at different types of PLF (22, 23) . PLF has a vast range of types, and they are likely to differ in terms of the reason for giving, the characteristics of mothers who give them, and the consequences they may bring. The research presented in this thesis is among one of the very few that looked at different types of PLF and discusses the importance of acknowledging the variation of PLF types. Moreover, although a few studies have reported PLF practice in some regions in Indonesia, little is known about the role of health facilities in preventing inappropriate PLF. This is important because more than 85% births take place at health facilities (24) and these settings are where public health interventions are intended to take place.

This thesis uses the IDHS data to address the research questions surrounding prevalence, determinants, and impacts on breastfeeding. Despite being a good source of epidemiological data, IDHS does not have all the information to answer my study objectives. Surveys that reported PLF prevalence in Indonesia, such as IDHS and Basic Health Survey (*Riset Kesehatan Dasar – Riskesdas*) are quantitative. Nevertheless, some things cannot be captured by numbers only, hence my thesis used a mixed methods approach.

A qualitative study using in-depth interviews with health professionals was designed to complement the quantitative research and provide insights to aid the interpretation of the IDHS analysis. The qualitative study was carried out to explore how PLF is practiced in the health care settings and to understand the role of health facilities in the prevention of inappropriate PLF practice. Although a few previous studies (13) have reported PLF practice in some regions in Indonesia, including the reasons for the practice, it is important to explore how this occurs and changes over time, particularly in the health facility, where public health interventions are intended to take place.

1.3 Aim and objectives

This thesis aims to describe the determinants of PLF, how PLF affects breastfeeding, and how these aspects have changed over time. This aim is composed of five study objectives as follows:

1. To describe the prevalence of PLF (any PLF and the predominant types of PLF, i.e. formula, honey, water, and other milk) in Indonesia in 2002, 2007, 2012, and 2017;
2. To identify the determinants of PLF (any PLF and the predominant types) in Indonesia and whether these have changed over time in 2002, 2007, 2012, and 2017;
3. To assess the association between PLF (any PLF and the predominant types) and breastfeeding duration in 2002, 2007, and 2017;

4. To assess the association between PLF (any PLF and the predominant types) and 'current EBF' in 2007, 2012, and 2017;
5. To understand the perception of PLF practice among health professionals in Indonesia and what they think about the role of the health care service in preventing inappropriate PLF practice.

1.4 Methodology

As mentioned earlier in the rationale, this thesis uses a mixed methods approach. The quantitative studies analysed data from the 2002-2017 IDHS to address Objectives 1-4. The qualitative study using in-depth interview with health professionals was carried out to address Objective 5.

1.5 Thesis structure and overview

My DPhil thesis has nine chapters including this chapter. The next chapter (Chapter 2) presents a review of the existing literature. There I describe the different definitions of PLF used in research, the empirical evidence identifying the determinants of PLF and how PLF is related to breastfeeding. Chapter 2 also describes in more detail the research gap that underpins the rationale for the research presented in this thesis.

Chapter 3 provides the overarching methods relevant for Chapters 4-7, which all use data drawn from the IDHS datasets. To avoid repetition, details such as IDHS design and methods, and the definitions of variables used in my analysis are provided there. However, each corresponding chapter still contains specific methods on its own.

Chapters 4-7 present quantitative studies to address Objectives 1-4 outlined above. Each chapter contains an introduction, study specific methods, results, and discussion of the findings. Specific components of the methods relevant for each objective such as statistical

analysis and study population are described in more detail in each chapter. Chapter 4 provides an epidemiological overview of PLF practice in Indonesia by describing the prevalence in this country in four consecutive IDHS surveys, conducted in 2002, 2007, 2012 and 2017. Chapter 5 examines the demographic and child and birth-related determinants of any PLF and the predominant types over the same period. Chapters 6 then describes the association between PLF and breastfeeding duration in 2002, 2007, and 2017. Lastly, Chapter 7 explores the association between PLF and 'current EBF' in 2007, 2012, and 2017.

Chapter 8 presents the methods, results and discussion of the findings from the qualitative study conducted to address Objective 5. The themes identified in this analysis describe the perception of PLF practice among health professionals and what they think about the role of the health care service in preventing inappropriate PLF practice in Indonesia.

Finally, Chapter 9 is the overarching discussion which corresponds to the overall aim of this thesis, drawing on the evidence presented in the earlier chapters. It summarises the main findings from all five study objectives and underlines the most important messages for practice, policy, and future research. This chapter explains how both the findings of the quantitative and qualitative studies added to each other, providing a richer insight into PLF practice in Indonesia.

2 LITERATURE REVIEW

2.1 Chapter introduction

This chapter describes the various definitions of prelacteal feeding (PLF) identified in the literature and what is used in my thesis. It also presents a structured review of the existing evidence on prevalence and determinants of PLF globally and in Indonesia. Additionally, it describes evidence on the association between PLF and breastfeeding outcomes. Lastly, it identifies the research gap that this thesis is trying to fill.

2.2 What is prelacteal feeding?

Etymologically, prelacteal comes from the words “pre-” (before) and “lac/lact/lacteus/lacteal” (pertaining to milk) (25, 26). Prelacteal (or pre-lacteal) feeding (PLF) therefore translates to any feed given to a baby before the mother’s breastmilk comes in or before breastfeeding has been established (27, 28). In the literature, however, the definition of PLF is not always consistent. The World Health Organisation (WHO), the Demographic Health Surveys (DHS), including the Indonesia DHS (IDHS), and several research studies have defined PLF differently (examples shown in **Table 2.1)**. While the concept of PLF is quite intuitive, the details on the timing and type of substances given can have different interpretations.

In terms of timing, these definitions refer to any time before breastfeeding is established or breastmilk comes in, any time within the first three to four days of birth, or a combination of both (**Table 2.1**). Consequently, existing studies have used different definitions of PLF, which may not always be directly comparable. Some definitions use any period before breast milk comes in or before breastfeeding is established without mentioning days (20, 29, 30). Others refer to any period within three days regardless of breast milk expression (7, 18, 31). Qiu et al. (32) used physiological timeframe i.e. before the onset of lactogenesis

II, which is the onset of copious lactation that occurs within four days of birth (32). These timings largely overlap with each other, but they are not necessarily identical. For this reason, some authors (33, 34) decided to call it early neonatal food (ENF) instead of PLF, although this term is less widely used.

Table 2.1. Some definitions of PLF

Sources	**Definition**
WHO (35)	"*Other* feeds given before breastfeeding is established"
WHO (2)	"*Artificial* feeds given before breastfeeding is established"
IDHS 2017 (English version (1)), some other DHS (36, 37), and studies analysing DHS datasets (7, 18, 31).	"In the *first three days after delivery*, … given anything to *drink* other than breast milk"
IDHS 2002-2012 (English and Indonesian versions) (10-12) and IDHS 2017 (Indonesian version)(38)	"In the first three days after delivery, *before milk began flowing regularly*, … given anything to drink other than breast milk"
Qiu et al.(32)	"…any feeds given before the *onset of lactogenesis II*, which is the onset of copious lactation that occurs *within four days of birth*"
McKenna & Shankar (39)	"…those *foods* given to newborns before breastfeeding is established or before breast milk "comes in," *usually on the first day of life*."
Kavle et al. (29)	"…giving foods and/or liquids, *other than colostrum*, to an infant prior to establishing breast-feeding."
Edmond et al. (40)	"…any *nonhuman milk food* or fluids provided to the newborn before breastfeeding on the first day of life."

In terms of substance type, research on PLF has described infant formula milk –or formula for short– and other feeds that are not specifically formulated for babies such as animal milk, plant-based milk, honey, butter, ghee, water, and tea. However, what might be unclear is whether PLF includes breastmilk of another human (donor human milk). My initial understanding when starting this DPhil project was that donor human milk is not a PLF, because it *is* breastmilk and questionnaires about PLF, including the ones from the IDHS (1, 10-12) rarely include donor milk. However, some definitions are more specific than the others and can be interpreted differently. For example, Edmond et al. (40) refer to PLF as any nonhuman milk, which means donor milk is not PLF, while Kavle et al. (29) define PLF as any food/liquid other than colostrum, which implies donor milk that is mature milk could

be classified as PLF. Furthermore, a clinical protocol from the Academy of Breastfeeding Medicine (ABM), a non-governmental organisation partner of UNICEF that contributes to the WHO's Ten Steps to Successful Breastfeeding guidelines (4), classifies donor human milk as supplementary feeding together with infant formula and glucose water (41). Meanwhile, different guideline documents from the WHO (2, 35) as shown in Table 2.1 are not strictly consistent, with one being more general and the other limits PLF to "artificial feed".

PLF is not to be confused with mixed feeding, which is defined by the WHO as feeding an infant younger than six months old liquids and/or foods together with breastmilk (42). PLF might overlap with mixed feeding, but it has more specific duration, which is only around three days after birth instead of the whole six months. It may also differ in the reason and quality of the feed given. In this thesis, the variable of PLF in the quantitative analyses refers to the definition used by the Indonesian version of the IDHS questionnaire from 2002 to 2017 (10-12, 38), as described in the next chapter (Methods). That includes anything other than breastmilk given within the first three days after the child's birth and before the breastmilk begins flowing.

2.3 Why does PLF matter?

From the biological and physiological perspective, the most suitable food for newborns is their mother's own milk (43). For this reason, most babies do not need PLF, but there are a few conditions where PLF is indicated. Moreover, PLF is also given for many other reasons. Regardless of the substance, the two main concerns about giving newborns other feeds instead of breastmilk are firstly, the exposure to potentially harmful substances and secondly, the risk of breastfeeding disruption. These adverse impacts can be difficult to separate and are especially problematic if the feeds are given to babies within the first few days of birth, which is what PLF is.

2.3.1 The exposure to potentially harmful substances

The gastrointestinal system of the newborn infant is different from that of adults and even of 6-month-old infants, thus it has very limited options of suitable food. Breastmilk can be digested and absorbed efficiently and is the only food biologically tailored to suit the newborn's needs throughout all development stages until at least six months (3). Hence, there are several types of breastmilk based on the composition that corresponds to the baby's age, i.e. colostrum, transition, and mature milk (3). To date, no food has been reported to have identical properties and components to those of breastmilk. Hence giving something other than breastmilk might come with a varying degree of health risks.

Despite not being identical to breastmilk, formula is the only substance that is designed to mimic breastmilk and is approved by the WHO as a substitute when breastmilk cannot be given (4). Human milk substitute was known since 2000 BC but the first kind of formula milk for infant was first introduced in the 19th century (44). The earlier versions of formula were more fulfilling rather than nutritious, but as research advances, modern formula is a good mimic for the nutritional content of breastmilk (44). Good quality modern formula, prepared correctly to reduce the risk of infection, has been a WHO-approved feeding alternative for babies who, for whatever reason, cannot receive breastmilk. Nevertheless, formula is still known to bear some health risks, either long-term or short-term (45). First of all, it still lacks other important benefits that provide immunological defence in which breastmilk has (3). When given as PLF, the short-term risks that can be seen immediately include cow's milk protein allergy (CMPA), contamination from substandard preparation, and gastrointestinal infection (45-47). Furthermore, formula is known to increase the risk of necrotising enterocolitis (NEC) in premature babies (48).

Those are just the recognised risks from prelacteal formula, the feed that has been studied for decades. Since PLF comes in many different forms and includes feeds that are not approved by the WHO, it is very likely that there are still unknown risks that come from other feeds. Moreover, some popular PLF are substances that are not even recommended for babies. For example, despite the WHO's warnings against honey for babies under 12-months-old (49) due to the risk of infant botulism, honey is a common PLF in countries like Bangladesh (50), Maldives(22), and Pakistan (51, 52). In addition, feeds such as non-formula milk, tea, herbs, and various kinds of water are reported elsewhere (51-57).

2.3.2 The practice associated with discarding colostrum

Newborns are more prone to infection because their immune system is not fully developed. In the first two or three days of birth, the early form of breastmilk, known as colostrum, is secreted in a very small amount, approximately 50 ml a day (3, 58). Colostrum contains abundant immunoglobulins, particularly secretory IgA, leukocytes, proteins, and fat-soluble vitamins (3, 58). These are the essential components to protect newborns from illnesses.

PLF is often closely related with the practice of discarding colostrum (59). Several studies have reported that in some areas where newborns frequently received PLF, colostrum was not given (56, 57, 60-63). The practice of discarding colostrum is usually due to lack of knowledge and understanding about infant feeding. A study from a rural region in India, for example, found that nearly 100% mothers in the study gave PLF and the majority of them believed colostrum was harmful and ghutti (a kind of herbal syrup or water mixed with honey and herbs (64) cleanses the intestine (60). In Ethiopia, colostrum was discarded because it was not considered as breastmilk and thought to cause abdominal problems (63).

2.3.3 The risk of breastfeeding disruption

There is a large body of evidence on the benefits and importance of breastfeeding, and it is likely one of the most cost-effective public health interventions to reduce child mortality (6). Some of the known effects include a reduction in infections in breastfed babies, improved birth spacing due to lactational amenorrhea, and a lower risk of breast cancer among women who breastfeed (6). Such health benefits have an economic impact at both the individual and societal level, and therefore breastfeeding is important for all countries regardless of socioeconomic settings. Consequently, breastfeeding has become a global priority and the WHO recommends that children are exclusively breastfed for the first six month of life, and then continue to be breastfed with complementary feeding for up two years or beyond (3). This recommendation has been in place since 1989 (65) and to achieve that, the WHO has developed the 10 Steps to Successful breastfeeding (**Figure 2.1**).

Establishing breastfeeding in the first days is critical because there is increasing evidence that early initiation of breastfeeding is associated with a lower risk of neonatal mortality and morbidity (40, 66, 67). Thus, breastfeeding initiation is specifically identified in Step 4 of the WHO guidance (**Figure 2.1**). Meanwhile, a delay in breastfeeding initiation is particularly linked to PLF practice, regardless of the temporal sequence (33, 68). Moreover, at least since three decades ago (30), PLF was reported to be associated with suboptimal breastfeeding outcomes and more studies reported similar findings over time (69).



Figure 2.1 The 2018 version of the WHO Ten Steps to Successful Breastfeeding (70), which was a revision of the 1989 version (65).

Since the WHO Ten Steps to Successful Breastfeeding were set out in 1989, a recommendation about supplementation has been stated in the Step 6 in the list (**Figure 2.1**). This step discourages giving any food or drink other than breastmilk to a breastfed newborn infant unless medically indicated (3, 70). The recommendation against giving PLF is based on the physiology of human milk. Milk production is a cyclic process working under

positive feedback of oxytocin and prolactin. These hormones are responsible for secretion and production of human milk, respectively. A baby's suckling at the breast stimulates the maternal posterior pituitary to release oxytocin and the anterior pituitary to release prolactin (3). The more the baby suckles, the more it stimulates the alveolar cells of the breast to produce and secrete milk. Conversely when there is no stimulation, the alveolar cells will stop producing and secreting milk.

Owing to the mechanism of breastmilk production, PLF can disrupt breastfeeding by making the baby feel full, which reduces his/her interest in feeding at the breast which in turn will decrease stimulation to the milk production (3). Even when breastfeeding has been initiated, the first weeks are important in establishing breastfeeding – as there is a learning process for both the mother and the baby as well as the biological mechanism driving milk production. Additionally, when PLF is given using a bottle, it can also interfere with the baby's ability to suckle at the breast (3).

In relation to the definition of PLF discussed earlier, the wording in the Step 6 has undergone a small but meaningful modification. Previously, in 1989, Step 6 recommended, "Give newborn infants no food or drink other than breastmilk, unless medically indicated" (65). By 2018, it had been revised to "Do not provide breastfed newborns any food or fluids other than breast milk, unless medically indicated" (4, 70). This implies that this recommendation only applies to newborn infants who are physiologically able and intended to be breastfed, and by no means should be viewed as a ban on other feeding options.

2.3.4 Common reasons PLF is given

As mentioned previously, PLF is frequently given as part of traditional, cultural, and/or religious practices. For example, in some Muslim communities, giving a smear of honey or chewed dates to a newborn (also known as 'tahnik' or 'tahneek') is perceived as following

the sunnah (good practice) of Prophet Mohammad and believed to bless the baby with luck and sweetness (22, 39, 52). In some Hindu communities, honey and *ghee* (a kind of butter) are given to newborns to pass 'virtuous qualities' to the child (39). PLF is also given as a traditional practice passed through the generations which is believed to help clean the baby's stomach, comfort the baby, and prevent colic (39, 71). Other common reasons include lack of knowledge, fear of not enough breastmilk, maternal and/or neonatal illness, the woman's mother's or mother-in-law's influence, and health professionals' advice (72-76) and these often overlap with each other.

The fear of lactation failure and/or insufficient breastmilk supply from either mother, family, or health care provider, have been recognised as the most common justifications for introducing a breastmilk substitute in the first days after birth (65). Therefore in the first document of breastfeeding guidance, the WHO has specifically stated that under normal circumstances, newborn babies do not need to be given any other food or drink even if breastmilk does not come in within the first two to four days (65).

2.3.5 The risk when medically indicated PLF is not given

It is difficult to estimate the global proportion of babies for whom PLF is medically indicated. However, based on the physiology of lactogenesis, most babies will be able to breastfeed even if there are difficulties in the first 24 hours, hence there are very limited reasons to give PLF (5, 41). However, it is equally important to acknowledge that in certain circumstances, PLF can be necessary when breastmilk feeding is not possible and failure to give PLF may result in conditions such as neonatal dehydration, hypernatremia, and jaundice due to suboptimal intake (77).

2.4 Guidelines surrounding PLF

In line with the WHO guidelines (**Figure 2.1**), PLF should be avoided unless medically indicated. This implies that although 'rare', there are circumstances when PLF is necessary. For example, very preterm babies may require PLF because breastfeeding is more challenging for them (3). Birth before 32 weeks accounts for approximately 10% of all preterm births that occur in 11% of all births worldwide, translating to roughly 1% of all births (78). The WHO has listed several maternal and neonatal medical conditions that justify permanent and temporary use of approved breastmilk substitutes i.e. infant formula milk (3, 5). These are summarised in **Table 2.2**. There is no official term for this, but for PLF given in the circumstances mentioned below, we can call it a medically indicated PLF or appropriate PLF.

Table 2.2 Medical indications for giving PLF based on the 2009 WHO guidelines (5)

Neonatal indication	Maternal indication
Infants who should not be fed breastmilk: 1. Classic galactosemia 2. Maple syrup urine disease 3. Phenylketonuria Infants who may need temporary additional supplementation to breastfeeding alone: 1. Very low birth weight infants (<1500 g) 2. Very pre-term infants (<32 weeks) 3. Newborns at risk of hypoglycaemia related to impaired metabolic adaptation or increased glucose demand if their blood glucose fails to respond to optimal breastfeeding or breastmilk feeding. These include infants with any of the following conditions: - preterm - small for gestational age - ill - have experienced significant intrapartum hypoxic/ischaemic stress - born to a diabetic mother	Mothers' conditions that justify permanent avoidance of breastfeeding: 1. Human immunodeficiency virus (HIV) infection when substitute is acceptable, feasible, affordable, sustainable, and safe Mothers' conditions that justify temporary or permanent avoidance of breastfeeding: 1. Severe illness e.g., sepsis that precludes a mother from caring for her infant. 2. Herpes simplex virus type 1 (HSV-1): direct contact between lesions on the mother's breasts and the infant's mouth should be avoided until all active lesions have resolved. 3. Maternal medication: - sedating psychotherapeutic drugs, - anti-epileptic drugs - opioids and their combinations - radioactive iodine-131 - excessive use of topical iodine or iodophors (e.g., povidone-iodine) - cytotoxic chemotherapy

According to **Table 2.2**, some newborns are not supposed to receive breastmilk at all and can only receive specialised formula because of conditions like classic galactosemia, maple

syrup urine disease, and phenylketonuria. Moreover, although HIV infections are not listed as contraindication for breastfeeding, HIV-positive mothers can choose to avoid breastfeeding permanently if breastmilk substitute is acceptable, feasible, affordable, sustainable, and safe. There are also other conditions that justify temporary use of breastmilk supplementation such as prematurity below 32 weeks, very low birth weight, maternal sepsis, maternal active lesion of HSV-1, and psychotherapeutic drugs taken by the mother are considered as acceptable medical reasons for giving PLF (5). Based on those references, giving formula as PLF and whether the feed is only given for a few days or continue permanently, is justified when such indications are present.

In addition to medical indications listed in **Table 2.2**, there are also conditions where breastfeeding can continue although some health risks may be of concerns. These include breast abscess, hepatitis B, hepatitis C, mastitis, tuberculosis, and substance use such as nicotine, alcohol, and opioids (5). Adjustment and/or adaptation to this guideline is subject to country, facility, and context settings. For example, in guidelines published by the Indonesian Paediatric Society (IDAI) in 2013 (79) and the Academy of Breastfeeding Medicine (ABM) in 2017, loss of 8-10% birthweight on day 5/later is listed as a possible indication for supplementation (41). Nevertheless, these guidelines imply that the final recommendation is decided based on the clinical judgement.

2.5 How is PLF practiced around the world?

2.5.1 Literature search strategy

To get an overview of PLF practice globally, including Indonesia, a structured literature search (80, 81) was carried out periodically throughout my DPhil studies. The search was also intended to inform variables to be used in the analysis of my quantitative studies (Chapters 5-7). The first batch of search was conducted in December 2018 and the last one was conducted in May 2022, where multiple updates were performed in between. Keyword searches were carried out using PubMed, Medline, and Web of Science

databases, but periodic search in the interim was primarily conducted using PubMed database (PubMed Advanced Search Builder) because it generated the most relevant search result (82-84).

Search strategies were used to fulfil three objectives : 1) to estimate prevalence of PLF (any PLF and by type) globally, 2) to identify potential determinants of PLF globally, and 3) to investigate the measurement of association between PLF and breastfeeding outcomes globally. The three search objectives started with the same initial keyword i.e prelacteal and possible synonyms as shown in **Figure 2.2**. After removing duplicates, no-full-text, and animal studies, there retrieved articles were narrowed down with additional keywords to address each objective**.** Additional keywords demographic and DHS was added for the first search objective (**Figure 2.2, box 1**).

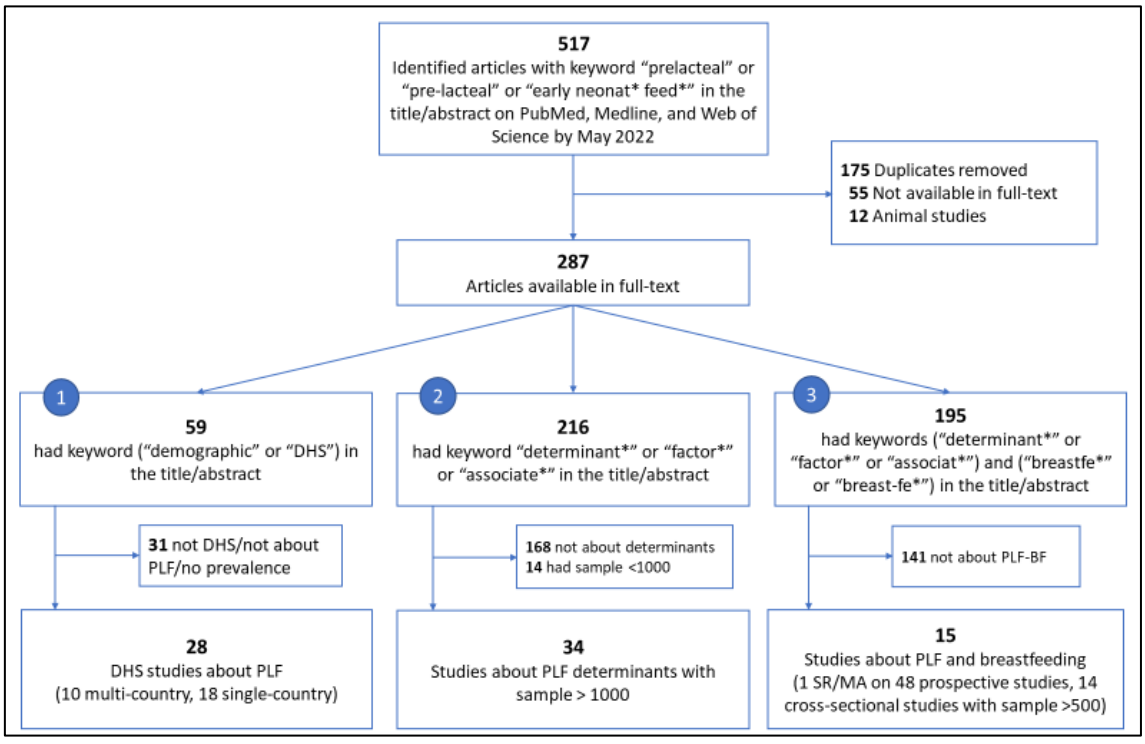


Figure 2.2 Structured literature search strategies to fulfil three objectives

The second search objective was addressed by reviewing articles that reported determinants of PLF practices (**Figure 2.2, box 2**). This time, search was not limited to DHS study. Country-level studies or studies with a sample of more than 1000 were included to gain broader perspectives of PLF determinants. This search aimed to detect keywords ((“prelacteal” OR “pre-lacteal”) AND (“factor*” OR “determinant*” OR “associat*”)) in title or abstract and was restricted to full text only. The review of this search result is summarised in section 2.5.3.

The third search objective was addressed by reviewing articles that reported association between PLF and breastfeeding outcomes (**Figure 2.2, box 3**). This search included all country-level studies or studies with a sample of more than 500. This search aimed to detect keywords ((“prelacteal” OR “pre-lacteal”) AND (“factor*” OR “determinant*”) AND (breastfe*)) in title or abstract and was restricted to full text only. Findings from systematic reviews or multi-country studies were preferred to be displayed in the summary table when available. The review of this search result is summarised in section 2.5.4.

Moreover, additional studies were included if any of the studies retrieved cited or referred to relevant papers. In addition to the three search objectives described above, another search strategy was used on Google and Google Scholar to retrieve PLF studies from Indonesia. This was because in December 2018 there was no study from Indonesia on PubMed, Medline, and Web of Science that specifically looked at PLF practices. By May 2022, there were only two studies (85, 86) including mine that was published in 2020 (85). Google Scholar is frequently used as an additional database as it recognises studies that are not indexed in mainstream databases because it is highly sensitive to keywords (83). However, it does not have the feature to search by abstract, hence it picks up a large number of grey literature and articles that are not relevant to the search (83). Therefore, a

slightly different approach was taken and the details of the search strategy including the search results are shown in the Appendix I.

2.5.2 PLF prevalence and types

Using the search strategy in **Figure 2.2** (boxes 1), 28 studies that used DHS datasets and reported PLF prevalence in any part of the text were included. Of these 28, 10 studies (7, 18, 87-94) used datasets from multiple countries and the majority of them focussed on African countries. The other 18 were single-country studies (1 Bangladesh (95), 1 Colombia (96), 1 Egypt (97), 5 Ethiopia (21, 98-100), 2 Indonesia (85, 86), 1 Nepal (101), 3 Nigeria (19, 20, 102), 1 Pakistan (52), 1 Timor-Leste (103), 1 Turkey (104), and 1 Uganda (105)).

For a simpler visualisation, global PLF prevalence from two multi-country studies and PLF prevalence from countries that had two-point estimates are presented in **Figure 2.3,** but details on all point estimates and countries can be found in Appendix I, Table I.1. Oakley et al. in 2018 analysed DHS datasets of 57 countries in Africa, Europe, Asia, and America, from 2000 to 2012 and estimated that 51% babies received any PLF during that period (7). The global prevalence decreased to about 30%, as reported by Neves et al in 2022 based on data from 76 countries with survey years of 2010-2018 (89). There was a wide range of prevalence across countries where it was constantly higher than 80% in Chad and was only less than 5% in Malawi. The prevalence of any PLF decreased globally and in most countries, although some, including Egypt, Turkey, Cambodia, Honduras, and Peru showed an increase. Indonesia's PLF prevalence decreased too but it was still higher than the global estimates (**Figure 2.3).**

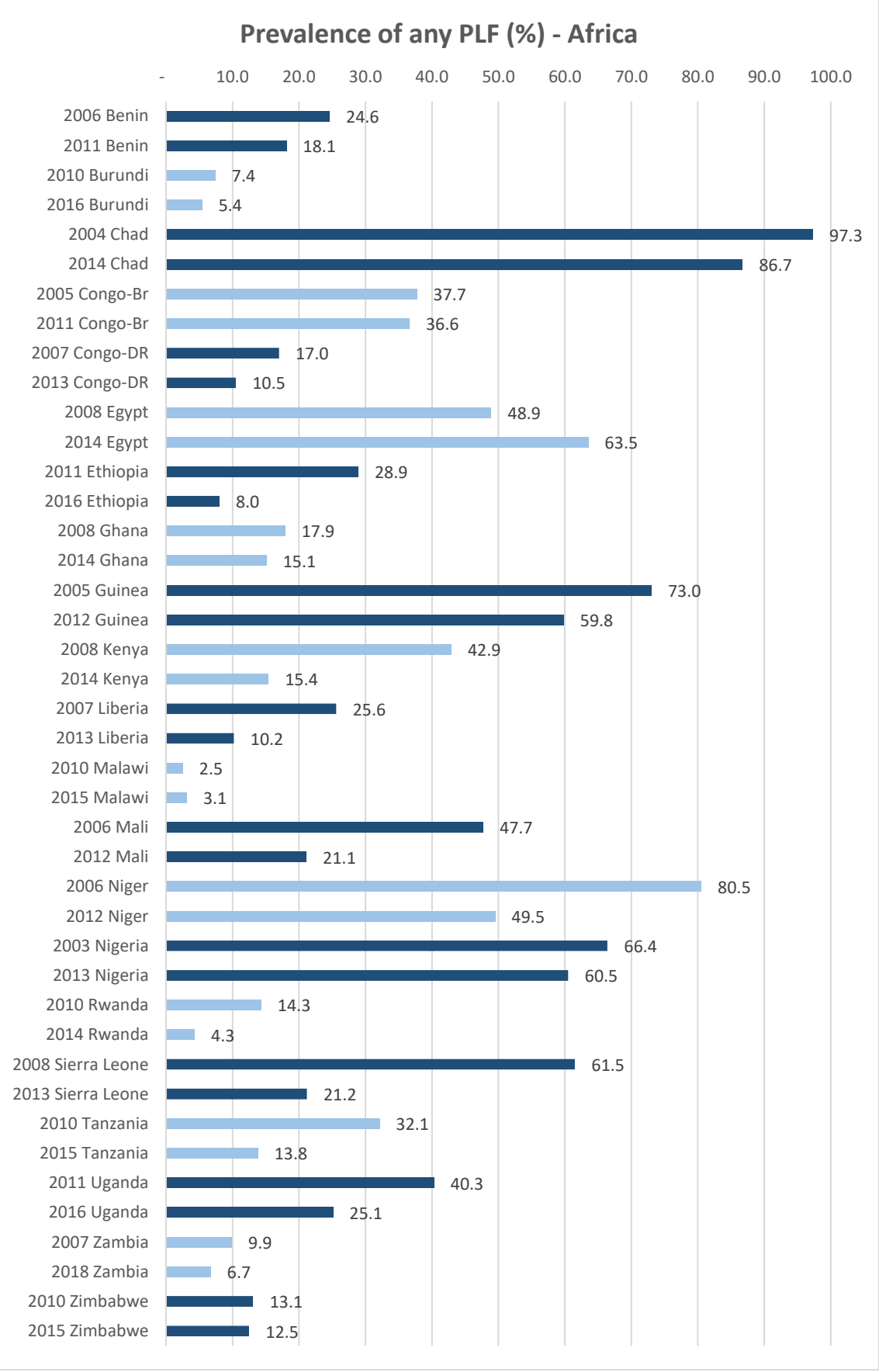


Figure 2.3 Prevalence of any PLF globally

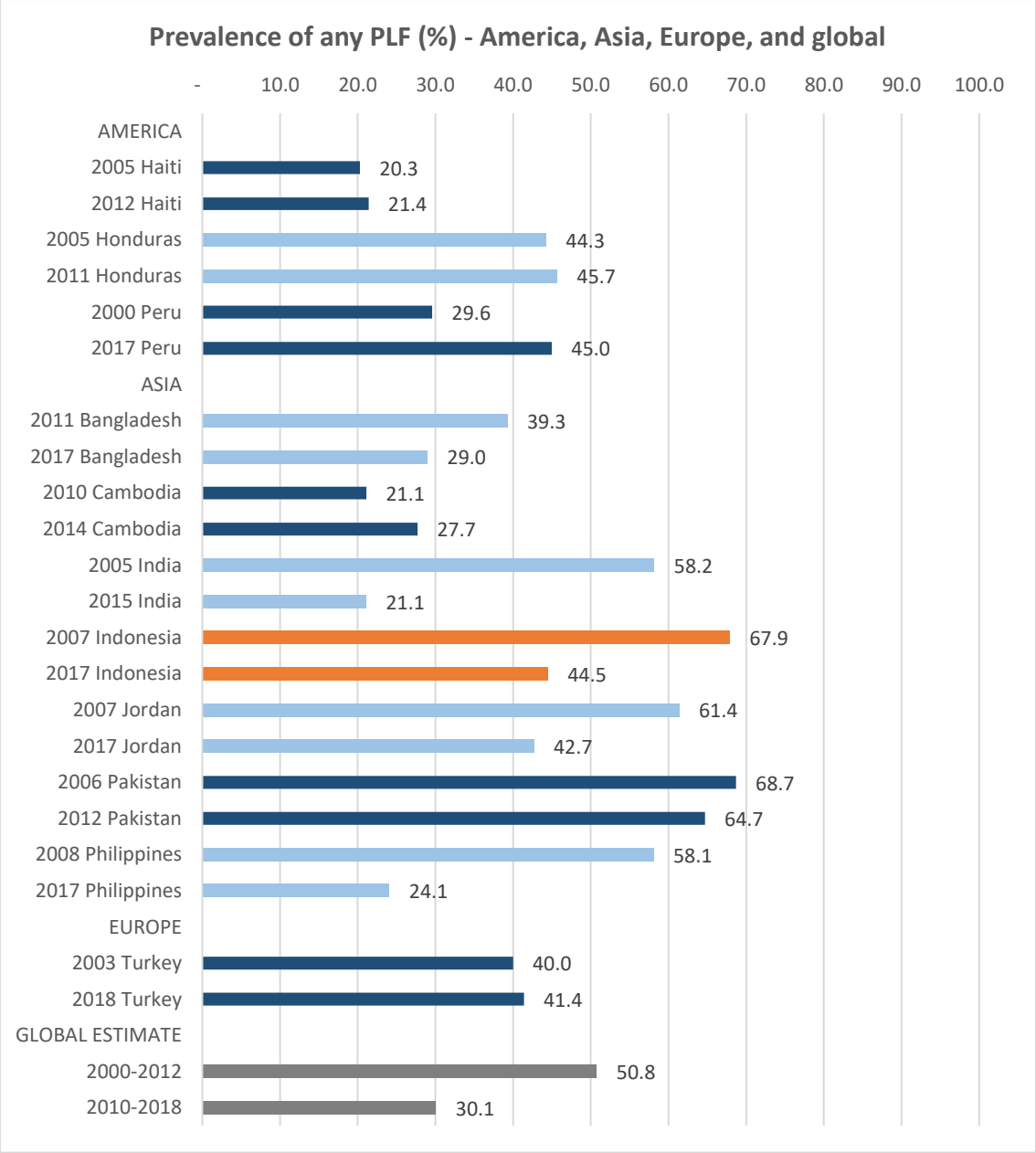


Figure developed from Table I.1 in Appendix I

Figure 2.4 Prevalence of any PLF globally (continued)

Of the 28 studies that reported the prevalence of any PLF, ten studies reported the prevalence by type or at least by base substance i.e. water-based/milk-based (18, 19, 21, 52, 85, 89, 92, 101, 103, 104) and there were some regional differences. According to the most recent study, 18.2% of newborn babies received milk-based PLF i.e., formula and/or other kind of milk, while 14.1% received water-based i.e., included water, tea, honey, juice, and sugar water (89). Similarly, in Latin America and Caribbean where 32.8% newborns received any PLF, milk-based PLF (22.9%), especially formula (17.5%), was generally

more common than other feeds (92). In contrast, the most common PLF the Sub-Saharan region, were plain water (22%), followed by formula (5%), sugar water (4%), or gripe (<1%) (18). Single-country studies reported a variety of common PLF types. For example, water was the most common PLF in Timor-Leste (103). Formula was the most common PLF type in Turkey (104) and Nepal (101), while milk other than formula was the most common PLF type in Pakistan (52). Butter was the most common PLF type in Ethiopia (21). Other feeds commonly reported were honey, sugar water, fenugreek, tea, sugar-salt solution, *ghutti*, fruit juice, tea, ghee, and gripe (18, 21, 52, 85). Details about the prevalence by type can be found in Appendix I, Table I.1.

By May 2022, there were four studies on PubMed and Web of Science that reported PLF prevalence in Indonesia, where two of them were multi-country studies (7, 89) and another two were single-country studies (85, 86). Using additional search strategy, the estimates of PLF prevalence were obtained from the IDHS reports (1, 10-12), Basic Health Survey report (106), and 21 community-based studies with small sample size (Appendix I). Based on IDHS data, the prevalence of any PLF in Indonesia was highest in 2007 (about 68%) and kept decreasing in 2017 (44%). My study, which was part of this thesis showed a variety of PLF types recorded in IDHS dataset including formula (most common), other milk, honey, water, gripe, tea, and rice water (85). Basic Health Survey report (106) reported a lower prevalence (33%) most likely because it was published after the latest IDHS. PLF types reported from the grey literature were similar with the ones I reported in my study (85), with some additional common types including banana and rice porridge (106).

2.5.3 Determinants of PLF practice

Using the search strategy in **Figure 2.2** (boxes 2), 35 studies were summarised in this section, but details can be found in Appendix I Table I.2. Of these, 9 were multi-country studies from multiple continents (89, 107), Africa (18, 87, 108, 109), Latin America and the

Caribbean (92, 110), and South Asia (111). Single-country studies were from Nigeria (19, 20), Ethiopia (21, 31, 99, 112-114), Sudan (115), Uganda(116), Egypt (117), Turkey (104), Vietnam (118, 119), Bangladesh (120-122), Nepal (101, 123), Timor-Leste (124), Pakistan (52), and India (125, 126). The two studies from Indonesia consisted of my study, which was published in 2020 (85), and a more recent study by Nurokhmah et al. in 2021 (86). Both studies used the 2017 IDHS (85, 86) and the similarities and differences between findings from these studies are discussed in Chapter 5.

Other Indonesian studies looking at PLF were retrieved from Google Scholar. However, they were mostly either not peer-reviewed, were in a form of thesis/assignment with restricted access or used small sample (ranging from 73 to 638 participants). Most of the PLF-related studies were descriptive and used Chi-square statistics to compare factors potentially associated with PLF (APPENDIX I, Table I.4). Common reasons for giving PLF were related to insufficient milk, infant hunger, and advice from the health care providers (13-15, 127-129). Cultural reasons include belief to bless the baby, clean the gut, and suggestion from older generation. Some studies using bivariable analyses reported that primiparity and lack of knowledge on PLF were associated with PLF practices. However, as there was no multivariable analysis found, these association were not adjusted for other factors. Moreover, despite a huge variety of PLF types, none of the studies looked at different types of PLF as the outcome variable.

Most studies retrieved were from PubMed and Web of Science, as listed in APPENDIX I Table I.2, were cross-sectional, used secondary data from large/country-level surveys (e.g. DHS or Multiple Indicator Cluster Survey (MICS), Alive and Thrive (A&T)), and used logistic regression to estimate effect size in odds ratio (OR). Of all the studies listed in APPENDIX I, Table I.2, very few studies separated PLF into different types. A 2013 study from Vietnam (118) and a 2022 multi-country study (89) separated it into any PLF, formula or milk-based,

and water or water-based, while another multi-country study from Latin America (92) looked specifically at milk-based PLF.

Determinants were classified differently but usually grouped into demographic factors of the mother and child factors that are related to pregnancy, birth, and health care service, although these factors may sometimes overlap. To inform selection of variables used in my thesis, findings from all these studies were summarised in **Table 2.3,** while details about the study description, association, and effect sizes are listed in APPENDIX I Table I.2. **Table 2.3** was developed based on the conceptual framework on the components of an enabling environment for breastfeeding by Rollins et al (6) informed by studies in APPENDIX I. Most studies reported variables in the setting-related and individual determinants.

Health systems and service

As shown by **Table 2.3**, in the health system and service variables, place of birth (home/facility), type of facility (private/public), mode of birth (caesarean/vaginal), were mostly reported and often found to be statistically significant determinant for any PLF, although the association were frequently inconsistent. Other variables that were also reported, but with different definitions and measurement were antenatal care, person who assisted birth (skilled/unskilled attendant), and employment.

Table 2.3 Summary of determinants of PLF practice

Components	Variables identified in the literature
Structural determinants	Sociocultural and market context
	- Knowledge on BF/EBF/PLF
	- Perception on BF/EBF
	- Community: social norm
Settings-related determinants	Health systems and service
	- Place of birth (home/facility)
	- Type of facility (public/private)
	- Mode of birth (caesarean/vaginal)
	- Health care provider (skilled/unskilled/none)
	- Service: antenatal utilisation, times of visit
	- Service: postnatal
	- Distance with facility (problem/not)
	Family and community
	- The woman's husband's education
	- Family size
	- The woman's mother/mother-in-law's education/knowledge
	- Empowerment: decision making, gender conforming
	Employment
	- Work status
	- Work sector
Individual determinants	Mother demographics
	- Age
	- Education
	- Wealth index or quintile
	- Area of residence rural/urban
	- Religion
	- Region
	- Ethnicity
	- Marital status
	- Caste
	- Body mass index (BMI)
	Infant/child demographics
	- Sex
	- Birth type (single/multiple)
	- Birth weight
	Birth and pregnancy related factors (mother-infant relationship)
	- Birth order/parity
	- Initiation of breastfeeding (timing when baby was put to breast)
	- Perceived birth size
	- Pregnancy intention
	- Breastfeeding self-efficacy
	- Normal suckling
	- Birth interval
Interventions	Social mobilisation
	Legislation, policy, financing, enforcement
	Mass media
	- Access to mass media (magazine, radio, television)
	Counselling and lactation management support

Compared to hospital or facility birth, home birth was found to be associated with higher odds of any PLF in Nigeria (19, 20), Ethiopia (31, 99, 112, 113), Sub-Saharan countries (18, 87, 108, 109), and Latin America (110), but the opposite was true in Bangladesh (122) and no association was found in some other countries in South Asia (111). Additionally, multi-country studies found that any PLF was more likely to be given in the private facility than in public facility (87, 89). Furthermore, caesarean birth as compared to vaginal birth was found to be strongly associated with higher odds of giving any PLF in most studies, with OR ranging from 1.2 to 13.9 (19, 21, 85, 86, 92, 99, 104, 107, 109, 114, 115, 118, 122, 125, 126). Skilled birth attendant were found to be inconsistently associated with any PLF, as mostly it was not statistically significant, but some found it associated with higher odds of PLF (21, 107) while others found the opposite (116).

Maternal demographic factors

Of all the individual determinants (**Table 2.3**), all studies included maternal age, education, wealth index, and area of residence to describe mothers' characteristics (APPENDIX I, Table I.2). Variables such as religion, region, marital status, and caste were occasionally reported. Similar to health system and service, there were some inconsistencies in the association between variables with any PLF across settings.

For example, maternal age had mixed association with any PLF across all settings, mostly not statistically significant (34, 99, 101, 107, 108, 113, 118, 122, 123), but younger age was a determinant in rural Nigeria (19) while older age was a determinant in Timor-Leste (124). Inconsistent association was also observed in maternal education, where most studies showed no association with PLF (20, 99, 109, 113, 115, 123, 125, 130), but a few others showed higher (131) or lower (18-20, 52, 101, 115) education to be a determinant of any PLF, with unclear dose-response relationship (20, 52, 101). Similarly, wealth quintiles were frequently reported to be non-statistically significant determinant, or to have no clear dose-

relationship association with any PLF (18-20, 52, 99, 122, 123) although in several Latin America countries, higher wealth was associated with higher odds of any PLF (131). Area of residence had inconsistent association with PLF. Based on studies from Vietnam (118), Timor-Leste (103), and East African countries (109), rural mothers were less likely to give any PLF, but the opposite was true for urban mothers in Ethiopia. Additionally, regional differences in PLF prevalence were reported by several studies from Nigeria (20), Sudan (115), Ethiopia (99), Nepal (101), Pakistan (52), and Bangladesh (122).

Infant demographic factors

Child's sex and type of birth were frequently used to describe infants' demographic characteristic (Appendix I, Table I.2). Child's sex was mostly not a statistically significant determinant, but in a few studies, male babies (18, 22) were more likely to receive any PLF, although very slightly. In studies that reported type of birth, multiple birth was usually increased the odds of any PLF (18, 114, 116).

Factors related to pregnancy and birth

Variables like birth order (parity), initiation of breastfeeding, and perceived birth size were reported in many studies (APPENDIX I, Table I.2). First birth (as compared to the subsequent birth) was quite frequently associated with higher risk of any PLF (18, 20, 101, 123), although some other studies showed no association between birth order and PLF (19, 52, 114, 115, 122). Meanwhile, babies perceived by their mother to be small at birth were frequently at risk of receiving any PLF (18, 19) (21, 107-109, 111). Another birth-related factor that was consistently reported to be a strong predictor for any PLF was the timing of initiation of breastfeeding, which was defined as the time the baby was put to the mother's breast. Of the studies that included early initiation of breastfeeding (EIBF) (21, 31, 52, 104, 109, 114, 116), all showed an inverse association between EIBF and PLF (APPENDIX I, Table I.2).

Other variables

Some studies included variables that reflected structural determinant variables such as infant feeding-related knowledge and social norm, but these variables varied in definition, measurement, and association. Some studies found that women with better knowledge on breastfeeding were less likely to give PLF (52, 118, 125) but the education level of the woman's husband and mother/mother-in-law did not appear to affect PLF practice (108, 115, 123, 125). Some studies also included interventions component, such as access to media (magazine, television, or radio) in their analysis (20, 99, 108, 109, 113, 118, 122), but it was rarely statistically significant.

2.5.4 Association between PLF and breastfeeding outcomes

Using the search strategy in **Figure 2.2** (boxes 3), findings from 15 studies were summarised in **Table 2.4**. Initially, I only focussed on larger studies with sample size of >1000 people, but not many studies used large sample, hence studies with at least 500 people were included. Of all 15 studies, 1 was a systematic review and meta-analysis of 48 studies (69) and 14 were cross-sectional studies from Honduras (30) Bolivia (132), Bangladesh (133, 134), Saudi Arabia (135), Vietnam (134, 136), Ethiopia (134, 137, 138), India (139, 140), Nepal (123, 141) , Colombia (142), and Haiti and Dominican Republic (143). Additional search using Google Scholar for Indonesian studies found one study from Indonesia.

Exposure variable is mostly any PLF, but two multi-country studies used any PLF and milk-based PLF (69, 143), while one study from Honduras used milk-based, water-based, and water PLF(30). Breastfeeding outcomes were mostly exclusive breastfeeding (EBF). EBF in this context were usually defined as no other food or drink except breastmilk at the point of assessment, which excluded the PLF given in the first few days of birth, as per WHO measurement indicators (144). Association between exposure and outcome was adjusted

for various variables including maternal demographic factors (age, education, urban-rural residence, religion, and socioeconomic status/wealth quintile), employment, child's sex, child's age, birth order, ANC visit, breastfeeding advice, and birth size.

A systematic review by Pérez-Escamilla et al examined 48 prospective studies from North America, East Asia and Pacific, South Asia, Central Asia, Middle East, North Africa, Latin America, and the Caribbean (69). The authors retrieved papers from major databases such as Medline, Web of Science, EMBASE, and PsycINFO. Breastfeeding outcomes were measured as any breastfeeding cessation in the first 6 months, EBF cessation in the first six months, any breastfeeding status in the first 6 months, EBF status in the first six months, or any breastfeeding cessation in the first 1 year. EBF here was defined as EBF after the introduction of PLF. Meta-analysis was conducted using 20 studies and found that among infants aged 6 months and younger, PLF was associated with a shorter duration of EBF (RR 1.44; 1.29–1.60) and any breastfeeding (2.23; 1.63–3.06).

Findings from the systematic review were consistent with most of the cross-sectional studies, where PLF was associated with a shorter duration of breastfeeding and/or non-exclusivity. Nevertheless, a few studies showed different results. Study from Honduras found that water PLF was not associated with breastfeeding duration (30). A study from Nepal showed no statistical significance in the association between any PLF and EBF after adjusting for other factors 140).

Some prospective studies in the systematic review (69) showed different findings. Another prospective study from multiple countries (Bangladesh, Brazil, India, Nepal, South Africa, Tanzania, Pakistan, and Peru) found no association between any PLF and transitioning to partial breastfeeding (145). Additionally, some small-sized randomised controlled trials found from the references showed some mixed findings. A study in the United States, found

that introduction of early limited formula in the first few days may instead reduce longer-term use of formula (146), while a study in Czech Republic showed that formula supplementation had no effect on breastfeeding (either exclusive or partial) at discharge, 3 months, and 6 months (147). Meanwhile, a study in Spain showed that the percentage of mothers who breastfed (either exclusively or partially) at 5 months postpartum was lower in the glucose water supplementation group than in control group (148).

Table 2.4. Association between PLF and breastfeeding outcomes

Author, year, setting	Design	Sample size	PLF type (exposure)	Breastfeeding outcome(s)	Main findings: adjusted effect measure (95% CI)
1. Perez-Escamilla, 1996, Honduras (30)	CS	714 mothers, child aged 0-6 month	Milk-based PLF, water-based PLF, and water PLF	- EBF: still BF in the past 24 hours and gave no other food/drink (yes/no) - Any BF in the past 24 hours (yes/no) as per WHO indicators (144)	- **Milk-based PLF was associated with lower odds of EBF** (OR 0.19, 0.08-0.43) and any BF (OR 0.21, 0.09-0.48) - **Water-based PLF was not associated with lower odds of** EBF (OR 1.38, 0.86-2.21) and any BF (OR 0.52, 0.23-1.18) - **Water PLF was associated with lower odds of EBF** (OR 0.19, 0.09-0.41) but not any BF (OR 0.52, 0.21-1.38) - Adjusted for mode of birth, parity, each of other PLF type, maternal age, education, urban-rural, marital status, employment, infant's sex, household floor
2. Ludvigsson, 2003, Bolivia (132)	CS	518 mothers, child aged <1 year	Any	EBF (still BF at interview and no fluid >3 spoon in the past 1 week)	- **Any PLF was associated with shorter EBF** (HR 2.11, 1.53-2.90) - Adjusted for colostrum, ethnicity, religion, urban/rural, employment, cohabitant, infant's sex, literacy, hospital, social class
3. Rasheed, 2009, Bangladesh (133)	CS	1,472 mothers, child <6 months	Any	Full breastfeeding trajectory (FBT) vs intermittent feeding trajectory (IFT)	- **Babies given any PLF were more likely to be FBT** compared to the IFT aOR = 1.76 (1.06–2.9) - Adjusted for rural-urban, SES, maternal education, employment, infant's sex, birth weight, maternal age, pre-pregnancy BMI
4. El-Gilany, 2011, Saudi Arabia (135)	CS	1,904 mothers, child <6 months	Any PLF	EBF as per WHO indicators (144)	- **Not giving any PLF was associated with EBF** (OR 3.1, 2.3–4.2) - Adjusted for: residence, mother's work, birth weight, mode of birth, BF initiation, and feeding pattern.
5. Nguyen, 2016, Vietnam (136)	CS	10,681 mothers, child age 0-24 months	Formula	Early BF cessation as per WHO indicators (144)	- **Formula was associated with early breastfeeding cessation** in 0-23 months (OR 1.33 (1.12, 1.59), 0-5 months (OR 1.93 (1.03-3.61), and 6-23 (OR 1.32 (1.10-1.59) - Adjusted for child age (m), child's sex, birthplace-mode, feeding misconception, formula promotion, SES, infention to formula fed.
6. Tariku, 2017, Ethiopia (137)	CS	5,227 mothers, child aged 0-6 months	Any	EBF as per WHO indicators (144)	- **Withholding PLF was associated with EBF** (1.34, 1.17-1.53) - Adjusted for mothers' education, age, urban-rural, ANC visit, SES

Author, year, setting	Design	Sample size	PLF type (exposure)	Breastfeeding outcome(s)	Main findings: adjusted effect measure (95% CI)
7. Chanani, 2018, India (139)	CS	888 mothers, child aged 0-5 months	Any	EBF as per WHO indicators (144)	- **Any PLF was associated with lower odds of EBF** (OR 0.57, 0.41-0.80) - Adjusted for child's age, sex, birth order, weight for height, born in Mumbai, BF advice, ANC location, place of birth, maternal education, maternal BMI, working status, home, ownership, religion, poverty index, lactation ANC, home visit
8. Bhandari, 2019, Nepal (DHS) (123)	CS	458 mothers, child aged 0-6 months	Any	Predominant BF (PBF) i.e., BF at 24 hr and receive water-based fluids (yes/no)	- **Giving any PLF was associated lower prevalence** of PBF PR 0.45 (0.32,0.62) - Adjusted for child's sex, age in months, birth order, EIBF, maternal education, ANC visit, maternal knowledge on EBF and diarrhoea, women's empowerment, ethnicity, caste, wealth quintile, paternal education, ecological zone
9. Das, 2019, India (140)	CS	10,262 mothers, infants aged up to 3 months	Any	EBF in 24 hours only, EBF between 3 days of birth until interview day	- **Any PLF was associated with EBF in 24 hour** OR 0.39 (0.33, 0.47) and EBF since birth (excluding 3 initial days) until interview 0.20(0.17, 0.24) - Adjusted for religion, maternal education, wealth index, wealth index, child's sex, parity
10. Dharel, 2020, Nepal (141)	CS	574 mothers, child aged 6-18 months	Any	EBF/PBF based on WHO recommendation (yes), no (partial BF) from birth to <6 months, as per WHO indicators (144)	- **EBF prevalence was higher among PLF group** (univariable analysis), but it **was not statistically significant in multivariable analysis (OR not shown)** - Adjusted for birth order, birth weight, mother's occupation, region, knowledge of breastfeeding, EIBF, breastfeeding problems, colostrum feeding
11. Finnie, 2020, Colombia (DHS) (142)	CS	1537 mothers, singleton child aged <24 months	Any	EBF interruption (no EBF in the last 24 hr). EBF as per WHO indicators (144)	- **Any PLF was associated with EBF interruption** OR 1.51 (1.37-1.68) - Adjusted for: income quintile, number of adults in the house, living with partner, overweight, pregnancy intention, place of birth, caesarean, number of prenatal visits, low birth weight, child's sex, birth order
12. McLennan, 2020, Haiti, DR (DHS) (143)	CS	686 Haiti, 264 DR, infants aged <6 months	Any, milk-based	EBF (BF and nothing else), predominant BF (BF and water-based liquids), partially BF	- **Any PLF was associated with lower BF exclusivity** OR 0.37 (0.27–0.51), - **Milk-based was associated with lower BF exclusivity** OR 0.35 (0.20–0.61)

Author, year, setting	Design	Sample size	PLF type (exposure)	Breastfeeding outcome(s)	Main findings: adjusted effect measure (95% CI)
				(BF and milk-based), no BF in the last 24 hr	- Adjusted for: country (DR, Haiti), EIBF, caesarean, child's age, maternal age, education, asset variable, birth order (using ordered logistic regression)
13. Nguyen, 2020, Bangladesh, Vietnam, Ethiopia (Alive&Thrive)(134)	CS	977 (B), 948 (V), 606 (Ethiopia) mothers, child age <6 months	Any	EBF at 24 hr (using WHO indicators (144)) yes/no	- **Any PLF was associated with EBF** at 24 hr in Bangladesh: OR 2.09 (1.44, 3.05) and Vietnam: OR 2.56 (1.77, 3.69) - In Ethiopia: NS
14. Kedir, 2022, Ethiopia (138)	CS	636 mothers, child aged 6-12 months	Any	EBF cessation before 6 month	- **Any PLF was associated with early cessation of breastfeeding** HR 1.8 (1.32–2.36) - Adjusted for rural-urban, maternal education, food insecurity, type of birth, knowledge about EBF
15. Perez-Escamilla, 2022, multi-country (69)	SR, MA of PCS	48 prospective studies (SR), 20 (MA)	Any Milk-based	EBF cessation, Any BF cessation (EBF as per WHO indicators) (144)	- **Any PLF was associated with a shorter duration of EBF (RR** 1.44; 1.29–1.60) and any BF (2.23; 1.63–3.06) - **Milk-based PLF was associated with a shorter duration of EBF** (RR 1.40; 1.24–1.58) and any BF (3.00; 1.99-4.53)
16. Triatmaja, 2021, Kediri, Java, Indonesia (127)	CS	41 mothers, child aged 6-12 months	Any	EBF, unspecified	- **Not giving PLF is associated with EBF** (PR 1.91, 1.27-2.87) - Adjusted for education, EIBF

ANC=antenatal care, BF= breastfeeding, CS=cross-sectional, CC=case-control, EBF= exclusive breastfeeding, EIBF=early initiation of breastfeeding, FBT= breastfeeding trajectory, IBT= intermittent feeding trajectory (IFT), MA= meta-analysis, OR=odds ratio, PCS= prospective cohort study, PNC=postnatal care, PR=prevalence ratio, RR= risk ratio, SES=socioeconomic status, SR= Systematic review.

2.6 Breastfeeding practice in Indonesia

Although formula is widely used and unethical formula marketing remains a concern (149, 150), breastfeeding has been the favoured feeding option and practiced by most mothers in Indonesia (9, 151). In addition to health benefits, breastfeeding has been valued culturally and/or religiously. Indonesia is the largest country in Southeast Asia and the largest island country in the world, has more than 273 million population consisting of over 300 ethnic groups (16, 17). Common religions in Indonesia (Islam, Christianity, Hinduism, and Buddhism) are generally supportive towards breastfeeding (152, 153). Islam, the majority religion in Indonesia has a specific verse in the Holy Qur'an (Al-Qur'an) that encourages mothers to breastfeed their child for two full years (154).

2.6.1 Practice indicators

In 1990, nearly all mothers ever breastfed their baby –only 4% did not-, while the median duration of breastfeeding was 17 months for urban mothers and 23 months for rural mothers (9). This relatively long duration of BF has remained the common practice, with some fluctuation over time (1, 10-12) but overall remained almost two years, as recommended by the WHO (4). EBF practice, however, falls short of the WHO's recommendation. The median duration of EBF, was only 1.6 month in 2002, 1 month in 2007, less than 1 month in 2012, and 3 months in 2017 (1, 10-12). When I started my DPhil in 2018, the proportion of infants under 6 months who received EBF decreased from 56% 2017 to 44% in 2018, although it steadily rose to over 70% after 2019 (155).

2.6.2 Laws and guidelines

The Indonesia Ministry of Health follows infant feeding recommendation from the WHO (4, 65). Some health professionals started promoting breastfeeding in 1977 but the first Indonesian regulation about the importance of breastmilk was set out in 1985 (156). In 2004, the ministerial decree on 6-month of EBF and promotion of the 10 Steps to Successful Breastfeeding, which includes recommendations against PLF, was established (157).

Public health campaigns spread this message more widely in the following years. In 2009, a law on 6-months of EBF was enforced as part of the national health laws (158). There are legal consequences in the form of fine up to IDR 100,000,000 (about GBP 5,500) or up to 1 year imprisonment for anyone who disrupts the EBF program (158). In 2012, the regulation on the 6-month EBF was established and there was a statement that said mothers should refuse formula in the first instance and that there are professional consequences for health care providers who give formula without medical indication (159).

2.7 Research gap and scope

This chapter shows that the prevalence of any PLF worldwide is very likely to have exceeded the proportion of newborns who need medically indicated PLF. Based on the two multi-country studies in 2018 (7) and 2022 (89), Indonesia has always showed a relatively higher-than-global average of PLF prevalence. Nevertheless, research about PLF in Indonesia remains scarce.

Some of the existing PLF-related studies used small sample and took place in certain regions only (13-15, 127-129), which are useful to understand local context, but do not represent PLF practice in Indonesia as a whole. In addition, the majority of PLF-related Indonesian studies are not in English and not indexed in mainstream online database like PubMed. Before my paper (85), which is part of this thesis, was published in late 2020, a PubMed search using keywords “prelacteal” or “pre-lacteal” in title/abstract returned zero result for Indonesia. Consequently, evidence about PLF practice from Indonesia is underrepresented globally and rarely included in multi-centre or multi-country studies. For example, in the systematic review of impacts of PLF on breastfeeding globally mentioned earlier (69), there was no study from Indonesia. Meanwhile, Indonesia is a very large country with a unique infant feeding situation: duration of breastfeeding is relatively long (±20 months), median EBF is suboptimal (1-3 months), and PLF practice remains prevalent

(44%-68%). Insights from Indonesia could give important contribution to the growing knowledge on PLF practice globally.

Understanding PLF practice at the national level is important because, as shown in **Figure 2.3**, PLF prevalence around the world varies widely. Moreover, PLF itself comes in many forms and the common feeds in one country or region often differ with those in another. Furthermore, existing literature have shown that some determinants of PLF and the reasons why PLF is given also differ across countries. Given the nature of each PLF type, it is plausible that the determinants and impacts on breastfeeding vary across types. As seen in Table I.2 APPENDIX II, there were only very few studies that looked at determinants and impacts on breastfeeding of PLF by type (22, 92, 118) when I started my study in 2018. Only in 2022, there was a global study that looked at determinants of milk-based and water-based PLF using DHS datasets (89). Moreover, not all studies reported PLF prevalence by type. IDHS reports have published country estimates of any PLF in Indonesia each year, but to my knowledge, nobody had conducted further research on PLF using IDHS when I started my DPhil programme. Little is known about what constitutes overall PLF in Indonesia and whether determinants and impacts on breastfeeding are the same for all types of PLF.

To address the knowledge gap, my DPhil thesis discusses determinants, impacts on breastfeeding, and trends over time of PLF practice in Indonesia. In this study, PLF refers to the definition used by IDHS, which takes on the assumption that PLF does not apply to newborn infants who cannot and/or are not intended to be breastfed. Additionally, impacts of PLF, other than breastfeeding-related, such as infection and physical hazards, are beyond the focus of my study although some aspects of those risks may appear in findings and discussion.

3 METHODS FOR QUANTITATIVE STUDIES

3.1 Overview of the methods

As described in the Introduction, my DPhil thesis aims to understand PLF practice in Indonesia, which covers the prevalence, determinants, and impacts on breastfeeding. This thesis uses a mixed methods approach, underpinned by the pragmatic research paradigm (160). In practice this means that quantitative and qualitative methods have been used to answer different research questions, with the choice of method being determined by what the most suitable and feasible way was to answer the individual question.

The aims of the thesis were broken down into five objectives and their connections are shown in Figure 3.1. The larger part of this thesis consists of quantitative analyses of Indonesia Demographic Health Surveys (IDHS) datasets. A qualitative study was added to provide insights on PLF practice from the perspectives of health professionals, which could not be obtained from IDHS datasets. Findings were then combined and discussed together to reach conclusions.

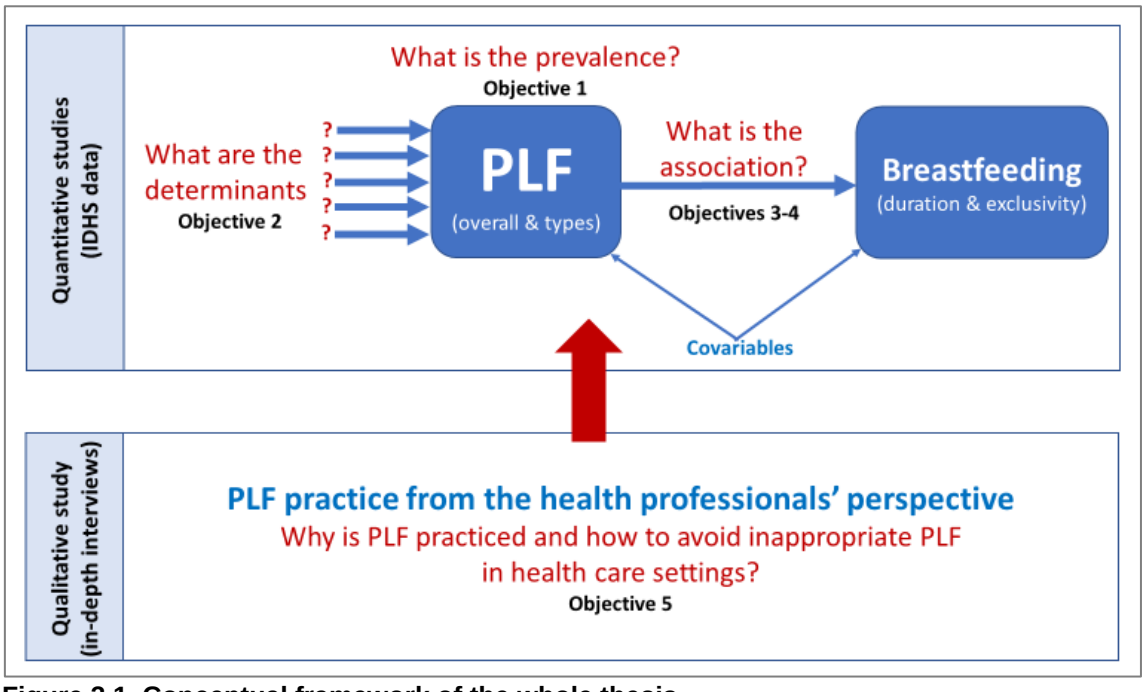


Figure 3.1. Conceptual framework of the whole thesis

As shown in Figure 3.1 and listed previously in the Introduction (Chapter 1), the four objectives that used IDHS datasets are as follows:

1. **Objective 1 (Chapter 4)**

   To describe the prevalence of PLF (any PLF and the predominant types of PLF, i.e. formula, honey, water, and other milk) in Indonesia in 2002, 2007, 2012, and 2017.

2. **Objective 2 (Chapter 5)**

   To identify the determinants of PLF (any PLF and the predominant types) in Indonesia and whether these have changed over time in 2002, 2007, 2012, and 2017.

3. **Objective 3 (Chapter 6)**

   To assess the association between PLF (any PLF and the predominant types) and breastfeeding duration in 2002, 2007, and 2017.

4. **Objective 4 (Chapter 7)**

   To assess the association between PLF (any PLF and the predominant types) and 'current exclusive breastfeeding (EBF)' in 2007, 2012, and 2017.

Since Objectives 1-4 used the same datasets, this chapter provides the overarching methods used for the quantitative analyses designed to address those objectives. General information about the data and variables are described here but the details of the statistical methods for each objective is explained separately in the corresponding chapters. The methods for the qualitative study (Objective 5) are described separately in Chapter 8.

3.2 Study settings

Indonesia is an archipelago nation in Southeast Asia. By 2020, it has 34 provinces consisting of at least 16,771 islands registered in the UN database (161). For this thesis, the islands are grouped into six regions based on the major islands: Sumatera, Java, Bali-Nusa Tenggara, Kalimantan, Sulawesi, and Maluku-Papua (Figure 3.2) (162).

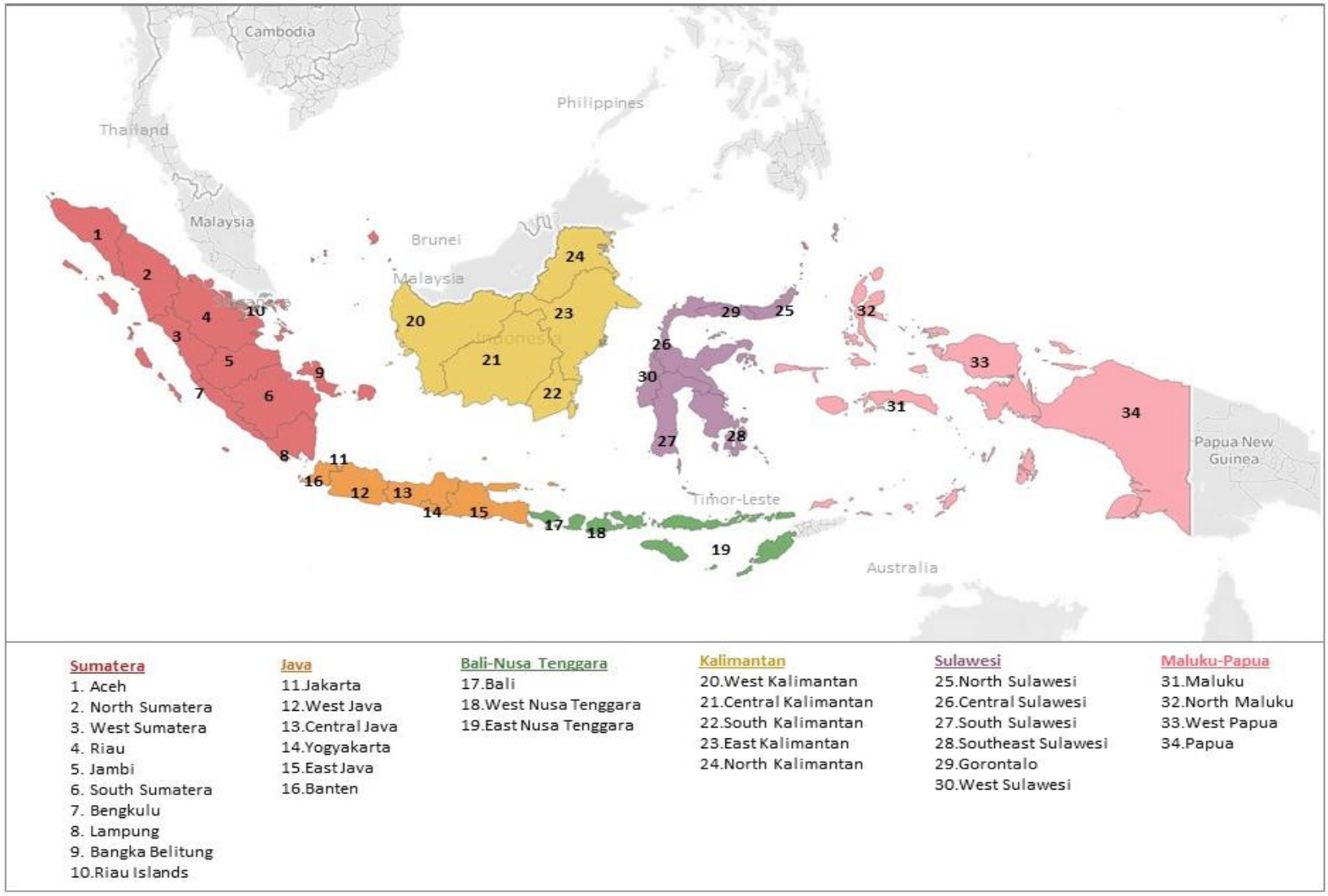


Figure 3.2. Map of Indonesia and grouping of the provinces based on major islands, made using Tableau software (162)

3.3 Data source: Indonesia Demographic and Health Surveys (IDHS)

The IDHS is part of the worldwide Demographic and Health Surveys (DHS) Program, a series of country-level surveys that have been conducted in at least 90 nations since 1984 (163). The first IDHS was completed in 1987 and since 2002, it has been conducted once every five years (164). Throughout the years, the surveys were carried out by Statistics Indonesia (*Badan Pusat Statistik—BP*S) in collaboration with the National Population and Family Planning Board (BKKBN) and the Ministry of Health of Indonesia (MoH). Technical assistance was provided under the auspices of the DHS Program by ORC Macro in 2002, Macro International in 2007, and ICF International in 2012 and 2017 (1, 10-12).For this thesis, IDHS datasets from four survey years were downloaded from https://dhsprogram.com/data/available-datasets.cfm (164). This is a public domain and access to the datasets is free-of-charge. Data were only used for the years in which PLF-related variables were available: 2002-2003 (which will be referred to in the thesis as 2002 for brevity (12)), 2007 (11), 2012(10), and 2017 (1).

3.3.1 Survey design

Most surveys in the DHS Program use two-stage probability sampling and the samples are drawn from an already existing sampling frame (165). In most cases, it is the most recent census frame. Likewise, IDHS used a two-stage stratified sampling based on the national census. IDHS was designed to represent Indonesia in the respective year by providing estimates at national, urban-rural, and regional (a.k.a provincial) levels (1, 10-12).

This section provides a simplified explanation of the IDHS design. More detailed information on the survey designs can be found in the DHS Guide documents (165). The document is available in PDF format or HTML version (https://www.dhsprogram.com/pubs/pdf/DHSG1/Guide_to_DHS_Statistics_DHS-7.pdf)

(https://dhsprogram.com/data/Guide-to-DHS-Statistics/Analyzing_DHS_Data.htm) (165). Alternatively, details of the survey designs can be found in APPENDIX B in each of the IDHS reports (1, 10-12).

Primary sampling unit

The sampling frame was the list of enumeration areas (known as census blocks) listed from the most recent population census (1). Therefore, the cluster, or as defined by the DHS, the primary sampling unit in all IDHSs was a census block (1). There were 1,592 census blocks in 2002 (12), 1,694 in 2007 (11), 1,840 in 2012 (10), and 1,970 in 2017 (1).

The first step of the sampling was to randomly select census blocks from the national census using probability proportional to size (PPS) methods and order them by wealth index category (165). This means that the census blocks with a larger populations had a higher chance of being selected (166). The second step was to randomly select 25 households from each selected census block before individuals were selected to be interviewed (1). The 2002 and 2007 IDHS used the 2000 Population Census while the 2012 and 2017 IDHS used the 2010 Population Census, but the sampling process were generally similar for all IDHS used for this thesis (1, 10-12).

As an example (1), the 2017 IDHS used the 2010 Population Census that had 183,000 census blocks as a sampling frame. A total of 1,970 census blocks in 2017 were randomly selected from each stratum with PPS. Then 49,250 households were randomly selected from the primary sampling units (census blocks). Consequently, the 1,970 census blocks obtained 49,250 households consisting of 25,300 households from the rural areas and another 23,950 from the urban areas.

Stratification

The IDHS sample was stratified by province and urban-rural area (1). Figure 3.2 shows the map for the 2017 IDHS, which consists of 34 provinces. This was the most recent map of Indonesia and was up to date in June 2022, when this chapter was written. Each province in Indonesia was divided into two strata that are urban and rural, except the capital province Jakarta (labelled 11 on the map), which only had an urban stratum as it was considered as an all-urban region.

The number of provinces in Indonesia changed over time due to either formation of new provinces across the years and/or security reasons. Consequently, the number of strata also varied across the survey years. In 2002, there were already fewer provinces (only 30) than there were in the later years. Moreover, some provinces like Aceh, Maluku, North Maluku, and Papua were not included in the survey because it was not considered safe to conduct a survey (12). Moreover, North Kalimantan (number 24 in Figure 3.2), was included in the 2017 IDHS but not in the previous surveys because it was not formed yet. As a result, there were 51 strata from 26 provinces in 2002 (12), 65 strata from 33 provinces in 2007-2012 (10, 11), and 67 strata from 34 provinces in 2017 (1).

Sampling weight

To account for uneven distribution of population characteristics and sizes in the surveyed countries, the DHS use sampling weights (165). Sampling weights are adjustment or inflation factors applied to each participant in tabulations to adjust for variations in probability of an individual being selected, due to survey design or chance (165). Regions with smaller populations are over-sampled to ensure that their sample is representative enough to calculate indicators while regions with larger populations are under-sampled for cost-effectiveness reasons. Likewise, for the IDHS, sampling weights were generated by the IDHS team to ensure the sample was representative and these weights were applied in my analyses as described in section 3.6.

Questionnaires and interviews

Data were collected by interviewers using three types of questionnaires: men, women, and household. For this thesis, only datasets from the women's questionnaires were used. The questionnaires across survey years were largely similar but not identical. The 2002 IDHS questionnaire was based on the DHS Model "A" Questionnaire, which was designed for countries that had high contraceptive prevalence (12). The 2007 IDHS questionnaire was based on the 2002 questionnaire to obtain trend analysis (11). The 2012 IDHS questionnaire was based on the standard DHS phase 6 (March 2011 version)(10), while the 2017 IDHS questionnaire was based on the standard DHS phase 7 (2015 version)(1). The complete IDHS questionnaires are available in Appendix F of each IDHS report (1, 10-12).

Since the base questionnaires were in English, they were initially translated to Indonesian. Some modifications were made by the Ministry of Health (MoH) of Indonesia in consultation with coordinating bodies including Central Bureau of Statistics (BPS), National Family Planning Coordinating Board (BkkbN), and Macro DHS to adapt with local settings and match relevant issues (1, 10-12). The questionnaires were pretested before the fieldwork commenced. The interviews were conducted in Indonesian by enumerators who had undergone training to ensure that the questions were asked, and the forms filled out properly. There were 530 interviewers involved in 2002 IDHS, 832 in 2007 IDHS, 922 in 2012 IDHS, and 1,160 in 2017 IDHS (1, 10-12). Interviewers were instructed to attempt a minimum of three visits to contact the survey respondents (12).

Data processing

Completed questionnaires were logged, edited, coded, and cleaned by the data processing team at BPS central office. The team consisted of editors, data entry operators, compare officers, secondary data editors, and data entry supervisors. Entry was performed twice and compared to detect errors. The data were processed using a special software called

Census and Survey Processing System (CSPro) (1, 10-12). The process took approximately seven months to complete for each IDHS (11).

3.3.2 Ethics review

The DHS obtained ethics review from the ICF Institutional Review Board (IRB) and an IRB in the host country (167). ICF IRB certifies that the data collection follows the U.S. Department of Health and Human Services regulations for the protection of human subjects (45 CFR 46)(167). Further details can be found in their website (https://dhsprogram.com/What-We-Do/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm) (167).

3.3.3 Response rates

Response rates were estimated for three groups in IDHS. These are 1) household response rate group, 2) men's individual response rate group, and 3) women's individual response rate group. This thesis only used women's individual response rate group, in which the coverage was all women aged 15-49 who stayed in the household the night before the survey(165). There is a slight difference between the first two and the latter two surveys. In 2002 and 2007, only ever-married women aged 15-49 were interviewed while in 2012 and 2017, *all* women aged 15-49 were (1, 10-12). The women's response rates were consistently high. As shown in Table 3.1, they ranged between 96-98% for all survey years (1, 10-12). Throughout the years, the response rates were comparably similar in rural and urban areas (1, 10-12).

Table 3.1. Response rates of the 2002-2017 IDHS

Survey year	Eligible women	Completed	Response rate
2002	29,996	29,483	98.3%
2007	34,227	32,895	96.1%
2012	47,533	45,607	95.9%
2017	50,730	49,627	97.8%

3.4 Study population

The target population for this thesis was mothers (or technically mother-child pairs) who had ever breastfed their last-born child. Mothers were defined as women aged 15-49 who had ever given birth. PLF-related questions were only asked to mothers who had ever breastfeed or were still breastfeeding. Since the definition of PLF includes the period of time "before breastfeeding", women who never breastfed were not eligible for the PLF questions.

To minimise recall bias for the questions on breastfeeding and PLF (168), the study population for Objectives 1-3 was restricted to mothers who had ever breastfed and whose last child was aged 0-23 months at interview. This was also the age cut-off used by the DHS guide (165). For Objective 4, which explores the association between PLF and EBF, the child's age cut-off was lower (<6 months) because the study outcome was related to the status of EBF within 24 hours of interview.

Sample sizes for each objective are shown in Table 3.7. These were dependent on the availability of data and eligibility for specific analysis. Details for each sample and consideration for inclusion are shown in the relevant chapter.

Objective 3 only used data from the 2002, 2007, and 2017 IDHS because the 2012 IDHS did not have the variables to generate time-to-event outcome i.e. age when breastfeeding stopped. Meanwhile, Objective 4 only used 2007, 2012, and 2017 IDHS because the 2002 IDHS had different variables to measure EBF status and had too many missing values (>40% of the target population). Further details on the selection of study population described in each corresponding chapter.

3.5 Variables used in the thesis

Many of the variables were used repeatedly in all four study objectives and it would be less efficient to define them in every single chapter. This section provides explanation about how

the variables were defined based on the IDHS questionnaire. Further details on how they were used in the regression models are described in the corresponding chapters.

In principle, variables that were included in the thesis were variables that fitted the conceptual framework for the study objectives (Figure 3.1), were consistently available in all survey years being analysed, and had missing values of no more than 10% of the target population. Several exceptions were made for some study objectives and are described further in the corresponding chapters. Each variable was defined according to the questions in the questionnaire which was taken from the APPENDIX F of each survey report (1, 10-12).

For the purposes of analysis, the variables were grouped as follows: PLF variables; maternal demographic variables; childbirth-related variables; and breastfeeding variables. Depending on the study objective (Figure 3.1), PLF variables were analysed as either outcome variables or explanatory variables. Similarly, the demographic and birth-related variables were analysed as either explanatory variables or covariables, subject to the conceptual framework. The study objective and conceptual framework are described in more details in each corresponding chapter.

Finally, there were additional variables that fitted the theoretical framework but were only included in sensitivity analyses. The results were not presented in the corresponding chapters as the main analysis because the variables were either inconsistently defined, unavailable in at least two survey years, or had a lot of missing values. Therefore, including them in the main analyses was considered to make the results less robust. However, they might still be adding insights to the discussion. For that reason, the results of the sensitivity analyses are included in appendices.

3.5.1 PLF variables

PLF variables consisted of any PLF and the predominant types of PLF, namely formula, honey, water, and other milk (Table 3.2). In Objectives 1 and 2, any PLF and the predominant PLF types were the outcome variables, while in Objectives 3 and 4 they were explanatory variables. Based on the Indonesian version of the IDHS questionnaire, PLF was described as "…anything other than breastmilk (given to newborn) in the first three days before birth, before breastmilk began flowing regularly" (Table 3.2).

Any PLF was a binary variable with only two possible answers: Yes (given) or No (not given). To simplify the selection of study population, only the answer corresponding to the youngest child was included in the analysis, even if the mother had more than one child. If the mother responded "Yes" to the question, it was coded as "PLF was given" and if she responded "No", it was coded as "PLF was not given". Unknown or incomplete response or code 9 was coded as "missing".

If the mother answered "No" to the question about any PLF, no further question would be asked. If she answered "Yes", the interviewer would proceed to ask what types of PLF were given. The interviewers had a list of substances in the form of tick boxes, but they did not read it aloud to the mothers. Instead, they only recorded the mother's response (Table 3.2). The list consisted of milk other than breastmilk (which was assumed to also be other than formula), plain water, sugar/glucose water, gripe water, sugar-salt solution, fruit juice, infant formula milk, tea, honey, rice water, semisolid foods, and others to specify (1, 10-12).

Multiple substances were possible and recorded accordingly. For example, a mother might mention two or more substances. The interviewers also asked again, "What else?" after the mother mentioned a substance. If they mentioned substances other than the ones in the list, it would be recorded as "others". The raw datasets sometimes provided the information

on the specific type, such as coffee in the 2007 IDHS, but mostly they were just coded as "others".

All types of PLF were described in Objective 1 about prevalence (Chapter 4). However, only four PLF types were selected to be analysed further for Objectives 2-4. These were prelacteal formula, honey, water, and other milk (No. 2a-d, Table 3.2). They were chosen for further analysis because according to the findings of Objective 1 (Chapter 4), they ranked top three most common types of PLF in at least one survey year. In 2002-2007, formula, honey, and water were the most predominant types. In 2012-2017, the predominant types were formula, other milk, and honey.

Table 3.2. PLF variables from 2002-2007 IDHS

Variable	Definition based on questionnaire	Categories	Analysed as
Any PLF	The practice of giving PLF to newborns, based on the following question: "In the first three days after delivery, before your milk began flowing regularly, was (NAME) given anything to drink other than breast milk?"*	Yes (PLF given) No (PLF not given)	Outcome variable (Objectives 1,2) Explanatory variable (Objectives 3,4)
Types of PLF** a. Formula b. Honey c. Water d. Other milk e. Glucose water f. Tea g. Coffee h. Rice water i. Sugar-salt solution j. Juice k. Gripe water l. Semisolid m. Unspecified others	"What was (NAME) given to drink?" Infant formula milk Honey Plain water Any kind of milk other than formula Glucose water Tea Coffee Rice water Sugar-salt solution Fruit juice Gripe water Semisolid food Other feeds that were not specified	Reported by the mother and recorded by the interviewer as ticked boxes (Yes/substance given) Not reported (No/substance not given)	Outcome variable (Objectives 1,2) Explanatory variable (Objectives 3,4)

PLF: prelacteal feeding
*) English questionnaire of 2017 IDHS and other countries' DHS reads: "In the first three days after delivery, was (NAME) given anything to drink other than breast milk?"
**) Types of PLF, based on the subsequent question following no.1. Multiple answers were possible.
2.a-b) Predominant types of PLF
2.e-m) Less frequent types of PLF

Note that there was a discrepancy between the questions published in English version (1) and the translated Indonesian version of the 2017 IDHS (38), where the Indonesian definition of PLF was stricter (Table 3.2). I highlighted this inconsistency to the DHS Team and they recommended that I used the 2017 IDHS's English version as it was the standard definition for all DHS surveys (169). However, it was important to acknowledge the possibility of the stricter definition being used due to the following reasons: 1) interviews were conducted in Indonesian, 2) the Indonesian version of all four IDHS questionnaires used the stricter definition, 3) the English version of 2002-2012 IDHS were consistent with the Indonesian version.

3.5.2 Maternal demographic variables

Maternal demographic factors consisted of age group, level of education, wealth quintile, place of residence, and region (Table 3.3). The first five variables were selected on an a priori basis, as they were largely included in most epidemiological studies and aimed to serve background characteristics of the study population. These variables were also selected to fit the conceptual framework by Rollins et al (6) as shown in the Chapter 2 (Literature Review). Major island group was added to facilitate analysis by region. It was not helpful to group the region by province as there were too many of them. The grouping intended to simplify categorisation of geographical areas in Indonesia as shown earlier in Figure 3.2. This was also done in accordance with what IDHS used in their latest reports (1).

All five maternal demographic factors presented in Table 3.3 were included in all studies that used regression analysis (Objectives 2, 3, and 4). In Objective 2 (Chapter 5), they were treated as explanatory variables to identify potential determinants of PLF. In Objectives 3 and 4 (Chapters 6 and 7), they were treated as covariables (or potential confounders) to adjust for the association between PLF and breastfeeding outcomes. Further details are provided in Chapters 5-7.

Most of the maternal demographic variables were not used in Objective 1 (Chapter 4) because this was a descriptive study about prevalence that did not require regression analysis. An exception, however, was made for major island group. It was used in the chapter as stratifying variable to show how the prevalence of PLF and predominant types varied in different regions in Indonesia.

Table 3.3. Maternal demographic variables

Variable	Definition based on questionnaire	Categories	Analysed as
Maternal age group	Mother's age at interview (in years). "In what month and year were you born?"	15-19 20-24 25-29 30-34 ≥35	Explanatory variable (Objective 2) Covariable (Objectives 3,4)
Level of education	Mother's highest level of educational attainment. "What is the highest level of school you attended: primary, junior high, senior high, academy or university?"	None/primary Secondary (junior/senior) Higher (academy/university)	As above
Wealth quintile	Percent distribution of the de jure population by wealth quintiles and the Gini coefficient for the household	Q1 (least affluent) Q2 Q3 Q4 Q5 (most affluent)	As above
Area of residence	Area of residence area based on country-specific classification.	Urban Rural	As above
Region (major island group)	Group of provinces based on geographical proximity (shown in Figure 3.2) as well as the grouping commonly shown in IDHS reports (1, 10-12)	Sumatera Java Bali-Nusa Tenggara Kalimantan Sulawesi Maluku-Papua	Stratifying variable (Objective 1) Explanatory variable (Objective 2) Covariable (Objectives 3,4)

3.5.3 Child and birth-related variables

Table 3.4 shows variables related to the child and birth process, which were child's age, child's sex, birth order, perceived birth size, mode of birth, place of birth, possession of maternal and child health (MCH) book. Based on the previous studies reviewed in Chapter 2, these variables were considered important in explaining PLF practice and were frequently associated with breastfeeding outcomes. Additionally, selection was made by

considering the temporal relationship between explanatory and outcome variable, plausibility, relevance with Indonesia's context, consistency across survey years, and the adequate sample in each category. As my analysis only included the youngest child, all the variables listed here only applied to the mother's youngest child at the time of interview. Responses for the older children were not included in the analyses.

Table 3.4. Child and birth-related variables

Variable	Definition based on questionnaire	Categories	Analysed as
Child's age	Age of the child at interview. "When is his/her birthday?"	In months	Covariable (Objective 4 only)
Child's sex	Child's sex based on mother's answer. "Is (NAME) a boy or a girl?"	Male Female	Explanatory variable (Objective 2) Covariable (Objectives 3,4)
Birth order	The order in which the mother gave birth e.g. first child, second child, third child etc.	First Second/later	As above
Perceived birth size	Size of the child's birth size according to mother's perception. "When (NAME) was born, was he/she very large, larger than average, average, smaller than average, or very small?"	Larger than average (very large and larger than average) Average Smaller than average (very small and smaller than average)	As above
Place of birth	Whether birth took place at home or at a health facility; health facility was either public or private owned. The questionnaire had a set of predetermined tick boxes to the question "Where did you give birth to (NAME)?" under each of the 'home', 'public facility', 'private facility' categories.	Home Public facility Private facility	As above
Mode of birth	How the child was born "Was (NAME) delivered by caesarean, that is, did they cut your belly open to take the baby out?"	Yes (caesarean birth) No (vaginal birth)	As above
Place and mode of birth	Combination of place and mode birth; this combination was based on the assumption that caesarean birth could not happen at home.	Home-vaginal Public facility-vaginal Public facility-caesarean Private facility-vaginal Private facility-caesarean	As above
MCH book	Possession of MCH book at interview, which was a proxy for provision of information related to breastfeeding and	Yes (given the book) No (not given the book)	Explanatory variable (Objective 2) Covariable

Variable	Definition based on questionnaire	Categories	Analysed as
	colostrum. The book was ideally given during antenatal visit but was used to monitor child growth and development after birth. "Were you given an antenatal card (KMS) for pregnant mother or MCH book for this pregnancy?"		(Objectives 3,4)

MCH: Maternal and child health

Child's age was only used in Objective 3 (Chapter 6) as a covariable to adjust for the association between PLF and breastfeeding duration. The remaining variables were treated as explanatory variables in Objective 2 (Chapter 5) and as potential confounders in Objectives 3 and 4 (Chapters 6 and 7). Child's sex was chosen to reflect demographic characteristic. Birth order (whether the child was the firstborn or not) was included as it represented mother-infant relationship that reflected her reproductive experience (parity).

Birth weight was poorly recorded in IDHS (<50% mothers reported their baby's birth weight based on written record in 2002-2017 and <80% babies were weighed in 2002-2007), and therefore was not used in the analyses. Instead, 'perceived birth size' (larger than average, average smaller than average) has been included, as it was considered to potentially reflect the general health condition of the baby (e.g. prematurity, twins, low birth weight). Moreover, mode and place of birth reflected health service settings in the first days of birth.

I decided not to use antenatal care (ANC) variable although several previous studies included it in their models because nearly all mothers in Indonesia already received ANC from a skilled health care provider (90% in 2002, 94% in 2007, 96% in 2012, and 98% in 2017) (1, 10-12) and it did not specifically reflect health intervention related to infant feeding. Similarly, postnatal care (PNC), despite fitting the conceptual framework, was not used due to potentially ambiguous temporal relationship with the event of PLF. Instead, possession of MCH book was used as a proxy for infant-feeding related intervention within ANC and

PNC scope. Lastly, MCH book is a nationally standardised document that is mass produced and given to a pregnant mother for free ideally at her first antenatal visit. It aims to keep basic information about pregnancy, birth, and child's health. It contains layman advice about infant feeding, which includes the importance of EBF, avoiding giving feeds other than breastmilk, and not discarding colostrum (170).

3.5.4 Breastfeeding variables

Table 3.5 shows variables that represented breastfeeding outcomes and were used in Objectives 3 and 4. Time-to-event of breastfeeding cessation was defined as the child's age when breastfeeding had stopped. This was used as the outcome variable for Objective 3 (Chapter 6).

Current exclusive breastfeeding (EBF) status refers to the feeding status within 24 hours prior to the interview. This is to clarify the difference between the meaning of EBF as set out by the WHO recommendation (4, 171) and the measurement indicator as recommended by the WHO (144). The exact meaning of EBF is "exclusively breastfed for the first 6 months of life – meaning no other foods or liquids are provided, including water" (171). Current EBF in this thesis was defined as the combination of still breastfeeding and not giving any other food or liquid to the child, regardless of whether PLF was given. This was the definition used by IDHS in accordance with WHO's measurement indicator (144). No current EBF was either the mother had stopped breastfeeding or was still breastfeeding but also gave her baby other food/liquid. This variable was the outcome variable for Objective 4 (Chapter 7).

These variables were generated by combining multiple variables available in the IDHS datasets. Time-to-event of breastfeeding cessation combined the variable on duration of breastfeeding and current breastfeeding status. Current EBF status was generated by combining current breastfeeding status and the food or drinks given within 24 hours prior to interview.

Table 3.5. Breastfeeding variables

Variable	Definition based on questionnaire	**Categories**	**Analysed as**
Time-to-event of breastfeeding cessation	The age of child when breastfeeding had stopped "Are you still breastfeeding (NAME)?" (If not, months of breastfeeding were recorded)	In months	Outcome in Objective 3
'Current' EBF status in the past 24 hours	Whether child was still breastfed and given nothing other than breastmilk in the past 24 hours "Are you still breastfeeding (NAME)?" "Now I would like to ask you about liquids or foods that (NAME FROM 649) had yesterday during the day or at night. I am interested in whether your child had the item I mention even if it was combined with other foods. "	Yes (EBF) No (Stopped breastfeeding or partial breastfeeding)	Outcome in Objective 4

EBF: Exclusive breastfeeding

3.5.5 Additional variables for the sensitivity analyses

Some variables were theoretically important for addressing some objectives, but I decided not to include them in the main analysis because of availability issue. These were maternal religion and immediate skin-to-skin contact, which were shown in Table 3.6

Maternal religion was an important demographic factor that may have affected the infant feeding decision including PLF and breastfeeding continuation. Unfortunately, it was only available in the 2002 and 2007 datasets, so comparison could not be made for all survey years. In addition, Islam comprised nearly 90% of religions in Indonesia while the other recognised faiths had very low prevalence and might not yield large enough numbers to aid meaningful comparisons (172). Similarly, immediate skin-to-skin contact was reported to be associated with PLF and breastfeeding outcomes, but it was only available in the 2017 IDHS.

However, these variables could still provide additional insights so ignoring them completely would be a waste of information. Hence, similar regression models were fitted as

appropriate where these variables were included. The results are referred to in the relevant chapter and described in full in appendices.

Table 3.6. Additional variables for sensitivity analyses

Variable	Definition based on questionnaire	Categories	Analysed as
Maternal religion	Mother's answer to question "What is your religion?"	Islam Protestant Catholic Hinduism Buddhism Confucianism Others	Explanatory variable (Sensitivity analysis of Objective 2) Covariable (Sensitivity analysis of Objectives 3,4)
Immediate skin-to-skin contact	Whether child was put to mother's bare chest right after birth	Yes No	As above

3.6 Summary of the statistical analyses for the quantitative studies

The statistical analysis used for each of the four objectives is summarised at the bottom of Table 3.7. This thesis used descriptive statistics and a variety of statistical modelling techniques depending on the study objective and type of outcome variable. Regression models were fitted when the outcome variables were consistently defined and available in at least three survey years. These techniques, together with modelling strategies, are described in more detail in the corresponding chapters.

For all of these approaches, the complex sample design was taken into account and the survey weights generated by the IDHS team were applied. All of the analyses were conducted using the survey ('svy') commands in Stata version 15 (173). Proportions, means, and measures of effect (e.g. prevalence ratios (PR), hazards ratios (HR)), and statistical tests used weighted data while frequencies shown in tables represented true counts (unweighted).

Table 3.7. Summary of the study population and analysis plans for the Objectives 1-4

	Objective 1 (Chapter 4)	**Objective 2** (Chapter 5)	**Objective 3** (Chapter 6)	**Objective 4** (Chapter 7)
To investigate…….	Prevalence of any PLF and predominant PLF types	Determinants of any PLF and predominant PLF types	Association between PLF and breastfeeding duration	Association between PLF and EBF
Study population	Mothers whose last child had ever been breastfed and was aged 0-23 months at interview	Mothers whose last child had ever been breastfed and was aged 0-23 months at interview	Mothers whose last child had ever been breastfed and was aged 0-23 months at interview	Mothers whose last child had ever been breastfed and was aged 0-5 months at interview
Sample size	6,067 (2002) 6,857 (2007) 6,715 (2012) 6,463 (2017)	5,741 (2002) 6,477 (2007) 6,149 (2012) 6,168 (2017)	5,558 (2002) 6,268 (2007) N/A (2012) 6,227 (2017)	N/A (2002) 1,603 (2007) 1,558 (2012) 1,552 (2017)
Outcome variable(s)	▪ Any PLF ▪ Predominant types of PLF (formula, honey, water, other milk)	▪ Any PLF ▪ Predominant types of PLF (formula, honey, water, other milk)	▪ Time-to-event of breastfeeding cessation	▪ EBF status in the past 24 hours
Explanatory variable(s)	N/A	▪ Maternal age group ▪ Level of education ▪ Wealth quintile ▪ Place of residence ▪ Region ▪ Child's sex ▪ Birth order ▪ Perceived birth size ▪ Mode and place of birth ▪ Possession of MCH book	▪ Any PLF ▪ Predominant types of PLF (formula, honey, water, other milk)	▪ Any PLF ▪ Predominant types of PLF (formula, honey, water, other milk)
Covariables	N/A	N/A	▪ Same as the explanatory variables in Objective 2 except MCH book, which was only used in sensitivity analysis	▪ Same as the covariables in Objective 2 ▪ Child's age at interview
Statistical analysis/ modelling strategy	Descriptive statistics	Modified Poisson regression; random effect meta-analysis	Survival analysis using Cox regression	Modified Poisson regression

As shown in Table 3.7, Objective 1 (Chapter 4) used descriptive statistics to describe the prevalence of PLF and predominant types in 2002-2017. Major island group was used to show the difference in prevalence across the nation. No regression analysis was performed in this chapter.

Objective 2 (Chapter 5) used modified Poisson regression and random effects meta-analysis to look at the determinants of PLF (Table 3.7). Since the outcome was common, modified Poisson regression was chosen instead of logistic regression (174). Consequently, the magnitude of association between the determinants and PLF was measured as prevalence ratio (PR). PR of >1 implied that a variable was associated with higher prevalence of PLF outcome. Random effect meta-analysis was then conducted to see if there was heterogeneity in these associations (PRs) over time.

Objective 3 (Chapter 6) used Cox regression survival analysis to assess association between PLF and breastfeeding duration (Table 3.7). The outcome was time-to-event of breastfeeding cessation. The association was adjusted for covariables (potential confounders). The outcome was measured as hazard ratio (HR), where HR of >1 meant that mothers who gave PLF were more likely to stop breastfeeding earlier.

For the same reason as Objective 2, i.e. prevalent outcome, Objective 4 used modified Poisson regression to examine the association between PLF and EBF (Chapter 7). The outcome was EBF status at interview for babies under 6 months. The association between PLF and EBF status was adjusted for potential confounders. In this chapter, PR of >1 meant that mothers who gave PLF were more likely to be exclusively breastfeeding at the time of interview.

3.7 Missing data

The extent of missing values in the data required for each study objective varied, so the approach to missing data is explained in more detail in each corresponding chapter. In principle, when missing data in all variables did not exceed 10% of the target population, a complete case analysis was preferred. Where the variables were missing less than 10% of values, the resulting risk of bias was considered to be small (175).

Since IDHS is a series of cross-sectional studies, it does not follow a cohort of women over time. Instead, each survey year samples a different group of women. As a result, the exclusion of individuals due to missing data in one year does not have implications for the sample in the next survey year. Therefore, the risk of getting biased results due to incomparable time points was expected to be minimal (175).

Other approaches to dealing with missing values were considered, including multiple imputation. However, after consultation with my supervisors, these had limitations that outweighed the benefits. Meanwhile, the main consequence of using the complete case approach was a reduced sample size. The smaller sample size led to a reduced precision in the estimate of effect and wider confidence intervals (CI) (176). Furthermore, if missing data in a variable exceeded 10% or could cause the total missing values to exceed 10%, a different approach was taken. Depending on the study design and objectives, the variable was either recoded (to classify missing value as a new category) or excluded from the statistical models. Subsequently, this variable was fitted in a sensitivity analysis. Results from these sensitivity analyses were compared with the results from the main analyses to give additional insights into the interpretation.

3.8 Sensitivity analysis

Sensitivity analyses were performed for Objectives 2-4 (Chapter 5-7). The detailed procedures are described in the corresponding chapters, but in principle, it involved the

same modelling strategy as the main results but by using different sets of variables. The results of the sensitivity analyses are only shown in Appendices, and not as the main analysis in the corresponding chapters.

In Objective 2 that looked at PLF determinants, a sensitivity analysis was performed for the multivariable analysis of 2002, 2007, and 2017 IDHS. Religion, which was only available in 2002 and 2007 IDHS, were included in the final model of these years as a sensitivity analysis to see if this was associated with PLF. The sensitivity analysis for 2002-2007 also included the variable about possession of MCH book which had large missing values. Additionally, immediate skin-to-skin contact, the variable that was only available in 2017 was included in the final model of the 2017 analysis. In the main results, these variables were not included to facilitate a consistent modelling strategy across the four survey years. However, I considered these were important variables to explore, therefore I added this in a sensitivity analysis.

In Objective 3 that looks at the association between PLF and breastfeeding duration, sensitivity analyses were performed for the analysis of IDHS 2002, 2007, and 2017. The MCH book, a variable with the largest number of missing values was used in the sensitivity analysis as a covariable to adjust for. In the main results, this was not included in the modelling strategy to preserve sample size. The effect sizes between PLF and breastfeeding duration from the main analysis and the sensitivity analysis were then compared.

In Objective 4 that looks at the association between PLF and EBF, sensitivity analyses were conducted for 2007, 2012, and 2017 datasets. The variable used as sensitivity analyses was MCH book, with the same reason for sensitivity analyses in Objective 3.

3.9 Sample size and power

As a consequence of using secondary data, the maximum sample size that I could analyse for my quantitative studies could not be larger than what was available in the IDHS datasets. Therefore, as shown in Table 3.8, I calculated the estimated effect size that could be detected with at least 80% power, using the Chi-square test for two independent proportion in Stata 15 (173). The calculation was carried out for the study addressing Objective 4 as it had the smallest sample size. For all of the comparisons (PLF types) in Objective 4, there was at least 80% power to detect PRs of 1.37 (prelacteal honey, 2012) or smaller, which is considered a small to moderate effect. Hence the studies addressing Objectives 1-3, which were substantially larger (n=5,558-6,857) were assumed to have sufficient power to detect even smaller effects.

Table 3.8. Effect size (PR) that can be detected with at least 80% power for Objective 4

Year	Exposure	Number of total sample size	Number of exposed (PLF)	Number of non-exposed (Not PLF)	% of EBF in non-exposed group	Estimated effect size that can be detected with ≥80% power
2007	Any PLF	1,603	1,031	572	38.3	1.18
	Formula		737	866	38.6	1.17
	Honey		178	1,425	33.0	1.32
	Water		167	1,436	33.1	1.33
2012	Any PLF	1,558	970	588	57.8	1.12
	Formula		656	902	48.6	1.14
	Honey		75	1,483	43.4	1.37
	Water		90	1,468	43.5	1.35
	Other milk		197	1,361	44.7	1.24
2017	Any PLF	1,552	722	830	63.5	1.11
	Formula		409	1,143	59.2	1.13
	Honey		62	1,490	53.0	1.33
	Water		63	1,489	54.0	1.32
	Other milk		205	1,347	55.2	1.19

4 PREVALENCE OF PRELACTEAL FEEDING IN INDONESIA (2002 – 2017)

4.1 Chapter introduction

As described in the literature review (Chapter 2), studies on prelacteal feeding (PLF) practice in Indonesia are limited and not representative at the national level. This chapter corresponds to Study Objective 1, which is to describe the prevalence of PLF in Indonesia between the survey period of 2002 and 2017. It aims to provide a context and epidemiological overview of PLF practice in Indonesia. In addition to the overall PLF (referred to as "any PLF" in this thesis), the prevalence of various types of PLF are described in this chapter.

4.2 Methods

This is a descriptive study using datasets from the 2002, 2007, 2012, and 2017 Indonesia Demographic and Health Surveys (IDHS)(1, 10-12). Details on the data collection and definition of variables are described in Chapter 3 (Methods for quantitative studies).

4.3 Study population

The target population of the overall PLF study was mothers whose last child had ever been breastfed and was aged 0-23 months at the time of interview (**Figure 4.1**), the number of mothers ranged between 6,076 and 6,877. Women with missing data on PLF were excluded, although these numbers were small (0.1% - 1.6%) which made the study population in each survey year nearly 100% of the target population, ranged from 6,067 to 6,857 (**Figure 4.1**). Note that women were excluded from the surveys if they never gave birth. The number of excluded ineligible women was larger in the latter two surveys than the first two (**Figure 4.1**). This was because in 2002-2007, the survey was only carried out

among ever-married women, while in 2012-2017, all women were interviewed regardless of their marital status.

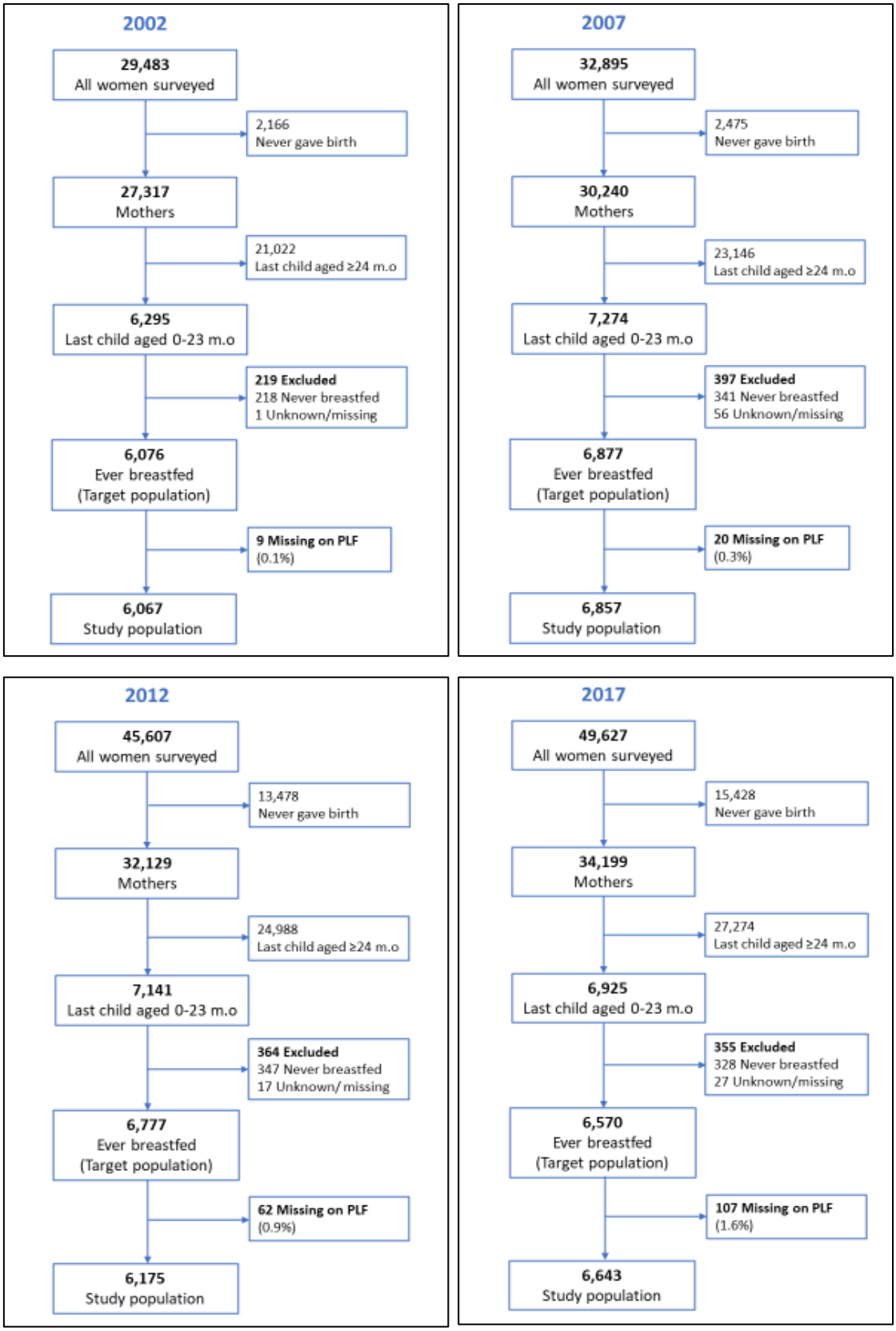


Figure 4.1. Selection of study population (2002-2017)

4.4 Outcome variables

The outcome variables were any PLF and the four most common or predominant types of PLF across all survey years. These were prelacteal formula, honey, water, and milk other than formula. The reason for choosing the four predominant types to analyse further was because they were ranked the three most common types of PLF in at least one survey year. As explained in Chapter 3, PLF was defined as "…anything other than breastmilk (given to newborn) in the first three days before birth, before breastmilk began flowing regularly". The specific types of PLF were the ones reported by the mothers, which were recorded by the interviewers using predetermined tick boxes.

4.5 Descriptive statistics

This study objective used descriptive statistics to show the prevalence of any PLF and various types of PLF in 2002, 2007, 2012, and 2017 at the country level. Firstly, to give the epidemiological overview, the national prevalence of any PLF and all types recorded in each survey year was made into bar charts. These charts show the proportion of mothers in the study population who gave any PLF and the proportion who gave specific types of PLF. No formal statistical inference was conducted in the chapter because the results were descriptive only. The trends over time were inspected visually and since linear trends were not consistently observed in all predominant types, it was not appropriate to conduct a formal statistical test.

As described in Chapter 3, multiple answers on PLF types were possible. This meant that one mother could contribute to the proportion of two or more different types of PLF. Since there were so many types of PLF and a lot of them were given in combination with each other, it was too complex to present all of the possible combinations. Therefore, each type of PLF was presented individually regardless of how they were combined with other types of PLF.

An exception was made for formula because this was the only substance that could be classified as newborn food according to the World Health Organisation (WHO), whereas honey, other milk, etc were not classified as newborn food. Hence, results are presented for both the proportions of mothers who gave only prelacteal formula and those who gave prelacteal formula in combination with other feeds. This distinction between groups of "formula only" and "formula + others" was only shown once in the thesis to describe how prelacteal formula was given. For the rest of analysis, the "formula" group was treated as a whole and did not distinguish between the "formula only" and "formula + others" groups.

Next, to show variation across regions and trends over time, the regional prevalence of any PLF in all survey years was shown in line graphs. The regions were classified into six major islands as described in Chapter 3. They were Sumatera, Java, Bali-Nusa Tenggara, Kalimantan, Sulawesi, and Maluku-Papua. The grouping was determined based on the geographical proximity as used by the IDHS reports.

The bar charts and line graphs were intended to give an introductory overview of the PLF practice in Indonesia. Therefore, to keep them simple, only point estimates of prevalence for any PLF and the predominant types are shown in the graphs. Additionally, point estimates with 95% confidence intervals (CI) are listed in a separate table.

Each region, which refers to a major island group, consisted of several provinces which were too many to display. Like the bar charts, the line graphs were used to visualise the trends of any PLF, and predominant types based on the regions. Therefore, details on prevalence of any PLF and the four predominant types at the provincial are listed in the APPENDIX II.

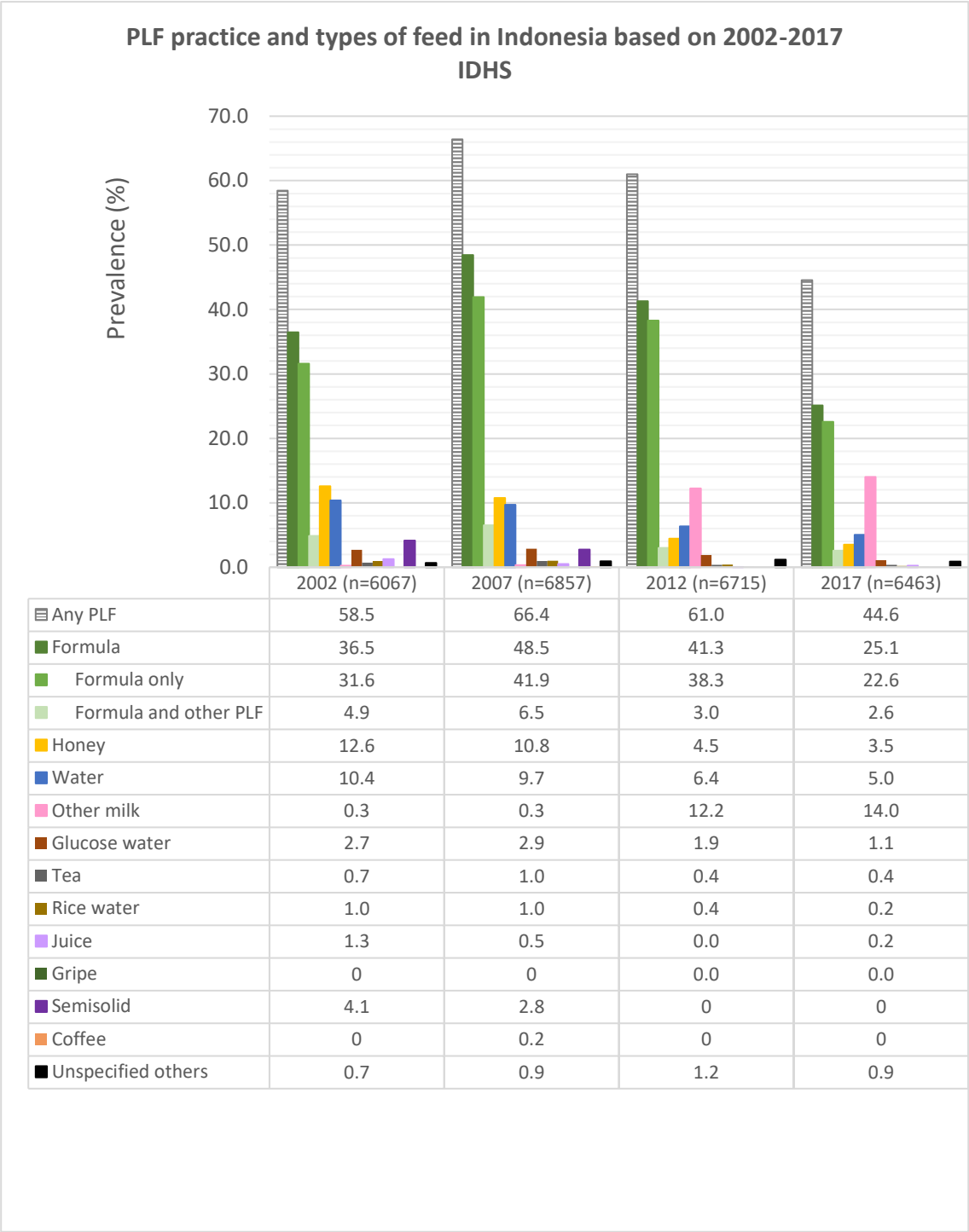
4.6 Results

4.6.1 Prevalence of any PLF and various types of PLF in 2002-2017 in Indonesia

Figure 4.2 shows the prevalence of overall PLF and various types of PLF reported by mothers whose last child was 0-23 months in 2002-2017 IDHS. The prevalence of any PLF was relatively common, ranging between 44.6% and 66.4%, with no clear linear trend over time. In 2002, 58.5% (95% CI 55.5-61.4%) of mothers said that their last child received any kind of PLF within 3 days after birth. In 2007, this proportion increased to 66.4% (95% CI 66.4-64.5%), then decreased to 61.0% (59.1-62.8%) and 44.6% (95% CI 42.9-46.3%) in 2012 and 2017, respectively.

A range of different feeds such as formula, honey, water, milk other than formula, glucose water, tea, rice water, coffee, and semisolid food, were reported by mothers to have been given to their baby within all four surveys (**Figure 4.2**). Formula was the most common PLF in every survey year (36.5% in 2002, 48.5% in 2007, 41.3% in 2012, and 25.1% in 2017), contributing to 57-73% of overall PLF given in each survey. Although these proportions were mostly comprised of 'only formula' (without other types of PLF), about 3-7% mothers across survey years said that their babies received formula along with other kinds of PLF.

Honey and water ranked second and third most common PLFs in 2002-2007, while in 2012-2017 these positions were taken by other milk and honey **(Figure 4.2**). Although the overall prevalence of any PLF was generally lower in 2012-2017, there was a marked increase in 'other milk' in these survey years. The less common PLF types were glucose water, tea, rice water, fruit juice, semisolid food, coffee, gripe water, and unspecified others. Some of the feeds such as semisolid food and coffee were not reported in all survey years because the options (tick boxes) were not consistently available.



	2002 (n=6067)	2007 (n=6857)	2012 (n=6715)	2017 (n=6463)
Any PLF	58.5	66.4	61.0	44.6
Formula	36.5	48.5	41.3	25.1
Formula only	31.6	41.9	38.3	22.6
Formula and other PLF	4.9	6.5	3.0	2.6
Honey	12.6	10.8	4.5	3.5
Water	10.4	9.7	6.4	5.0
Other milk	0.3	0.3	12.2	14.0
Glucose water	2.7	2.9	1.9	1.1
Tea	0.7	1.0	0.4	0.4
Rice water	1.0	1.0	0.4	0.2
Juice	1.3	0.5	0.0	0.2
Gripe	0	0	0.0	0.0
Semisolid	4.1	2.8	0	0
Coffee	0	0.2	0	0
Unspecified others	0.7	0.9	1.2	0.9

Figure 4.2. Prevalence of any PLF and various types of PLF in Indonesia at the national level, 2002-2017

4.6.2 Trends of any PLF and the predominant types of PLF in 2002-2017 by region

Figure 4.3 summarises the trends of any PLF (a) as well as prelacteal formula (b), honey (c), water (d), and milk other than formula (e). The line graphs show the prevalence in the six regions of Indonesia. The confidence intervals of the prevalence estimates at the

national and regional (island group) level are shown in **Table 4.1**. The details at the provincial level (population count and PLF prevalence) can be found in APPENDIX II.

Note that each of five graphs in **Figure 4.3** had different upper bounds for the axis. This was to make the graph more efficient. The upper bound in any PLF graph (**Figure 4.3a**) was set at 80% while the upper bound for the predominant types (Figure 4.3b-e) was lower depending on the highest prevalence estimate. The upper bound of the axis was set at 60% for prelacteal formula graph (**Figure 4.3b**) and 40% for prelacteal honey, water, and other milk graphs (**Figure 4.3c-e**, respectively).

Any PLF

Graphically, there was no obvious trend in prevalence of any PLF in Indonesia as a whole (**Figure 4.3a**, dashed red line). It increased from 59% in 2002 to 66% in 2007 and decreased again in to 61% and 45% in 2012 and 2017, respectively. However, the national prevalence of any PLF was lower in 2017 than in the previous survey years. This was confirmed by the 95% CIs of PLF prevalence in 2017, which did not overlap with those in the other survey years (**Table 4.1**).

Most regions exhibited a similar pattern over time, with a small increase in prevalence between 2002-2007 and a large decrease in prevalence in 2017. However, the prevalence varied by region and survey year. For example, Bali-Nusa Tenggara region (**Figure 4.3**a, yellow line) consistently had the lowest prevalence of any PLF over time (nearly 40% in 2002 and 2007, 36% in 2012, and 30% in 2017). The second lowest prevalence was found in Maluku-Papua region (navy line), although its CIs did not overlap with Bali-Nusa Tenggara's in 2012 and 2017 (**Table 4.1**).

Meanwhile, some regions exhibited a higher prevalence throughout the survey years. Sumatera region (**Figure 4.3a**, orange line) consistently showed the highest prevalence of

any PLF in all survey years (68% in 2002, 72% in 2007, 71% in 2012 and 57% in 2017). The prevalence of any PLF in the other three regions, Java (grey line), Kalimantan (blue line), and Sulawesi (green line) were similar to each other and Indonesia as a whole (red line) (**Table 4.1**).

Prelacteal formula

Similar to any PLF, the prevalence of prelacteal formula in Indonesia as a whole (**Figure 4.3b,** dashed red line) was lowest in 2017, despite fluctuating estimates in 2002, 2007, and 2012. As shown in **Table 4.1**., in 2017, it was 25.1% (23.6%-26.7%) while in the previous years it was 36.4% (33.5%-39.4%), 48.5% (46.3%-50.6%), and 41.3% (39.2%-43.4%). The prevalence in all the regions were either decreased (lower point estimates and non-overlapping CIs) or remained the same (different point estimate but overlapping CIs) as the previous survey years.

In most survey years, the prevalence of prelacteal formula was consistently lowest in either Bali-Nusa Tenggara region or Maluku-Papua region (**Figure 4.3, Table 4.1**). Meanwhile, the highest prevalence of formula was mostly seen in Sumatera (46% in 2002, 49% in 2012, and 37% in 2017). In the first three survey years, Sumatera, Java, and Kalimantan always had the highest prevalence of prelacteal formula than did other regions. However, in 2017, prelacteal formula had decreased a lot in Java, making Sumatera, Sulawesi, and Kalimantan the regions with the highest prevalence of prelacteal formula.

Prelacteal honey

For Indonesia as a whole, prelacteal honey decreased from 12.6% (11 .0%-14.3%) in 2002 to 3.5% (3.0%-4.1%) in 2017 (Figure 4.2c, Table 4.1). This decreasing pattern over the survey years is similar in most regions. The prevalence of prelacteal honey was similar to or above the national average in Sulawesi (14%-6%) across all survey years. The prevalence was either the same with or lower than national average in Bali-Nusa Tenggara

region. The other regions (Sumatera, Java, Kalimantan, and Maluku-Papua) generally showed no statistically significant difference with the national average in almost all survey years (**Table 4.1**).

Prelacteal water

Figure 4.2d shows that the point estimates for the prevalence of prelacteal water decreased over time (10.4% in 2002, 9.7% in 2007, 6.4% in 2012, and 5% in 2017). Although the CIs in 2002 and 2007 were overlapped, the estimate in 2017 was significantly lower than the first two survey years (**Table 4.1**). Prevalence of prelacteal water was always higher (16% in 2002, 20% in 2007, and 12.3% in 2012) in Sulawesi compared to the national prevalence. Meanwhile, Bali-Nusa Tenggara, always had the lowest) prevalence of prelacteal water (9% in 2002, 4% in 2007, 5% in 2012, and 4% in 2017 in nearly all survey years.

Prelacteal milk other than formula

The prevalence of any other milk given as PLF rose sharply in the last two survey years (**Figure 4.2e**). Previously, the national prevalence was very low (<1%) in 2002 and 2007, but it increased to above 10% in 2012 and 2017. The pattern was generally similar in most regions, except Maluku-Papua which showed a decline in 2017 after a prominent increase in 2012. Again, the prevalence of prelacteal milk other than formula remained lower than national average in Bali-Nusa Tenggara region. Meanwhile, in 2017, Sulawesi had the highest estimate (19%). The CI for Sulawesi however, overlapped with that of Sumatera, Java, and Kalimantan, which suggested that the prevalence in these four regions in 2017 might just be equally high (**Table 4.1**).

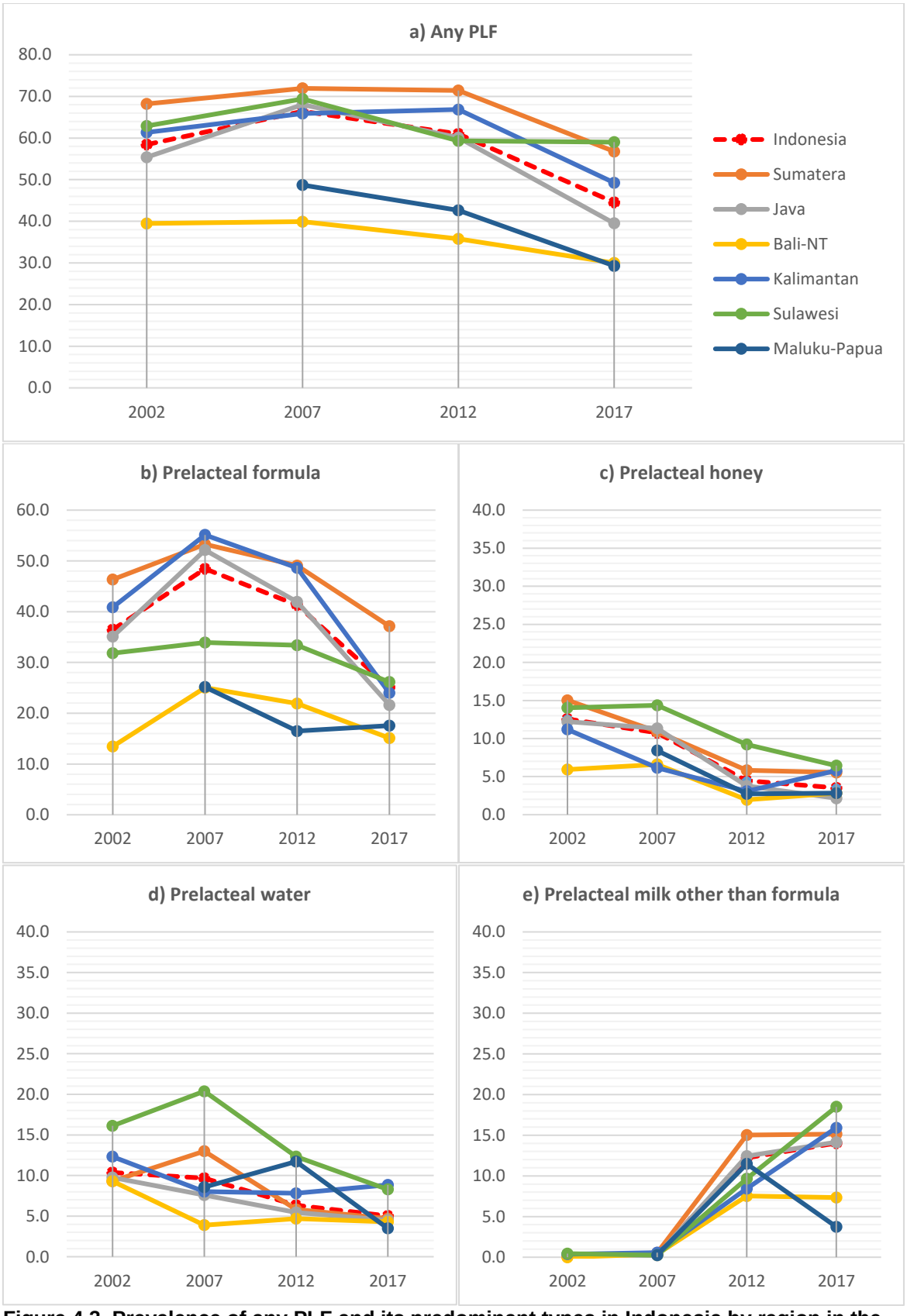


Figure 4.3. Prevalence of any PLF and its predominant types in Indonesia by region in the 2002-2017 IDHS

Table 4.1. Prevalence of any PLF and predominant types by island group (2002-2017)

	2002	2007	2012	2017
Any PLF				
Indonesia	**58.5 (55.5-61.4)**	**66.4 (64.5-68.3)**	**61.0 (59.1-62.8)**	**44.6 (42.9-46.3)**
Sumatera	68.2 (64.3-71.9)	71.9 (69.3-74.4)	71.4 (68.5-74.1)	56.8 (53.4-60.2)
Java	55.4 (50.6-60.1)	68.0 (64.8-71.1)	60.1 (57.0-63.1)	39.5 (37.0-42.1)
Bali-Nusa Tenggara	39.5 (34.0-45.2)	39.9 (34.4-45.7)	35.8 (31.5-40.3)	30.0 (25.7-34.6)
Kalimantan	61.4 (56.7-65.8)	65.9 (61.4-70.1)	66.9 (62.9-70.6)	49.3 (42.9-55.6)
Sulawesi	62.9 (55.2-70.0)	69.4 (65.7-72.9)	59.3 (55.4-63.1)	59.0 (55.4-62.5)
Maluku-Papua	Data not available	48.7 (42.7-54.8)	42.7 (36.9-48.6)	29.3 (23.6-35.8)
Formula				
Indonesia	**36.4 (33.5-39.4)**	**48.5 (46.3-50.6)**	**41.3 (39.2-43.4)**	**25.1 (23.6-26.7)**
Sumatera	46.4 (41.9-50.9)	53.3 (49.8-56.7)	49.1 (46.2-52.0)	37.1 (33.5-40.9)
Java	35.1 (30.7-39.8)	52.1 (48.6-55.6)	41.9 (38.4-45.5)	21.6 (19.5-23.9)
Bali-Nusa Tenggara	13.5 (10.5-17.1)	25.0 (20.5-30.2)	21.9 (18.4-25.9)	15.1 (11.8-19.1)
Kalimantan	40.8 (36.3-45.5)	55.1 (50.0-60.1)	48.7 (44.3-53.0)	24.0 (18.9-29.9)
Sulawesi	31.8 (21.1-44.9)	33.9 (30.1-38.0)	33.4 (30.2-36.8)	26.1 (22.6-30.0)
Maluku-Papua	Data not available	25.2 (20.6-30.4)	16.5 (13.3-20.3)	17.5 (13.2-22.9)
Honey				
Indonesia	**12.6 (11.0-14.3)**	**10.8 (9.4-12.3)**	**4.5 (3.8-5.2)**	**3.5 (3.0-4.1)**
Sumatera	15.0 (12.6-17.9)	10.9 (9.1-13.1)	5.8 (4.7-7.3)	5.5 (4.2-7.3)
Java	12.2 (9.8-15.1)	11.3 (9.0-14.2)	3.8 (2.8-5.1)	2.2 (1.5-3.0)
Bali-Nusa Tenggara	5.9 (3.9-8.9)	6.6 (4.6-9.4)	2.0 (1.0-3.6)	2.8 (1.8-4.6)
Kalimantan	11.2 (8.3-15.0)	6.2 (4.3-8.7)	3.1 (1.9-4.9)	5.8 (3.7-8.9)
Sulawesi	14.0 (9.5-20.3)	14.4 (11.8-17.4)	9.2 (7.4-11.5)	6.4 (4.9-8.4)
Maluku-Papua	Data not available	8.4 (5.7-12.3)	2.7 (1.6-4.6)	2.8 (1.7-4.7)
Water				
Indonesia	**10.4 (8.7-12.3)**	**9.7 (8.6-10.9)**	**6.4 (5.5-7.4)**	**5.0 (4.3-5.9)**
Sumatera	9.3 (6.8-12.6)	13.0 (10.8-15.5)	5.8 (4.7-7.1)	4.7 (3.5-6.2)
Java	9.8 (7.2-13.0)	7.6 (6.0-9.6)	5.5 (4.1-7.2)	4.5 (3.4-5.8)
Bali-Nusa Tenggara	9.3 (6.7-12.8)	3.9 (2.7-5.6)	4.7 (3.0-7.3)	4.3 (2.9-6.4)
Kalimantan	12.3 (9.8-15.4)	8.0 (6.0-10.6)	7.8 (5.8-10.4)	8.9 (6.4-12.1)
Sulawesi	16.1 (12.2-21.1)	20.4 (17.1-24.1)	12.3 (9.3-16.1)	8.3 (6.1-11.1)
Maluku-Papua	Data not available	8.6 (5.6-12.8)	11.7 (8.3-16.3)	3.5 (2.0-6.0)
Other milk				
Indonesia	**0.3 (0.1-0.5)**	**0.3 (0.2-0.6)**	**12.2 (10.9-13.6)**	**14.0 (12.9-15.3)**
Sumatera	0.1 (0.0-0.3)	0.5 (0.3-1.2)	15.0 (13.1-17.2)	15.1 (12.9-17.6)
Java	0.3 (0.1-0.8)	0.2 (0.1-0.8)	12.4 (10.4-14.8)	14.1 (12.4-16.1)
Bali-Nusa Tenggara	Number too small	0.4 (0.1-1.5)	7.5 (5.3-10.6)	7.3 (5.2-10.2)
Kalimantan	0.4 (0.1-1.2)	0.6 (0.2-1.7)	8.4 (6.2-11.4)	15.9 (12.0-20.8)
Sulawesi	0.4 (0.1-1.4)	0.2 (0.1-0.6)	9.7 (7.6-12.3)	18.5 (15.3-22.2)
Maluku-Papua	Data not available	0.3 (0.1-1.3)	11.5 (7.1-18.0)	3.8 (2.4-5.9)

4.7 Discussion

4.7.1 Summary of results

This study describes PLF practice in the context of Indonesia's settings. Based on the 2002-2017 IDHS, PLF was a very common practice in Indonesia. The prevalence of PLF was highest in 2002, where two thirds of babies in the country received any PLF. By 2017, the prevalence of PLF had declined although it was still relatively high at 45%, suggesting that nearly half of all babies were being given PLF.

PLF in Indonesia was given in various types. Formula was the most common feed across the surveys. The next most common feeds were honey, water, and other milk, although their relative popularity changed across the survey years. The prevalence of these feeds tended to decrease over time except for other milk that had a sharp increase in the last two survey years. The less common types included glucose water, tea, rice water, fruit juice, semisolid food, coffee, and gripe water. These feeds did not include other feeds that were not specified within the IDHS questionnaires, meaning that there were most probably still many kinds of feed given to the babies.

PLF did not appear to be practiced equally across different regions in Indonesia. Some of the regions showed unique patterns. For example, Bali-Nusa Tenggara region constantly had prevalence that was lower than national average for any PLF and all four predominant types. Meanwhile, Sulawesi had a higher prevalence of prelacteal honey and water, the prevalence of prelacteal formula was either the same or lower than national average.

4.7.2 Prevalence of any PLF in 2002-2017

General trends

Despite some fluctuations, PLF practice in Indonesia appears to be decreasing. The prevalence of any PLF in Indonesia had decreased from a peak of 66% in 2007 to 45% in 2017. It was not clear why the prevalence was highest in 2007, as there were four provinces that were excluded in 2002 due to safety reason (12). Three of the excluded provinces were located in Maluku-Papua, which had a lower prevalence of any PLF in the subsequent years, and one was in Sumatera, which had a higher prevalence in some later years (APPENDIX II). It will be useful to look at the prevalence of any PLF in the coming years, but IDHS 2022 will not be released until at least early 2023. However, a national survey conducted by local officials on the basic health indicators (Riskesdas 2018) recorded that PLF prevalence was around 33% in 2018 (106). These suggest that PLF practice in Indonesia has continued to decrease over time, at least between 2007 and 2017.

Several factors are thought to have contributed to the decline of PLF prevalence in 2017. One of them might be related to the increasing public awareness on the importance of breastfeeding and exclusive breastfeeding in more recent years (177). This will be discussed in more details in the qualitative study (Chapter 8). Other factors such as socioeconomic status and birth-related factors as reported in other studies (19, 101, 103) may also have contributed to a decline in PLF. These and other factors that might be associated with PLF are discussed in the next study objective about determinants of PLF (Chapter 5).

Comparison with other countries

As mentioned in the Literature Review, PLF practice in Indonesia is still higher than that in neighbouring countries. Considering the WHO guidelines on infant feeding that recommends against PLF unless under medical indication (2), PLF prevalence in Indonesia, even from the most recent IDHS estimate, was still considered high. This is because medically indicated PLF is rare, and so the prevalence should be low as few children receive formula by medical necessity. Furthermore, compared to other countries in Asia (7), Indonesia had a higher-than-average prevalence.

In a pooled study published in 2018, Oakley et. al used DHS data from 57 countries published between 2000 and 2013 (7), which included 2007 IDHS. In that study, the overall prevalence of any PLF was about 51% and the prevalence in the Asian region was 59%(7). Meanwhile, Indonesia's prevalence of any PLF was more than 66%. Even if the average prevalence in the Asian region was compared to Indonesia's prevalence from 2012 IDHS, the estimate of Indonesia's prevalence was still higher (61%). Furthermore, although only 10 Asian countries were included in this study (7), Indonesia was found to have a higher PLF prevalence and lower optimal breastfeeding indicators than other Southeast Asian countries. These included Philippines, Cambodia, and even Timor-Leste, a country that

used to be part of Indonesia (178). In that study, the prevalence of any PLF in those countries were 58%, 21%, and 14%, respectively. Furthermore, a more recent multi-country study by Neves et al using data from 2013-2018 showed that the global average of any PLF prevalence was 30%, and Indonesia's prevalence remained above average (179).

Variation across regions in Indonesia

PLF practice varies across the regions of Indonesia. The prevalence of any PLF in Indonesia came from an uneven distribution of PLF prevalence at the provincial level, as seen in APPENDIX II. This reflects the diverse characteristics of the population, with recognised provincial inequities affecting sociodemographic factors, including access to health care and education. The variation observed within the six regions might also suggest differing preferences and customs.

Previous studies from many parts of Indonesia have also reported a wide variation of PLF prevalence, ranging from 44% to 83% (13, 128, 180-183). The prevalence of any PLF in 2017 was higher but close to that reported by another national survey in 2018 (106), indicating that the practice is decreasing over time. The wide range of prevalence was also found in my study, as shown in the provincial tables (APPENDIX II). In the APPENDIX II, the most recent prevalence of any PLF was highest in North Sulawesi (80%) and was lowest in West Nusa Tenggara (21%). Meanwhile, in Jakarta, the capital city that happens to be the sixth most populous province(184) with the highest population density in Indonesia (185), the prevalence of any PLF declined markedly from 72% in 2002 to 30% in 2017.

Graphically, the trend of PLF prevalence at the country level over time was closest to that of Java (Figure 4.2a). One possible reason for this is because approximately 60% of the Indonesia's population reside in this island (184). Five of six provinces in Java, including Jakarta, are among the most populous provinces in Indonesia.

In general, the regions (Chapter 3, Figure 3.2) in the more western parts of Indonesia, especially Java, are considered to be more economically developed than those in the more eastern part of the country. Despite some disparities between rural and urban areas in each region, people in any province in Java and most provinces in Sumatera are on average are wealthier than people in most provinces in Maluku-Papua and Bali-Nusa Tenggara regions (1). Additionally, they also have higher human development index (186), and have a better access to education (187), improved drinking water (188), electricity (189), internet (1), and information technology (190).

Looking at the regional data, the prevalence of any PLF seemed to be higher in wealthier regions. One of the potential explanations might be because formula was the predominant type of PLF. Hence, mothers in the poorer regions could not afford to give it to their baby. Another possibility is because these regions were considered disadvantaged, more programs targeting maternal and child health (191-193), including infant feeding practice, are implemented and/or modelled there with support from local or international organisations.

Nevertheless, generalisation should be done cautiously as the regional grouping in this study cannot always accurately represent the situation in all member provinces. Take Bali and its regional group as an example. Despite the geographical proximity to Nusa Tenggara islands, indicators that reflect development were better in Bali than those in East Nusa Tenggara or West Nusa Tenggara(1, 186-190).

4.7.3 Prevalence of the predominant PLF types in 2002-2017

Prelacteal formula

Prelacteal formula remained the most common type of PLF throughout the years, contributing to more than a half of the overall PLF given to babies in Indonesia in 2002 until 2017. Formula is the only breastmilk substitute (BMS) approved by the WHO (5) and the

local policy in Indonesia(79). The majority of people who gave prelacteal formula did not give any other kinds of PLF, which suggests they understood the ideal concept of infant feeding practice as recommended by the WHO. However, as seen in Figure 4.2 (light green coloured-bars), about 2.6-6.5% of mothers still gave something else along with prelacteal formula.

The prevalence of prelacteal formula was seen to be more common in the more western part of Indonesia such as Sumatera and Kalimantan. These were the regions with higher proportion of wealthier quintiles, which suggests that affordability and access might contribute to the variability of prelacteal formula across the Indonesian regions. The decline of formula prevalence in more recent years might be related to breastfeeding policy and regulation on formula marketing introduced in early 2000, although this study does not have data to support this hypothesis. This issue will be discussed further in the qualitative study in Chapter 8 (Study Objective 5).

Feeds other than formula

Many of the PLF types are not suitable for newborn babies. Nearly half of any PLF in Indonesia was not formula, and this include honey, other kinds of milk, and water. Other feeds like glucose water, tea, rice water, and semisolid foods were also reported although less prevalent. In fact, among mothers who gave any PLF in each survey year, more than one-third of them gave something that was not even made for newborn babies.

In Indonesia, it is not uncommon to hear a newborn baby being given PLF other than formula, such as banana or rice. There have been some anecdotal reports about PLF practice in the social media (194-196) and local news (197, 198), especially when it resulted in disease or death. Despite limited literature on PLF, previous Indonesian studies (13, 14, 182, 199) reported the practice of giving prelacteal honey, dates, rice water, and other feeds as documented in the IDHS. Moreover, honey, banana, and rice porridge were reported by

another national survey in Indonesia as the most common PLF after formula (106). These reports and studies, including my study, are the evidence that giving feeds other than formula to a newborn baby is a common phenomenon in Indonesia.

Another concern was related to the fact that although prelacteal formula was relatively less common in central and eastern parts of Indonesia, water and honey were popular in some regions in this area. Honey is not supposed to be given to babies under 12 months as it is known to introduce the risk of botulinum intoxication. Water is not recommended for newborn babies as it can fill up newborn's stomach quickly, has zero calorie, and may bring a risk of contamination in areas with limited access to clean water. Nevertheless, in Sulawesi and Maluku-Papua regions, which consisted more of the poorer provinces, prelacteal water was more common there. Furthermore, in Sulawesi, the prevalence of prelacteal honey was much higher than the national average. This implies another possible scenario such as a local custom or tradition that encouraged sweet substances to newborns, as reported elsewhere (13, 39, 52). Another potential reason for giving feeds other than formula might be related to affordability, where mothers who could not afford formula, gave something else that was not a better option. The association between PLF and wealth and other sociodemographic factors will be discussed in the subsequent chapters, particularly Chapter 5 (Study Objective 2: Determinants of PLF practice) and Chapter 8 (Study Objective 5: Qualitative study).

Lastly, the one finding that was difficult to explain was the sharp increase of prelacteal milk other than formula in the latter two survey years. The IDHS questionnaire only included the category "milk (other than breastmilk)", which was assumed to be milk other than breastmilk or formula because formula was a separate category. It was possible that 'milk (other than breastmilk)' included cow's milk or other animal and plant-based milk that was not made specifically for newborn babies but was reported in some Indonesian studies as traditional milk (200) and known to be given as PLF (14). Another possibility is condensed milk,

because it is widely consumed in Indonesia (201) and was reported to be given as PLF in Indramayu, a regency in Java (13). The sharp increase might be caused by misclassification because in the previous years, people might have used the widely term 'sufor' (*susu formula*) or infant formula to refer to any kind of milk, whereas in the more recent years they are more informed about the differences. Similar confusion was observed in Bangladesh where mothers were not able to tell the difference between formula and regular tinned milk (202, 203)

4.8 Strengths and limitations

The IDHS reports published the prevalence of any PLF in every survey year, which was a useful estimate and comparable to other countries, but the types of PLF was not specified. My study is the first to describe the trends of various types of PLF in Indonesia using datasets from the 2002-2017 IDHS. It benefits from the IDHS' large sample size and national representativeness. Most previous studies from Indonesia were conducted at the regional level or even lower (13-15, 127-129), while the use of the IDHS data has allowed my study to look at national data, and with a sufficient sample size to look at regional differences and rarer PLF behaviours. The additional information on how PLF was practiced across provinces in Indonesia is provided in the APPENDIX II.

This study has several limitations. First, it did provide prevalence of all types of PLF. Some of the reported feeds in the existing literature, such as banana and rice porridge (13, 106, 199) were not specified in IDHS questionnaires. Next, due to the nature of the information in the IDHS datasets, this study has a limited interpretation on certain types of PLF such as "other milk", "semisolid", and "unspecified others". Additionally, caution must be taken in interpreting trends by region with data from IDHS 2002, because one province in Sumatera region and all three provinces in the Maluku-Papua region were not included in this survey year due to security reason (12).

4.9 Conclusion

In the four IDHS surveys conducted between 2002 and 2017, PLF was a very common practice in Indonesia with at least half of newborns given some type of PLF. Although the prevalence was lower in 2017 (45%) compared with that in the early 2000s (>60%), it was still higher than many other countries. Formula was the predominant type across all survey years, but a variety of feeds that were not designated for newborns were also frequently reported. Prelacteal honey, water, and milk other than formula were found to be the next most common feeds after formula, although the relative prevalence of these differed in each survey year. Some of the feeds such as banana and porridge were not reported in IDHS although they are known in other Indonesian studies (106), news reports (197, 198), or social media(194). There are regional variations in the prevalence of any PLF and the predominant types, suggesting that there might be preference of feeds in different populations.

By 2020, Indonesian crude birth rate was 17 per 1000 people and the population was approximately 273 million people in Indonesia (16), which translates to roughly 4.6 million births a year. With such a large population, even very low prevalence translates to a large number of individuals. This implies that a large number of newborn babies in Indonesia may have received food or drinks that are at least unnecessary and can potentially be harmful. The harms include breastfeeding disruption (which will be discussed in the Chapter 6, 7, and 8) and risks of infection (Chapter 8). The sociodemographic as well as child and birth-related determinants of PLF are explored in the next chapter (Chapter 5).

5 DETERMINANTS OF PRELACTEAL FEEDING IN INDONESIA (2002 – 2017)

5.1 Chapter introduction

Determining which factors are associated with an increased risk of prelacteal feeding (PLF) practice is the next step to understand how PLF is practiced in Indonesia. Following on from the previous chapter on the prevalence of PLF, this chapter aims to identify the key determinants of PLF, overall and by type, and whether these have changed over time. This aim corresponds to Objective 2 of the thesis.

Part of the research presented in this chapter has previously been published in a peer-reviewed journal article, PLoS ONE (85). Additionally, it has been presented in several academic conferences throughout my study. Comments and feedback from my co-authors, reviewers, readers, and audience have been incorporated into this chapter, but the work presented here remains my own. The detailed information about my roles and my co-authors' in the publication is described in the statement of contribution to work.

5.2 Methods

This study identified putative determinants of PLF by estimating the association between several variables and PLF. Similar to the research presented in Chapter 4, the analyses were carried out using IDHS datasets from the years 2002, 2007, 2012, and 2017. Details about IDHS data, the data collection process, and the definition of the variables used here were described in detail in Methods (Chapter 3).

The conceptual framework developed for this study is shown in Figure 5.1. This framework is part of the overall thesis framework shown in Chapter 3 (Figure 3.1). The selection of the variables included here was informed by the Literature Review (Chapter 2), and the

availability of adequate measures in the IDHS datasets. This study described the association between these variables and PLF.

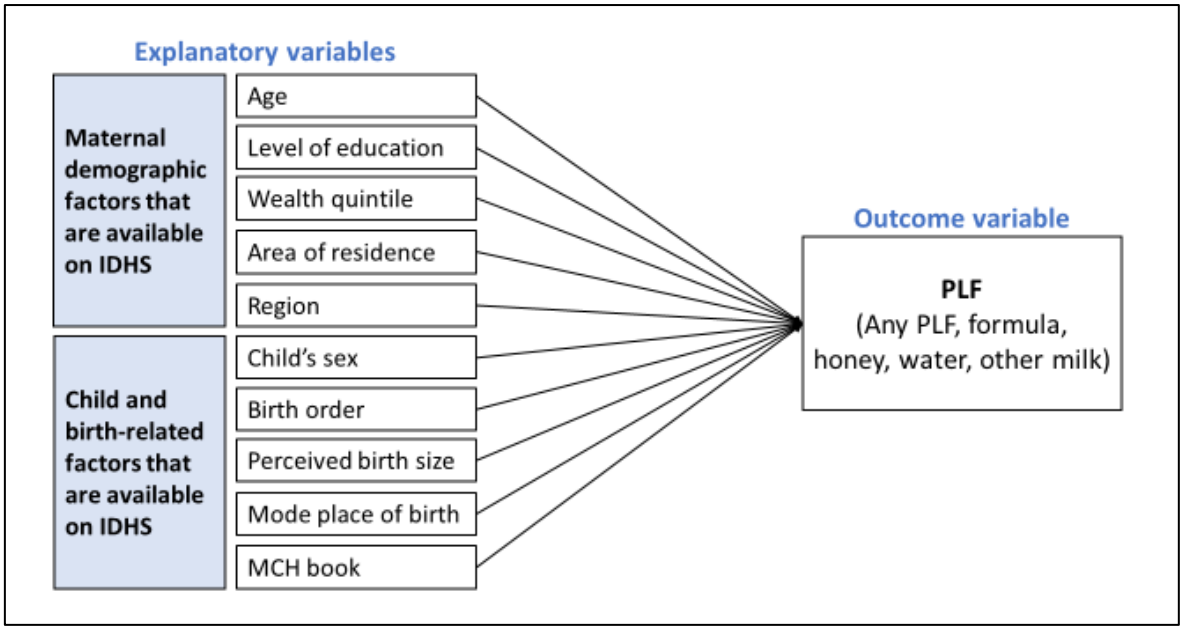


Figure 5.1. Conceptual framework for the Study Objective 2

5.2.1 Study population

Figure 5.2 describes the selection of the study population in each survey year. The inclusion criteria were mothers whose last child had ever been breastfed and was aged 0-23 months at the time of the IDHS interview. Mothers who had missing values in any investigated variables were excluded (**Figure 5.2**); the rationale for this approach to missing data is outlined in more detail in Section 5.2.5. The initial study population ranged between 5,741 (in 2002) and 6,477 (in 2007). Several sub-populations were used for additional analyses and dealing with missing data (Section 5.2.5).

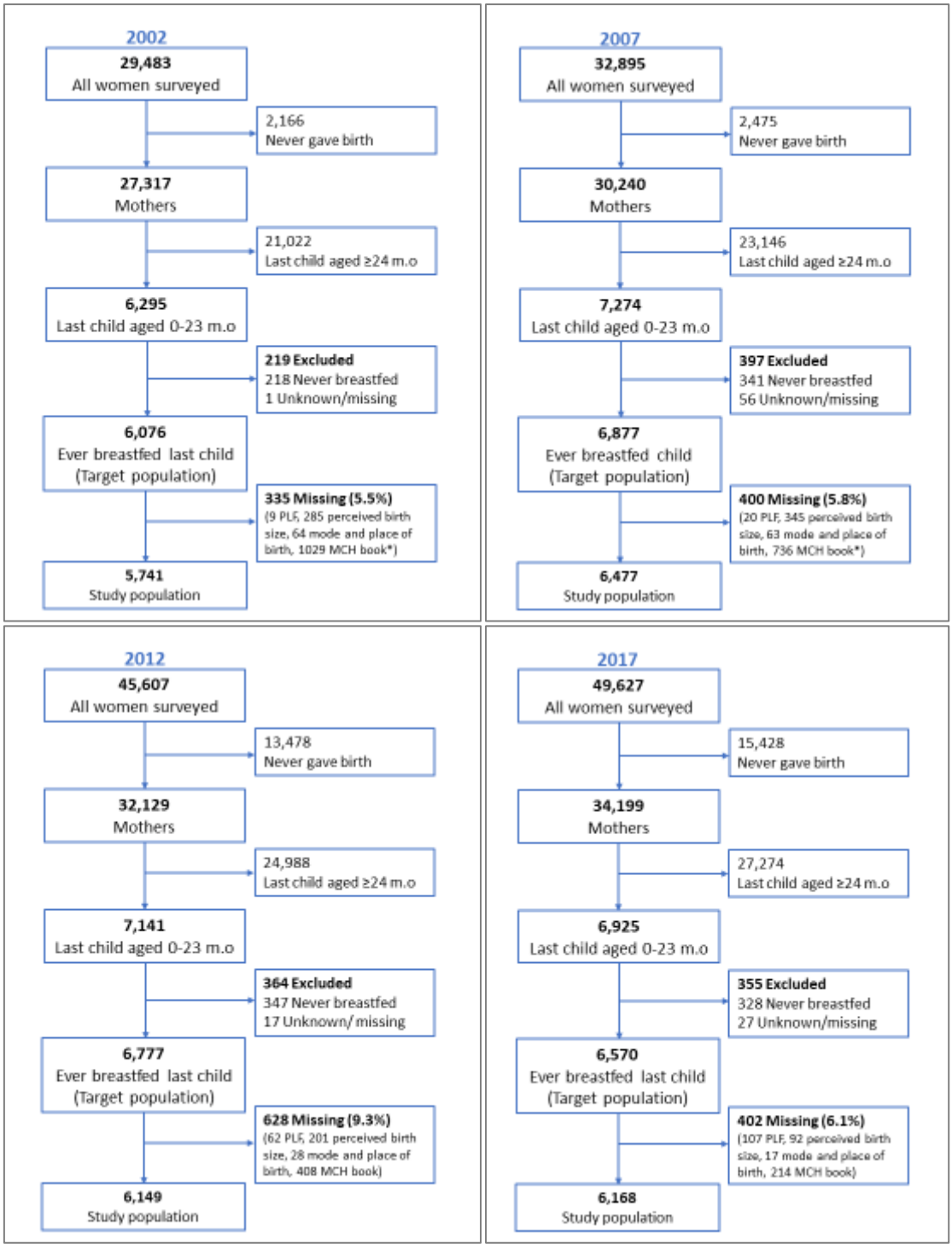


Figure 5.2. Selection of the initial study population for all survey years

5.2.2 Outcome variables

The outcome variable for this study was PLF. Any PLF and the four predominant PLFs i.e. formula, honey, water, and milk other than formula (or interchangeably called 'other milk') were analysed separately. Details of the definition and measurement of these are described

in Methods (Chapter 3). Any PLF was categorised as “Yes (child was given any PLF)” and “No (child was not given any PLF at all)”.

There was a slight difference in defining categories for the predominant PLF types, which resulted in different study populations. For each of the predominant types, the categories were “Yes (child was given that type of feed)” and “No (child was not given any PLF at all)”. For example, the denominator of prelacteal formula was those who answered “No” to any PLF and those who answered “Yes” to formula. Mothers who gave any PLF but not formula, e.g., honey, were not included in analysis of prelacteal formula, because the objective was to compare those who gave prelacteal formula with those who did not give PLF at all. The same approach applied to the other types of PLF and the number of mothers for each analysis across all survey years is shown in **Table 5.1.**

5.2.3 Explanatory variables

The explanatory variables included in this chapter are variables that were thought to have an association with PLF as shown in Figure 5.1 and were available in all four survey years. These variables were grouped as ‘maternal demographic factors’ and ‘child and birth-related factors. Maternal demographic factors consisted of 1) age at interview, 2) level of education, 3) wealth quintile, 4) area of residence, and 5) region (major island group). Child and birth-related factors included 1) sex of the child, 2) birth order, 3) perceived birth size, 4) mode and place of birth, and 5) possession of maternal and child (MCH) book. The definition of these variables and consideration for the selection have been described in more detail in Methods (Chapter 3).

Other than the above-mentioned variables, there were some other factors that were considered important but the information about them was not available in all survey years. Based on existing literature (Chapter 2), both religion and immediate skin-to-skin contact between mother and baby after birth would ideally have been included in the analysis (39,

204). Early initiation of breastfeeding (EIBF) was consistently shown to have association with PLF in studies including the ones that used DHS datasets (Chapter 2). However, the Indonesian translation of the question was not the timing the baby was put to breast, but the time mother breastfed for the first time, which makes temporal relationship between PLF and EIBF rather ambiguous. Immediate skin-to-skin contact was a more plausible and temporally less ambiguous indicator to reflect the process of EIBF. Unfortunately, this variable was only available in 2017 datasets. Meanwhile, religion was only available in the 2002 and 2007 datasets. Consequently, these variables were not included in the main analyses, but have been included in the sensitivity analyses (see Section 5.2.5.1).

5.2.4 Statistical analysis

Modified Poisson regression was used to estimate Prevalence Ratios (PR), describing the association between the explanatory variables and the outcome variables (any PLF, formula, honey, water, and other milk). Variables with statistically significant PRs at the 5% level were reported as determinants. Tests for heterogeneity in PRs across the survey years were conducted to describe changes in the determinants of PLF over time. All analyses were performed using Stata 15 (173).

5.2.4.1 Consideration for choosing the methods

Modified Poisson regression analysis

Since the prevalence of PLF was considered high (i.e. a relatively common outcome) in all four survey years (45-67%), odds ratios (OR) would overestimate the true association (i.e. PR) between the explanatory variables and PLF outcomes (205). For this reason, modified Poisson regression was used as the alternative to logistic regression. Modified Poisson regression in this study refers to Poisson regression with variance linearisation, as per the default estimations of complex survey analysis, which provides very close estimates to Poisson regression with a robust error variance (174, 205).

Random effect meta-analysis

After identifying the determinants of PLF and their effect size, the next step was to see whether the strength of the observed associations changed over time from 2002 to 2017. This was to understand whether the PR remains stable, or if the data suggests that some factors were not consistently associated with PLF, or become more or less important over time. Unfortunately, it was not possible to pool the data from all four surveys and fit a trend term in the model because of the different survey weights required to account for the complex study design and sampling. Consequently, a meta-analysis approach was used to assess changes in the survey-specific PRs. A random-effects model was chosen because of the assumption that there was some variability between the four surveys (206). Under this assumption, the true effect size can differ across survey years due to changes in the population characteristics, which was contributed by, for example, policy introduction and increasing knowledge among mothers on infant feeding in the more recent years.

5.2.4.2 Descriptive Analysis

The frequency distributions for each variable described the characteristics of the study population in all survey years. These results are also stratified by urban and rural area because Indonesia is known to have inequality especially between urban and rural areas (184, 187, 189). The difference in PLF prevalence across categories in each explanatory variable was assessed using Chi squared tests for association. A p value of <0.05 was considered evidence of a statistically significant difference across categories.

5.2.4.3 Modelling strategy using modified Poisson regression analysis

Initially, a univariable analysis using modified Poisson regression was fitted to determine the association between each explanatory variable and any PLF, and to estimate effect size in the form of the crude PR. After calculating the crude PRs, multivariable analyses were performed in several steps.

The first step in the multivariable analysis was to include maternal demographic factors that had crude PRs with a *p* value <0.10 into a multivariable model. Similarly, child and birth-related factors that had crude PRs with *p* value <0.10 were fitted into another multivariable model. The reason for setting a *p* value cutoff higher than 0.05 and fitting the variables in two separate models (instead of adjusting all variables at once) was to minimise the risk of losing potentially significant variables at the early steps of building the model.

Next, in each model, variables with *p* value that remained <0.10 after adjusting for each other were combined in one model. This time, only variables that remained statistically significant after adjusting for all other variables in the model (Wald *p* <0.05 from the overall test of significance for a variable using the Stata "testparm" command) were included in the final models. The same steps were repeated for the prelacteal formula, honey, and water in each survey year, while for other milk, this was only done for 2012 and 2017 IDHS due to very low prevalence in the 2002 and 2007 IDHS. Hence there was a final model which included the main determinants of PLF (overall and for each PLF type) for each survey.

5.2.4.4 Test for heterogeneity in the effect size (PRs)

The PRs for the main determinants of PLF were compared across the four surveys. A forest plot was used to visualize the pattern of the changes in the determinants. Here, a random-effects meta-analysis (206) was used to test for heterogeneity of the PRs in the four survey years using "metan" command in Stata 15 (173). In the X^2 estimation of heterogeneity, a *p* value <0.10 was interpreted as a statistically significant presence of variability across the survey estimates (207).

The degree of the variability in PRs that was more likely to be caused by heterogeneity instead of by chance or sampling error alone was represented by I^2 (207). Since there was no exact way of interpreting I^2, this study followed the Cochrane Handbook guide which states that I^2 under 50% and closer to 0% might be considered less important while I^2 closer

to 100% might represent substantial or indicate considerable heterogeneity (207). The interpretation of I^2 in this study was dependent on the direction and size of PRs as well as the statistical significance (*p* value of the X^2 test).

Tests for heterogeneity in PRs were only performed for variables whose associations with outcomes in the final models were found to be statistically significant in at least two survey years. Effect measures in the other survey years were calculated by adding the variable into the final models, so that PRs could be obtained to produce forest plots. Since this approach required tested variables to be either binary or continuous, variables with more than two categories were regrouped. These included:

1. Wealth quintile: changed to a continuous variable (so that one unit increase reflects a change from one quintile to the next),
2. Birth size: made into average vs smaller and average vs larger,
3. Mode and place of birth: made into home birth vs vaginal delivery at public facility, home birth vs caesarean delivery at public facility, home birth vs vaginal delivery at private facility, and home birth vs caesarean delivery at private facility.

The prevalence ratios for prelacteal milk other than formula were not tested for heterogeneity, because there were too few data points for analysis (the prevalence was negligible in 2002 and 2007). Hence, it was analysed for determinants in 2012 and 2017, but not tested for heterogeneity.

5.2.5 Sub-populations and missing data

As mentioned briefly in Section 5.2.1, the numbers in the initial study population ranged between 5,741 and 6,477 (**Figure 5.2**). These were the total number of eligible mothers to be included in the descriptive analysis, univariable analysis, and multivariable analysis for the determinants of any PLF in all survey years.

This study used several sub-populations for the predominant types of PLF. The number of eligible mothers for the analysis of predominant PLF types was smaller because it was a subset of the sample taken from the initial study population. As described in section 5.2.2 (the outcome variables), the denominators for the predominant PLF types were not everyone in the study population, but the total number of mothers who answered “No” to any PLF and “Yes” to the specific type asked.

Table 5.1. The initial study population and sub-populations for each analysis

Outcome variable	2002		2007		2012		2017	
	Main	Sens.	Main	Sens.	Main	Sens.	Main	Sens.
Any PLF	5,741	4,843	6,477	5,867	6,149	-	6,168	6,127
Formula	4,475	3,877	5,268	4,874	4,891	-	4,915	4,883
Honey	3,158	2,600	3,057	2,711	2,712	-	3,590	3,573
Water	2,948	2,410	3,538	2,575	2,774	-	3,652	3,634
Other milk	2,393	1,980	2,096	2,095	3,150	-	4,148	4,124

Main: main analysis as presented in the chapter; Sens.: sensitivity analysis that is available as APPENDIX III; (-) analysis not done

5.2.5.1 Dealing with missing data

As explained in Chapter 3, I decided to conduct a complete case analysis when mothers with missing data for any variables represented less than 10% of the target population. If missing values from a variable exceeded 10% of the target population, mothers with missing values in that particular variable were included in the analysis and coded as a ‘missing response’ category to avoid a large reduction in sample size and minimize selection bias. To assess the impact of this approach, an alternative model in which mothers with missing values were excluded was run as a sensitivity analysis. The results of the sensitivity analyses are referred to in the relevant sections.

Using this approach, the missing values were 5.5% in 2002, 5.8% in 2007, 9.3% in 2012, and 6.1% in 2017 (**Figure 5.2** and **Table 5.1**). In the study populations shown in **Table 5.1**, mothers with missing data were excluded with two exceptions. For the variable ‘possession of MCH book’, 17% and 11% of the target population had missing data in 2002 and 2007 respectively. These mothers are included in the analysis with a ‘missing response’ category.

Using this approach, the initial study population for all survey years remained at 91%-96% of the target population.

5.2.5.2 Sensitivity Analysis

Sensitivity analyses were conducted for the analyses of the 2002, 2007, and 2017 IDHS. The modelling strategy was similar to that of the main analysis, but there were additional variables included in the model. These variables were the ones that were not available in all survey years. In 2002 and 2007 IDHS, sensitivity analyses were conducted by including religion in the final models. This variable was not available in 2012 and 2017 IDHS. Additionally, in these analyses, subjects with missing values in the possession of MCH book variable were excluded from the final models, resulting in smaller study populations. In 2017, sensitivity analyses were conducted by including the variable immediate skin-to-skin contact between mother and baby after birth in the final models, which was not available in the previous survey years. Additionally, an interaction term between wealth quintile and area of residence was fitted in the final models for 2017 because there was evidence that wealth quintiles were not evenly distributed across urban and rural areas (85).

5.3 Results

5.3.1 Prevalence of PLF and characteristic of study populations over time

Table 5.2 describes the prevalence of PLF group (any PLF and the four predominant types i.e., formula, honey, water, and milk other than formula). Approximately 60% of the mothers in in 2002 reported that their baby received any form of PLF. Figures were broadly similar for the next two surveys (67% in 2007, 62% in 2012) but fell to 45% in 2017.

Note that these results are not directly identical to those from Chapter 4. For example, the prevalence of the predominant subtypes are based on different denominators (section 5.2.5), after excluding mothers who gave other prelacteal feeds (labelled ‘Others’ in **Table 5.2**). Nevertheless, the prevalence of any PLF and the predominant subtypes in these

analyses are similar to the results shown in Chapter 4. Prelacteal formula was consistently the most common PLF type overall but displayed an inconsistent pattern over time (37% in 2002, increasing to 50% in 2007, before falling to 43% in 2012, and 25% in 2017). The prevalence of prelacteal honey was lower and declined over the survey years (from 13% in 2002 to 3% in 2017). The prevalence of prelacteal water was about 10% in 2002 and gradually declined to 5% in 2017. In contrast, the prevalence of prelacteal milk other than formula was very low at the start of the study period and became more prevalent in later surveys (<1% in 2002 and 2007 but it increased to 12-14% in 2012-2017) (**Table 5.2**).

Table 5.2. Prevalence of PLF (any PLF and the predominant types 2002-2017

	2002		2007		2012		2017	
	n	%	n	%	n	%	n	%
Total	5741	100.0	6477	100.0	6149	100.0	6168	100.0
Any PLF								
No (not given any PLF)	2,372	40.8	2,335	32.7	2,388	38.3	3,329	55.2
Yes (given any PLF)	3,369	59.2	4,142	67.3	3,761	61.7	2,839	44.8
Prelacteal formula								
No (not given any PLF)	2,372	40.8	2,335	32.7	2,388	38.3	3,329	55.2
Yes (given prelacteal formula)	2,103	37.4	2,933	49.5	2,503	42.5	1,586	25.4
Others (given other PLFs)	1,266	21.8	1,209	17.8	1,258	19.2	1,253	19.4
Prelacteal honey								
No (not given any PLF)	2,372	40.8	2,335	32.7	2,388	38.3	3,329	55.2
Yes (given prelacteal honey)	786	12.7	722	10.8	324	4.3	261	3.4
Others (given other PLFs)	2,583	46.5	3,420	56.5	3,437	57.4	2,578	41.4
Prelacteal water								
No (not given any PLF)	2,372	40.8	2,335	32.7	2,388	38.3	3,329	55.2
Yes (given prelacteal water)	576	10.4	594	9.7	386	6.0	323	5.0
Others (given other PLFs)	2,793	48.8	3,548	57.7	3,375	55.7	2,516	39.8
Prelacteal milk other than formula						38.3		
No (not given any PLF)	2,372	40.8	2,335	32.7	2,388	38.3	3,329	55.2
Yes (given other milk)	21	0.3	25	0.3	762	12.4	819	14.2
Others (given other PLFs)	3,348	58.9	4,117	67.0	2,999	49.3	2,020	30.7

Table 5.3 describes the maternal demographic, child and birth-related characteristics of the study population in each survey year. Mean maternal age increased over the four surveys: from 27.9 in 2002 to 28.3 in 2007, 28.5 in 2012, and 29.5 in 2017. The proportion of mothers with secondary and higher education increased over time while that of none/primary decreased. From all surveys, the majority of mothers sampled were from Java, and the relative proportion from each region remained stable across the surveys. The proportion of

home births was larger in earlier surveys than it was in 2017 while more mothers had the MCH book in later surveys.

The wealth distribution differed when the study population was stratified by area of residence (**Table 5.4**). There were higher proportions of more affluent mothers in urban areas than in rural areas, indicating greater rural poverty (**Table 5.4**). For example, in 2002, more than third of urban mothers were from Q5 (the wealthiest) while only 3% came from Q1 (least affluent). Meanwhile in more rural areas, one third of mothers were in Q1 (the poorest quintile, based on the distribution in the full population). The distribution of sex of the child, birth order, and perceived child's birth size were similar across the years and differed little between mothers in urban and rural areas.

Home births were more commonly reported in 2002 than 2017 (56% compared to 15%; **Table 5.3**). The greatest decline in home births was seen in rural areas but the urban-rural disparity remains substantial in 2017 (35% home births in urban compared to 75% in rural 2002, falling to 23% and 6% respectively in 2017 as seen in **Table 5.3**). Overall, caesarean section also increased from less than 5% in 2002 to more than 19% in 2017 (**Table 5.3**), and possession of an MCH book increased from 60% in 2002 to 92% in 2017 (**Table 5.3**); both urban and rural women seemed to share similar distribution for these factors.

Table 5.3. Characteristics of study population by explanatory variables 2002-2017

	2002		2007		2012		2017	
	n	%	n	%	n	%	n	%
Total	5741	100.0	6477	100.0	6149	100.0	6168	100.0
Maternal demographic factors								
Age								
15-19	370	6.9	370	5.6	375	5.8	282	4.2
20-24	1503	26.7	1598	25.4	1446	24.4	1215	20.0
25-29	1675	28.4	1865	28.1	1765	28.2	1683	26.8
30-34	1239	19.7	1492	22.1	1411	23.0	1581	26.0
≥35	954	18.3	1152	18.8	1152	18.6	1407	23.0
Education								
None/primary	2696	49.3	2566	40.6	1744	29.6	1381	22.8
Secondary	2621	44.0	3349	50.7	3464	56.7	3535	59.9
Higher	424	6.7	562	8.7	941	13.7	1252	17.4
Wealth quintile								
Q1 (least affluent)	1782	21.2	1828	20.7	1580	18.1	1553	18.7
Q2	1100	18.9	1270	18.5	1342	21.3	1251	20.6
Q3	987	20.2	1182	20.7	1139	20.1	1152	20.2
Q4	921	20.3	1128	20.8	1130	21.1	1134	20.9
Q5 (most affluent)	951	19.4	1069	19.4	958	19.4	1078	19.7
Area of residence								
Urban	2409	47.7	2509	42.0	2906	50.7	3065	49.2
Rural	3332	52.3	3968	58.0	3243	49.3	3103	50.8
Region (major islands group)								
Sumatera	1680	22.9	2004	22.6	1829	22.0	1620	22.6
Java	1492	55.6	1481	54.2	1517	56.5	1867	55.4
Bali-Nusa Tenggara	665	6.0	596	6.4	540	5.9	610	6.1
Kalimantan	785	6.5	648	6.2	666	6.1	533	5.6
Sulawesi	1119	8.9	1136	8.4	1035	7.3	973	7.4
Maluku-Papua	n/a	n/a	612	2.2	562	2.3	565	2.9
Child and birth-related factors								
Sex of the child								
Male	2961	51.8	3416	53.1	3213	51.2	3209	51.5
Female	2780	48.2	3061	46.9	2936	48.8	2959	48.5
Birth order								
First	1886	32.2	2128	35.5	2292	39.4	1970	32.8
Second/later	3855	67.8	4349	64.5	3857	60.6	4198	67.2
Perceived birth size								
Larger than average	1802	31.7	2168	32.9	1952	30.1	2051	31.3
Average	3138	55.4	3324	53.3	3398	56.9	3349	57.6
Smaller than average	801	12.9	985	13.8	799	12.9	768	11.1
Place-mode of birth								
Home-vaginal birth	3464	56.0	3624	49.1	2255	28.1	1205	14.7
Public facility-vaginal birth	536	8.4	725	8.9	1116	15.9	1893	27.6
Public facility-caesarean birth	93	1.5	208	2.7	356	4.5	536	7.2
Private facility-vaginal birth	1510	31.2	1641	34.1	1925	42.2	1918	38.6
Private facility-caesarean birth	138	2.9	279	5.3	497	9.2	616	11.9
MCH book								
No	1909	35.5	1794	26.1	1044	14.7	642	8.5
Yes	2938	52.8	4080	67.1	5105	85.3	5526	91.5
Missing	894	11.6	603	6.6	0	0.0	0	0.0

Table 5.4. Characteristics of study population, stratified by area of residence (%)

	2002		2007		2012		2017	
Maternal demographic factors	urban	rural	urban	rural	urban	rural	urban	rural
Age								
15-19	6.0	7.6	2.7	7.7	4.0	7.7	3.3	5.0
20-24	24.8	28.4	23.4	26.9	22.4	26.5	17.8	22.1
25-29	30.2	26.8	31.2	25.9	29.6	26.7	26.9	26.7
30-34	21.1	18.5	24.0	20.8	25.1	20.9	27.4	24.7
≥35	17.9	18.7	18.7	18.8	18.9	18.3	24.6	21.5
Education								
None/primary	34.2	63.0	27.7	49.9	20.5	39.0	15.0	30.4
Secondary	55.1	33.9	57.6	45.8	59.6	53.7	63.0	56.8
Higher	10.7	3.1	14.8	4.3	19.9	7.4	22.1	12.8
Wealth quintile								
Q1 (least affluent)	3.0	37.9	4.6	32.3	5.6	30.9	6.2	30.8
Q2	10.9	26.2	9.8	24.8	13.6	29.2	13.0	27.9
Q3	22.7	17.8	19.5	21.6	21.4	18.8	21.9	18.5
Q4	28.2	13.1	29.3	14.6	28.7	13.3	27.2	14.8
Q5 (most affluent)	35.3	4.9	36.8	6.7	30.7	7.9	31.7	8.0
Region (major islands group)								
Sumatera	19.1	26.5	17.8	26.1	16.5	27.6	17.4	27.6
Java	64.8	47.2	66.0	45.7	67.9	44.7	67.3	43.9
Bali-Nusa Tenggara	3.1	8.7	5.0	7.5	4.2	7.7	4.4	7.7
Kalimantan	5.6	7.4	4.6	7.3	4.9	7.3	4.8	6.5
Sulawesi	7.4	10.3	5.2	10.7	5.1	9.5	4.7	10.1
Maluku-Papua			1.4	2.8	1.4	3.1	1.5	4.2
Child and birth-related factors								
Sex of the child								
Male	52.0	51.6	53.3	52.9	48.6	53.9	51.0	52.0
Female	48.0	48.4	46.7	47.1	51.5	46.1	49.1	48.0
Birth order								
First	34.4	30.1	38.4	33.4	39.1	39.7	33.7	31.9
Second/later	65.6	69.9	61.6	66.6	60.9	60.3	66.3	68.1
Perceived birth size								
Larger than average	33.3	30.2	34.1	32.0	29.7	30.6	29.4	33.1
Average	54.5	56.2	54.8	52.2	58.0	55.8	60.3	55.1
Smaller than average	12.1	13.6	11.1	15.8	12.3	13.5	10.3	11.8
Place-mode of birth								
Home-vaginal birth	35.0	75.2	27.1	65.0	13.7	43.0	6.0	23.0
Public facility-vaginal birth	11.1	6.0	10.5	7.7	16.9	15.0	20.1	34.8
Public facility-caesarean birth	2.0	1.0	3.4	2.1	5.5	3.5	8.2	6.3
Private facility-vaginal birth	47.2	16.7	50.1	22.6	51.1	33.0	49.4	28.3
Private facility-caesarean birth	4.8	1.1	8.9	2.6	12.9	5.5	16.3	7.6
MCH book								
No	36.4	34.8	23.1	28.3	14.4	15.0	9.2	7.9
Yes	58.8	47.4	74.4	62.2	85.6	85.0	90.9	92.1
Missing	4.8	17.9	2.5	9.5	0	0.0	0	0.0

5.3.2 Determinants of any PLF in 2002-2017

Table 5.5 shows the prevalence of any PLF by each of the explanatory variables. The *p* values indicate evidence of a statistically significant difference across categories at the 5% level. **Table 5.6** shows the crude and adjusted prevalence ratios (PRs) of the maternal demographic variables. **Table 5.7** shows the crude and adjusted PRs of the child and birth-

related variables. Adjusted PRs are from the final model, where the association had been adjusted for all other variables (both maternal and child/birth-related) that remained statistically significant (Wald p <0.05).

As shown in **Table 5.6**, the maternal demographic variables that had statistically significant associations in at least two survey years were wealth quintiles (with the prevalence of PLF being highest in the most affluent quintile in 2002-2012) and region (with the prevalence being generally highest in Sumatera (adjusted PR range: 1.09-1.46) and lowest in Bali-Nusa Tenggara (adjusted PR range: 0.61-0.76) as compared to Java in 2002-2017). Despite the prevalence of any PLF being different between urban and rural areas (p values <0.05, **Table 5.5**), the adjusted PR was only statistically significant in 2017 where any PLF was more prevalent among rural mothers (adjusted PR 1.09, 1.00-1.18) (**Table 5.6**). Maternal age and education were not a significant determinant in any survey years.

As shown in **Table 5.7**, the child and birth-related variables that were associated with any PLF in at least two survey years were birth order (lower prevalence among second/subsequent births in all survey years, PR range: 0.80-0.89), place-mode of birth (higher prevalence among institutional births than home birth, especially caesarean in private facility, adjusted PR range 1.14-1.45 in all survey years), and possession of MCH book (lower prevalence among those who had the book, PR 0.88 in 2007 and 0.90 in 2012). Perceived birth size was only found to be statistically significant in 2017, where any PLF was more prevalent among babies perceived to be smaller than average (adjusted PR 1.21, 1.10-1.32). Child's sex was the only child and birth-related variable that was not a statistically significant determinant in any survey year.

Sensitivity analysis

Results from the sensitivity analysis (**APPENDIX III**) are generally in line with those from the main analysis presented here. Some additional findings from the sensitivity analysis

were related to wealth quintile and area of residence, religion, and immediate skin-to-skin contact. In the main analysis for 2017 IDHS, any PLF was more prevalent among mothers from the Q3-Q4 quintile (**Table 5.5,** crude PR in **Table 5.6**), but wealth quintile was not statistically significant in the multivariable analysis (adjusted PR, **Table 5.6**). In the sensitivity analysis (**APPENDIX III, Table III.1**), an interaction term was fitted between area of residence and wealth quintile as continuous variable for this year. It was found that an increasing level of wealth quintile remained a determinant for any PLF, but it was only statistically significant in the rural area (adjusted PR 1.07, 1.03-1.11), but not in urban area. This interaction was not seen in 2002-2012. In addition, the sensitivity analyses (**APPENDIX III, Table III.1**) also found that religion was a determinant for any PLF in 2002, but not in 2007. In 2002, Muslim mothers were more likely to give any PLF than Christian or Hindu mothers. Lastly, immediate skin-to-skin contact between mother and baby after birth, a variable that was only available in 2017, was found to be associated with a lower prevalence of any PLF (adjusted PR 0.77, 0.72-0.83). (**APPENDIX III, Table III.5**)

Table 5.5. Prevalence of any PLF by explanatory variables over time

	2002			2007			2012			2017		
	n	%	p	n	%	p	n	%	p	n	%	p
Total	3369	59.2		4142	67.3		3761	61.7		2839	44.8	
Maternal demographic												
Maternal age												
15-19	213	61.7		244	70.6		226	61.7		122	44.4	
20-24	896	61.1		1024	69.5		883	64.0		595	48.6	
25-29	972	58.2		1177	66.4		1099	62.4		768	44.8	
30-34	732	58.0		964	66.2		858	60.3		704	43.4	
≥35	556	58.4	0.78	733	66.1	0.53	695	59.4	0.43	650	43.3	0.21
Education												
None/primary	1450	54.6		1524	62.8		957	55.2		595	42.8	
Secondary	1631	63.1		2220	69.5		2164	63.0		1621	45.2	
Higher	288	67.6	<0.001	398	75.5	<0.001	640	70.3	<0.001	623	46.2	0.33
Wealth quintile												
Q1 (least affluent)	929	53.3		1025	59.7		833	51.3		636	41.6	
Q2	643	56.2		789	66.1		796	59.9		601	45.0	
Q3	588	58.3		810	72.7		724	62.4		550	46.6	
Q4	547	57.7		753	64.9		734	64.2		549	47.0	
Q5 (most affluent)	662	71.1	<0.001	765	73.4	<0.01	674	70.0	<0.01	503	43.5	0.22
Area of residence												
Urban	1571	63.5		1732	69.7		1882	64.1		1402	42.6	
Rural	1798	55.3	0.01	2410	65.6	0.05	1879	59.2	0.01	1437	47.0	0.01
Region												
Sumatera	1105	69.1		1414	72.5		1299	72.6		906	57.8	
Java	873	56.0		1009	68.8		889	60.4		717	39.5	
Bali-Nusa Tenggara	272	39.6		253	41.7		214	36.7		176	29.8	
Kalimantan	476	62.5		434	66.5		440	66.4		255	50.2	
Sulawesi	643	64.4		721	68.8		648	60.4		557	58.4	
Maluku-Papua	na	na	<0.001	311	50.2	<0.001	271	44.5	<0.001	228	32.5	<0.001
Child and birth-related												
Sex of the child												
Male	1762	61.1		2197	66.4		2013	62.4		1477	44.6	
Female	1607	57.1	0.08	1945	68.3	0.00	1748	61.0	0.43	1362	45.1	0.76
Birth order												
First	1210	64.9		1489	73.8		1531	68.2		1037	51.6	
Second/later	2159	56.5	<0.001	2653	63.8	<0.001	2230	57.5	<0.001	1802	41.5	<0.001
Perceived birth size												
Larger	1094	61.3		1437	68.8		1147	60.2		930	45.0	
Average	1796	57.8		2106	67.7		2106	61.7		1504	42.8	
Smaller	479	60.2	0.30	599	62.1	0.08	508	65.5	0.19	405	54.6	<0.001
Place-mode of birth												
Home-vaginal	1908	54.8		2192	63.1		1317	59.6		549	46.8	
Public-vaginal	303	61.1		434	63.6		577	50.2		739	39.2	
Public-caesarean	69	68.8		169	88.0		267	75.6		347	62.2	
Private-vaginal	979	64.3		1115	70.7		1215	62.9		852	42.1	
Private-caesarean	110	79.6	<0.001	232	80.3	<0.001	385	75.6	<0.001	352	53.6	<0.001
MCH book												
No	1128	58.7		1201	70.4		684	67.5		334	50.5	
Yes	1752	60.0	0.72	2600	66.4	0.08	3077	60.7	<0.01	2505	44.3	0.02
Missing	489	57.3		341	64.5							

Table 5.6. Determinants of any PLF over time (maternal demographic)

	2002		2007		2012		2017	
Variables	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR
Maternal demographic								
Age								
15-19	1.06 (0.90-1.25)		1.06 (0.94-1.20)		0.99 (0.88-1.12)		0.99 (0.81-1.21)	
20-24	1.05 (0.96-1.15)		1.05 (0.98-1.12)		1.03 (0.95-1.11)		1.08 (0.98-1.20)	
25-29	1		1		1		1	
30-34	1.00 (0.90-1.10)		1.00 (0.93-1.07)		0.97 (0.90-1.04)		0.97 (0.88-1.07)	
≥35	1.00 (0.90-1.12)		0.99 (0.92-1.07)		0.95 (0.88-1.03)		0.97 (0.87-1.07)	
Education								
None/primary	0.87 (0.80-0.94)		0.90 (0.85-0.96)		0.88 (0.82-0.94)		0.95 (0.87-1.03)	
Secondary	1		1		1		1	
Higher	1.07 (0.95-1.21)		1.09 (1.00-1.18)		1.12 (1.03-1.21)		1.02 (0.94-1.12)	
Wealth quintile								
Q1 (least affluent)	1	1	1	1	1	1	1	
Q2	1.05 (0.93-1.20)	1.06 (0.94-1.20)	1.11 (1.02-1.20)	1.06 (0.97-1.16)	1.17 (1.06-1.28)	1.14 (1.04-1.25)	1.08 (0.97-1.20)	
Q3	1.10 (0.97-1.24)	1.09 (0.97-1.23)	1.22 (1.13-1.32)	1.15 (1.06-1.25)	1.22 (1.10-1.34)	1.19 (1.07-1.32)	1.12 (1.00-1.26)	
Q4	1.08 (0.95-1.24)	1.08 (0.94-1.25)	1.09 (0.99-1.19)	1.02 (0.92-1.14)	1.25 (1.14-1.38)	1.23 (1.12-1.36)	1.13 (1.01-1.26)	
Q5 (most affluent)	1.33 (1.20-1.48)	1.29 (1.14-1.47)	1.23 (1.13-1.34)	1.13 (1.03-1.25)	1.37 (1.25-1.50)	1.35 (1.22-1.49)	1.05 (0.92-1.19)	
Area of residence								
Urban	1		1		1		1	1
Rural	0.87 (0.79-0.96)		0.94 (0.89-1.00)		0.92 (0.87-0.98)		1.10 (1.02-1.19)	1.09 (1.00-1.18)
Region								
Sumatera	1.23 (1.11-1.36)	1.31 (1.19-1.45)	1.05 (0.99-1.12)	1.09 (1.02-1.16)	1.2 (1.13-1.28)	1.24 (1.16-1.32)	1.46 (1.34-1.60)	1.43 (1.31-1.56)
Java	1	1	1	1	1	1	1	1
Bali-Nusa Tenggara	0.71 (0.60-0.83)	0.76 (0.65-0.89)	0.61 (0.53-0.70)	0.64 (0.55-0.74)	0.61 (0.53-0.70)	0.69 (0.6-0.79)	0.75 (0.64-0.89)	0.76 (0.64-0.89)
Kalimantan	1.11 (0.99-1.25)	1.21 (1.08-1.36)	0.97 (0.89-1.05)	1.04 (0.96-1.14)	1.10 (1.02-1.19)	1.18 (1.09-1.29)	1.27 (1.10-1.47)	1.27 (1.10-1.46)
Sulawesi	1.15 (0.99-1.33)	1.21 (1.07-1.38)	1.00 (0.93-1.07)	1.08 (0.99-1.17)	1.00 (0.92-1.09)	1.11 (1.02-1.22)	1.48 (1.35-1.62)	1.43 (1.30-1.57)
Maluku-Papua	NA	NA	0.73 (0.64-0.84)	0.83 (0.73-0.94)	0.74 (0.63-0.86)	0.83 (0.71-0.98)	0.82 (0.68-0.99)	0.84 (0.69-1.01)

Numbers in brackets are 95% CI, red font indicates PR>1, blue font indicates PR<1, adjusted PR is PR in the final model, where the association had been controlled for other (maternal and child/birth-related) factors that remained statistically significant (Wald p <0.05).

Table 5.7.Determinants of any PLF over time (child and birth-related)

	2002		2007		2012		2017	
	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR
Birth-related factors								
Sex of the child								
Male	1		1		1		1	
Female	0.93 (0.87-1.01)		1.03 (0.98-1.08)		0.98 (0.92-1.03)		1.01 (0.94-1.08)	
Birth order								
First	1	1	1	1	1	1	1	1
Second/later	0.87 (0.81-0.93)	0.88 (0.82-0.94)	0.86 (0.82-0.91)	0.89 (0.84-0.93)	0.84 (0.80-0.89)	0.84 (0.79-0.89)	0.80 (0.75-0.86)	0.80 (0.74-0.86)
Perceived birth size								
Larger	1.06 (0.98-1.15)		1.02 (0.95-1.08)		0.98 (0.91-1.04)		1.05 (0.97-1.14)	1.05 (0.97-1.13)
Average	1		1		1		1	1
Smaller	1.04 (0.94-1.16)		0.92 (0.84-1.00)		1.06 (0.98-1.15)		1.28 (1.16-1.40)	1.21 (1.10-1.32)
Place-mode of birth								
Home-vaginal	1	1	1	1	1	1	1	1
Public-vaginal	1.11 (0.94-1.32)	1.05 (0.89-1.26)	1.01 (0.92-1.10)	1.03 (0.94-1.13)	0.84 (0.76-0.94)	0.87 (0.79-0.97)	0.84 (0.75-0.93)	0.91 (0.82-1.02)
Public-caesarean	1.26 (0.98-1.60)	1.16 (0.92-1.48)	1.39 (1.31-1.49)	1.40 (1.30-1.50)	1.27 (1.14-1.42)	1.21 (1.09-1.35)	1.33 (1.18-1.49)	1.40 (1.25-1.58)
Private-vaginal	1.17 (1.06-1.29)	1.09 (0.98-1.22)	1.12 (1.05-1.19)	1.08 (1.00-1.17)	1.06 (0.98-1.14)	1.00 (0.92-1.09)	0.90 (0.81-1.00)	0.99 (0.89-1.11)
Private-caesarean	1.45 (1.28-1.65)	1.29 (1.11-1.51)	1.27 (1.14-1.42)	1.21 (1.08-1.35)	1.27 (1.16-1.39)	1.14 (1.04-1.26)	1.14 (1.01-1.29)	1.23 (1.09-1.40)
MCH book								
No	1		1	1	1	1	1	
Yes	1.02 (0.93-1.12)		0.94 (0.89-1.00)	0.94 (0.88-0.99)	0.9 (0.84-0.97)	0.92 (0.86-0.98)	0.88 (0.79-0.97)	
Missing	0.98 (0.87-1.10)		0.92 (0.83-1.01)	0.99 (0.91-1.09)	-	-	-	

Numbers in brackets are 95% CI, red font indicates PR>1, blue font indicates PR<1, adjusted PR is PR in the final model, where the association had been controlled for other (maternal and child/birth-related) factors that remained statistically significant (Wald p <0.05).

5.3.3 Determinants of prelacteal formula in 2002-2017

Table 5.8 shows the prevalence of prelacteal formula by each of the explanatory variables. The *p* values indicate whether there is evidence of a statistically significant difference across categories, with the threshold used in this analysis being $p<0.05$. **Table 5.9** shows the crude and adjusted PRs of the maternal demographic variables. **Table 5.10** shows the crude and adjusted PRs of the child and birth-related variables. Adjusted PRs are from the final model, where the association had been adjusted for all other variables (both maternal and child/birth-related) that remained statistically significant (Wald $p<0.05$).

Similar to any PLF, the maternal demographic variables (**Table 5.9**) that were associated with prelacteal formula in at least two survey years were wealth quintiles (2002-2012) and region (all survey years). The prevalence of prelacteal formula was higher among the more affluent mothers, mothers in Sumatera (adjusted PR range: 1.18-1.78), and mothers in Kalimantan (adjusted PR range: 1.20-1.63), but it was lower among mothers who lived in Bali-Nusa Tenggara (adjusted PR range: 0.55-0.76). In 2007 only, the prevalence of prelacteal formula was higher among mothers with no/primary education than those with secondary education (adjusted PR 0.84, 0.73-0.96). Area of residence (urban-rural) was statistically significant determinant for prelacteal formula in 2017 only (adjusted PR 1.21, 1.06-1.37) (**Table 5.9**). Maternal age was not a determinant in any survey year.

As shown in **Table 5.10**, the child and birth-related variables that were associated with prelacteal formula in at least two survey years were birth order (lower prevalence among second/subsequent births in all survey years, adjusted PR range: 0.74-0.86) and place-mode of birth (higher prevalence among institutional births than home birth, especially caesarean in any facility, adjusted PR range 1.36-1.87 in all survey years). Perceived birth size was only found to be statistically significant in 2017, where any PLF was more prevalent among babies

perceived to be smaller than average (adjusted PR 1.26, 1.09-1.45). Child's sex and possession of MCH book were not a determinant in any survey year.

Sensitivity analysis

Results from the sensitivity analysis (**APPENDIX III, TABLE III.2**) are generally in line with those from the main analysis presented here. Some additional findings from the sensitivity analysis were related to wealth quintile and area of residence and immediate skin-to-skin contact. When an interaction term was fitted between wealth quintile and area of residence, more affluent mothers in rural area were more likely to give prelacteal formula (adjusted PR 1.12 CI 1.06-1.19) and this association was not statistically significant for urban mothers (**APPENDIX III, Table III.2**). Additionally, immediate skin-to-skin contact between mother and baby after birth, a variable that was only available in 2017, was found to be associated with lower prevalence of prelacteal formula (adjusted PR 0.73, 0.65-0.81) (**APPENDIX III, Table III.5**)

Table 5.8. Prevalence of prelacteal formula by explanatory variables over time

	2002			2007			2012			2017		
	n	%	p	n	%	p	n	%	p	n	%	p
Study population	4475	100.0		5268	100.0		4891	100.0		4915	100.0	
Total	2103	47.8		2933	60.2		2503	52.6		1586	31.6	
Maternal demographic												
Age												
15-19	107	43.8		143	55.9		148	50.7		71	33.1	
20-24	548	49.9		729	62.4		576	54.7		316	34.7	
25-29	625	47.8		849	60.2		744	53.4		438	31.7	
30-34	493	49.0		704	60.5		573	51.5		385	29.4	
≥35	330	44.9	0.66	508	58.2	0.64	462	50.6	0.65	376	30.7	0.32
Education												
None/primary	654	35.0		814	48.9		552	42.7		282	27.3	
Secondary	1196	56.7		1,752	65.0		1,475	54.8		929	32.6	
Higher	253	64.9	<0.001	367	74.9	<0.001	476	64.1	<0.01	375	33.4	0.02
Wealth quintile												
Q1 (least affluent)	294	25.8		430	36.9		429	36.2		281	25.1	
Q2	359	39.3		498	55.4		529	48.9		340	31.9	
Q3	392	46.4		633	68.0		503	54.2		313	34.2	
Q4	451	51.5		656	61.4		538	56.8		345	34.6	
Q5 (most affluent)	607	68.5	<0.001	716	72.0	<0.001	504	64.2	<0.001	307	31.2	<0.001
Area of residence												
Urban	1,293	57.6		1,521	67.0		1,336	56.0		819	29.5	
Rural	810	37.0	<0.001	1,412	54.2	<0.001	1,167	49.0	<0.001	767	33.6	0.03
Region												
Sumatera	763	60.7		1,091	66.2		884	64.8		600	47.3	
Java	646	44.8		796	62.9		632	51.7		401	26.4	
Bali-Nusa	126	19.5		177	31.8		140	27.1		83	18.1	
Tenggara												
Kalimantan	327	53.2		363	62.3		334	59.7		115	32.8	
Sulawesi	241	48.1		342	52.4		364	47.2		250	38.8	
Maluku-Papua	NA	NA	<0.001	164	36.1	<0.001	149	26.9	<0.001	137	22.5	<0.001
Child and birth-related												
Sex of the child												
Male	1094	49.6		1,559	59.2		1,345	53.1		821	31.2	
Female	1009	46.0	0.13	1,374	61.4	0.28	1,158	52.1	0.60	765	31.9	0.67
Birth order												
First	837	56.7		1164	69.0		1052	60.2		593	38.3	
Second/later	1266	43.4	<0.001	1,769	55.2	<0.001	1,451	47.7	<0.01	993	28.4	<0.01
Perceived birth size												
Larger	687	50.5		1052	61.9		761	51.4		538	32.4	
Average	1152	46.6		1,515	61.2		1,424	52.9		840	29.7	
Smaller	264	46.4	0.33	366	52.2	0.02	318	54.5	0.63	208	39.5	<0.01
Place-mode of birth												
Home-vaginal	797	33.1		1120	46.7		713	44.4		253	30.0	
Public-vaginal	255	57.8		369	60.9		402	40.7		376	24.9	
Public-caesarean	64	67.1		166	87.8		197	69.1		218	50.3	
Private-vaginal	880	60.7		1050	68.9		899	56.3		511	30.3	
Private-caesarean	107	79.3	<0.001	228	80.1	<0.01	292	70.7	<0.01	228	42.3	<0.01
MCH book												
No	739	47.8		795	61.5		436	57.1		175	34.4	
Yes	1175	50.5	<0.001	2,011	61.1	0.87	2,067	51.9	0.07	1,411	31.3	0.28
Missing	189	32.5		262	41.0							

Table 5.9. Determinants of prelacteal formula over time (demographic)

	2002		2007		2012		2017	
	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR
Demographic factors								
Maternal age								
15-19	0.92 (0.69-1.22)		0.93 (0.76-1.13)		0.95 (0.80-1.13)		1.04 (0.78-1.39)	
20-24	1.04 (0.91-1.20)		1.04 (0.95-1.13)		1.02 (0.92-1.14)		1.09 (0.95-1.27)	
25-29	1		1		1		1	
30-34	1.03 (0.89-1.18)		1.01 (0.92-1.10)		0.96 (0.87-1.07)		0.93 (0.80-1.07)	
≥35	0.94 (0.81-1.10)		0.97 (0.88-1.07)		0.95 (0.85-1.06)		0.97 (0.84-1.12)	
Education								
None/primary	0.62 (0.54-0.71)		0.75 (0.69-0.82)	0.90 (0.82-0.98)	0.78 (0.70-0.86)		0.84 (0.73-0.96)	
Secondary	1		1	1	1		1	
Higher	1.14 (0.99-1.32)		1.15 (1.06-1.25)	1.02 (0.93-1.11)	1.17 (1.06-1.29)		1.03 (0.90-1.17)	
Wealth quintile								
Q1 (least affluent)	1	1	1	1	1	1	1	1
Q2	1.53 (1.21-1.92)	1.45 (1.17-1.79)	1.50 (1.31-1.72)	1.32 (1.16-1.50)	1.35 (1.17-1.56)	1.25 (1.09-1.43)	1.27 (1.08-1.50)	1.21 (1.03-1.44)
Q3	1.80 (1.45-2.24)	1.64 (1.33-2.02)	1.84 (1.62-2.10)	1.57 (1.38-1.79)	1.5 0(1.31-1.72)	1.38 (1.20-1.58)	1.36 (1.14-1.63)	1.35 (1.12-1.63)
Q4	2.00 (1.61-2.48)	1.77 (1.42-2.21)	1.66 (1.45-1.91)	1.37 (1.19-1.58)	1.57 (1.37-1.80)	1.44 (1.25-1.66)	1.38 (1.16-1.64)	1.39 (1.16-1.67)
Q5 (most affluent)	2.66 (2.21-3.19)	2.13 (1.76-2.58)	1.95 (1.72-2.21)	1.51 (1.30-1.74)	1.77 (1.56-2.02)	1.61 (1.4-1.86)	1.24 (1.03-1.49)	1.27 (1.02-1.56)
Area of residence								
Urban	1		1		1		1	1
Rural	0.64 (0.55-0.74)		0.81 (0.75-0.87)		0.87 (0.80-0.95)		1.14 (1.01-1.28)	1.21 (1.06-1.37)
Region								
Sumatera	1.36 (1.17-1.57)	1.62 (1.41-1.86)	1.05 (0.98-1.13)	1.18 (1.09-1.27)	1.25 (1.15-1.37)	1.37 (1.26-1.50)	1.79 (1.57-2.04)	1.78 (1.56-2.04)
Java	1	1	1	1	1	1	1	1
Bali-Nusa Tenggara	0.44 (0.33-0.57)	0.55 (0.44-0.7)	0.51 (0.42-0.61)	0.58 (0.48-0.69)	0.52 (0.44-0.63)	0.66 (0.55-0.79)	0.69 (0.53-0.89)	0.76 (0.58-0.99)
Kalimantan	1.19 (1.02-1.39)	1.63 (1.40-1.91)	0.99 (0.90-1.10)	1.20 (1.08-1.33)	1.15 (1.04-1.28)	1.35 (1.21-1.51)	1.24 (0.98-1.58)	1.29 (1.02-1.64)
Sulawesi	1.08 (0.78-1.48)	1.27 (1.03-1.58)	0.83 (0.75-0.93)	0.99 (0.89-1.11)	0.91 (0.81-1.02)	1.12 (0.99-1.27)	1.47 (1.26-1.72)	1.50 (1.27-1.76)
Maluku-Papua	NA	NA	0.57 (0.47-0.70)	0.73 (0.62-0.86)	0.52 (0.42-0.65)	0.69 (0.55-0.85)	0.85 (0.66-1.11)	1.00 (0.78-1.29)

Numbers in brackets are 95% CI, red font indicates PR>1, blue font indicates PR<1, adjusted PR is PR in the final model, where the association had been controlled for other (maternal and child/birth-related) factors that remained statistically significant (Wald p <0.05).

Table 5.10. Determinants of prelacteal formula over time (birth-related)

	2002		2007		2012		2017	
	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR
Birth-related factors								
Sex of the child								
Male	1		1		1		1	
Female	0.93 (0.84-1.02)		1.04 (0.97-1.11)		0.98 (0.91-1.06)		1.02 (0.92-1.13)	
Birth order								
First	1	1	1	1	1	1	1	1
Second/later	0.77 (0.69-0.84)	0.82 (0.75-0.9)	0.80 (0.75-0.86)	0.86 (0.8-0.92)	0.79 (0.74-0.85)	0.79 (0.74-0.85)	0.74 (0.66-0.83)	0.74 (0.66-0.82)
Perceived birth size								
Larger	1.08 (0.98-1.21)		1.01 (0.93-1.10)		0.97 (0.89-1.06)		1.09 (0.97-1.23)	1.10 (0.98-1.24)
Average	1		1		1		1	1
Smaller	1.00 (0.84-1.18)		0.85 (0.76-0.96)		1.03 (0.92-1.15)		1.33 (1.15-1.54)	1.26 (1.09-1.45)
Place-mode of birth								
Home-vaginal	1	1	1	1	1	1	1	1
Public-vaginal	1.75 (1.41-2.16)	1.50 (1.22-1.85)	1.30 (1.16-1.46)	1.27 (1.13-1.43)	0.92 (0.79-1.06)	0.95 (0.82-1.10)	0.83 (0.69-1.00)	0.95 (0.80-1.13)
Public-caesarean	2.03 (1.53-2.70)	1.66 (1.26-2.18)	1.88 (1.72-2.05)	1.70 (1.55-1.86)	1.56 (1.33-1.82)	1.44 (1.24-1.67)	1.68 (1.38-2.03)	1.76 (1.46-2.12)
Private-vaginal	1.83 (1.58-2.14)	1.54 (1.31-1.80)	1.47 (1.35-1.61)	1.28 (1.16-1.41)	1.27 (1.14-1.41)	1.16 (1.04-1.29)	1.01 (0.85-1.21)	1.12 (0.94-1.33)
Private-caesarean	2.40 (2.02-2.85)	1.87 (1.55-2.26)	1.71 (1.51-1.94)	1.45 (1.27-1.66)	1.59 (1.41-1.80)	1.36 (1.19-1.54)	1.41 (1.16-1.72)	1.48 (1.21-1.80)
MCH book								
No	1		1		1		1	
Yes	1.06 (0.93-1.19)		0.99 (0.92-1.08)		0.91 (0.82-1.00)		0.91 (0.77-1.08)	
Missing	0.68 (0.54-0.86)		0.67 (0.53-0.84)					

Numbers in brackets are 95% CI, red font indicates PR>1, blue font indicates PR<1, adjusted PR is PR in the final model, where the association had been controlled for other (maternal and child/birth-related) factors that remained statistically significant (Wald p <0.05).

5.3.4 Determinants of prelacteal honey in 2002-2017

Table 5.11 shows the prevalence of prelacteal honey by each of the explanatory variables. The *p* values indicate whether there is evidence of a statistically significant difference across categories, with the threshold used in this analysis being $p<0.05$. **Table 5.12** shows the crude and adjusted PRs of the maternal demographic variables. **Table 5.13** shows the crude and adjusted PRs of the child and birth-related variables. Adjusted PRs are from the final model, where the association had been adjusted for all other variables (both maternal and child/birth-related) that remained statistically significant (Wald $p<0.05$).

As shown in **Table 5.12**, the determinants of prelacteal honey were different from those of any PLF, where region was the only maternal demographic variable that had a statistically significant association in all survey years. Prelacteal honey was almost always lower in Bali-Nusa Tenggara (adjusted PR range: 0.31-0.43) than in Java, except in 2017 where it was not statistically significant. However, it was only occasionally higher in Sumatera in 2002 and 2017 (PR 1.39-2.81) and Sulawesi in 2012 (PR 1.4-2.73). **Table 5.11** shows that the prevalence of prelacteal honey was mostly higher among mothers with primary/no education, lowest wealth quintiles, and rural residence, but after adjusting for other factors (**Table 5.12**), none of these factors were statistically significant.

Table 5.13 shows that the child and birth-related variables that were associated with prelacteal honey in at least two survey years were birth order, place-mode of birth, and possession of MCH book. Similar to any PLF and prelacteal formula, prelacteal honey was lower among second/subsequent birth than first birth, but it was only statistically significant in 2007 (adjusted PR 0.77, 0.61-0.98) and 2017 (adjusted PR 0.58, 0.43-0.77). On the other hand, the most apparent difference compared to any PLF and prelacteal formula was that prelacteal honey was practiced less by mothers who gave birth at health facility. This was also consistent for vaginal birth at public facility. Possession of MCH book was associated with a lower prevalence of prelacteal honey in 2007 (adjusted PR 0.73, 0.59-0.90) and 2012 (adjusted PR 0.69, 0.48-

0.99) (**Table 5.13**). Meanwhile, perceived smaller birth size was associated with prelacteal honey only in 2002 (adjusted PR 1.4, 1.09-1.81) and child's sex was not a determinant in any survey year.

Sensitivity analysis

Results from the sensitivity analysis (**APPENDIX III, Table III.3**) were generally in line with those from the main analysis presented here. Some additional findings from the sensitivity analysis were related to religion and immediate skin-to-skin contact. Religion was a determinant for prelacteal honey in 2002 and 2007. Christian mothers were less likely to give prelacteal honey than were Muslim mothers, but there was no difference in the prevalence between Muslim mothers and mothers with other religions. Additionally, immediate skin-to-skin contact between mother and baby after birth, a variable that was only available in 2017, was found to be associated with lower prevalence of prelacteal honey (adjusted PR 0.72, 0.53-0.97) (**APPENDIX III, Table III.5**)

Table 5.11. Prevalence of prelacteal honey by explanatory variables over time

	2002			2007			2012			2017		
	n	%	p	n	%	p	n	%	p	n	%	p
Study population	3158	100.0		3057	24.8		2712	100.0		3590	100.0	
Total	786	23.7		722	24.8		324	10.9		261	5.9	
Maternal demographic												
Age												
15-19	70	31.7		54	36.6		21	12.3		15	6.2	
20-24	216	24.6		181	26.3		84	11.9		57	4.2	
25-29	204	23.4		199	24.0		86	9.8		80	4.0	
30-34	168	21.9		156	21.8		56	7.7		67	3.0	
≥35	128	21.8	0.41	132	24.1	0.17	77	10.4	0.48	42	2.2	0.02
Education												
None/primary	400	24.2		334	26.2		94	10.2		73	4.8	
Secondary	347	23.8		347	24.4		196	10.5		137	3.0	
Higher	39	17.9	0.54	41	17.5	0.29	34	7.8	0.62	51	3.1	0.03
Wealth quintile												
Q1 (least affluent)	277	27.0		234	26.8		103	10.5		101	5.8	
Q2	182	25.9		167	26.2		88	13.0		48	3.8	
Q3	145	25.2		143	30.4		59	9.1		47	3.3	
Q4	103	17.1		85	15.6		39	8.8		32	2.6	
Q5 (most affluent)	79	21.5	0.12	93	25.0	0.01	35	7.9	0.33	33	1.9	<0.01
Area of residence												
Urban	262	21.9		233	23.4		118	9.1		97	2.5	
Rural	524	25.0	0.36	489	25.7	0.47	206	10.9	0.29	164	4.4	<0.01
Region												
Sumatera	283	32.9		220	28.4		100	16.2		69	11.5	
Java	168	22.0		186	26.7		60	8.5		37	3.2	
Bali-Nusa Tenggara	40	9.1		36	10.8		11	3.2		15	3.9	
Kalimantan	72	21.5		43	15.8		18	7.7		33	10.8	
Sulawesi	223	28.5	<0.01	180	30.9		112	19.1		84	13.4	
Maluku-Papua				57	13.4	<0.01	23	6.3	<0.01	23	3.9	<0.01
Child and birth-related												
Sex of the child												
Male	418	24.7		397	24.7		176	10.2		143	3.6	
Female	368	22.8	0.48	325	25.0	0.91	148	10.0	0.91	118	3.2	0.51
Birth order												
First	254	24.1		225	29.2		112	11.8		98	4.2	
Second/later	532	23.6	0.85	497	22.9	0.05	212	9.3	0.15	163	3.1	0.05
Birth size												
Larger	266	25.1		247	25.5		85	7.8		77	3.1	
Average	393	21.6		365	25.6		187	10.9		155	3.7	
Smaller	127	29.5	0.06	110	20.7	0.41	52	12.1	0.17	29	2.9	0.46
Place-mode of birth												
Home-vaginal	626	28.3		575	31.8		216	19.6		109	10.2	
Public-vaginal	29	7.3		49	11.6		49	6.4		81	3.5	
Public-caesarean	6	16.9		7	26.4		4	2.1		17	2.4	
Private-vaginal	121	17.0		74	12.5		48	5.3		45	1.8	
Private-caesarean	4	11.2	<0.01	17	27.1	<0.01	7	4.0	<0.01	9	0.7	<0.01
MCH book												
No	231	21.9		254	33.7		69	17.5		27	3.5	
Yes	403	23.7	0.29	386	20.9	<0.01	255	8.9	0.00	234	3.4	0.97
Missing	*152*	*28.6*		*82*	*27.9*							

Table 5.12. Determinants of prelacteal honey over time (demographic)

	2002		2007		2012		2017	
	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR
Demographic factors								
Maternal age								
15-19	1.36 (0.94-1.96)		1.53 (1.02-2.29)		1.25 (0.61-2.58)		1.48 (0.76-2.89)	
20-24	1.05 (0.79-1.41)		1.10 (0.81-1.49)		1.21 (0.78-1.88)		1.11 (0.72-1.72)	
25-29	1		1		1		1	
30-34	0.94 (0.70-1.26)		0.91 (0.67-1.23)		0.78 (0.49-1.24)		0.74 (0.49-1.11)	
≥35	0.93 (0.68-1.28)		1.00 (0.75-1.35)		1.06 (0.67-1.67)		0.55 (0.35-0.86)	
Education								
None/primary	1.02 (0.81-1.27)		1.08 (0.88-1.32)		0.98 (0.69-1.37)		1.48 (1.02-2.13)	
Secondary	1		1		1		1	
Higher	0.75 (0.45-1.26)		0.72 (0.41-1.25)		0.74 (0.41-1.36)		1.04 (0.67-1.61)	
Wealth quintile								
Q1 (least affluent)	1		1		1		1	
Q2	0.96 (0.72-1.28)		0.98 (0.75-1.28)		1.24 (0.86-1.79)		0.71 (0.46-1.10)	
Q3	0.93 (0.67-1.29)		1.13 (0.87-1.48)		0.87 (0.56-1.36)		0.65 (0.41-1.04)	
Q4	0.63 (0.43-0.92)		0.58 (0.39-0.87)		0.84 (0.49-1.44)		0.52 (0.32-0.82)	
Q5 (most affluent)	0.79 (0.52-1.21)		0.93 (0.65-1.34)		0.75 (0.43-1.32)		0.36 (0.22-0.59)	
Area of residence								
Urban	1		1		1		1	
Rural	1.14 (0.86-1.51)		1.10 (0.85-1.43)		1.19 (0.86-1.66)		1.83 (1.29-2.58)	
Major islands group[a]								
Sumatera	1.50 (1.14-1.96)	1.39 (1.06-1.82)	1.06 (0.82-1.38)	0.95 (0.73-1.24)	1.91 (1.32-2.75)	1.36 (0.94-1.97)	3.56 (2.28-5.55)	2.81 (1.81-4.35)
Java	1	1	1	1	1	1	1	1
Bali-Nusa Tenggara	0.41 (0.26-0.67)	0.43 (0.26-0.70)	0.40 (0.27-0.60)	0.41 (0.26-0.63)	0.38 (0.19-0.76)	0.31 (0.16-0.63)	1.20 (0.66-2.20)	0.90 (0.49-1.65)
Kalimantan	0.98 (0.68-1.40)	0.89 (0.62-1.28)	0.59 (0.40-0.89)	0.55 (0.37-0.83)	0.91 (0.52-1.61)	0.61 (0.34-1.10)	3.34 (1.91-5.85)	2.22 (1.23-4.02)
Sulawesi	1.29 (0.93-1.79)	1.18 (0.86-1.61)	1.16 (0.88-1.52)	1.03 (0.78-1.35)	2.25 (1.55-3.26)	1.40 (0.94-2.06)	4.12 (2.65-6.41)	2.73 (1.74-4.26)
Maluku-Papua			0.50 (0.33-0.77)	0.47 (0.30-0.73)	0.74 (0.39-1.39)	0.40 (0.21-0.76)	1.20 (0.63-2.27)	0.63 (0.32-1.22)

Numbers in brackets are 95% CI, red font indicates PR>1, blue font indicates PR<1, adjusted PR is PR in the final model, where the association had been controlled for other (maternal and child/birth-related) factors that remained statistically significant (Wald p <0.05).

Table 5.13. Determinants of prelacteal honey over time (birth-related)

	2002		2007		2012		2017	
	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR
Birth-related factors								
Sex of the child								
Male	1		1		1		1	
Female	0.92 (0.74-1.15)		1.01 (0.82-1.25)		0.98 (0.71-1.36)		0.91 (0.67-1.24)	
Birth order								
First	1		1	1	1		1	1
Second/later	0.98 (0.79-1.22)		0.79 (0.62-1.00)	0.77 (0.61-0.98)	0.79 (0.57-1.09)		0.63 (0.46-0.85)	0.58 (0.43-0.77)
Perceived birth size								
Larger	1.16 (0.93-1.46)	1.17 (0.93-1.46)	0.99 (0.77-1.28)		0.72 (0.49-1.06)		0.88 (0.63-1.23)	
Average	1		1		1			
Smaller	1.37 (1.06-1.78)	1.40 (1.09-1.81)	0.81 (0.60-1.08)		1.11 (0.69-1.79)		1.00 (0.61-1.64)	
Place-mode of birth								
Home-vaginal	1		1	1	1	1	1	1
Public-vaginal	0.26 (0.14-0.47)	0.28 (0.15-0.52)	0.36 (0.25-0.53)	0.43 (0.29-0.64)	0.33 (0.20-0.54)	0.40 (0.24-0.67)	0.34 (0.23-0.50)	0.41 (0.28-0.61)
Public-caesarean	0.60 (0.20-1.78)	0.62 (0.20-1.93)	0.83 (0.38-1.82)	0.71 (0.33-1.55)	0.11 (0.03-0.36)	0.13 (0.04-0.42)	0.38 (0.19-0.74)	0.43 (0.22-0.83)
Private-vaginal	0.60 (0.43-0.84)	0.61 (0.44-0.85)	0.39 (0.27-0.57)	0.39 (0.27-0.57)	0.27 (0.17-0.42)	0.28 (0.17-0.45)	0.19 (0.12-0.29)	0.23 (0.15-0.36)
Private-caesarean	0.40 (0.14-1.10)	0.43 (0.15-1.22)	0.85 (0.46-1.58)	0.80 (0.44-1.48)	0.20 (0.09-0.47)	0.21 (0.09-0.48)	0.09 (0.04-0.21)	0.11 (0.05-0.25)
MCH book								
No	1		1	1	1	1	1	
Yes	1.08 (0.84-1.40)		0.62 (0.50-0.77)	0.73 (0.59-0.9)	0.51 (0.36-0.73)	0.69 (0.48-0.99)	0.89 (.54-1.47)	
Missing	1.31 (0.95-1.80)		0.83 (0.62-1.10)					

Numbers in brackets are 95% CI, red font indicates PR>1, blue font indicates PR<1, adjusted PR is PR in the final model, where the association had been controlled for other (maternal and child/birth-related) factors that remained statistically significant (Wald p <0.05).

5.3.5 Determinants of prelacteal water in 2002-2017

Table 5.14 shows the prevalence of prelacteal water by explanatory variables The *p* values indicate whether there is evidence of a statistically significant difference across categories, with the threshold used in this analysis being $p<0.05$. **Table 5.15** shows the crude and adjusted PRs of the maternal demographic variables. **Table 5.16** shows the crude and adjusted PRs of the child and birth-related variables. Adjusted PRs are from the final model, where the association had been adjusted for all other variables (both maternal and child/birth-related) that remained statistically significant (Wald $p<0.05$).

As shown in **Table 5.15**, region was the only maternal demographic variable that had statistically a significant association with prelacteal water in all survey years. The prevalence of prelacteal water was consistently higher in Sulawesi than in Java (adjusted PR range: 1.51-2.01) across all survey years. Another variable that was statistically significant was education, but only in 2002. The prevalence of prelacteal water was higher among mothers with no/primary education (adjusted PR 1.4, 1.04-1.90) than among those with secondary education. Maternal age, education, wealth quintile, and area of residence were not a determinant for prelacteal water in any survey year. **Table 5.14** shows that the prevalence of prelacteal water was mostly higher among mothers with primary/no education, lowest wealth quintiles, and rural residence, but after adjusting for other factors (**Table 5.15**), none of these factors were statistically significant.

Table 5.16 that the child and birth-related variables that were associated with prelacteal honey in at least two survey years were birth order and place-mode of birth. The prevalence of prelacteal water was significantly lower among mothers with second/subsequent child in 2012-2017 (PR 0.60-0.64), but this did not reach statistical significance in 2002 and 2007. Like prelacteal honey, the prevalence of prelacteal water was generally lower among births at any facilities than home births (**Table 5.16**). Child's sex, birth size, and possession of MCH book were not a determinant in any survey year.

Sensitivity analysis

Results from the sensitivity analysis (**APPENDIX III, TABLE III.4**) are generally in line with those from the main analysis presented here. The sensitivity analyses (**APPENDIX III.4**) found that religion was a determinant for prelacteal water in 2002 and 2007 although the pattern was inconsistent and therefore hard to interpret. Christian mothers more likely to give prelacteal water than were Muslim mothers in 2007 (adjusted PR 1.59, 1.27-1.99), while Hindu mothers were less likely to give water (adjusted PR 0.07, 0.01-0.50). Additionally, immediate skin-to-skin contact between mother and baby after birth, was not a statistically significant determinant of prelacteal water in 2017 (**APPENDIX III.5**)

Table 5.14. Prevalence of prelacteal water by explanatory variables over time

	2002			2007			2012			2017		
	n	%	p	n	%	p	n	%	p	n	%	p
Study population	2948	100.0		2929	100.0		2744	100.0		3652	100.0	
Total	576	20.4		594	22.8		386	13.6		323	8.3	
Maternal demographic												
Age												
15-19	39	28.4		39	25.8		30	18.1		14	9.1	
20-24	151	22.2		137	25.0		104	15.8		88	12.6	
25-29	162	16.1		156	19.0		102	13.4		84	7.5	
30-34	113	18.0		131	18.8		82	11.8		71	6.4	
≥35	111	23.4	0.10	131	28.5	0.13	68	11.7	0.30	66	7.5	0.01
Education												
None/primary	326	23.1		294	24.5		142	14.0		104	10.6	
Secondary	225	17.1		268	22.1		201	13.3		166	7.9	
Higher	25	13.4	0.04	32	14.9	0.13	43	13.8	0.93	53	6.1	0.02
Wealth quintile												
Q1 (least affluent)	238	22.7		242	26.6		144	14.2		113	11.8	
Q2	128	23.5		117	23.4		89	15.2		74	9.6	
Q3	97	21.8		103	25.9		62	12.2		55	7.3	
Q4	54	13.6		75	20.0		44	11.2		49	7.4	
Q5 (most affluent)	59	18.5	0.14	57	15.4	0.05	47	15.0	0.68	32	5.0	<0.01
Area of residence												
Urban	198	18.1		170	16.6		152	13.0		140	7.2	
Rural	378	22.0	0.24	424	26.3	<0.01	234	14.1	0.60	183	9.4	0.06
Region												
Sumatera	140	22.4		201	31.8		108	17.4		72	9.7	
Java	146	18.5		103	19.7		74	12.0		79	6.9	
Bali-Nusa Tenggara	59	12.6		25	6.4		20	6.1		35	5.5	
Kalimantan	113	25.3		55	20.0		47	17.8		47	15.7	
Sulawesi	118	31.5	0.01	162	38.5		113	23.2		68	15.9	
Maluku-Papua				48	15.2	<0.01	24	9.4	<0.01	22	5.7	<0.01
Child and birth-related												
Sex of the child												
Male	296	22.7		294	21.2		209	13.7		158	8.1	
Female	280	18.0	0.07	300	24.6	0.13	177	13.4	0.85	165	8.5	0.76
Birth order												
First	179	20.5		165	23.8		155	17.5		120	11.3	
Second/later	397	20.3	0.94	429	22.4	0.57	231	11.5	0.00	203	7.0	<0.01
Birth size												
Larger	145	19.5		183	25.6		120	12.4		97	7.7	
Average	335	19.6		307	21.8		213	14.3		183	8.3	
Smaller	96	25.4	0.32	104	20.2	0.25	53	12.9	0.63	43	10.6	0.36
Place-mode of birth												
Home-vaginal	445	23.5		445	28.0		214	21.1		102	15.5	
Public-vaginal	38	16.4		56	16.9		59	10.9		99	7.1	
Public-caesarean	6	13.7		4	11.5		13	8.6		21	8.8	
Private-vaginal	82	14.6		81	15.1		86	10.0		85	6.9	
Private-caesarean	5	7.4	0.02	8	11.3	<0.01	14	6.9	0.00	16	6.0	<0.01
MCH book												
No	179	18.7		198	27.7		73	17.0		43	12.2	
Yes	265	19.8	0.12	306	19.3	<0.01	313	13.1	0.13	280	7.9	0.06
Missing	132	26.9		90	35.7							

Table 5.15.Determinants of prelacteal water over time (demographic)

	2002		2007		2012		2017	
	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR
Demographic factors								
Maternal age								
15-19	1.77 (1.05-2.98)		1.36 (0.85-2.18)	1.17 (0.76-1.80)	1.35 (0.8-2.28)		1.21 (0.59-2.50)	
20-24	1.38 (0.95-2.01)		1.31 (1.00-1.74)	1.25 (0.95-1.63)	1.18 (0.82-1.7)		1.67 (1.17-2.38)	
25-29	1		1	1	1		1	
30-34	1.12 (0.8-1.57)		0.99 (0.73-1.34)	0.99 (0.74-1.31)	0.88 (0.62-1.25)		0.85 (0.56-1.28)	
≥35	1.46 (1.01-2.1)		1.50 (1.14-1.97)	1.50 (1.16-1.95)	0.87 (0.59-1.29)		1.00 (0.67-1.48)	
Education								
None/primary	1.35 (1.00-1.83)	1.40 (1.04-1.90)	1.11 (0.89-1.39)		1.05 (0.8-1.38)		1.34 (1.00-1.78)	
Secondary	1	1	1					
Higher	0.79 (0.43-1.43)	0.78 (0.43-1.40)	0.67 (0.42-1.09)		1.04 (0.67-1.62)		0.76 (0.51-1.13)	
Wealth quintile								
Q1 (least affluent)	1		1		1		1	
Q2	1.03 (0.75-1.42)		0.88 (0.69-1.13)		1.07 (0.79-1.46)		0.81 (0.58-1.14)	
Q3	0.96 (0.70-1.32)		0.97 (0.74-1.29)		0.86 (0.56-1.32)		0.62 (0.41-0.94)	
Q4	0.60 (0.38-0.95)		0.75 (0.53-1.07)		0.79 (0.52-1.21)		0.63 (0.43-0.92)	
Q5 (most affluent)	0.82 (0.50-1.33)		0.58 (0.39-0.87)		1.06 (0.62-1.81)		0.43 (0.26-0.70)	
Area of residence								
Urban	1		1		1		1	
Rural	1.21 (0.88-1.67)		1.59 (1.23-2.05)		1.09 (0.79-1.49)		1.32 (0.98-1.77)	
Major islands group[a]								
Sumatera	1.21 (0.82-1.78)	1.24 (0.85-1.80)	1.62 (1.24-2.11)	1.53 (1.18-2.00)	1.45 (1.04-2.03)	1.31 (0.93-1.83)	1.40 (0.96-2.04)	1.29 (0.89-1.88)
Java	1	1	1	1	1	1	1	1
Bali-Nusa Tenggara	0.68 (0.43-1.07)	0.67 (0.42-1.06)	0.32 (0.21-0.51)	0.32 (0.20-0.50)	0.51 (0.30-0.88)	0.47 (0.28-0.81)	0.79 (0.49-1.26)	0.74 (0.46-1.20)
Kalimantan	1.37 (0.96-1.95)	1.37 (0.96-1.95)	1.02 (0.72-1.45)	0.92 (0.65-1.30)	1.48 (0.98-2.25)	1.13 (0.74-1.71)	2.26 (1.49-3.43)	1.86 (1.18-2.92)
Sulawesi	1.70 (1.19-2.44)	1.78 (1.25-2.52)	1.96 (1.49-2.58)	1.72 (1.31-2.27)	1.93 (1.32-2.84)	1.51 (1.02-2.25)	2.29 (1.56-3.37)	2.01 (1.34-3.02)
Maluku-Papua			0.77 (0.47-1.27)	0.67 (0.41-1.11)	0.79 (0.45-1.38)	0.57 (0.32-1.02)	0.82 (0.45-1.51)	0.61 (0.32-1.14)

Numbers in brackets are 95% CI, red font indicates PR>1, blue font indicates PR<1, adjusted PR is PR in the final model, where the association had been controlled for other (maternal and child/birth-related) factors that remained statistically significant (Wald p <0.05).

Table 5.16.Determinants of prelacteal water over time (birth-related)

	2002		2007		2012		2017	
	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR	Crude PR	Adjusted PR
Birth-related factors								
Sex of the child								
Male	1		1		1		1	
Female	0.79 (0.62-1.02)		1.16 (0.95-1.41)		0.97 (0.75-1.27)		1.04 (0.80-1.35)	
Birth order								
First	1		1		1	1	1	1
Second/later	0.99 (0.77-1.28)		0.94 (0.76-1.16)		0.66 (0.49-0.88)	0.64 (0.48-0.86)	0.62 (0.47-0.81)	0.60 (0.45-0.78)
Birth size								
Larger	0.99 (0.73-1.36)		1.18 (0.92-1.50)		0.87 (0.62-1.20)		0.93 (0.67-1.28)	
Average	1		1		1		1	
Smaller	1.29 (0.96-1.74)		0.93 (0.69-1.26)		0.9 (0.59-1.38)		1.28 (0.88-1.86)	
Place-mode of birth								
Home-vaginal	1		1	1	1	1	1	1
Public-vaginal	0.70 (0.40-1.21)		0.60 (0.42-0.86)	0.69 (0.48-0.98)	0.52 (0.34-0.77)	0.57 (0.37-0.86)	0.46 (0.32-0.67)	0.49 (0.33-0.72)
Public-caesarean	0.58 (0.16-2.16)		0.41 (0.13-1.33)	0.47 (0.14-1.53)	0.41 (0.22-0.77)	0.45 (0.24-0.83)	0.57 (0.31-1.03)	0.57 (0.32-1.04)
Private-vaginal	0.62 (0.41-0.93)		0.54 (0.40-0.72)	0.57 (0.42-0.76)	0.47 (0.31-0.72)	0.48 (0.31-0.75)	0.44 (0.31-0.64)	0.47 (0.31-0.71)
Private-caesarean	0.31 (0.12-0.84)		0.40 (0.18-0.92)	0.46 (0.21-1.02)	0.33 (0.18-0.59)	0.32 (0.17-0.60)	0.39 (0.21-0.71)	0.42 (0.22-0.79)
MCH book								
No	1		1		1		1	
Yes	1.06 (0.80-1.41)		0.70 (0.55-0.87)		0.77 (0.55-1.08)		0.65 (0.42-1.02)	
Missing	1.44 (0.99-2.09)		1.29 (1.00-1.68)					

Numbers in brackets are 95% CI, red font indicates PR>1, blue font indicates PR<1, adjusted PR is PR in the final model, where the association had been controlled for other (maternal and child/birth-related) factors that remained statistically significant (Wald p <0.05).

5.3.6 Determinants of prelacteal milk other than formula in 2012-2017

Table 5.17 shows the prevalence of prelacteal milk other than formula by each of the explanatory variables. The *p* values indicate whether there is evidence of a statistically significant difference across categories, with the threshold used in this analysis being $p<0.05$. **Table 5.18** show the crude and adjusted PRs for all variables. Adjusted PRs are from the final model, where the association had been adjusted for all other variables (both maternal and child/birth-related) that remained statistically significant (Wald p <0.05). Regression analysis was only completed for 2012 and 2017 due to the very low number of babies receiving prelacteal milk other than formula in 2002-2007.

The maternal demographic determinants of other milk in 2012 and 2017 were similar to those of any PLF and formula. The prevalence was higher among mothers with higher wealth quintile (2012) and lower among rural mothers in 2012 (**Table 5.18**). The prevalence was higher in Sumatera (adjusted PR range: 1.38-1.70) and lower in Bali-Nusa Tenggara (adjusted PR range: 0.50-059) in both survey years.

In both years, the prevalence of other milk (**Table 5.18**) was lower among second/subsequent child compared to firstborns (adjusted PR range: 0.70-0.75), higher among babies who were perceived to be smaller than average (adjusted PR range: 1.35-1.42), and higher among institutional births, especially caesarean births (adjusted PR range: 1.41-2.44). Meanwhile, having MCH book was associated with lower prevalence of prelacteal milk other than formula, but it was only statistically significant in 2017.

Sensitivity analysis

Results from the sensitivity analysis (**APPENDIX III. Table III.5**) are generally in line with those from the main analysis presented here. The sensitivity analyses found that immediate skin-to-skin contact between mother and baby after birth, a variable that was only available in 2017, was found to be associated with lower prevalence of other milk (adjusted PR 0.77, 0.62-0.97)).

The effect size and direction of the association of the determinants from the main analysis were consistent with those of the sensitivity analysis.

Table 5.17. Prevalence of any other milk by explanatory variables over time

	2002			2007			2012			2017		
	n	%	p	n	%	p	n	%	p	n	%	p
Study population	2393	100.0		2096	100.0		3150	100.0		4148	100.0	
Gave any milk	21	0.6		25	1.0		762	24.4		819	20.4	
Maternal demographic												
Maternal age												
15-19	1	0.1		2	1.5		38	24.2		27	10.2	
20-24	9	0.8		1	0.1		178	26.2		162	13.7	
25-29	7	0.5		9	1.9		233	26.2		222	14.4	
30-34	2	0.6		9	1.0		176	23.2		220	15.6	
≥35	2	0.8	0.85	4	0.5	0.03	137	21.1	0.50	188	13.6	0.38
Education												
None/primary	13	0.7		16	1.7		180	19.9		158	12.6	
Secondary	7	0.4		9	0.3		456	25.5		474	14.2	
Higher	1	2.2	0.19	0	0.0	0.03	126	31.9	0.01	187	16.1	0.17
Wealth quintile												
Q1 (least affluent)	11	1.1		14	1.7		138	15.7		139	10.5	
Q2	6	0.8		4	1.9		156	23.7		170	13.1	
Q3	2	0.2		2	0.3		165	25.7		177	14.7	
Q4	1	0.6		4	0.3		160	26.6		170	16.2	
Q5 (most affluent)	1	0.4	0.59	1	0.2	0.05	143	31.9	0.00	163	16.2	0.01
Area of residence												
Urban	4	0.5		4	0.2		419	28.5		446	15.2	
Rural	17	0.7	0.68	21	1.4	0.00	343	20.4	0.00	373	13.2	0.11
Region												
Sumatera	5	0.3		9	1.8		293	35.6		236	26.7	
Java	6	0.7		4	0.7		186	23.8		255	19.0	
Bali-Nusa Tenggara	0	0.0		1	0.3		49	10.8		41	9.0	
Kalimantan	5	1.0		3	1.8		59	20.8		90	24.7	
Sulawesi	5	1.0	0.48	5	0.8		108	20.2		163	30.5	
Maluku-Papua				3	0.6	0.35	67	20.7	0.00	34	5.9	0.00
Child and birth-related												
Sex of the child												
Male	10	0.5		10	0.4		396	24.8		425	14.0	
Female	11	0.8	0.47	15	1.6	0.01	366	24.0	0.69	394	14.4	0.73
Birth order												
First	6	0.5		7	0.8		316	29.9		303	16.0	
Second/later	15	0.7	0.62	18	1.0	0.62	446	21.4	0.00	516	13.3	0.02
Birth size												
Larger	6	0.9		9	0.6		246	23.9		267	14.2	
Average	12	0.5		8	0.6		414	23.0		434	13.6	
Smaller	3	0.3	0.49	8	2.8	0.01	102	31.8	0.06	118	17.1	0.14
Place-mode of birth												
Home-vaginal	17	0.7		19	1.5		229	21.1		111	9.6	
Public-vaginal	1	0.6		2	0.3		115	17.7		195	12.0	
Public-caesarean	1	9.6		1	2.3		64	43.8		113	22.0	
Private-vaginal	1	0.1		3	0.2		266	25.3		281	14.6	
Private-caesarean	1	1.8	0.00	0	0.0	0.07	88	39.5	0.00	119	18.9	0.00
MCH book												
No	5	0.5		8	1.2		130	28.9		106	18.7	
Yes	9	0.6	0.72	15	0.9	0.63	632	23.7	0.12	713	13.8	0.01
Missing	7	1.0		2	0.5							

Table 5.18. Determinants of prelacteal milk other than formula over time

	2012		2017	
	Crude PR	Adjusted PR	Crude PR	Adjusted PR
Demographic factors				
Maternal age				
15-19	0.92 (0.63-1.35)		0.75 (0.47-1.18)	
20-24	1.00 (0.78-1.28)		1.02 (0.81-1.27)	
25-29	1		1	
30-34	0.89 (0.70-1.12)		1.05 (0.84-1.30)	
≥35	0.81 (0.62-1.05)		0.93 (0.75-1.16)	
Education				
None/primary	0.78 (0.62-0.99)		0.87 (0.71-1.07)	
Secondary	1		1	
Higher	1.25 (0.97-1.61)		1.12 (0.92-1.36)	
Wealth quintile				
Q1 (least affluent)	1	1	1	
Q2	1.51 (1.14-2.00)	1.38 (1.05-1.82)	1.26 (0.98-1.62)	
Q3	1.64 (1.22-2.20)	1.37 (1.00-1.87)	1.42 (1.10-1.83)	
Q4	1.69 (1.24-2.30)	1.38 (0.99-1.91)	1.54 (1.19-1.98)	
Q5 (most affluent)	2.04 (1.51-2.75)	1.70 (1.23-2.36)	1.47 (1.12-1.92)	
Area of residence				
Urban	1	1	1	
Rural	0.71 (0.59-0.87)	0.77 (0.61-0.97)	0.95 (0.81-1.12)	
Major islands group				
Sumatera	1.50 (1.23-1.83)	1.70 (1.40-2.07)	1.41 (1.17-1.70)	1.38 (1.15-1.67)
Java	1	1	1	1
Bali-Nusa Tenggara	0.46 (0.31-0.67)	0.59 (0.40-0.86)	0.48 (0.33-0.69)	0.50 (0.35-0.72)
Kalimantan	0.88 (0.63-1.21)	1.02 (0.73-1.43)	1.30 (0.97-1.74)	1.38 (1.03-1.85)
Sulawesi	0.85 (0.64-1.13)	1.04 (0.77-1.41)	1.60 (1.31-1.96)	1.57 (1.28-1.93)
Maluku-Papua	0.87 (0.54-1.39)	1.18 (0.72-1.93)	0.31 (0.19-0.51)	0.37 (0.23-0.61)
Child and birth-related				
Sex of the child				
Male	1		1	
Female	0.97 (0.82-1.14)		1.03 (0.88-1.20)	
Birth order				
First	1	1	1	1
Second/later	0.71 (0.59-0.87)	0.70 (0.58-0.85)	0.74 (0.64-0.87)	0.75 (0.64-0.87)
Birth size				
Larger	1.04 (0.85-1.28)	1.10 (0.89-1.35)	1.07 (0.91-1.26)	1.08 (0.92-1.26)
Average	1	1	1	1
Smaller	1.38 (1.06-1.80)	1.42 (1.09-1.87)	1.42 (1.15-1.76)	1.35 (1.10-1.66)
Place-mode of birth				
Home	1	1	1	1
Public-vag	0.84 (0.60-1.17)	0.79 (0.57-1.10)	1.07 (0.82-1.40)	1.17 (0.89-1.52)
Public-cs	2.07 (1.47-2.91)	1.70 (1.18-2.43)	2.40 (1.81-3.18)	2.44 (1.85-3.23)
Private-vag	1.20 (0.93-1.54)	0.99 (0.74-1.32)	1.32 (1.02-1.69)	1.34 (1.04-1.73)
Private-cs	1.87 (1.38-2.54)	1.41 (0.99-2.01)	1.89 (1.42-2.52)	1.89 (1.42-2.52)
MCH book				
No	1		1	1
Yes	0.82 (0.64-1.05)		0.72 (0.58-0.90)	0.76 (0.60-0.94)

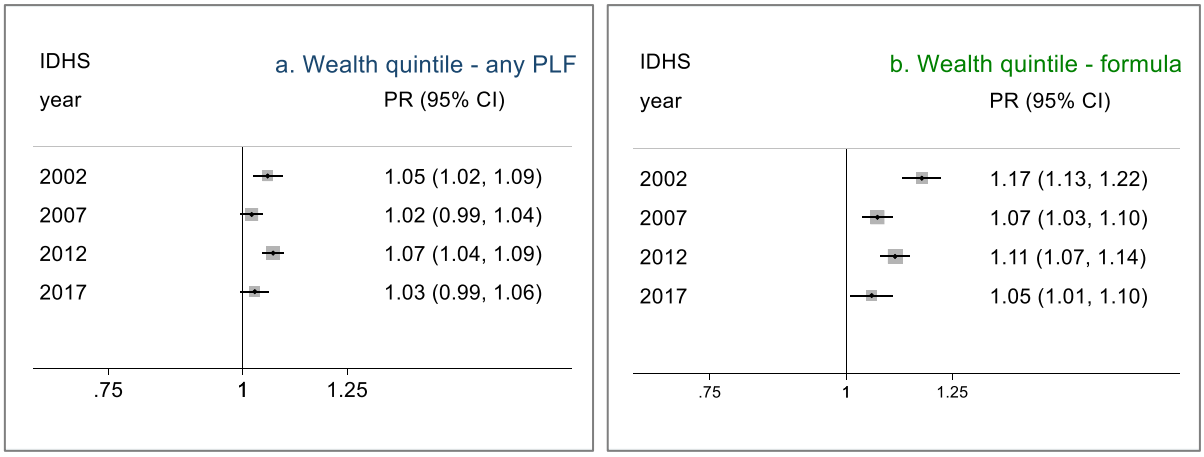
Numbers in brackets are 95% CI, red font indicates PR>1, blue font indicates PR<1, adjusted PR is PR in the final model, where the association had been controlled for other (maternal and child/birth-related) factors that remained statistically significant (Wald p <0.05).

5.3.7 Changes in the determinants of any PLF, formula, honey, and water

Figures 5.3-5.9 describe the trends in some of the determinants of any PLF and predominant types from 2002 to 2017. As described in Section 5.2.4.4, random-effects meta-analysis (206) was used to test for heterogeneity of the PRs in the four survey years. In the X^2 estimation of heterogeneity, a *p* value <0.10 was interpreted as a statistically significant presence of variability across the survey estimates (207).

Determinants to be tested were the ones that were statistically significant in at least two survey years in any PLF outcome. These included wealth quintile, birth order, mode and place of birth, and possession of MCH book. An exception was made for region (major island group). Despite being statistically significant, region was not tested for heterogeneity in PRs as it was not meaningful to make it a binary variable. Where necessary, variables tested for heterogeneity were initially modified to have binary categories, as described in Section 5.2.4.4.

Figure 5.3a shows the PRs by fitting wealth quintile as a linear trend in the final model for each survey. For example, in 2002, the prevalence of any PLF increased by 5% (PR=1.05) for every increase in one level of wealth quintile. The increase ranged from 2%-7% across survey years, although the PRs were not statistically significant in 2007 and 2017. There was some evidence of heterogeneity in PRs over time (I^2=66.0%; p=0.032), although the effect sizes and changes over time were small (Figure 5.3a). For the association between wealth quintile and prelacteal formula (**Figure 5.3b**), the shape of the plot was similar to any PLF (**Figure 5.3a**), but for prelacteal formula, there was clearer direction away from the null. The PR tended to decrease from 1.17 in 2002 to 1.05 in 2017 (**Figure 5.3b**), and there was some evidence of heterogeneity in the PRs over time (I^2 =81.7%; p=0.001), suggesting that mothers from the higher wealth quintile were consistently more likely to give prelacteal formula, but the effect size diminished over time.



Heterogeneity Chi^2=8.81 (df=3) p=0.032; I^2= 66.0% Het Chi^2=16.43 (df=3) p=0.001; I^2= 81.7%

Figure 5.3. Changes in the PR for a unit increase in wealth quintile in a) any PLF and b) formula

Figure 5.4 shows that across all survey years, mothers with the second/subsequent child were less likely to give any PLF, formula, honey, or water than were first-time mothers. For any PLF, the PRs ranged from about 0.80 to 0.89 (**Figure 5.4a**). Although the CIs across the years overlapped, there was some evidence of heterogeneity in the PRs (I^2=52.6%, p<0.10) (**Figure 5.4a**), suggesting that the effect was stronger in the more recent years.

Evidence of heterogeneity in the effect of birth order was also observed in the predominant types of PLF, as shown by borderline p values and I^2 values of about 52% for formula, honey, and water. For prelacteal formula, the PR for mothers with two or more children was statistically significant in all survey years, but the effect was strongerin 2017. For prelacteal honey and water, the PRs were both close to the null (0.90-0.91) and not statistically significant in 2002, but the effect size became larger and statistically significant over time. By 2017, the PR was 0.58 (0.43-0.77) for prelacteal honey and 0.60 (0.45-0.78) for prelacteal water.

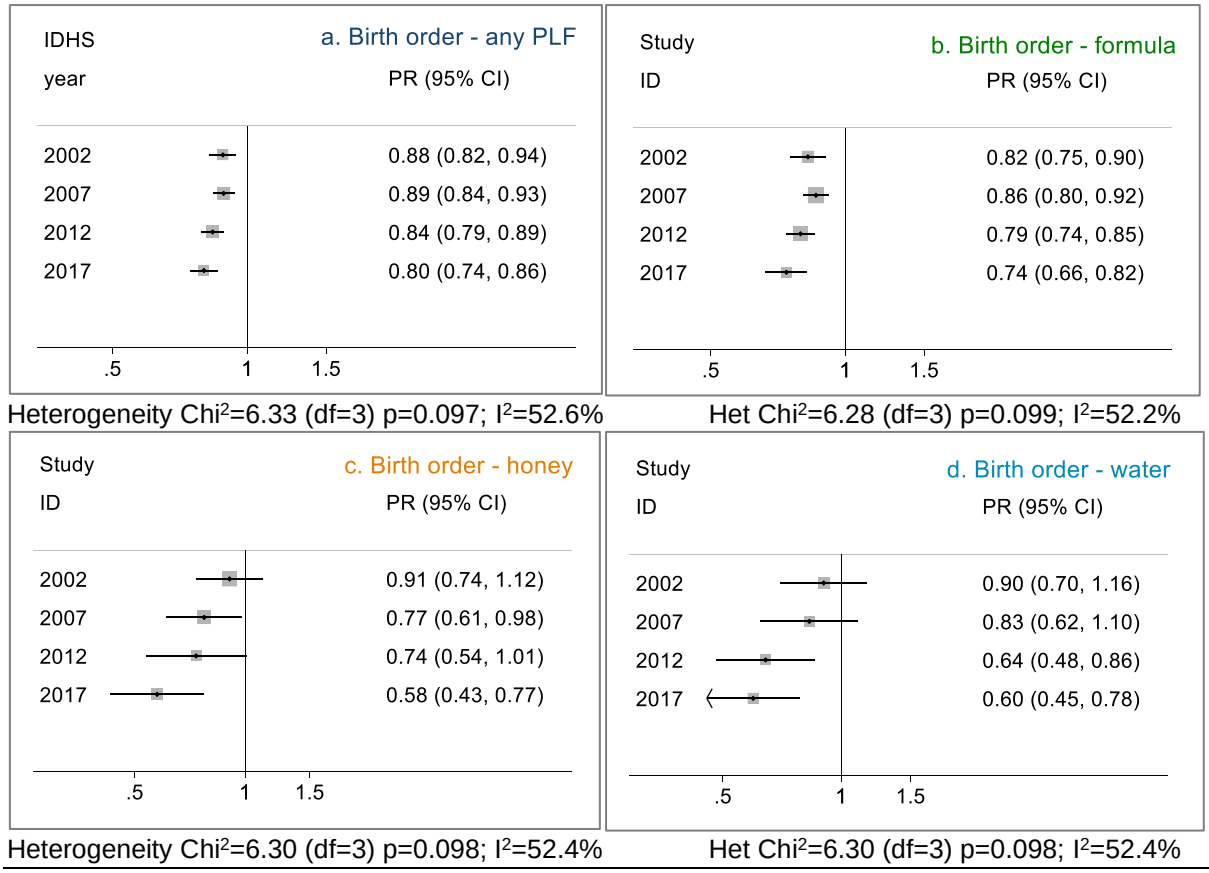


Figure 5.4. Changes in the effect of higher birth order vs first birth for a) any PLF, b) formula, c) honey, and d) water

Figure 5.5 shows the trends in the PRs of PLF outcomes for vaginal birth at public facilities versus vaginal birth at home. As this is restricted to vaginal births, a difference reflects the effect of giving birth in a public hospital/facility rather than at home. For any PLF (**Figure 5.5a**), vaginal birth at public facilities was not a statistically significant determinant, except in 2012 (0.87 (0.79-0.97)) where it was associated with a lower prevalence of any PLF. There was weak evidence of heterogeneity in the PRs (p=0.071; I2=57.3%), suggesting some variation in PRs probably because of the change in direction, although the PR was not very large in any year.

For prelacteal formula (**Figure 5.5b**), the direction of the PRs changed from 2002 to 2017. The PR went from 1.50 (1.22-2.85) in 2002 to 0.95 (0.80-1.13) in 2017 and there was strong evidence of heterogeneity in the PRs (p<0.10; I^2 84.8%). In contrast, vaginal birth at a public facility was associated with a lower prevalence of prelacteal honey (PRs range: 0.28-0.41,

Figure 5.5c-d) and water (PRs range: 0.49-0.81, **Figure 5.5d**) throughout the years with no evidence of heterogeneity in the PRs (I^2 0% and p>0.10) for both types.

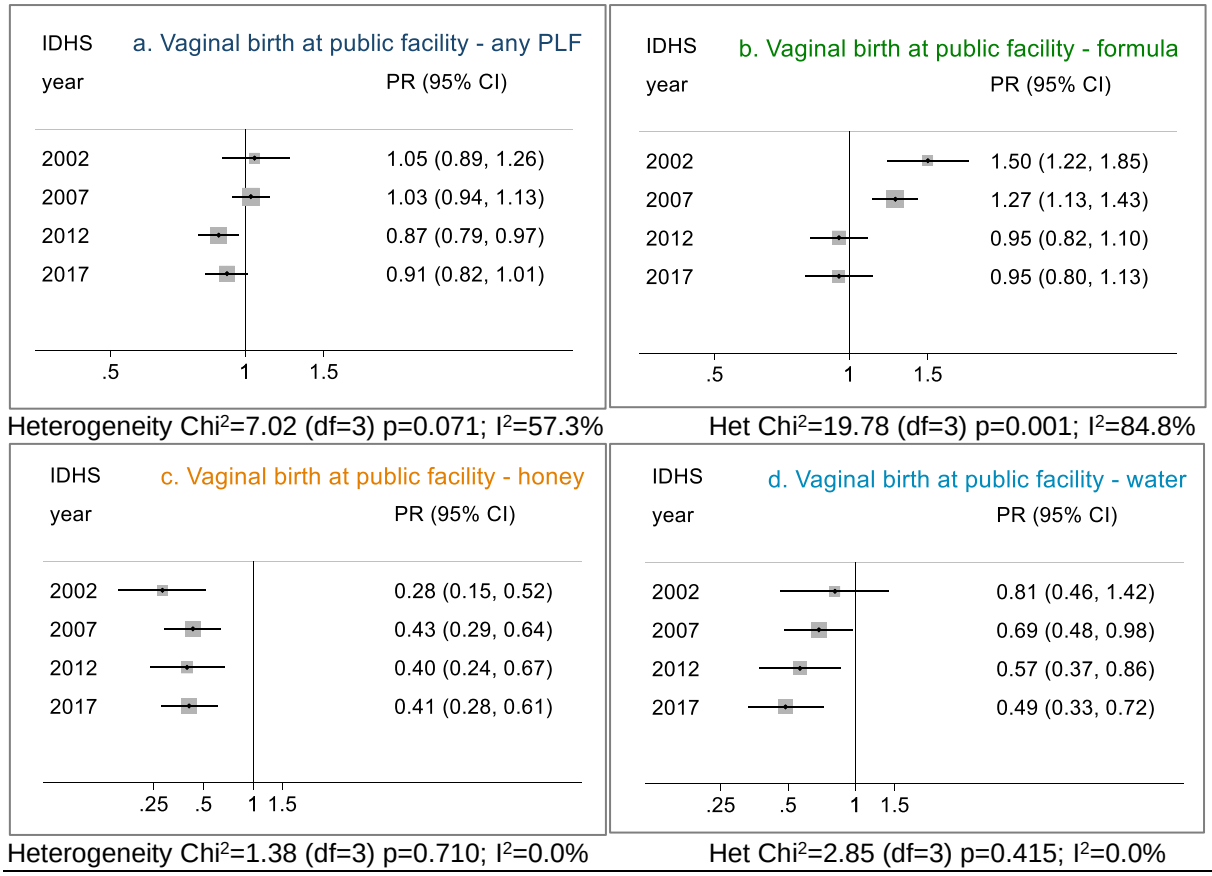


Figure 5.5. Changes in the effect of vaginal birth at public facilities compared to home birth for a) any PLF, b) formula, c) honey, and d) water

Figure 5.6 shows the changes in the PRs of PLF outcomes for caesarean birth at public facilities versus vaginal birth at home. For any PLF (**Figure 5.6a**), the PR was smaller (1.16) and not statistically significant (0.92-1.48) in 2002. In 2007-2017, the PRs were larger (1.21-1.40) and statistically significant, suggesting that any PLF was more likely among caesarean birth at public facilities than among vaginal births at home. There was weak evidence of heterogeneity (I^2=53.7%, p=0.090).

The shape of the forest plot for prelacteal formula (**Figure 5.6b**) appears to be different from that for prelacteal honey (**Figure 5.6c**) and water (**Figure 5.6d**). For prelacteal formula, the PRs ranged from 1.44 to 1.76, were always statistically significant, and there was no evidence

of heterogeneity in the PRs (I^2=30.0%, p=0.232) (**Figure 5.6b**). This suggests that prelacteal formula was consistently more prevalent among mothers who had caesarean birth at public facilities than among those who had vaginal birth at home and this association did not really change throughout the years.

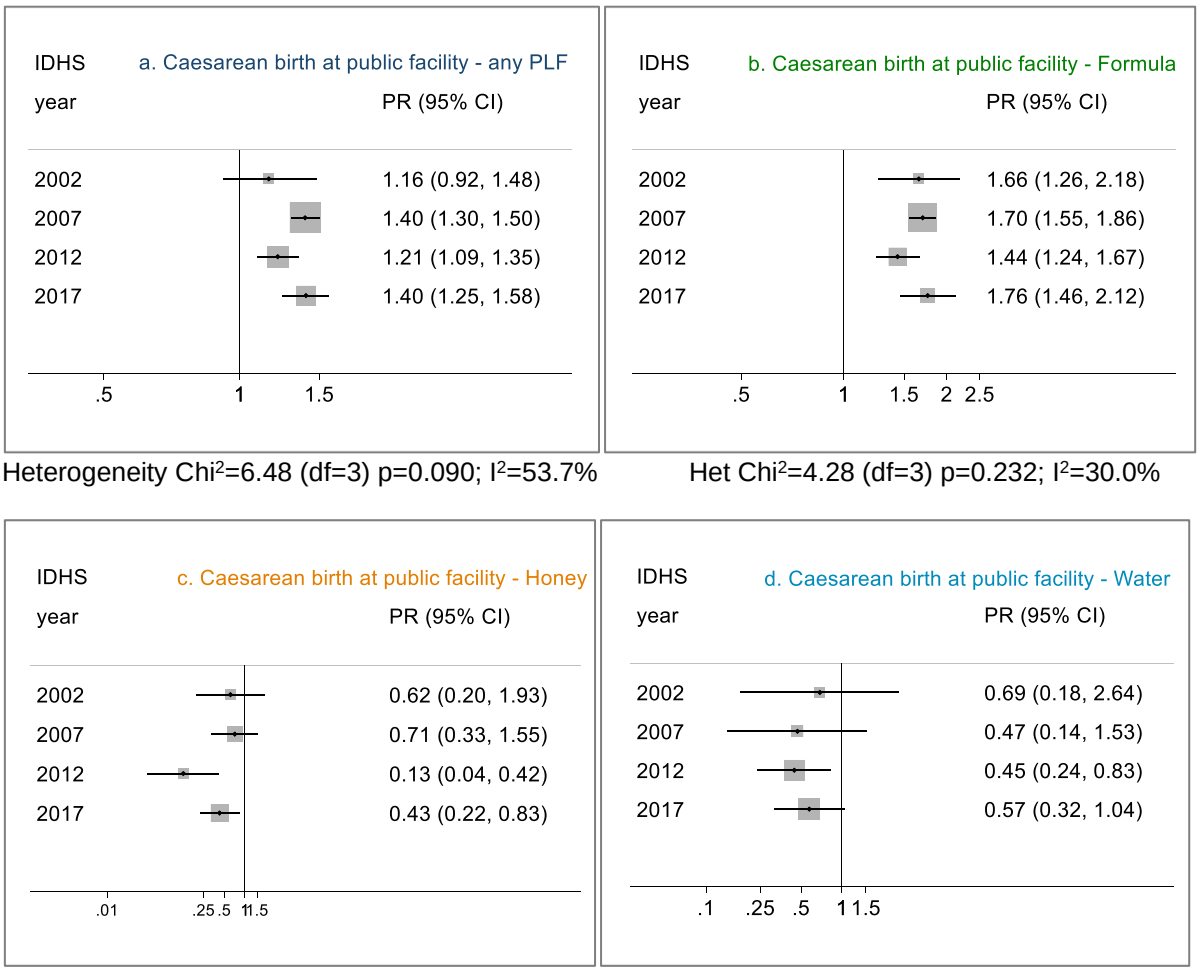


Figure 5.6. Changes in the effect of caesarean birth at public facilities compared to home birth for a) any PLF, b) formula, c) honey, and d) water

In contrast with prelacteal formula, prelacteal honey was less prevalent among caesarean births at public facilities, as the PRs ranged between 0.13 and 0.71. However, there was no evidence of heterogeneity in the PRs (I^2=49.2%, p=0.116), suggesting that the effect of caesarean birth at public facility on prelacteal honey remained unchanged over time.

The shape of the forest plot for prelacteal water (**Figure 5.6d**) was also visibly different from that of any PLF and prelacteal formula. The PRs for prelacteal water ranged from 0.47 to 0.6, but again there was no evidence of heterogeneity (I^2=0.0%, p=0.912). The lower prevalence of prelacteal water was the reason for the smaller numbers and wider confidence intervals, which resulted in less power to detect a difference.

Figure 5.7 shows the changes in the PRs of PLF outcomes for vaginal birth at private facilities versus vaginal birth at home. As this is restricted to vaginal births, a difference reflects the effect of giving birth in a private hospital/facility rather than at home. Although in all survey years vaginal birth at private facilities did not show statistically significant associations with any PLF compared to vaginal birth at home, the forest plot was produced throughout the years (Figure 5.7a). This was to show the contrasting effects across PLF, honey, and water (**Figure 5.7b, c,** and **d** respectively).

In 2002, prelacteal formula (**Figure 5.7b**) was more prevalent among mothers who had vaginal birth at a private facility than those at home (1.54, 1.32-1.80). However, the strength of this association diminished over time and was no longer statistically significant by 2017 (1.12, 0.94-1.33). The evidence of heterogeneity in the PRs (I^2 70.4%, p=0.018) suggests that the practice of giving prelacteal formula among mothers who gave birth at vaginal birth at a private facility had significantly changed over time.

Throughout the years, the prevalence of prelacteal honey was consistently lower among mothers who had vaginal birth at a private facility than those at home (**Figure 5.7c**). The size of association increasingly shifted away from the null (PR 0.61 in 2002 to 0.23 in 2017) and there was evidence of heterogeneity (p<0.01, I^2 79.1%). These suggest that the 'protective' effect of vaginal birth at private facilities on prelacteal honey became stronger over time.

The forest plot for prelacteal water (**Figure 5.7d**) was rather similar to that of prelacteal honey and the size of PRs also increasingly shifted away from the null (0.72 in 2002 to 0.47 in 2017). However, there was no strong evidence of heterogeneity (I^2 of 0.0%, p value 0.483).

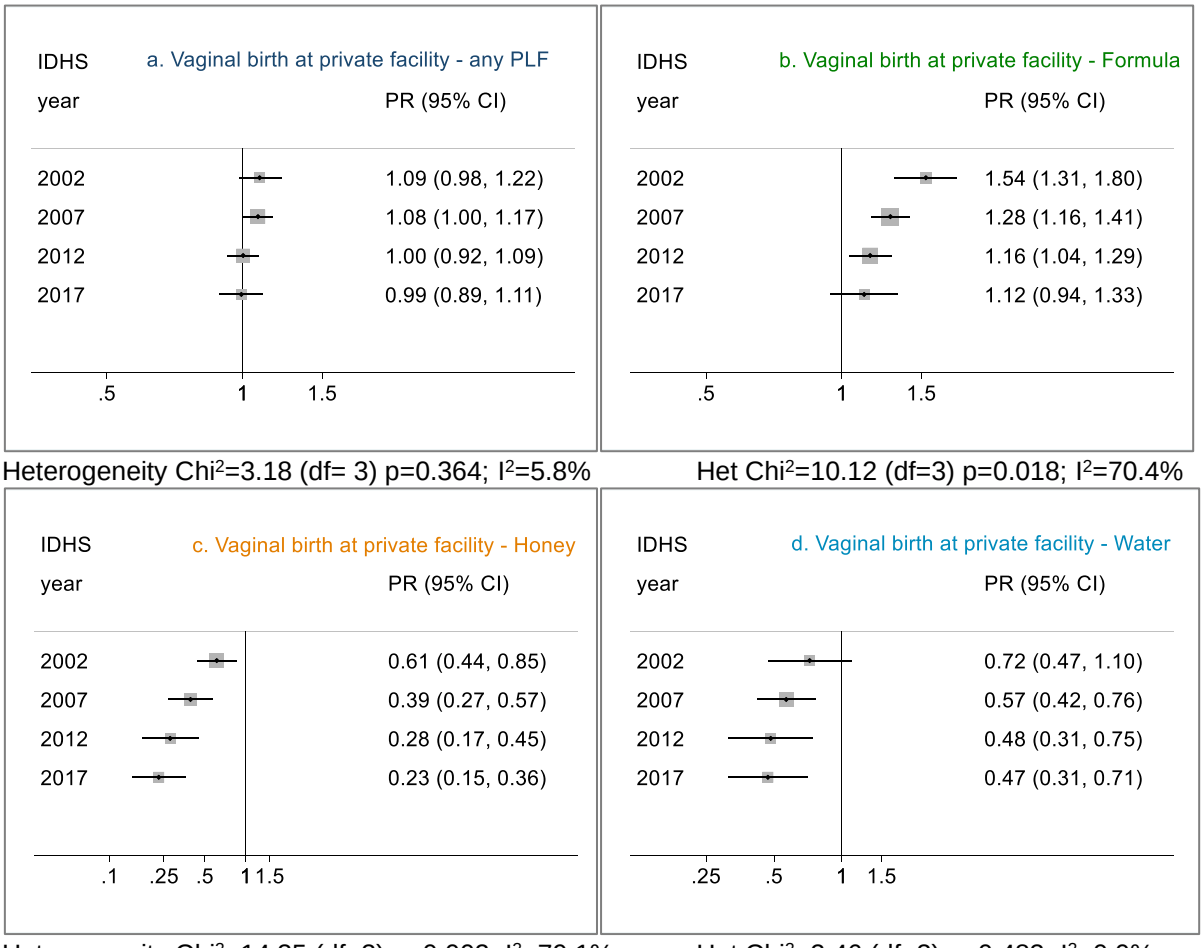


Figure 5.7. Changes in the effect of vaginal birth at private facilities compared to home birth in a) any PLF, b) formula, c) honey, and d) water

Figure 5.8 shows the changes in the PRs of PLF outcomes for caesarean birth at private facilities versus vaginal birth at home. For any PLF (**Figure 5.8a**), the PRs ranged from 1.14 to 1.23 and were statistically significant across the years, suggesting that any PLF was consistently more prevalent among mothers who had caesarean birth at a private facility. There was no evidence of heterogeneity in the PRs (p=0.565; I2=0.0%), suggesting that this association has not changed over time (**Figure 5.8a**).

Similar to any PLF, the PRs for prelacteal formula (**Figure 5.8b**) were also statistically significant over time but fluctuated between 1.36 and 1.87 with evidence of heterogeneity in PRs (p=0.054, $I^{2=}$60.8%). In contrast with formula, the PRs for prelacteal honey (Figure 5.8c) became stronger (0.43 in 2002, 0.11 in 2017) over time, also with evidence of heterogeneity in PRs (p=0.001; I^2 81.8%). Meanwhile, the PRs for prelacteal water (**Figure 5.8d**), fluctuated between 0.36 and 0.46 with no evidence of heterogeneity (p=0.901; I^2=0.0%)

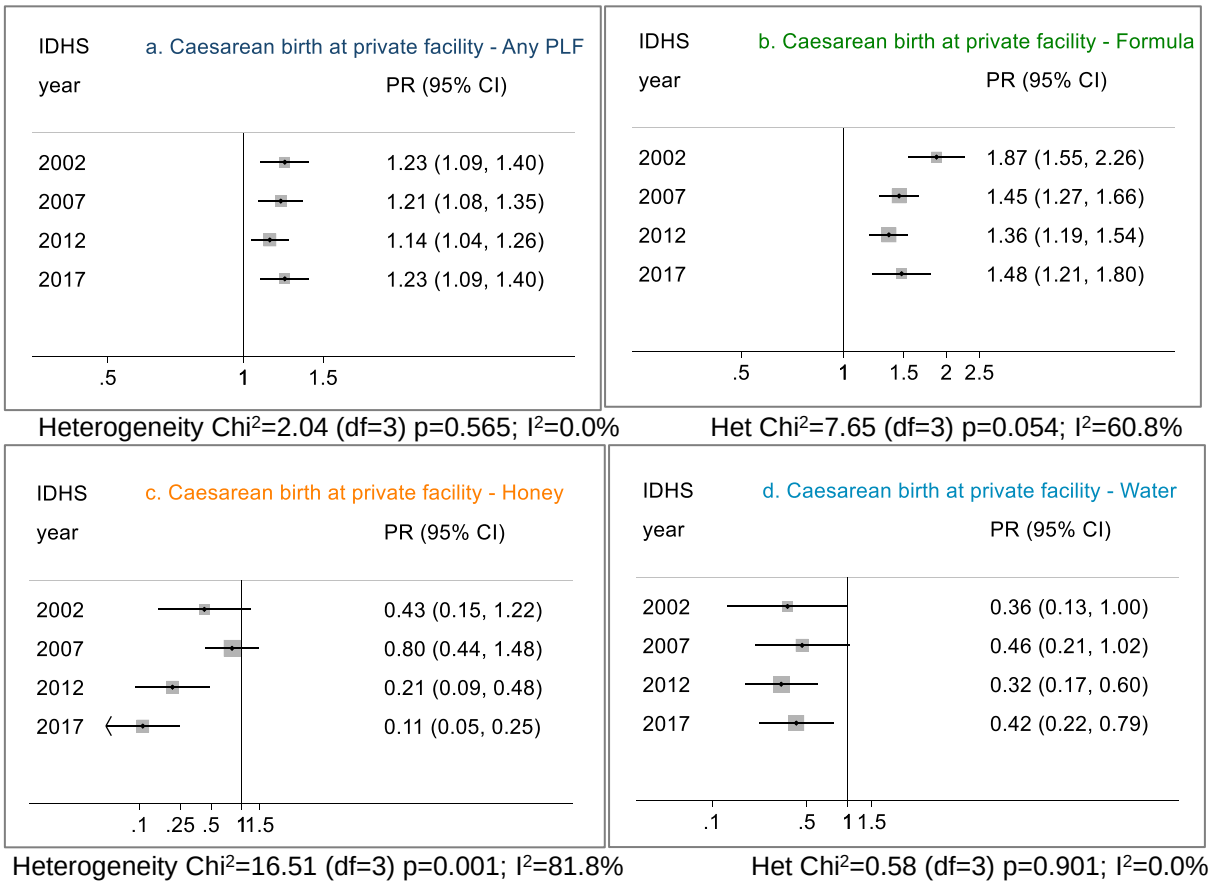
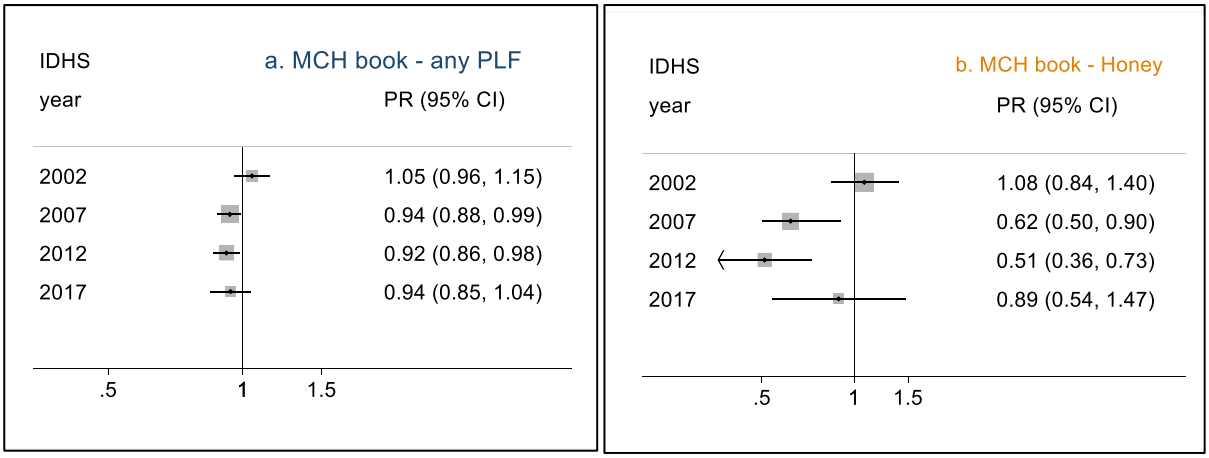


Figure 5.8. Changes in the effect of caesarean birth at private facilities compared to home birth in a) any PLF, b) formula, c) honey, and d) water

Figure 5.9 shows the changes in the PRs of PLF for the possession of maternal and child (MCH) book, which was only found to be statistically significant in some survey years for any PLF (**Figure 5.9a**) and prelacteal honey (**Figure 5.9b**), but not in prelacteal formula and honey. The forest plots for any PLF and prelacteal honey showed different changes of association across the years. For any PLF, the 'protective' effect of having MCH book was very little (Figure 5.9a) with no evidence of heterogeneity (p=0.134; I^2=46.2%). For prelacteal honey, there PRs fluctuated PRs (range: 0.51-1.08) with a lack of precision in the PRs (wide, overlapping CIs)

accompanied by some evidence of heterogeneity (p=0.001; I^2=81.3%), suggesting that there were changes over time in the association between having MCH book and prelacteal honey.



Heterogeneity Chi²=5.58 (df=3) p=0.134; I^2=46.2% Het Chi²=16.08 (df=3) p=0.001; I^2=81.3%

Figure 5.9. Changes in the effect of possession of an MCH book in a) any PLF b) honey

5.4 Discussion

5.4.1 Summary of results

Table 5.19 summarises the determinants of any PLF and the four predominant types of PLF (formula, honey, water, and other milk) resulting from the multivariable analysis using modified Poisson regression. Of the 10 variables examined in the main analysis, this study found evidence that wealth quintile, region, birth order, and place-mode of birth were the most consistent determinants of any PLF in Indonesia, as they were observed in all survey years. The determinants that were statistically significant in only one survey year or two were area of residence (2017), perceived birth size (2017), and possession of MCH book (2007, 2012). The determinants identified for the predominant PLF types differed, but birth order and place-mode of birth were seen to be particularly unique and important.

Table 5.19. Summary of PLF determinants

Variables used	Any PLF				Formula				Honey				Water				Other milk	
	'02	'07	'12	'17	'02	'07	'12	'17	'02	'07	'12	'17	'02	'07	'12	'17	'12	'17
In the main analysis																		
1. Older age	-	-	-	-	-	-	-	-	-	-	-	-	-	↑	-	-	-	-
2. Increasing level of education	-	-	-	-	-	↑	-	-	-	-	-	-	↓	-	-	-	-	-
3. Increasing wealth quintile	↑	↑	↑	-	↑	↑	↑	↑	-	-	-	-	-	-	-	-	↑	↑
4. Rural areas (vs urban)	-	-	-	↑	-	-	-	↑	-	-	-	-	-	-	-	-	↑	-
5. Region (vs Java)																		
Sumatera	↑	↑	↑	↑	↑	↑	↑	↑	↑	-	-	↑	-	↑	-	-	↑	↑
Bali-Nusa Tenggara	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	-	-	↓	↓	-	↓	↓
Kalimantan	↑	-	↑	↑	↑	↑	↑	↑	-	↓	-	↑	-	↓	-	-	-	↑
Sulawesi	↑	-	↑	↑	↑	-	↑	↑	-	-	↑	↑	↑	↑	↑	↑	-	↑
Maluku-Papua	NA	↓	↓	-	NA	↓	-	-	NA	↓	-	-	NA	-	-	-	↓	↓
6. Child's sex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7. First birth (vs second/subsequent birth)	↑	↑	↑	↑	↑	↑	↑	↑	-	↑	-	↑	-	-	↑	↑	↑	↑
8. Perceived smaller birth size (vs average)	-	-	-	↑	-	-	-	↑	↑	-	-	-	-	-	-	-	↑	↑
9. Place-mode of birth (vs home-vaginal birth)																		
Public facility-vaginal birth	-	-	↓	-	↑	↑	-	-	↓	↓	↓	↓	-	↓	↓	↓	-	-
Public facility-caesarean birth	-	↑	↑	↑	↑	↑	↑	↑	-	-	↓	↓	-	-	↓	-	↑	↑
Private facility-vaginal birth	-	↑	-	-	↑	↑	↑	-	↓	↓	↓	↓	-	↓	↓	↓	-	↑
Private facility-caesarean birth	↑	↑	↑	↑	↑	↑	↑	↑	-	-	↓	↓	-	-	↓	↓	↑	↑
10. Having MCH book	-	↓	↓	-	-	-	-	-	-	↓	↓	-	-	-	-	-	-	↓
In the sensitivity analysis only	-																	
1. Increasing wealth quintile in rural areas	NA	NA	NA	↑	NA	NA	NA	↑	NA	NA	NA	-	NA	NA	NA	NA	NA	↑
2. Religion (vs Islam)																		
Christianity	-	↓	NA	NA	-	-	NA	NA	↓	↓	NA	NA	-	↑	NA	NA	NA	NA
Hinduism	-	↓	NA	NA	-	-	NA	NA	↓	-	NA	NA	↓	-	NA	NA	NA	NA
Buddhism, Confucianism, and others	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	-	NA	NA	NA	NA	NA
3. No skin-to-skin contact	NA	NA	NA	↑	NA	NA	NA	↑	NA	NA	NA	↑	NA	NA	NA	-	NA	↑

MCH = maternal and child; PLF= prelacteal feeding; (-) = not a statistically significant determinant; (↑) = risk factor as compared to the reference category; (↓) = protective factor as compared to the reference category; (NA) = analysis not available.

5.4.2 Determinants of any PLF and the predominant types

This section discusses the results for any PLF and the predominant types and compares with the existing literature on PLF in other settings. Each of the 10 determinants included in the main analysis is discussed in the order shown in Table 5.19. Results from the sensitivity analysis are discussed last and/or added into the discussion of the main analysis wherever relevant.

Maternal age

Maternal age was not a determinant for any PLF and the predominant types in most survey years. The only time it was found to be statistically significant was in 2007, where mothers aged >35 were more likely to give prelacteal water than were mothers aged 25-29. However, this association came from a relatively smaller sample sizes, had inconsistent dose-response relationship, and showed unclear pattern of the effect size in the other years. Hence, it is likely that this association only occurred by chance. Additionally, many studies reported maternal age to have no association with any PLF (34, 99, 101, 107, 108, 113, 118, 122, 123), suggesting that age might not be a consistent determinant.

Level of education

Similar to age, maternal level of education was not a determinant for any PLF and predominant types in most survey years. The only time it was found to be statistically significant was in 2002, where mothers with primary/no education were more likely to give prelacteal water than mothers with secondary education. This was quite plausible because mothers with lower education may lack of knowledge about avoiding PLF and/or be less likely to afford formula if they want to give PLF. There was a dose-response relationship and sensible pattern of the crude PRs from the other years. Moreover, other studies from Nepal (101), Nigeria (19), and other Sub-Saharan countries (18) where water was a common PLF type, also reported that lower education is a risk factor for any PLF. In Vietnam (23), higher education was associated with lower prevalence water-based PLF. However, most

studies found no association between education and any PLF. In my study, analysis on prelacteal water had smaller sample sizes, suggesting that this one-time association in 2002 might simply have occurred by chance.

Wealth quintile

Wealth quintile is the only maternal demographic variable whose association differs depending on the PLF type. In general, mothers from the highest wealth quintile (Q5) were more likely to give any PLF compared to those from the lowest wealth quintile (Q1). This association was more consistent in prelacteal formula, where the association was statistically significant for any wealth quintiles higher than Q1 in all survey years. Similar association was also found in prelacteal milk other than formula in 2012, but not in prelacteal honey and water. The non-significant association for honey and water in the multivariable analyses might be due to the small sample sizes, because in the descriptive and univariable analysis, the prevalence of both prelacteal honey and water tended to be higher in the lowest wealth quintile. This suggests that the association of wealth quintile with prelacteal formula might be different from that with prelacteal honey or water.

The dose-response and pattern of association between wealth quintile and any PLF were rather unclear compared to those of prelacteal formula because any PLF consisted of different types of PLF, where the effect went in opposite directions. This explains inconsistent findings in the literature. Wealth quintiles were frequently reported to be non-statistically significant determinant or to have no clear dose-relationship association with any PLF (18-20, 52, 99, 122, 123) but in several Latin America countries, higher wealth was associated with higher odds of any PLF (131). In my study, higher wealth quintile was a consistent risk factor for any PLF most likely because the largest proportion of any PLF in Indonesia was always formula, and it is expensive. Hence, it is likely that it can only be afforded by the more affluent mothers. This might be the case with other milk too. Meanwhile prelacteal honey and water are likely to be cheaper than milk-based PLF. This

may explain why studies that found lower wealth quintiles to be the risk factors for any PLF usually came from settings where prelacteal water was the most common PLF type (18, 21, 113).

Interestingly, although the association between higher wealth quintile and any PLF and prelacteal formula were seen across all survey years, there was some evidence that the effect size had become smaller over time. The change may not be so clear for any PLF as it consisted of many different types, but it was for prelacteal formula. This interpretation was supported by the findings from the sensitivity analysis for 2017 dataset (APPENDIX II).

After fitting an interaction term with area of residence (APPENDIX II), the sensitivity analysis shows that determinants in 2017 were generally similar to those found in the main analysis, but it also shows that wealth quintile interacted with area of residence. The higher wealth quintile was only a risk factor for any PLF and formula among rural mothers, but not among urban mothers. One plausible explanation may be related to the changes of knowledge and behaviour of urban mothers about the importance of breastfeeding, especially EBF, in the more recent years. This phenomenon might not be captured by IDHS dataset, but studies found that fast-growing information especially via the internet in the last two decades, had shaped information seeking behaviour, including information related to infant feeding (177, 208). Some insights about this change is covered in the qualitative study (Chapter 8). Urban mothers may have been more likely to be exposed to this health information and therefore show behaviour changes as a result, that may not have yet reached the more rural areas where information is less accessible. Even if they could afford to buy formula, they were less likely to give it to their baby because they had been informed that formula was no longer a wealth symbol and PLF should be avoided whenever possible.

Area of residence

Area of residence was not a consistent determinant for any PLF because in 2002-2012, the prevalence was higher in urban than rural areas, but multivariable analysis showed no statistical significance in any of these years. Interestingly, in 2017 the prevalence was higher in rural areas and multivariable analysis showed statistical significance. This association was observed for prelacteal formula in 2017 and other milk in 2012, but not for honey and water. The plausible explanation is likely to be related to the changes in urban mothers' behaviour in the more recent years where they are moving towards avoiding any PLF, particularly formula, because they were more aware about the importance of achieving exclusive breastfeeding, as described previously.

Region

In Chapter 4, I discussed how any PLF was practiced differently across the regions in Indonesia, as categorised into major island groups. These groups were Sumatera, Java, Kalimantan, Bali-Nusa Tenggara, Sulawesi, and Maluku-Papua. Findings from this chapter are consistent with those from Chapter 4 as here the association of region with the prevalence of any PLF mostly remained even after adjustment for all other variables.

Compared to mothers who lived in Java, mothers in Sumatera, Kalimantan, and Sulawesi regions were more likely to give any PLF. There are, however, some regional differences where formula was consistently higher in Sumatera and Kalimantan, while honey and water were more consistently higher in Sulawesi. There are many different factors affecting the association, but it might be related to regional culture and not merely about the affordability of PLF. The phenomenon related to this finding will be discussed further in the qualitative study presented in Chapter 8.

Java is the most populous region of Indonesia and is considered more economically developed (185, 186, 188-190). Hence it is possible that mothers in Java had adopted infant

feeding practices as recommended by the WHO earlier than had mothers in the other regions. Moreover, there was a combination of wealthier and poorer provinces in Sumatera, Kalimantan, and Sulawesi, some of which might have a strong infant feeding tradition. It was possible that the higher prevalence of any PLF in these regions was partly because of mothers who lacked knowledge about the need to avoid PLF, and who gave formula when they could afford it and other PLFs when they could not.

On the other hand, the prevalence of any PLF was always lower among mothers in Bali-Nusa Tenggara and Maluku-Papua regions. These patterns were consistent across the survey years where data were available, except for the PRs in Maluku-Papua in 2017. The adjusted PRs in Maluku-Papua in 2017 was not statistically significant, but this might be due to the small sample size in this region. Most provinces in these regions (except Bali, where the tourism trade brings income to the province, resulting in better access and development) were relatively poorer than provinces in Java, which may result in inability among mothers to afford formula and give it as a PLF even if they had wanted to. Additionally, because these regions were considered disadvantaged, they have been frequently chosen as the area for implementing programs relating to maternal and child health (191-193), including infant feeding practice. This might have resulted in a better awareness among the people to avoid any PLF, including cultural feeds, whenever possible.

Child's sex

Child's sex is the only variable that had no association with any PLF and the predominant types in any survey year. This finding was in line with most studies (20, 107, 115, 120), but Sub-Saharan countries male babies had higher odds of receiving any PLF (18). My study adds evidence that the practice of any PLF, no matter the type is, affects both male and female babies equally in Indonesia.

Birth order

Birth order is the only determinant that was consistently found for any PLF, and the direction of association was uniform for all predominant types. First-time mothers in Indonesia were more likely to give any PLF than those who had a second/subsequent child, and this is in line with findings from many other studies (18, 20, 101, 123, 209). This association remained consistent and, to some extent, became stronger over time. This suggests that primiparity is a consistent determinant for any PLF and is not limited to Indonesia. The most plausible explanation is because any PLF was often given due to perceived breastmilk supply or insufficiency among the mothers (74). These perceptions are often thought to come from the lack of experience, skills, and confidence among primiparous mothers compared to that among multiparous mothers (210), as reported elsewhere (18, 20, 101, 209). Consistent with previous studies, all these conditions could lead to difficulties in breastfeeding initiation and potentially result in PLF practice (18, 101). This finding is important because it highlights the importance of acknowledging challenges faced by new mothers.

Perceived birth size

Perceived birth size was not a consistent determinant for any PLF, because it was only observed in 2017, where mothers who perceived their child to be smaller than average were more likely to give any PLF. This association was seen for prelacteal formula in 2017, honey in 2002, and any milk in 2012-2017, but not for water. Although a more conclusive interpretation is difficult to reach, this finding is consistent with many other studies (18, 19) (21, 107-109, 111). It is possible that smaller babies tended to be premature, very low-birthweight, and with other birth complications, that often belong to a population with breastfeeding difficulties including low milk supply and separation (211-213), which eventually leads to formula supplementation.

Additionally, Belachew et al (21) described another possibility about maternal misperception that babies with smaller birth size could benefit from additional feeds other than breastmilk. Perceived insufficient breastmilk was also reported to be one of the reasons for giving PLF in Indonesia (14). Consequently, mothers who were worried about their baby's birth size may think that he or she would require supplementation to be able to catch-up with normal growth. Moreover, perhaps this association was not statistically significant in the previous years because the use of formula supplementation in Indonesian health facilities was less strict then, while in 2017, formula supplementation had become more limited to babies who really needed it. Unfortunately, this study could not use the prematurity (gestational age at birth) variable collected in IDHS because it was not clearly defined and had a large proportion of missing values.

Place and mode of birth

The association between place-mode of birth and PLF was the most complex determinant, as seen in Table 5.19 where many arrows go the opposite directions for different types of PLF. Any PLF was generally more prevalent among births at the health facilities because formula was more common among births in those settings, and it dominated the overall PLF results. The opposite association was observed for honey and water probably because health facilities were much less likely to encourage or allow these types of PLF. This association became stronger over time, particularly for honey, suggesting that awareness of avoiding non-medical PLF is increasing.

Meanwhile, caesarean birth at either public or private facility was a consistent determinant for prelacteal formula. This is in line with most studies about PLF determinants where caesarean birth was frequently found to be a risk factor of any PLF (18, 111, 118, 209, 214). This finding is also particularly important because caesarean birth in Indonesia is generally increasing over time, hence it is useful for mothers and health professionals to be aware of the PLF-associated risks that come with it. Formula, which contributes to the largest

proportion of any PLF is more likely to be available at the health facility than at home. Moreover, mothers who had caesarean birth are more likely to experience birth complications, pain or discomfort, and separation between mother and baby in the first days. These conditions may require formula supplementation in the first days of birth. Fortunately, although the PRs of caesarean birth at both public and private remained statistically significant over time, at least the effect size decreased in the more recent years for caesarean at private facility. This suggests that in the more recent years, even among caesarean births, there was greater caution in the use of prelacteal formula, possibly due to the breastfeeding policy.

The association between vaginal birth at either public or private facility and any PLF, especially formula changed over time. This suggests that vaginal birth might not have as many complications as caesarean birth that may lead to difficulties in initiating breastfeeding. However, there were some significant associations in the earlier years because formula was given more liberally during that time, as reported by studies in Malang/Semarang, Java (215, 216). In the more recent years, this effect has become smaller and may be because staff in health facilities might have become less willing to give prelacteal formula where it is not needed.

The different associations across PLF types perhaps helps to explain inconsistent evidence seen across previous studies. Home birth was found to be associated with higher odds of any PLF in Nigeria (19, 20), Ethiopia (31, 99, 112, 113), Sub-Saharan countries (18, 87, 108, 109), and Latin America (110), but the opposite was true in Bangladesh (122) and no association was found in some other countries in South Asia (111). Without adjusting for other factors, the proportion of PLF was generally higher among home births (65%) than among institutional births (51%) in low-middle income countries in Asia (7). The patterns are most likely related to the substances that are most prevalent in the investigated settings and possibly because hospitals are moving away from giving PLF in any form.

Possession of MCH book

Mothers who reported to have received an MCH book were less likely to give any PLF than those who reported not to receive it. This association was observed in 2007 and 2012. It was seen for prelacteal honey during the same years and other milk in 2017, suggesting that this association might not be simply due to chance.

There are two possible explanations for this finding. First, the possession of MCH book may reflect the reception of information about PLF among mothers. MCH book contains information about the importance of exclusive breastfeeding (EBF) and the recommendation to avoid giving PLF (217). Second, MCH book might indicate a better quality in maternity care, including antenatal care, which results in avoidance of any PLF. In other studies, antenatal care was found to have a negative association with PLF practice (18, 31). Third, it might be possible that mothers who had MCH book avoided reporting PLF because they knew it was something that was discouraged by the recommendation.

It is unclear why the results were different in 2002 and 2017, but perhaps the content of MCH book was not as complete as the later version and only contained information about EBF without specifically mentioning PLF. Meanwhile in 2017, perhaps having an MCH book had become less significant because with the growing awareness of EBF in more recent years, information about PLF can also be obtained from other sources, especially the internet and social media (177, 208).

Possession of MCH book was not a determinant of prelacteal formula in any survey year. One potential explanation is because having the book is not equal to having knowledge (at least reading and understanding the information). The other potential explanation was because the reason for giving prelacteal formula was not related to receiving this information. For example, mothers might have read that breastfeeding is beneficial and PLF

should be avoided, but when they perceive they have insufficient breastmilk, they decide to give formula anyway.

Sensitivity analysis: religion and immediate skin-to-skin contact

The sensitivity analysis found that Muslim mothers were more likely to give any PLF than Christian or Hindu mothers (APPENDIX III, Table III.1). However, it was only statistically significant in 2002 but not in 2007, where this variable was also available. PLF may be related to religious and/or cultural practice rather than nutritional reasons because this association was not found for prelacteal formula. Therefore, it was not a determinant for formula, but was for honey and water. The higher prevalence of prelacteal water among Christian mothers compared to Muslim mothers was difficult to explain other than perhaps a chance finding. However, prelacteal honey being more prevalent among Muslim mothers than those of other religions might be related to the tradition called 'tahnik' practiced by some groups of Muslims. 'Tahnik' is the practice of giving a sweet substance to a newborn baby in the form of dates or honey and it has been cited elsewhere (22, 52). This practice will also be discussed in Chapter 8.

In the sensitivity analysis, immediate skin-to-skin contact between mother and baby after birth was associated with a lower prevalence of any PLF, formula, other milk, and honey in 2017 (the only year where data were available). Despite not being available in the previous survey years, immediate skin-to-skin contact has been listed as one of the Ten Steps to Successful Breastfeeding (70). It is also the component of early initiation breastfeeding, which has been reported to reduce PLF practice (218) and promote optimal breastfeeding practice (204, 219). Those studies have shown that one of the most common reasons for PLF being introduced is related to the idea that mother's breastmilk is not enough, hence it is plausible that mothers who manage to initiate breastfeeding without too much difficulty no longer have the need to give their baby anything else (204, 219).

Similarities and differences between my study and a study from Indonesia which used the 2017 IDHS

As mentioned in the Literature Review, the following year after I published my study (85) on the 2017 IDHS analysis, Nurokhmah et al (86) published a similar study. Some findings from their study were similar to mine, although effect sizes were larger in their study, this may be because they used logistic regression which may overestimate the effect when the outcome is common. Perceived smaller birth size (adjusted OR 1.43, 1.15-1.79), caesarean birth (adjusted OR 1.36, 1.14-1.63), higher birth order, and no EIBF was associated with higher odds of any PLF (86). Some differences including outcome (they did not separate PLF by type) and interaction term. They did not fit an interaction term between area of residence and wealth quintile, hence they found that rural residence was associated with higher odds of any PLF, while in my study, higher wealth quintile was only a determinant among the rural mothers. Lastly, they included variable on gender role, which was found that nonconforming attitude was associated with higher odds of any PLF. Gender conforming was defined by questions about attitude on whether the mother justified husband's reason to beat his wife (86). Conforming means she agreed that there was a reason for a man to beat his wife.

5.4.3 Strengths and limitations

A previously described in Chapter 4, this study was the first epidemiological study of PLF in Indonesia that investigated determinants of PLF using data representative at the country level. This study also separated out predominant types of PLF and showed how their determinants differed with each other, which was rarely done in the existing literature. To my knowledge, when this study was designed, I only found two other studies that looked at factors associated with different PLF feeding types (22, 118), and in 2022 a multi-country study also separated out any PLF, milk-based, and water-based (89).

The main limitation of my study was that it did not have data on feeding intention and potential reasons for giving any PLF that have previously been reported in the existing studies (14, 128, 181-183, 220, 221), because the IDHS questionnaire did not ask questions about them. These include traditions, concern for newborn hunger, perceived insufficiency of breastmilk, pressure from family (husband/mother/mother in-law), advice from health providers, or failure to initiate breastfeeding within first hour. Moreover, the cross-sectional design had limited the possibility to make causal inference. However, to minimise ambiguous temporal sequence, variables were carefully selected to ensure that outcome variables did not occur before explanatory variables. Lastly, the relatively low prevalence of prelacteal honey and water implied that power to detect statistically significant associations was limited for these outcomes.

5.5 Conclusion

Determinants of PLF are not always the same for all types of PLF. Some factors, such as giving birth for the first time, had a consistent association across all types. Meanwhile other factors, such as mode and place of birth, wealth quintiles, and education, differed in the direction of association according to the nature of the feeds. Determinants for each type also evolved over time, possibly suggesting changes in the behavioural patterns which may have been contributed to by changes in the law, information, and public preferences. Understanding why PLF is practiced will help identify vulnerable groups and allow better targeted interventions to improve breastfeeding practice.

6 ASSOCIATION BETWEEN PRELACTEAL FEEDING AND BREASTFEEDING DURATION IN INDONESIA (2002 – 2017)

6.1 Chapter introduction

As reviewed in Chapter 2, PLF is considered to have detrimental impacts on optimal breastfeeding, hence the WHO/UNICEF recommends against it except when medically indicated (4). It is recognised that PLF can interfere with the positive feedback cycle in breastmilk production (3) and extensive evidence from multiple countries has shown that PLF is negatively associated with breastfeeding outcomes (34, 69, 136, 222-224). However, as shown in Literature Review (Chapter 2) some prospective studies have found no (145, 147) or a positive association (146) between PLF and breastfeeding outcomes. Furthermore, most studies have assessed PLF as one entity rather than looking at different PLF types.

Ideally, a randomised controlled trial is needed to investigate a causal relationship between PLF and breastfeeding outcomes. However, under the current global infant feeding recommendations, giving PLF as a direct intervention in general population can be complex and would be considered unethical, especially when the feed is known to be 'less ideal' (e.g. formula) or even unsuitable (e.g. honey) for infants. For this reason, observational studies from many different settings remain a valuable approach to seek further evidence. Indonesia is an interesting setting because in this country, breastfeeding for two years is the favourable and practiced tradition. This chapter aims to address Study Objective 3, which is to measure the association between PLF (overall and by type) and breastfeeding duration in Indonesia using IDHS 2002 – 2017.

6.2 Methods

This study investigated the association between PLF (overall and by type) and the duration of any breastfeeding by analysing IDHS datasets from the years 2002, 2007, and 2017. Analysis was not performed for the 2012 datasets as the 2012 IDHS did not have data on the children's age when their mother stopped breastfeeding. Details about IDHS data, the data collection process, and the definition of the variables used here were described in detail in Methods (Chapter 3). The conceptual framework developed for this study is shown in **Figure 6.1,** where the association between PLF (any, formula, honey, water, other milk) and breastfeeding duration was adjusted for covariables that were considered to be potential confounders. This framework is part of the overall thesis framework shown in Chapter 3 (Figure 3.1). The selection of the covariables included here was informed by the Literature Review (Chapter 2), findings from Chapter 5, and the availability of adequate measures in the IDHS datasets. The detailed modelling strategy is described in **6.2.5**.

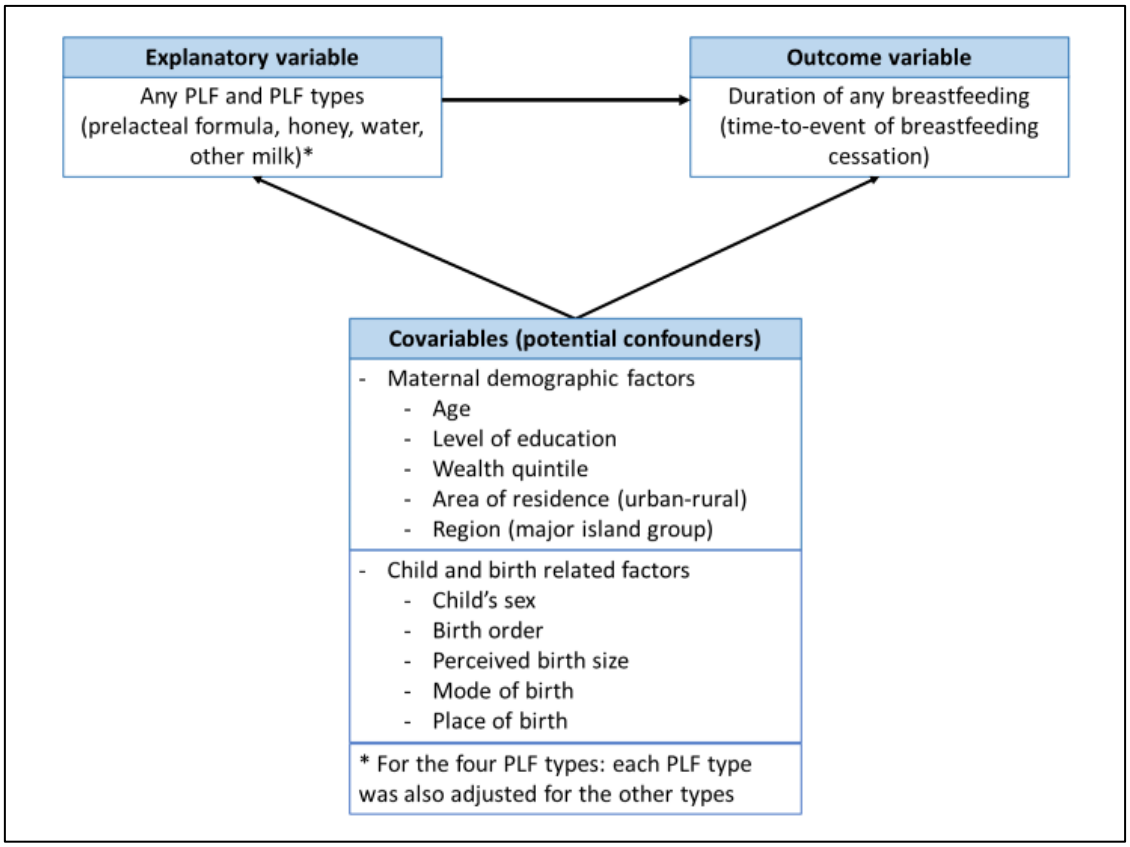


Figure 6.1. The conceptual framework of the association between PLF and breastfeeding duration.

6.2.1 Study population

As shown in **Figure 6.2**, the study population included mothers whose last child had ever been breastfed and was aged 0-23 months old at the time of the IDHS interview. This age range was selected by considering the WHO's current recommendation which states that breastfeeding should continue up to two years and beyond. Other guidelines may have a different age cut-off, but Indonesia follows the WHO recommendation (157). Similar to the previous chapters, the child's age in IDHS was measured in months, so children who were aged several weeks older than 23 months but had not yet had their second birthday would still be recorded as 23 months. The study population ranged between 5,558 in 2002 and 6,268 in 2007 (Figure 6.2), and details about handling missing data are explained in **Section 6.2.6**.

6.2.2 Outcome variables

In this study, the outcome of interest is the timing of breastfeeding cessation (**Figure 6.1**), defined as the child's age at which the mother reported that she stopped breastfeeding her child. The age was recorded in months and the question only applied to the youngest (last) child at the time of the interview. For example, if the mother had two children or more at the time she was interviewed, only information about the youngest child was collected and analysed in this study.

The follow-up time varies for each mother-child dyad and is determined by the child's age at the time of interview. If the mother reported that she stopped breastfeeding before interview, then the child's age when she stopped breastfeeding was recorded as the timing of the event. Consequently, for mothers who were still breastfeeding at the time of interview, the data were censored at the age of the child when interview took place.

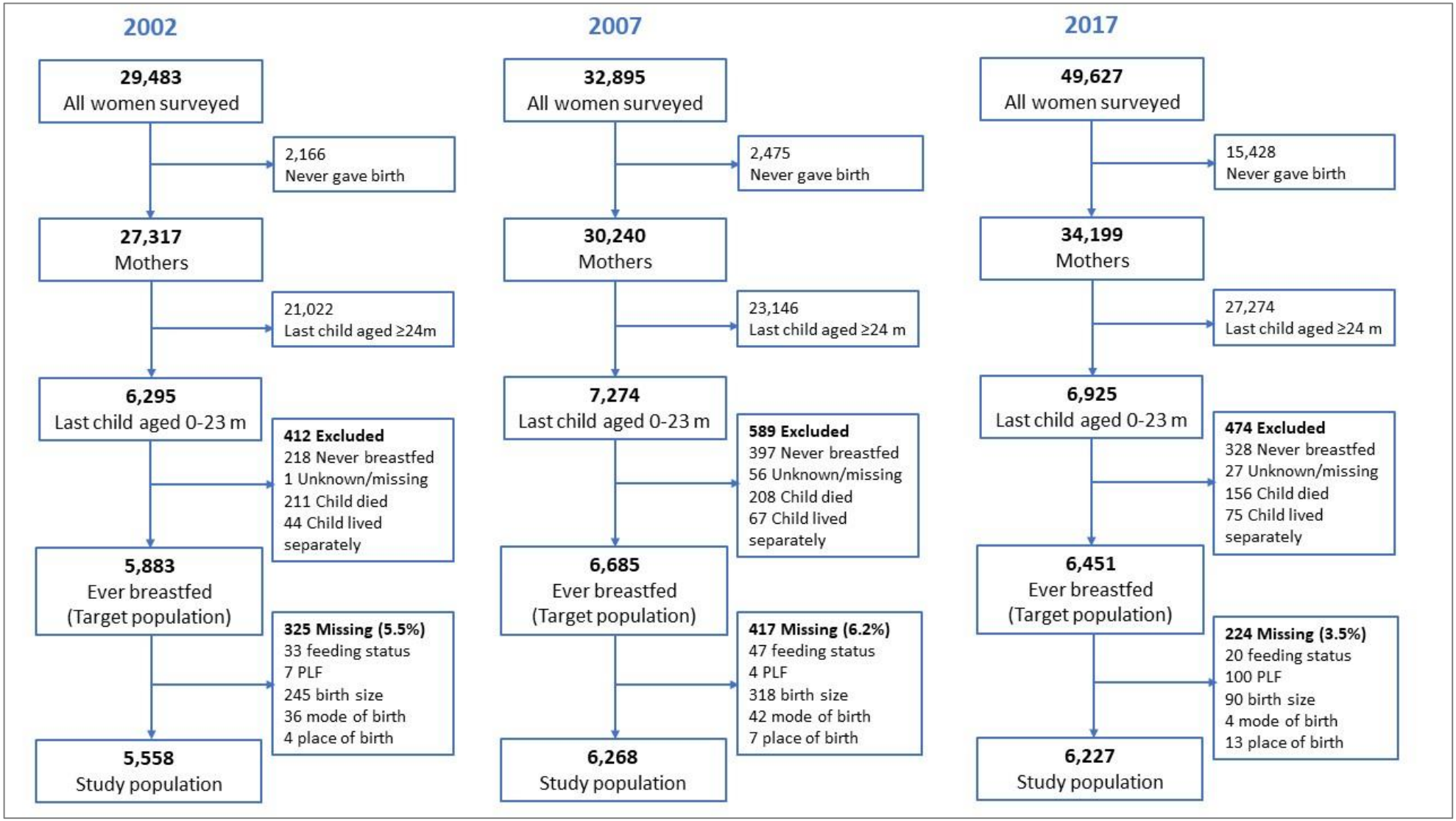


Figure 6.2. Selection of study population

6.2.3 Explanatory variables

In this chapter, PLF was the main explanatory variable and separate analyses were conducted for any PLF and three of the four predominant PLFs i.e. formula, honey, and water in all survey years (**Figure 6.1**). Other milk, despite being popular in the 2012 and 2017 surveys, was not explored in multivariable analyses for 2002 and 2007 because the prevalence was negligible in those survey periods, and the numbers were not sufficient for multivariable analysis. The definition of each explanatory variable is shown in Chapter 3 (Table 3.1).

6.2.4 Covariables (potential confounders)

As shown in **Figure 6.1**, the association between PLF and breastfeeding duration was adjusted for covariables that were potential confounders. These were IDHS variables that theoretically may have an association with both PLF and breastfeeding but are not a mediator. Additionally, these variables must have a clear and consistent definition in all IDHS datasets being analysed as well as have missing values of less than 10% in all IDHS datasets being analysed.

Maternal demographic factors (age, wealth quintile, education, area of residence, and major island group) and child's sex were included on an a priori basis. They were considered potential confounders based on the conceptual framework (**Figure 6.1**) and are routinely controlled for in other studies of PLF and therefore facilitate meaningful comparison across the literature. Child and birth-related variables were included based on the plausibility as well as evidence from previous studies as discussed in the Literature Review (Chapter 2) and my study findings in Chapter 5. Birth order (whether this was first child or subsequent child), place of birth, and mode of birth, were associated with PLF and were thought to affect breastfeeding duration as they might be related to mother's skill, experience, and potential subsequent pregnancy. Perceived birth size was also included as it may be related to the reason for giving PLF and the future decision of infant feeding.

6.2.5 Statistical modelling

Survival analysis was used to compare the reported duration of breastfeeding in mothers who gave PLF (any PLF, formula, honey, water, and other milk) and those who did not. The "event" of interest was the cessation of breastfeeding. The strength of the association or effect size is indicated by the hazard ratio (HR) obtained from Cox proportional hazards regression, where a HR larger than 1 is interpreted as the PLF group having a higher rate of breastfeeding cessation (i.e. a shorter duration of breastfeeding) than those who did not give PLF.

Initially, the effect of PLF on breastfeeding duration was examined graphically using the Kaplan–Meier (KM) estimate of survival. The survival difference between PLF groups was formally tested using the log-rank test. Next, a graphical assessment using log-log plots was used to test if the HR for all PLF explanatory variables was constant over time. A statistical test to check the proportional-hazards assumption based on Schoenfeld residuals was performed after fitting a model with Cox regression. All these assessments were only completed for the explanatory variables i.e. (any PLF, formula, honey, water, and other milk) because in this chapter I was interested to specifically look at the association between PLF and breastfeeding duration, not to build a prediction model for breastfeeding duration.

Since both graphical and statistical tests indicated violation of the proportional hazards assumption, I addressed this by fitting an interaction with time. The HR of breastfeeding cessation was estimated within three periods of observation time, which were 0-6 months, 7-12 months, and 13-23 months. These cut-offs were based on clinical importance, where 0-6 is the duration of exclusive breastfeeding as recommended by WHO, one year is the continued breastfeeding duration recommended by other guidelines such as the American Academy of Paediatrics (225), and two years is the continued breastfeeding duration recommended by WHO (3). Whether PLF is given or not, breastfeeding would eventually decrease as the baby gets older. As PLF is given

soon after birth, splitting observation time into several periods would allow clearer assessment on how PLF affected breastfeeding in the short and long term.

In the final multivariable model, the association between any PLF and breastfeeding duration was estimated, controlling for all the potential confounders (maternal and child and birth-related variables) shown in **Figure 6.1**. The association between each type of PLF was not only adjusted for maternal and child and birth-related variables, but also for each of the other PLF types. For example, the association between prelacteal formula and breastfeeding duration was adjusted for potential confounders, prelacteal honey, water, and other milk.

6.2.6 Dealing with missing and/or inconsistent data

As shown in Figure 6.2, the study population comprised of over 98% of the target population in each survey year. As explained in the Methods (Chapter 3), a complete case analysis was preferred over multiple imputation or other strategies because the proportion of missing values against the target population were below 10% for each survey year. Hence, a complete case analysis was adopted and mothers with missing values in one or more variables were not included in the analysis.

In addition, an occasional data discrepancy happened when duration of breastfeeding exceeded child's age at interview. This happened in 28 cases out of 6,227 respondents in 2017 IDHS and was considered as a technical error in recording. In such cases, the timing was corrected to the child's age at interview. For example, a mother whose last child was aged 16 months at interview was mistakenly recorded to have stopped breastfeeding at 19 months. Therefore, the month or breastfeeding cessation was corrected to 16 months.

6.2.7 Sensitivity analysis

Similar to Chapter 5, a sensitivity analysis was conducted for each survey year by adjusting for additional potential confounders to the main analysis presented in this chapter. The additional potential confounders were IDHS variables that were not available in all survey years and/or had missing values of >10% in at least one survey year. These were maternal and child (MCH) book (missing >10% in 2002-2007), religion (only available in 2002-2007), and immediate skin-to-skin contact (only available in 2017).

Religion may be associated with both PLF and breastfeeding. Possession of MCH book, also known as 'antenatal card' in the IDHS dataset, contained information about PLF and breastfeeding, thus having this book could influence decisions related to PLF and breastfeeding.

As described in Chapter 3, although there were other variables to reflect antenatal and postnatal care in the IDHS, MCH book was considered the closest proxy among the variables chosen for the present analysis, to reflect the quality of ANC and PNC services, as well as more specific information related to breastfeeding and PLF avoidance. Immediate skin-to-skin contact was seen as part of the process of early initiation of breastfeeding, which could affect both PLF and breastfeeding. Therefore, in 2002 and 2007, a sensitivity analysis was conducted by adding religion and MCH book to the multivariable model. In 2017, a sensitivity analysis was conducted by adding MCH book and immediate skin-to-skin contact to the multivariable model. The results of sensitivity analysis are shown in APPENDIX IV.

6.3 Results

6.3.1 Characteristics of the study population

Tables 6.1- 6.3 show characteristics of the study population in 2002, 2007, and 2017, respectively. They describe the characteristics of the study population by child's age group,

explanatory variables (any PLF, formula, honey, water, other milk), as well as covariables (maternal demographic, birth-related factors). They also show the rate of breastfeeding cessation, overall and by explanatory variables and covariables. As discussed in Chapter 4, the prevalence of any PLF ranged from 45% in 2017 to 67% in 2007. Across all survey years, at least half the children were aged 7-23 months at interview, and at least half the mothers were aged 20-34, had at least secondary education, lived in Java, gave birth for the second or subsequent time (multiparous), and perceived their child to be of average birth size. In 2002, among all mothers whose last child was aged 0-23 months, nearly 15% had stopped breastfeeding at the time of interview (**Table 6.1**). This prevalence increased to 17% and 21% in 2007 (**Table 6.2**) and 2017 (**Table 6.3**), respectively.

In 2002, as shown in **Table 6.1**, the breastfeeding cessation rate prior to 2 years was 18.2 per 100 person-years. The median (50th percentile) breastfeeding duration was not very meaningful because 50% mothers were still breastfeeding when their child was 23 months old in both PLF and non-PLF groups, hence it is not shown in the table. Overall, the 25th percentile for breastfeeding duration was 18 months, meaning that by the time the child turned 18-months-old, 25% mothers had stopped breastfeeding, while the remaining 75% were still breastfeeding. However, the 25th percentile for breastfeeding duration was shorter for mothers who gave prelacteal formula (16 months) compared to those who did not (20 months). In contrast, the 25th percentile for breastfeeding duration was 21 months for mothers who gave prelacteal honey and 18 months for mothers who did not.

In 2007 the breastfeeding cessation rate was about 21.3 per 100 person-years (**Table 6.2**) and, overall, the median breastfeeding duration was 23 months (not shown). Similar to 2002, the 25th percentile for breastfeeding duration in 2007 was 18 months for all mothers regardless of whether they gave any PLF, honey, water, or other milk. However, the 25th percentile for breastfeeding

duration was shorter for mothers who gave prelacteal formula (16 months) compared to those who did not (18 months).

In 2017, the breastfeeding cessation rate was 24.7 per 100 person-years and 25% of mothers had stopped breastfeeding at 16 months (**Table 6.3**) while the median breastfeeding duration was 23 months (not shown). The 25th percentile for breastfeeding duration was 14 months for mothers who gave any PLF and 18 months for mothers who did not. The 25th percentile was also shorter among mothers who gave prelacteal formula, other milk, and water, compared to those who did not give each of these substances. In contrast, the 25th percentile for breastfeeding duration was 20 months among mothers who gave prelacteal honey and 17 months among those who did not.

The breastfeeding cessation rate varied among women with different characteristics. In 2002 (**Table 6.1**), the rate was higher among mothers who had a higher level of education, came from a higher wealth quintile, lived in urban areas, and gave birth for the first time. In general, these patterns continued to be similar in 2007 (**Table 6.2**) and 2017 (**Table 6.3**).

Table 6.1. Characteristics of study population (2002)

Variable	Total		Stopped BF		Person-month	BF cessation rate /100 person-years	25th percentile of BF duration (months)
	n	%	N	%			
Total	**5,558**	**100.0**	**817**	**14.7**	52472.33	18.15 (16.1-20.52)	18
Child's age at interview							
0-6 months	1,758	31.7	71	4.5	4958.89	18.13 (12.39-27.57)	.
7-12 months	1,339	24.6	142	11.2	11609.30	14.95 (10.68-21.57)	.
13-23 months	2,461	43.7	604	25.1	35904.14	19.18 (16.81-21.99)	18
PLF variables							
Any PLF							
No	2,292	40.7	309	14.1	21,599.66	16.73 (13.84-20.41)	18
Yes	3,266	59.3	508	15.8	30,872.67	19.14 (16.43-22.43)	18
Formula							
No	3,505	62.5	439	12.6	33,825.90	14.62 (12.46-17.26)	20
Yes	2,053	37.5	378	19.4	18,646.42	24.55 (20.54-29.55)	16
Honey							
No	4,798	87.3	721	15.6	44,985.55	19.07 (16.78-21.74)	18
Yes	760	12.8	96	11.8	7,486.78	12.64 (8.93-18.58)	21
Water							
No	5,007	89.6	743	15.2	46,699.20	18.35 (16.16-20.92)	18
Yes	551	10.4	74	14.6	5,773.13	16.52 (11.61-24.46)	21
Other milk*							
No	5,538	99.7	813	15.2	52,344.86	18.15 (16.11-20.53)	18
Yes	20	0.3	4	12.4	127.46	15.98 (4.48-68.48)	17
Maternal demographic							
Maternal age							
15-19	358	6.9	42	17.5	2,848.80	26.54 (16.03-47.48)	12
20-24	1,457	26.8	228	15.8	13,549.39	19.65 (15.51-25.25)	18
25-29	1,619	28.4	247	16.7	15,255.81	19.61 (15.82-24.6)	18
30-34	1,199	19.7	176	12.8	10,903.86	14.53 (11.67-18.31)	21
>=35	925	18.2	124	13.3	9,914.47	15.41 (11.52-21.02)	20
Level of education							
None/primary	2,597	49.1	253	8.4	26,275.69	9.85 (7.86-12.51)	23
Secondary	2,541	44.1	455	20.1	23,027.29	24.18 (20.76-28.33)	16
Higher	420	6.9	109	31.7	3,169.34	43.11 (31.48-60.24)	8
Wealth quintile							
Q1 (least affluent)	1,708	21.0	180	10.3	11,565.93	11.74 (9.49-14.69)	20
Q2	1,065	18.9	117	8.0	10,199.03	9.33 (7.19-12.3)	22
Q3	963	20.2	126	13.5	10,657.25	16.07 (12.01-21.95)	20
Q4	897	20.3	163	16.0	10,794.21	18.98 (14.34-25.58)	20
Q5 (most affluent)	925	19.6	231	28.1	9,255.91	37.3 (30.44-46.19)	12
Area of residence							
Urban	2,342	47.9	460	20.7	23,874.86	26.11 (22.31-30.74)	15
Rural	3,216	52.1	357	10.1	28,597.47	11.5 (9.74-13.67)	20
Region							
Sumatera	1,631	22.9	230	14.8	12,079.14	17.67 (14.82-21.22)	18
Java	1,446	55.8	240	15.0	29,076.96	18.04 (14.95-21.96)	20
Bali-Nusa Tenggara	644	5.9	85	13.3	3,356.08	14.82 (11.66-19.12)	18
Kalimantan	768	6.6	96	13.2	3,503.62	15.64 (12.44-19.89)	22
Sulawesi	1,069	8.8	166	19.8	4,456.53	24.62 (17.75-35.5)	12
Maluku-Papua	NA	NA	NA	NA	NA	NA	NA
Child and birth-related							
Sex of the child							
Male	2,857	51.7	427	16.4	26,674.44	20.02 (17.03-23.7)	18
Female	2,701	48.3	390	13.8	25,797.89	16.21 (13.61-19.45)	19
Birth order							

Variable	Total		Stopped BF		Person-month	BF cessation rate /100 person-years	25th percentile of BF duration (months)
	n	%	N	%			
First	1,828	32.3	330	21.0	16,677.14	25.64 (21.16-31.36)	15
Second/subsequent	3,730	67.7	487	12.3	35,795.19	14.66 (12.65-17.08)	20
Perceived birth size							
Larger	1,758	32.0	255	15.2	16,080.56	18.97 (15.14-24.11)	18
Average	3,045	55.4	444	15.3	29,495.16	18.04 (15.49-21.12)	18
Smaller	755	12.7	118	14.5	6,896.61	16.7 (11.86-24.18)	19
Place of birth							
Home birth	3326.0	55.7	367	10.5	30,340.05	12.1 (10.09-14.64)	21
Public facilities	617.0	10.0	115	20.8	4,888.94	26.79 (19.37-38.15)	13
Private facilities	1615.0	34.3	335	21.1	17,243.33	26.34 (22.12-31.58)	14
Mode of birth							
Vaginal	5,328	95.6	760	14.9	50,473.99	17.68 (15.6-20.11)	18
Caesarean	230	4.4	57	21.6	1,998.34	30.03 (20.05-46.06)	15

*Other milk was not included in the multivariable analysis due to low prevalence

Table 6.2. Characteristics of study population (2007)

Variable	Total		Stopped BF		Person-month	BF cessation rate /100 person-years	25th percentile of BF duration (months)
	n	%	n	%			
Total	**6,268**	**100.0**	**1,222**	**17.4**	56536.73	21.34 (19.61-23.25)	18
Child's age at interview							
0-6 months	1,918	31.3	126	5.1	5586.67	19.75 (15.07-26.35)	.
7-12 months	1,714	27.3	249	12.8	13845.42	17.48 (14.47-21.28)	.
13-23 months	2,636	41.3	847	29.9	37104.65	23.02 (20.81-25.5)	18
PLF variables							
Any PLF							
No	2,253	32.6	388	14.3	19,390.11	16.66 (14.37-19.41)	18
Yes	4,015	67.4	834	19.0	37,146.62	23.78 (21.48-26.38)	18
Formula							
No	3,425	50.5	567	14.8	30,220.94	17.12 (15.18-19.37)	18
Yes	2,843	49.5	655	20.1	26,315.80	26.19 (23.26-29.55)	16
Honey							
No	5,565	89.1	1110	17.7	49,970.47	21.8 (19.94-23.87)	18
Yes	703	10.9	112	15.5	6,566.27	17.84 (13.71-23.58)	18
Water							
No	5,686	90.2	1132	17.7	50,666.83	21.77 (19.92-23.82)	18
Yes	582	9.8	90	15.2	5,869.91	17.62 (13.38-23.62)	18
Other milk*							
No	6,245	99.7	1219	17.5	56,315.94	21.39 (19.66-23.31)	18
Yes	23	0.3	3	7.6	220.80	7.57 (1.67-46.07)	.
Maternal demographic							
Maternal age							
15-19	354	5.6	44	11.1	2,695.55	16.05 (10.4-26.14)	18
20-24	1,552	25.4	317	17.2	13,746.96	21.96 (18.46-26.28)	18
25-29	1,820	28.2	383	20.3	15,283.91	25.93 (22.49-30.02)	16
30-34	1,436	22.1	286	18.0	13,159.07	20.86 (17.54-24.96)	18
>=35	1,106	18.7	192	14.7	11,651.25	16.34 (13.17-20.48)	19
Level of education							
None/primary	2,476	40.6	358	12.5	25,081.02	14.01 (12.09-16.32)	19
Secondary	3,243	50.7	693	19.3	27,293.56	24.76 (22.14-27.76)	18
Higher	549	8.7	171	29.7	4,162.15	43.04 (33.38-55.94)	7
Wealth quintile							
Q1 (least affluent)	1,751	20.5	240	13.1	12,131.19	15.29 (13-18.1)	18
Q2	1,233	18.5	212	13.8	11,055.72	16 (13.28-19.43)	18
Q3	1,153	21.0	205	14.9	11,907.38	18.1 (14.73-22.43)	18
Q4	1,094	20.7	258	19.4	11,622.99	23.94 (19.84-29.05)	18
Q5 (most affluent)	1,037	19.3	307	26.3	9,819.46	35.68 (29.8-42.91)	12
Area of residence							
Urban	2,433	42.0	608	21.8	22,238.27	28.5 (25.2-32.31)	14
Rural	3,835	58.1	614	14.3	34,298.47	16.7 (14.87-18.81)	18
Region							
Sumatera	1,946	22.7	403	20.3	12,993.67	24.53 (21.85-27.61)	23
Java	1,440	54.3	268	15.7	30,584.30	19.34 (16.63-22.59)	18
Bali-NusaTenggara	577	6.3	102	17.3	3,643.72	20.81 (17.16-25.46)	16
Kalimantan	628	6.1	125	19.7	3,414.32	24.5 (20.19-29.94)	15
Sulawesi	1,096	8.4	201	18.2	4,706.84	22.32 (19.02-26.33)	15
Maluku-Papua	581	2.2	123	21.0	1,193.87	26.68 (21.77-33)	13
Child and birth-related							
Sex of the child							
Male	3,301	52.9	649	17.8	29,129.49	22.33 (19.91-25.12)	18
Female	2,967	47.1	573	17.1	27,407.25	20.28 (17.93-23.02)	18
Birth order							

Variable	Total		Stopped BF		Person-month	BF cessation rate /100 person-years	25th percentile of BF duration (months)
	n	%	n	%			
First	2,063	35.3	479	20.7	18,833.18	26.91 (23.38-31.08)	16
Second/subsequent	4,205	64.7	743	15.6	37,703.55	18.55 (16.71-20.65)	18
Perceived birth size							
Larger	2,102	32.9	384	17.5	18,448.40	21.56 (18.6-25.11)	18
Average	3,227	53.5	657	17.2	29,762.96	21.44 (19.11-24.11)	18
Smaller	939	13.6	181	18.2	8,325.38	20.49 (16.37-25.93)	18
Place of birth							
Home birth	3,488	49.0	561	14.1	29,570.90	16.19 (14.36-18.31)	18
Public facilities	911	11.6	195	21.1	5,828.24	28.99 (23.08-36.8)	16
Private facilities	1,869	39.4	466	20.5	21,137.60	26.43 (23.11-30.32)	15
Mode of birth							
Vaginal	5,795	92.1	1099	17.0	53,044.21	20.42 (18.69-22.35)	18
Caesarean	473	7.9	123	22.6	3,492.53	35.29 (26.76-47.07)	12

Table 6.3. Characteristics of study population (2017)

Variable	Total		Stopped BF		Person-month	BF cessation rate /100 person-years	25th percentile of BF duration (months)
	n	%	n	%			
Total	**6,227**	**100.0**	**1,421**	**20.5**	59589.04	24.72 (23.13-26.45)	17
Child's age at interview							
0-6 months	1,802	28.1	156	7.7	5195.09	29.85 (24.39-36.89)	.
7-12 months	1,555	25.2	299	17.6	12871.09	24.78 (21.47-28.73)	.
13-23 months	2,870	46.7	966	29.8	41522.87	24.07 (22.21-26.1)	17
PLF variables							
Any PLF							
No	3,371	55.4	638	17.2	34,466.55	19.87 (18.07-21.9)	18
Yes	2,856	44.7	783	24.6	25,122.49	31.38 (28.58-34.5)	14
Formula							
No	4,639	74.7	954	18.6	45,738.62	21.77 (20.09-23.61)	18
Yes	1,588	25.3	467	26.3	13,850.43	34.48 (30.57-38.97)	12
Honey							
No	5,963	96.5	1,362	20.7	57,449.94	24.92 (23.29-26.69)	17
Yes	264	3.5	59	16.6	2,139.10	19.36 (13.53-28.27)	20
Water							
No	5,898	95.1	1,345	20.5	56,523.69	24.72 (23.09-26.49)	17
Yes	329	4.9	76	21.5	3,065.36	24.78 (18.47-33.75)	16
Other milk*							
No	5,406	86.0	1,184	19.6	51,645.17	23.5 (21.86-25.28)	18
Yes	821	14.0	237	25.9	7,943.87	32.7 (27.6-38.89)	12
Maternal demographic							
Maternal age							
15-19	296	4.4	55	16.2	2,096.52	24.17 (16.79-35.62)	18
20-24	1,220	20.0	292	22.2	11,202.46	28.4 (24.62-32.89)	16
25-29	1,702	26.8	407	22.1	15,489.42	27.5 (24.3-31.19)	15
30-34	1,589	25.8	336	19.4	15,794.78	22.74 (19.88-26.11)	18
>=35	1,420	23.0	331	19.3	15,005.86	21.28 (18.51-24.55)	18
Level of education							
None/primary	1,432	23.6	231	13.5	15,160.43	15.08 (12.79-17.88)	20
Secondary	3,556	59.4	800	20.9	35,515.83	25.13 (23.05-27.43)	17
Higher	1,239	17.0	390	28.9	8,912.78	39.53 (34.53-45.34)	8
Wealth quintile							
Q1 (least affluent)	1,637	19.8	279	14.6	12,614.96	16.41 (14.13-19.15)	18
Q2	1,252	20.4	254	16.0	12,274.42	19.04 (16.16-22.54)	18
Q3	1,151	20.0	260	20.4	11,963.95	24.46 (20.96-28.66)	17
Q4	1,126	20.7	291	22.7	12,139.12	27.85 (24.21-32.13)	16
Q5 (most affluent)	1,061	19.2	337	29.2	10,596.58	37.94 (33.09-43.58)	9
Area of residence							
Urban	3,060	48.5	847	25.0	27,989.47	31.08 (28.55-33.87)	13
Rural	3,167	51.5	574	16.3	31,599.58	19.1 (17.17-21.28)	18
Region							
Sumatera	1,654	22.9	353	19.5	13,427.40	23.87 (21.15-27.01)	17
Java	1,869	55.0	402	20.1	33,528.26	23.71 (21.37-26.36)	18
Bali-Nusa Tenggara	614	6.0	122	19.5	3,666.13	22.98 (18.85-28.24)	16
Kalimantan	535	5.6	141	22.4	3,255.28	27.81 (22.6-34.41)	16
Sulawesi	971	7.3	239	24.4	4,047.96	31.8 (27.31-37.15)	13
Maluku-Papua	584	3.1	164	24.7	1,664.01	32.66 (26.63-40.36	12
Child and birth-related							
Sex of the child							
Male	3,229	51.4	781	22.0	30,176.47	26.9 (24.56-29.5)	15

Variable	Total		Stopped BF		Person-month	BF cessation rate /100 person-years	25th percentile of BF duration (months)
	n	%	n	%			
Female	2,998	48.6	640	18.9	29,412.58	22.49 (20.4-24.84)	18
Birth order							
First	1,981	32.6	556	25.8	18,452.23	32.72 (29.39-36.49)	12
Second/subsequent	4,246	67.5	865	17.9	41,136.81	21.14 (19.42-23.04)	18
Perceived birth size							
Larger	2,067	31.4	460	19.8	18,757.99	23.8 (21.16-26.85)	17
Average	3,384	57.6	756	20.2	34,516.04	24.25 (22.17-26.56)	17
Smaller	776	11.0	205	24.1	6,315.02	30.06 (25.06-36.22)	15
Place of birth							
Home birth	1,291	15.9	277	18.2	10,388.20	20.06 (17.13-23.61)	18
Public facilities	2,419	34.4	490	18.2	19,949.02	22.56 (20.05-25.43)	18
Private facilities	2,517	49.7	654	22.8	29,251.82	27.86 (25.38-30.62)	15
Mode of birth							
Vaginal	5,083	81.1	1,084	19.3	48,933.32	23 (21.33-24.83)	18
Caesarean	1,144	18.9	337	25.6	10,655.72	32.64 (28.3-37.74)	12

6.3.2 Association between PLF and breastfeeding duration

Figure 6.3 shows Kaplan-Meier (KM) curves for breastfeeding continuation rates and log-rank p-values for all PLF types (i.e. overall PLF and formula, honey, water, and other milk) in all survey years. These were unadjusted and did not take potential confounders into account. Since the curves indicate that the HRs were not constant over time (log-rank $p<0.05$), an interaction with time was fitted and age-specific HRs are presented in **Table 6.4**.

Table 6.4 shows the HRs for breastfeeding cessation for overall PLF and the four types of PLF, except that the HRs for other milk are not presented for 2002 and 2007 because the prevalence was too low to produce interpretable results. Both the crude and adjusted HRs are shown. A *p*-value of less than 0.05 indicated evidence of an interaction with time that was considered statistically significant at the 5% level. For the four PLF types, HRs were adjusted for other types of PLF when the mother reported giving multiple PLFs (e.g., honey and formula). Sensitivity analyses, where potential confounders with inconsistent availability and/or many missing values were included, produced similar direction and size of the association between PLF and breastfeeding duration (APPENDIX IV).

Any PLF

As shown in **Figure 6.3** (top left picture), there was no difference in breastfeeding duration between the PLF and no-PLF groups (p=0.49) in 2002. However in 2007 and 2017, mothers who gave any PLF appeared to be more likely to stop breastfeeding earlier than those who did not (**Figure 6.3**, last two pictures on the left). After adjusting for potential confounders, any PLF was found to be associated with shorter breastfeeding duration in 2007 and 2017 (**Table 6.4**). In particular, mothers who gave any PLF were about 1.3-1.5 more likely to stop breastfeeding earlier compared to those who did not give any PLF.

After fitting an interaction with time (**Table 6.4**), this association was found to be observed only in the first 6 months and was only statistically significant in 2007 and 2017. For the 0-6 months period, the HR was 2.13 (1.55-2.92) in 2007 and 2.07 (1.74-2.47) in 2017. This means that in the first 6 months, mothers who gave any PLF were about twice as likely to stop breastfeeding earlier than those who did not give PLF.

Prelacteal formula

Similar to any PLF, mothers who gave prelacteal formula were more likely to stop breastfeeding earlier than those who did not, and this was apparent in the KM curves from all survey years (**Figure 6.3**, first three pictures on the right). However, after adjusting for potential confounders, this association was found to be statistically significant only in 2007 and 2017. Again, there was a significant interaction with time, with mothers who gave prelacteal formula being more likely to stop breastfeeding earlier in the first 6 months in 2007 (HR 2.34, 1.73-3.16) and 2017 (HR 2.13,1.78-2.53) (**Table 6.4**). In 2002, this association was not statistically significant, but the lower CI bound was very close to 1 (HR 1.58, 0.99-2.50).

Prelacteal honey

In 2002, mothers who gave prelacteal honey were less likely to stop breastfeeding earlier than those who did not (**Figure 6.4**, the top left picture). After adjusting for potential confounders (**Table 6.4**), the association was not statistically significant for the period as a whole (0-23 months). After fitting an interaction with time, mothers who gave prelacteal honey in 2002 were less likely to stop breastfeeding earlier in the first 6 months (HR 0.55, 95% CI 0.31-0.99) and in the 7-12 months period (HR 0.3, 0.19-0.70). However, the KM curves for prelacteal honey did not show the same patterns in 2007 and 2017 (**Figure 6.4**, the second and third pictures on the left). After adjusting for potential confounders and fitting an interaction with time, there was no association between prelacteal honey and breastfeeding cessation except for being less likely to stop earlier in the first 6 months in 2007, with HR 0.47 (0.27-0.81).

Prelacteal water

The observed effects of prelacteal water on breastfeeding duration were the least consistent across survey years (**Figure 6.4**, the first three pictures on the right). After adjusting for potential confounders and fitting an interaction with time (**Table 6.4**), the association remained not statistically significant in most periods of all survey years. Prelacteal water was only statistically significant in the first 6 months in 2007, with HR 0.55 (0.34-0.91).

Prelacteal milk other than formula

KM curves and HRs for prelacteal milk other than formula was only shown for the 2017 IDHS because the prevalence for this type of PLF was negligible in 2002 and 2007. Like any PLF and prelacteal formula, mothers who gave other milk as PLF were more likely to stop breastfeeding earlier than those who did not (**Figure 6.4**, last picture at the bottom). After adjusting for potential confounders, HR for 0-23 months was 1.46 (1.21-1.76). After fitting an interaction with time, this association was only statistically significant for 0-6 months period, with HR 1.73 (1.39-2.15)

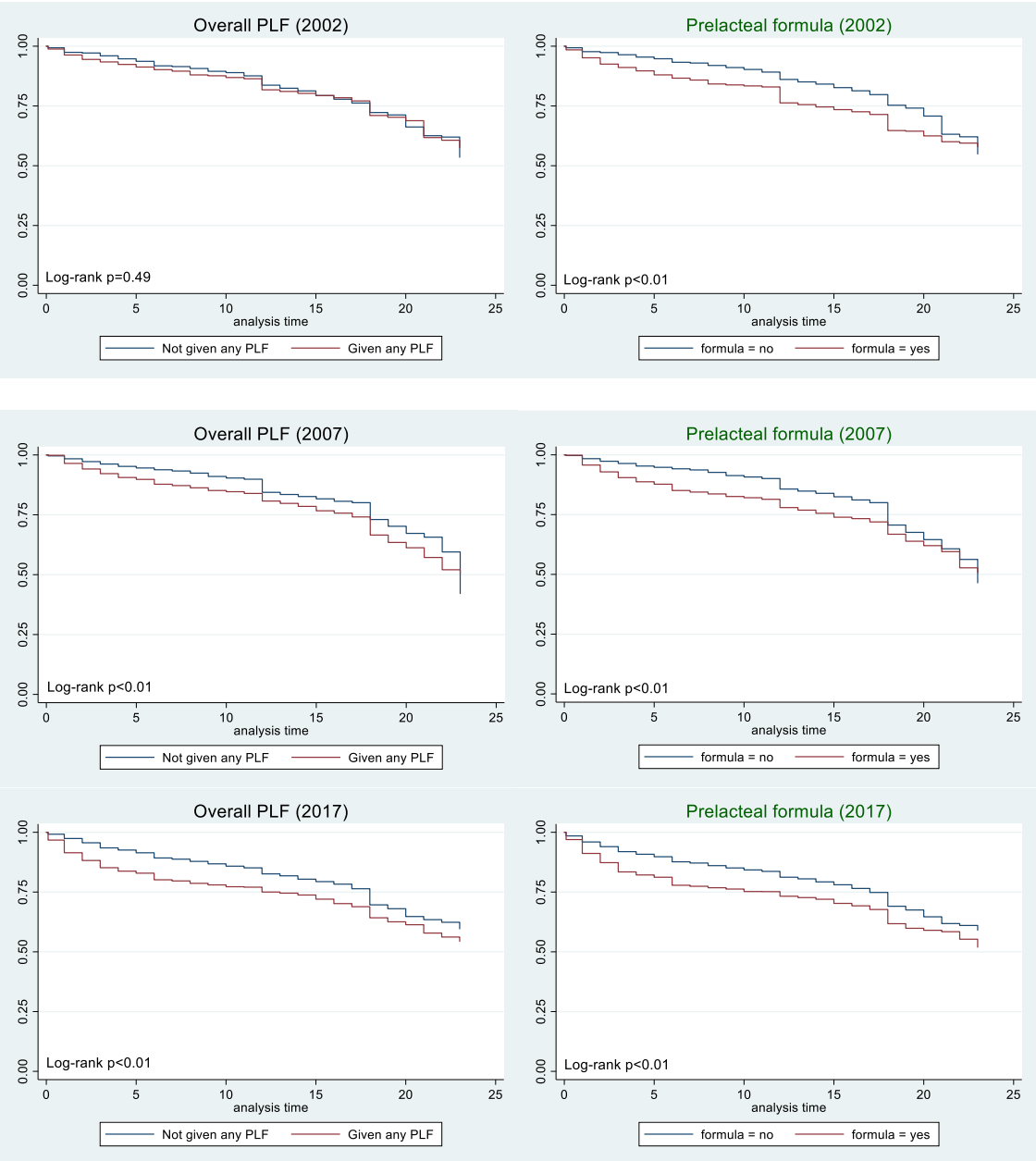


Figure 6.3. Kaplan-Meier curves for any PLF and prelacteal formula (2002-2017)

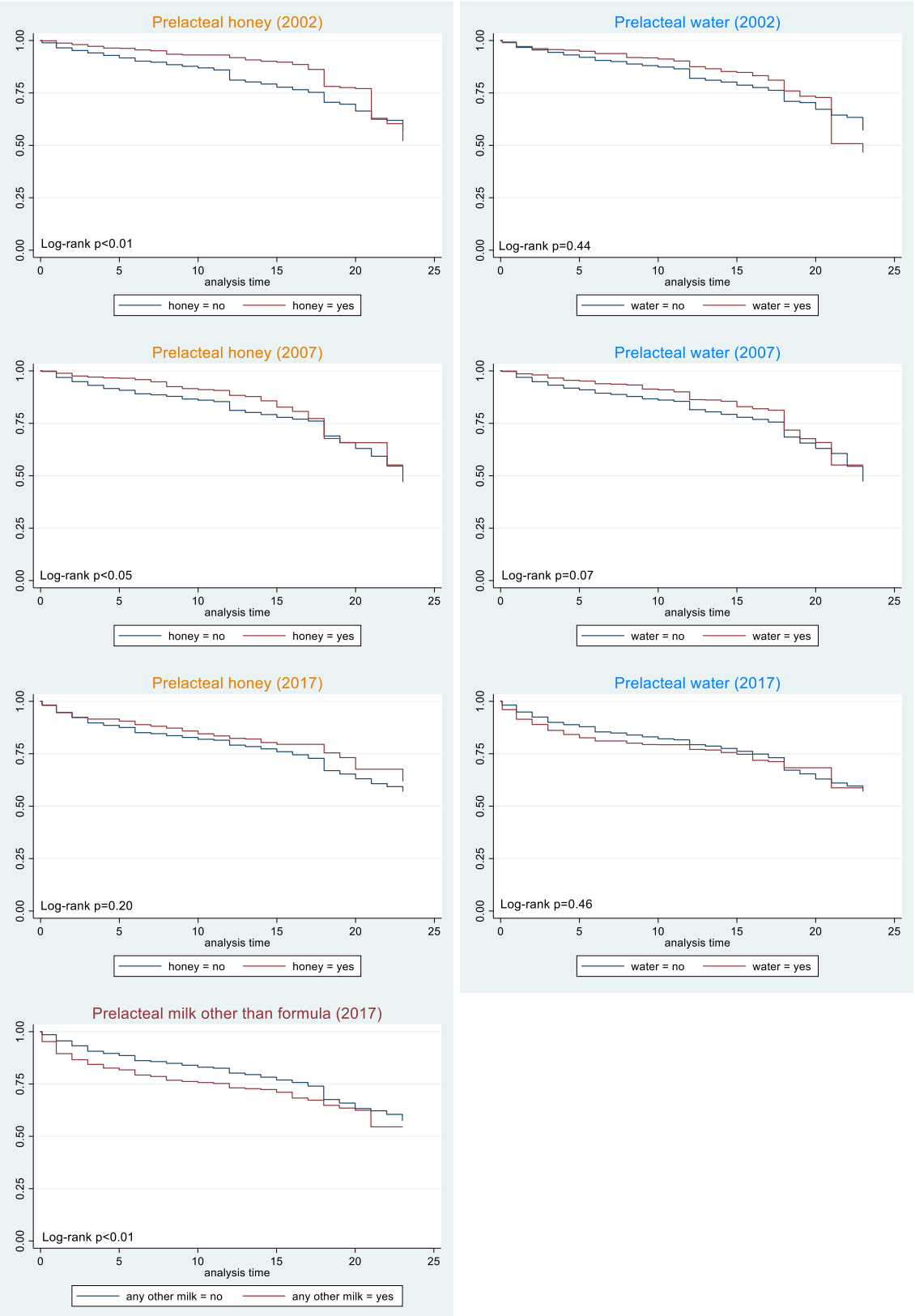


Figure 6.4. Kaplan-Meier curves for prelacteal honey and water (2002-2017) and other milk (2017)

Table 6.4. Hazard ratio (HR) and the 95% CI of breastfeeding cessation for any PLF and each type 2002-2017

Variable	2002		2007		2017	
	Crude HR	Adjusted HR	Crude HR	Adjusted HR	Crude HR	Adjusted HR
Any PLF						
HR 0-23 mo	1.13 (0.88-1.46)	0.90 (0.70-1.16)	1.43 (1.18-1.72)	1.33 (1.11-1.61)	1.55 (1.36-1.77)	1.47 (1.28-1.69)
*p-value**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
HR 0-6 mo	1.43 (0.91-2.25)	1.12 (0.72-1.75)	2.32 (1.69-3.18)	2.13 (1.55-2.92)	2.17 (1.83-2.58)	2.07 (1.74-2.47)
HR 7-12 mo	1.09 (0.68-1.74)	0.85 (0.55-1.33)	0.81 (0.60-1.10)	0.76 (0.56-1.03)	0.83 (0.61-1.13)	0.79 (0.58-1.08)
HR 13-23 mo	0.85 (0.59-1.23)	0.70 (0.48-1.01)	1.23 (0.87-1.73)	1.18 (0.83-1.67)	0.98 (0.75-1.30)	0.91 (0.68-1.21)
Formula						
HR 0-23 mo	1.71 (1.34-2.18)	1.07 (0.80-1.44)	1.53 (1.28-1.82)	1.19 (0.99-1.43)	1.56 (1.35-1.79)	1.58 (1.36-1.84)
*p-value**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
HR 0-6 mo	2.56 (1.68-3.90)	1.58 (0.99-2.50)	3.08 (2.31-4.11)	2.34 (1.73-3.16)	2.08 (1.75-2.46)	2.13 (1.78-2.53)
HR 7-12 mo	1.67 (1.03-2.71)	1.03 (0.64-1.66)	0.92 (0.68-1.25)	0.72 (0.53-0.98)	0.73 (0.50-1.06)	0.73 (0.50-1.06)
HR 13-23 mo	0.92 (0.62-1.36)	0.60 (0.39-0.91)	0.88 (0.63-1.24)	0.71 (0.5-1)	1.02 (0.74-1.39)	1.02 (0.73-1.41)
Honey						
HR 0-23 mo	0.63 (0.45-0.90)	0.74 (0.55-1.01)	0.81 (0.60-1.08)	0.96 (0.71-1.30)	0.79 (0.55-1.14)	0.83 (0.57-1.22)
*p-value**	0.03	<0.001	<0.001	<0.001	0.89	<0.001
HR 0-6 mo	0.45 (0.25-0.80)	0.55 (0.31-0.99)	0.39 (0.22-0.67)	0.47 (0.27-0.81)	0.79 (0.49-1.26)	0.82 (0.52-1.31)
HR 7-12 mo	0.31 (0.16-0.59)	0.37 (0.19-0.70)	1.02 (0.61-1.71)	1.20 (0.71-2.02)	0.96 (0.47-1.99)	1.02 (0.49-2.13)
HR 13-23 mo	1.20 (0.72-2.03)	1.33 (0.86-2.06)	1.28 (0.78-2.10)	1.53 (0.92-2.54)	0.67 (0.30-1.46)	0.71 (0.32-1.61)
Water						
HR 0-23 mo	0.86 (0.60-1.22)	1.01 (0.72-1.42)	0.80 (0.59-1.08)	0.97 (0.72-1.30)	1.01 (0.75-1.37)	1.05 (0.76-1.45)
*p-value**	0.28	<0.001	0.05	<0.001	0.09	<0.001
HR 0-6 mo	0.58 (0.29-1.20)	0.79 (0.39-1.62)	0.55 (0.34-0.91)	0.67 (0.41-1.09)	1.19 (0.83-1.70)	1.28 (0.89-1.84)
HR 7-12 mo	0.68 (0.37-1.23)	0.84 (0.45-1.55)	0.94 (0.56-1.60)	1.10 (0.65-1.85)	0.64 (0.28-1.47)	0.67 (0.29-1.55)
HR 13-23 mo	1.37 (0.80-2.35)	1.37 (0.83-2.24)	1.05 (0.61-1.79)	1.31 (0.78-2.22)	0.83 (0.43-1.60)	0.78 (0.39-1.55)
Other milk						
HR 0-23 mo	The prevalence of 'other milk' was too low in these study years for meaningful analysis to be conducted.				1.37 (1.14-1.64)	1.46 (1.21-1.76)
*p-value**					<0.001	<0.001
HR 0-6 mo					1.63 (1.32-2.02)	1.73 (1.39-2.15)
HR 7-12 mo					1.16 (0.76-1.78)	1.32 (0.85-2.06)
HR 13-23 mo					0.88 (0.58-1.34)	0.93 (0.60-1.46)

*Indicates p-value for interaction with time.
Adjusted HRs were HRs after controlling for maternal demographic and child-and birth related variables.
HR>1 (red font) indicates that PLF is associated with earlier cessation of any breastfeeding.

6.4 Discussion

6.4.1 Summary of findings

This study finds that majority of mothers in Indonesia breastfed for at least 23 months, which is in line with the current global recommendation (2). However, giving any PLF was associated with shorter duration of any breastfeeding in most of the survey years. Generally, for any PLF and most types of PLF, the largest effect size was seen on the breastfeeding cessation rates in the first 6 months. After this period, there was no evidence that cessation was associated with PLF. There were some differences in the association between each of the four types of PLF (formula, honey, water, and other milk) and breastfeeding duration. Similar to any PLF, prelacteal formula and other milk were associated with a shorter breastfeeding duration in most survey years. However, prelacteal honey was associated with a longer breastfeeding duration in most survey years. Finally, prelacteal water had no association in any survey year.

6.4.2 Any PLF and breastfeeding duration

Results presented in this chapter indicate that mothers who gave any PLF to their child were more likely to stop breastfeeding earlier than those who did not. This is consistent with results from most studies on PLF and breastfeeding duration (34, 69, 136, 222-224). This association was only found in the first 6 months, most likely due to the fact that closer to the end of the second year, breastfeeding will stop regardless of PLF status. Moreover, babies are expected to start complementary feeds (solids) after six months of age because breastmilk alone cannot fulfil their entire nutritional requirements.

This study also gives evidence that although giving any PLF was associated with a shorter breastfeeding duration, this association can differ across different types of PLF. In this case, prelacteal formula and other milk were also associated with a shorter breastfeeding duration, prelacteal honey with a longer duration, while no association was found for prelacteal water. This shows that the impact of PLF on breastfeeding is likely to be

dependent on the substance given, which is also related to the amount, frequency, reason for giving it.

6.4.3 Prelacteal formula and breastfeeding duration

Prelacteal formula was the most common feed which made up the largest part of PLF types in all survey years, hence the pattern of association with breastfeeding duration was similar to that of any PLF. These findings suggest that prelacteal formula may affect breastfeeding duration through a mechanism that is different from prelacteal honey or water. Compared to the other feeds, formula has the closest features to breastmilk and is most likely given for nutritional purposes, rather than cultural or religious reasons. Hence, the chance of disrupting breastfeeding by making the baby feel full and decreasing the frequency for breastfeeding as well as stimulation for milk production (3) was more plausible in this context. Consequently, supplementing with formula due to breastfeeding difficulties in the first few days can lead to more problems (3, 4). In addition to disrupting the baby's natural hunger and satiety, prelacteal formula is often given using bottles and teats which can affect the baby's ability to suckle at the breast (3, 4). Despite unclear causal evidence, feeding difficulties are considered to contribute to maternal psychological stress, which negatively affects the mother's milk production (226). A combination of maternal stress and decreased frequency of baby's suckling may create a vicious cycle of suboptimal breastfeeding (3, 4, 226, 227).

In the context of prelacteal formula, this study supports the current WHO guidelines that recommend avoidance of food or drink for newborns other than breastmilk, unless medically indicated. My findings were also consistent with many studies from other countries which found that administration of formula in the early days of birth was associated with shorter breastfeeding duration (69, 136, 222-224, 228, 229), including the most recent systematic review that looked at 48 prospective studies from countries in North America, East Asia and Pacific, South Asia, Latin America and Caribbean, Europe, North Africa, and Sub-Saharan

Africa (69). My study, however, had a different finding from some experimental studies from the Czech Republic (147) and the United States (146), which showed that a limited amount of formula feeding in the first days was found to have no adverse effects or instead improved breastfeeding duration. The study populations were restricted to babies who lost at least 5% of their birthweight in the first few days. In clinical practice, this condition presents a dilemma for health practitioners, because medically indicated prelacteal formula is not always a clear-cut decision and can be affected by many other factors. Moreover, a later study by the same first author as the US study found that early limited feeding did not improve breastfeeding duration (230) when it was introduced in a population with a high breastfeeding rate.

These mixed findings show that there is a thin line between when PLF can be harmful and beneficial. However, WHO recommends that under normal conditions, a newborn does not need additional or substitute food/drink other than breastmilk in the first 2-4 days of life (65). My study acknowledges such circumstances and did not intend to disprove that prelacteal formula can sometimes be needed in certain circumstances including neonatal hyperbilirubinemia and dehydration.

Multiple factors contribute to breastfeeding success (6) and the challenges to achieving it can vary among different populations and individuals (29). In Indonesia, some of the challenges include unethical formula marketing to women and health professionals and managing mothers' own perception of poor milk supply (220, 231). Qualitative studies in Jakarta reported that giving formula in the first days of birth contributed to difficulties in maintaining breastfeeding (15, 232, 233). Consequently, it is essential to be aware of the role of prelacteal formula as a starting point for breastfeeding disruption.

6.4.4 Prelacteal honey and breastfeeding duration

To date, there is no published literature that comprehensively describes how prelacteal honey affects breastfeeding duration. In my study, prelacteal honey had an association with breastfeeding duration which was mostly the opposite to that of prelacteal formula. Interestingly, in 2002 and 2007, giving prelacteal honey seemed to reduce the risk of early breastfeeding cessation. While the direction of the association was consistent across all survey years, the adjusted HR was not statistically significant in 2017. This is likely because the prevalence of prelacteal honey was much lower in 2017 than in earlier surveys, resulting in reduced statistical power.

It is unlikely that prelacteal honey promotes the continuation of breastfeeding; this finding probably reflects residual confounding, where the women who gave prelacteal honey were often the same individuals who breastfed for a longer time, without the association being causal. In the univariable analysis in Chapter 5, prelacteal honey was more prevalent among mothers with lower socioeconomic and education level, while in **Tables 6.1-6.3**, breastfeeding was mostly longer among mothers with such backgrounds. Although the association was adjusted for these variables, residual confounding may still be present.

Moreover, unlike formula, honey is often given for traditional or religious purposes, rather than as a designated nutritional replacement. For example in Indramayu, West Java, honey was a quite popular PLF choice and it was given with the intention to bless the baby and make him/her behave sweetly in the future, and prevent the throat from drying up (13). More recently, the practice persists based on advice from parents, neighbours, and older people in the family (14). Most of the time, it is just a ritual that has been practiced throughout generations and the amount of honey given may be so low that it has very little disruptive effect to breastfeeding.

Additionally, it is possible that a certain belief might be a residual confounder. Common religions in Indonesia (Islam, Christianity, Hinduism, and Buddhism) are generally supportive towards breastfeeding (152, 153), but both breastfeeding and honey are particularly valued in Islam (154, 234, 235), which constitutes 87% of all religions in Indonesia (172). One of the verses in the Muslims' holy book, Al-Qur'an, contains a message for mothers to breastfeed for two full years (154). This implies that breastfeeding has a religious basis or at least is well acknowledged in Muslim community (152).

Regarding honey, other verses in Al-Qur'an also mention it as a precious substance (235) with a lot of healing benefits (234), although there is no specific recommendation to give it to a newborn baby. Nevertheless, a number of studies report the use of honey as 'tahnik' or 'tahneek', a tradition practiced by several groups of Muslims, which involves putting a sweet substance to a newborn baby's mouth (22, 39, 52). While dates are used more often for this, honey can also sometimes be used for 'tahnik' (233) or other Islamic-related rituals to celebrate birth such as "aqiqah" (14). There is some uncertainty as to whether 'tahnik' is a religious or cultural tradition as it is not acknowledged or practiced by all Muslims in the world. The reference for 'tahnik' is unclear while the recommendation about breastfeeding is written in Al-Qur'an, so this is something that Muslims in general are aware of. Therefore, if a Muslim mother decided to give honey for a religious reason, then she may also intend to breastfeed for two years. However, there is very little evidence to support this notion. In the 2002 and 2007 sensitivity analyses (APPENDIX IV), religion was added to the multivariable analysis. Whilst the hazard ratio in 0–6-month period in 2002 was no longer statistically significant, the direction of the association (protective) remained the same as shown in the main analyses. Moreover, the effect size and statistical significance of the other findings in the sensitivity analyses were similar to those in the main analyses. This provides further evidence that giving prelacteal honey did not appear to shorten breastfeeding duration and was instead associated with a longer breastfeeding duration.

Although this study found no link between prelacteal honey and shorter breastfeeding duration, it is important to acknowledge other potential health risks of honey. To date, WHO still warns against giving honey to infants under 1 year-old due to the risk of botulinum toxin (49, 236). Despite this being rare, the consequences can be life-threatening (236-240). Hence avoiding unnecessary exposure remains the most sensible action and clear explanation on why prelacteal honey is discouraged should be given.

6.4.5 Prelacteal water and breastfeeding duration

In my study, prelacteal water was found to have no effect on breastfeeding duration in any survey years. As shown in Literature Review (Chapter 2), there are not many studies looking at the effect of prelacteal water on breastfeeding duration. However, a study from Honduras that looked at water PLF also found no association between water PLF and breastfeeding duration, which was in line with my study (adjusted OR 0.52, 0.21-1.38). Moreover, some of the findings from the 2016 Cochrane systematic review also showed that brief additional water or glucose water did not have any benefits on breastfeeding duration (241). These suggest that prelacteal water might not be detrimental to breastfeeding, but it might not be necessary either.

The plausible explanation for the findings in my study is likely related to the reason plain water is given in the first few days. In other studies, plain water may be used only to prevent thirst or simply clean the mouth (118), but it can also be involved in in some religious practices (22), similar to honey. For example, Zam-zam water is a kind of plain water available only in Mecca, Saudi Arabia, that is considered sacred by Muslims and sometimes given as a PLF (22). A qualitative study from Indonesia also mentioned Zam-zam water for similar reasons (233), suggesting that prelacteal water in Indonesia is frequently given for ritual rather than nutritional reasons. Moreover, even if plain water is given to prevent neonatal dehydration, it contains no calories. Therefore, it may not easily satisfy the baby's

hunger like formula does and is therefore less disruptive to breastmilk production and breastfeeding in the long term.

Owing to newborn babies' limited stomach capacity (242), there may be concerns that any food or drinks, including plain water, may quickly fill up their stomach and make them feel full, especially if given multiple times; this may lead to breastmilk disruption and result in early cessation. However, in my study, there is no evidence to support this concern. My findings suggest that plain water in the first few days may not affect breastfeeding duration. Avoidance of prelacteal water remains sensible, however, as there is still a health risk beyond shorter breastfeeding duration, such as contamination and infection, especially in a setting with restricted access to clean water.

6.4.6 Prelacteal milk other than formula and breastfeeding duration

My results suggest that prelacteal milk other than formula is associated with shorter breastfeeding duration although these results are difficult to interpret. In Indonesia, 'other milk' can refer to a wide range of substances. Condensed milk, for instance, is widely consumed in Indonesia (201, 243) and is sometimes given as PLF (13). Other milk also possibly refers to plant-based milk, such as coconut milk, that is also reported to be given as PLF (14). There are also other milk products like cow's and buffalo's milk, although their use as PLF is not specified (200).

Looking at the association observed in the 2017 survey, other milk in this study might have been perceived to have nutritional properties as it was as 'disruptive' to breastfeeding as formula. However, regardless of the nutritional content/properties of other milk, it is a less ideal PLF choice compared to formula. This is because milk other than formula can be both satisfying, thus altering breastmilk stimulation, while on the other hand, containing non-standard ingredients that are not suitable for newborn's gastrointestinal system and/or may increase risk of infection or allergy.

6.4.7 Strengths and limitations

To my knowledge, this is the first epidemiological study from Indonesia that investigates the association between different kinds of PLF and the duration of any breastfeeding. The main advantage of this study is that it is relatively large and representative at the country level from a series of surveys over time. As described previously, the only quantitative study looking at PLF and any breastfeeding (244) was conducted in a small region in Indonesia and cannot be generalised at the national level.

Just like the previous chapters, this study adds evidence on how different types of PLF were associated with breastfeeding duration. To date, this is the first study from Indonesia and one of the very few studies that looked at the association between any breastfeeding and different types of PLF. Although the general recommendation is to avoid any kind of PLF, understanding the potential impacts of each type of PLF and how they differ from each other are important when delivering messages to mothers.

Again, a potential limitation is that IDHS did not have enough details on what it meant by 'other milk'. The DHS Team could not give further explanation and local IDHS organisers in Indonesia did not respond to my queries about this. The very low prevalence of other milk in 2002-2007 and sudden increase in 2012-2017 were poorly understood. It may be caused either by misclassification during data collection (interpretation of the question and/or how it was asked), as discussed in Chapter 4, or a real surge of prelacteal milk other than formula.

In addition, cautious interpretation is needed because this study did not have information on the amount, frequency, and reason why PLF was given, as well as the reason breastfeeding was stopped and details on prelacteal milk other than formula. Moreover, causal relationships cannot be established due to the cross-sectional study design. For

example, it is still possible that prelacteal formula was given by mothers who intended to give mixed feeding from the beginning, which would have affected the outcome.

6.5 Conclusion

This study adds evidence on the negative association between PLF and the duration of any breastfeeding. Nevertheless, the negative association was observed for prelacteal formula and other milk, but not for honey and water. Giving a baby any PLF, especially prelacteal formula and other milk, is more likely to be associated with shorter breastfeeding duration, especially in the first six months after birth. My study supports the WHO/UNICEF's current guidelines that recommend against giving newborn infants food or drink other than breastmilk without medical indication.

Although prelacteal honey was associated with longer breastfeeding duration and prelacteal water generally had no association with breastfeeding duration, it does not mean that the other types of PLF are more acceptable (or "less harmful") for babies, as this study did not look at other health risks such as infection or gastrointestinal problems which may be caused by other feeds. This study points to the need to collect data on the reason and quantity of feed given in the first few days of life. Giving a one-off of any of the PLF types may have a negligible impact on breastfeeding duration, but with formula and other milk, the frequency might be higher (multiple times rather than a one-off). Nevertheless, richer detail is required to properly understand what is happening. Findings from my study can be used to inform mothers about impacts of several types of PLF on breastfeeding.

7 ASSOCIATION BETWEEN PRELACTEAL FEEDING AND CURRENT EXCLUSIVE BREASTFEEDING IN INDONESIA (2007 – 2017)

7.1 Chapter introduction

This chapter is an extension of the previous chapter about the association of preleacteal feeding (PLF) and breastfeeding duration. The results presented in Chapter 6 indicate that any PLF, especially formula, is associated with overall shorter breastfeeding duration, although this effect is only observed in the first six months. This chapter has a specific focus on how PLF is associated with the exclusivity of breastfeeding within the first 6 months.

A widely accepted definition of exclusive breastfeeding (EBF) from the WHO/UNICEF is giving the baby only breastmilk, without any other food or drink, not even water (2-4). Hence, by this definition, babies who received any PLF in the first few days of birth are not exclusively breastfed, even though later they may receive only breastmilk for the remaining six months. However, Demographic Health Surveys (DHS) including Indonesia DHS (IDHS) define EBF as babies who are still breastfed at the time of interview and receive no other food/liquid in the past 24 hours before interview (165), with the assumption that this time period would capture information about mixed feeding. These DHS indicators are based on the WHO definition, but have been intentionally simplified to minimise technical difficulties during data collection (144). I adopted this concept and called it EBF although theoretically it should be called 'current' EBF or "EBF within 24 hours before interview", which in reality may not always meet the strict definition of EBF (2, 3). Therefore, this chapter focusses on how PLF is associated with a general pattern of EBF beyond the first three days up to six months.

7.2 Methods

This study addresses Objective 4 of the thesis, using the IDHS datasets from 2007 to 2017. Details on the data collection and definition of variables were described in Chapter 3. The 2002 dataset was not included in this analysis because of the large amount of missing data on the outcome (>60%). Additionally, the 2002 IDHS used different raw variables to define EBF as compared to the raw variables used by the 2007-2017. Hence for consistency, the 2002 IDHS was not used in this analysis. The conceptual framework developed for this study is shown in **Figure 7.1**, where the association between PLF (any, formula, honey, water, other milk) and current EBF was adjusted for covariables that were mostly considered to be potential confounders. The detailed modelling strategy is described in Section **7.2.5.**

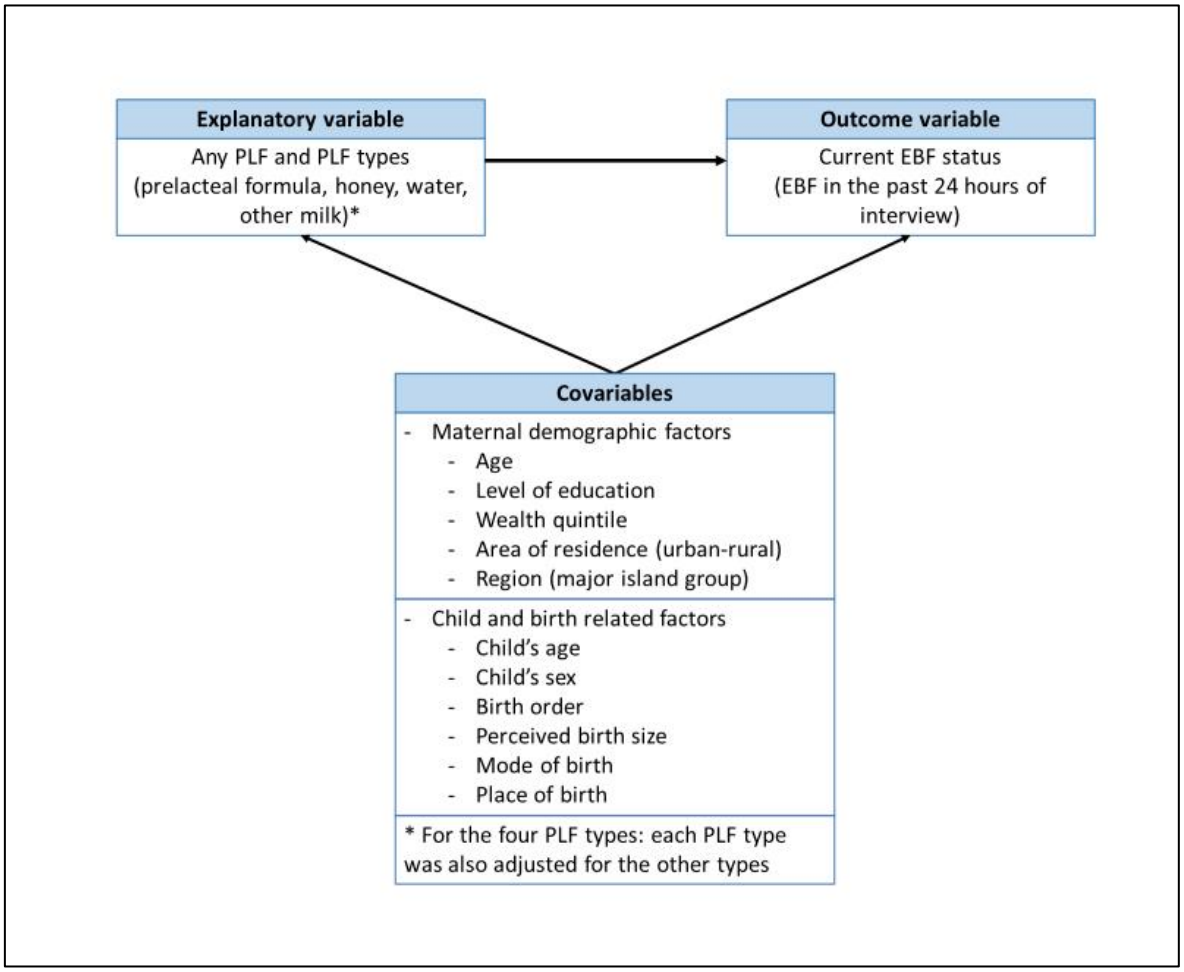


Figure 7.1. The conceptual framework of the association between PLF and current EBF.

7.2.1 Study population

As shown in **Figure 7.2**, the study population was mothers whose last child had ever been breastfed and was aged 0-5 months old at the time of the IDHS interview. This age range was selected by considering the WHO's current recommendation that states that babies should be exclusively breastfed for six months. This is also the age range that is used more widely by the DHS to measure EBF for their reports (245). In the DHS, any child aged 5 months and a few weeks but are not yet 6 full months are calculated as 5 months. Therefore, all children included in this analysis were expected to be exclusively breastfed according to the WHO recommendation. Additionally, children who had died or lived separately from their mother at the time of interview were excluded from the analysis. The study population ranged from 1,552 in 2017 to 1603 in 2007.

7.2.2 Outcome variables

In this study, the outcome of interest was EBF status within the 24 hours before interview, which is referred to as current EBF for simplicity. "Current EBF=Yes" was defined as the infant was still breastfed at the time of interview and received no fluid or food 24 hours prior interview; note that this was irrespective of whether or not the infant had received PLF. "EBF=No" was defined as the infant was longer breastfed, or was still breastfed but received other fluid/food prior interview; again, this was irrespective of PLF status.

7.2.3 Explanatory variables

Similar to Chapter 6, PLF was the main explanatory variable and separate analyses were conducted for any PLF and the four predominant PLFs i.e. formula, honey, water and other milk. Other milk, despite being popular in the 2012 and 2017 surveys, was not explored in multivariable analyses for 2002 and 2007 because the prevalence was negligible in those survey periods. The definition of each explanatory variable is shown in Chapter 3 (Table 3.1).

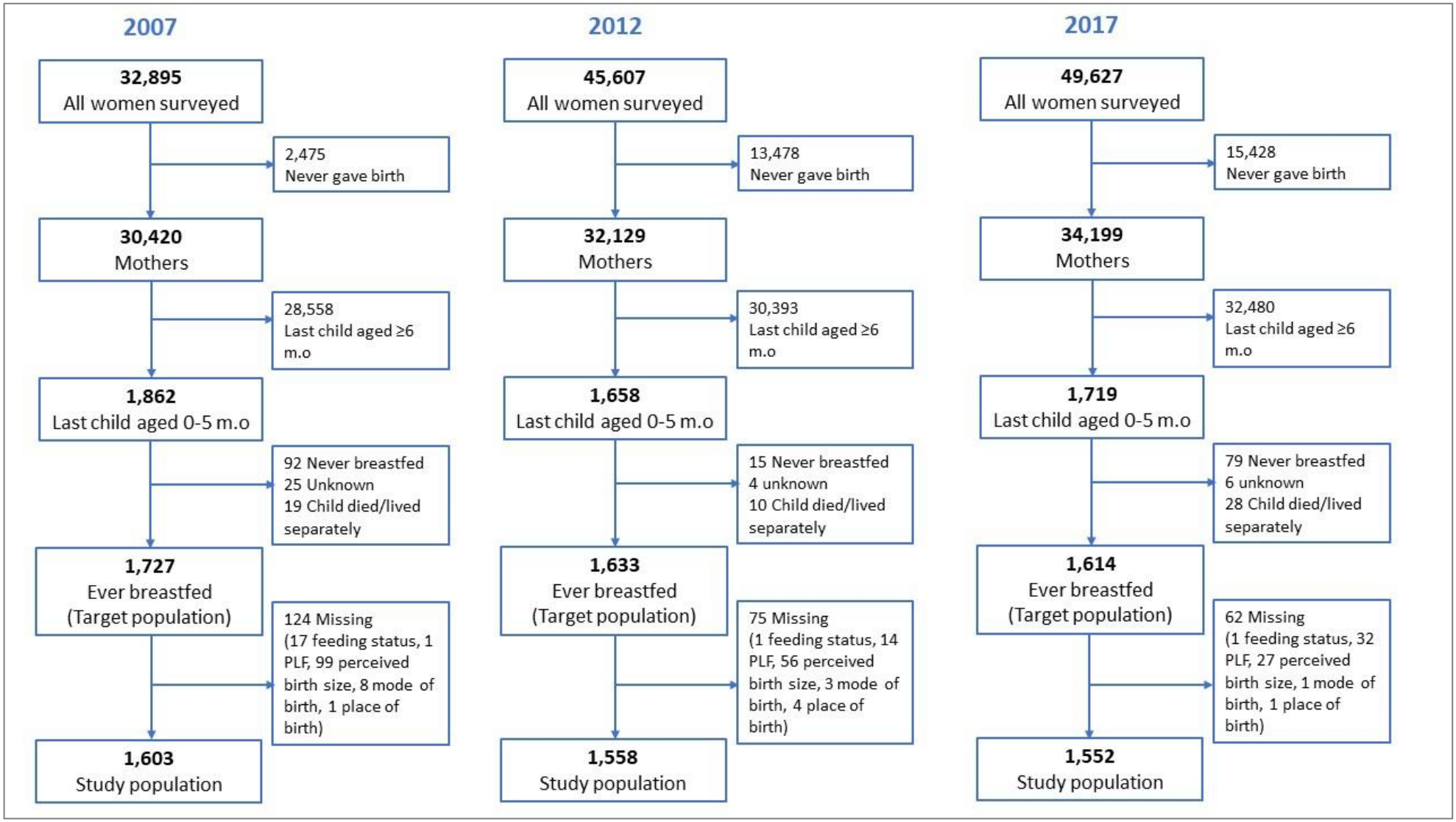


Figure 7.2. Selection of study population

7.2.4 Covariables (potential confounders)

As shown in **Figure 7.1,** the association between PLF and current EBF was adjusted for potential confounders, which were similar to those used in Chapter 6. These were maternal demographic variables (age, level of education, wealth quintile, area of residence, region) and child and birth-related variables (child's age, child's sex, birth order, perceived birth size, place of birth, mode of birth). These were IDHS variables that theoretically may have an association with both PLF and EBF but are not a mediator. Additionally, they must have a clear and consistent definition in all IDHS datasets being analysed as well as have missing values of less than 10% in all IDHS datasets being analysed. The only difference with Chapter 6 was that in this analysis, child's age was included as a covariable to adjust for, because exclusivity status was likely to differ by child's age.

7.2.5 Statistical modelling

Modified Poisson regression was used to compare current EBF among mothers who gave PLF (any PLF, formula, honey, water, and other milk) and those who did not. The association was measured using the prevalence ratio (PR). Adjusted PRs were estimated after controlling for all IDHS potential confounders listed **Figure 7.1.**

In the final multivariable model, the association between any PLF and current EBF was estimated, controlling for all the covariables (maternal and child and birth-related variables). The association between each type of PLF was not only adjusted for maternal and child and birth-related variables, but also for each of the other PLF types. For example, the association between prelacteal formula and breastfeeding duration was adjusted for potential confounders, prelacteal honey, water, and other milk.

7.2.6 Dealing with missing data

As shown in **Figure 7.2**, the study population comprised of about 93-96% of the target population in each survey year. As explained in the Methods (Chapter 3), a complete case

analysis was preferred over multiple imputation or other strategies because the proportion of missing values against the target population was below 10% for each survey year. Hence, mothers with missing values in one or more variables were not included in the analysis.

7.2.7 Sensitivity analysis

Similar to Chapter 6, sensitivity analyses were conducted for each survey year by adjusting for additional potential confounders to the main analysis presented in this chapter. The additional potential confounders were IDHS variables that were not available in all survey years and/or had missing values of >10% in at least one survey year. These were maternal and child (MCH) book (missing >10% in 2007), religion (only available in 2007), and immediate skin-to-skin contact (only available in 2017). Additionally, another sensitivity analysis for each survey year was also conducted by excluding child's age equal to '0' month (i.e. less than 1 month) as this group was more likely to be different from the older group. Therefore, in each survey year, two sensitivity analyses were conducted as follows.

1. In 2007: First by adding religion and MCH book in the multivariable model. Second by adjusting for all confounders and excluding child's age '0 month'.
2. In 2012: First by adding MCH book in the multivariable model. Second by adjusting for all confounders and excluding child's age '0 month'.
3. In 2017: First by adding immediate skin-to-skin contact in the multivariable model. Second by adjusting for all confounders and excluding child's age '0 month'.

The results of sensitivity analysis are shown in APPENDIX V.

7.3 Results

7.3.1 Characteristics of the study population

Table 7.1, shows the characteristics of the study population by outcome variable (current EBF), explanatory variable (PLF), and covariables in all survey years. The proportion of infants under 6 months who were exclusively breastfed at the time of interview increased

from 33% in 2007 to 54% in 2017. In addition, as discussed in Chapter 4, PLF was given to more than two-thirds of infants in 2007 and 2012, while by 2017 this had dropped to less than half of the study population. Across all survey years, more than 50% of the mothers were aged 20-34, had secondary level of education, lived in rural areas, were based in Java, and had a second or subsequent child (multiparous).

Table 7.1. Characteristics of the study population

	2007		2012		2017	
	n	%	n	%	n	%
Study population	1,603	100.0	1,558	100.0	1,552	
Outcome variable						
Current EBF status						
No	1,022	67.0	942	57.4	739	46.5
Yes	581	33.0	616	42.6	813	53.5
Explanatory variables						
Any PLF						
No	572	31.3	588	38.2	830	54.1
Yes	1,031	68.7	970	61.8	722	45.9
Formula						
No	866	48.1	902	55.9	1,143	73.6
Yes	737	52.0	656	44.1	409	26.4
Honey						
No	1,425	88.7	1,483	96.3	1,490	96.7
Yes	178	11.3	75	3.7	62	3.3
Water						
No	1,436	89.7	1,468	95.3	1,489	96.4
Yes	167	10.3	90	4.7	63	3.6
Other milk						
No	1,598	99.9	1,361	89.0	1,347	85.5
Yes	5	0.1	197	11.0	205	14.5
Covariables: Maternal demographic						
Maternal age						
15-19	139	9.1	146	9.6	106	6.8
20-24	420	26.9	391	28.1	319	21.6
25-29	444	29.1	429	26.5	442	27.5
30-34	349	20.3	332	19.6	390	25.6
≥35	251	14.6	260	16.2	295	18.4
Education						
None/primary	604	37.8	457	28.9	367	24.2
Secondary	842	52.3	871	57.9	890	59.8
Higher	157	10.0	230	13.1	295	16.0
Wealth quintile						
Q1 (least affluent)	446	20.0	449	20.8	430	21.1
Q2	313	19.8	328	19.5	324	21.0
Q3	317	21.6	263	19.4	290	20.7
Q4	269	19.0	293	21.3	271	20.0
Q5 (most affluent)	258	19.6	225	18.9	237	17.3
Area of residence						
Urban	625	43.6	714	49.0	711	45.8
Rural	978	56.4	844	51.0	841	54.2

	2007		2012		2017	
	n	%	n	%	n	%
Study population	1,603	100.0	1,558	100.0	1,552	
Region (major island group)						
Sumatera	485	22.0	472	22.7	434	24.9
Java	382	56.1	362	54.0	415	51.7
Bali-Nusa Tenggara	146	6.2	146	6.6	152	6.1
Kalimantan	159	5.7	166	6.3	127	5.3
Sulawesi	268	7.8	244	7.4	262	8.3
Maluku-Papua	163	2.3	168	3.2	162	3.7
Covariables: Child and birth-related						
Child's age (month)						
0	163	9.9	154	10.1	110	7.5
1	299	19.3	322	19.1	286	17.7
2	292	18.2	278	17.5	279	19.3
3	302	16.7	259	17.3	301	18.9
4	275	17.9	270	18.1	297	18.7
5	272	18.0	275	18.0	279	18.0
Child's sex						
Male	835	55.6	824	50.5	760	49.8
Female	768	44.4	734	49.5	792	50.2
Birth order						
First	556	38.7	584	42.4	469	30.1
Second/subsequent	1,047	61.3	974	57.6	1,083	69.9
Perceived birth size						
Larger than average	544	32.9	480	28.2	508	31.8
Average	829	55.4	867	58.0	850	56.9
Smaller than average	230	11.8	211	13.9	194	11.3
Mode of birth						
Vaginal	1,468	89.5	1,316	83.5	1,277	81.9
Caesarean	135	10.5	242	16.5	275	18.1
Place of birth						
Home	885	46.5	524	23.9	302	14.5
Public facility	257	12.2	427	24.2	674	38.5
Private facility	461	41.3	607	51.9	576	47.0

7.3.2 Association between PLF and current EBF

Table 7.2 shows the prevalence of current EBF by PLF and covariables. In all survey years, the prevalence of current EBF was higher among those who did not give any PLF or prelacteal formula. In most survey years, current EBF was more prevalent among mothers who lived in rural areas, were based in Sulawesi or Bali-Nusa Tenggara region, were multiparous, and gave birth vaginally. Additionally, the prevalence of current EBF was higher among mothers whose child was younger. At age 0 months, about 54-75% of infants across all survey years were reported to be exclusively breastfed (current EBF) at the time of interview. However, the prevalence of current EBF at 4 and 5 months in all survey years

was consistently below 50%. Even in 2017, when current EBF was higher than in the previous years, it was less than 35% among infants at 5 months of age.

Table 7.2. Prevalence of current EBF by explanatory variables (PLF) and covariables

	2007			2012			2017		
	EBF (n)	**EBF (%)**	*p* value	**EBF (n)**	**EBF (%)**	*p* value	**EBF (n)**	**EBF (%)**	*p* value
Overall	581	33.0		616	42.6		813	53.5	
Explanatory variables									
Any PLF									
No	254	38.3		333	57.8		524	63.5	
Yes	327	30.7	*0.06*	283	33.2	*<0.001*	289	41.7	*<0.001*
Formula									
No	369	38.6		421	48.6		664	59.2	
Yes	212	27.9	*0.01*	195	34.9	*<0.001*	149	37.5	*<0.001*
Honey									
No	518	33.0		597	43.4		774	53.0	
Yes	63	33.6	*0.92*	19	21.7	*<0.001*	39	67.9	*0.07*
Water									
No	522	33.1		594	43.5		789	54.0	
Yes	59	32.5	*0.93*	22	25.0	*0.02*	24	37.9	*0.05*
Other milk									
No	579	33.0		570	44.7		735	55.2	
Yes	2	35.0	*0.93*	46	25.9	*0.00*	78	43.1	*0.01*
Maternal demographic									
Maternal age									
15-19	48	26.0		45	34.4		47	52.3	
20-24	151	32.1		164	41.8		166	53.0	
25-29	163	35.6		166	42.8		248	55.5	
30-34	129	33.8		141	46.0		205	52.6	
≥35	90	33.0	*0.71*	100	44.3	*0.62*	147	52.6	*0.95*
Education									
None/primary	246	35.1		183	41.6		195	54.2	
Secondary	295	34.1		345	42.3		464	53.6	
Higher	40	19.7	*0.04*	88	45.9	*0.79*	154	52.0	*0.90*
Wealth quintile									
Q1 (least affluent)	186	38.7		195	44.8		251	62.4	
Q2	132	38.3		135	40.9		181	60.4	
Q3	117	36.1		110	45.9		123	42.6	
Q4	88	32.2		96	34.8		130	47.9	
Q5 (most affluent)	58	19.4	*0.01*	80	47.2	*0.19*	128	53.5	*<0.001*
Area of residence									
Urban	196	28.2		269	42.2		341	49.1	
Rural	385	36.8	*0.03*	347	43.0	*0.85*	472	57.1	*0.01*
Major islands									
Sumatera	165	32.1		158	32.3		218	49.8	
Java	116	30.1		159	46.2		222	54.6	
Bali-Nusa Teng.	52	38.1		79	55.9		99	64.9	
Kalimantan	55	35.3		48	29.5		56	41.1	
Sulawesi	126	49.0		110	52.4		150	58.2	
Maluku-Papua	67	40.7	*0.01*	62	30.4	*<0.001*	68	50.9	*0.03*
Birth and child related									
Age (month)									
0	90	54.8		76	54.0		80	74.7	
1	142	47.4		164	51.2		185	66.6	
2	136	40.6		133	47.6		163	55.8	
3	100	30.4		109	51.5		164	55.1	
4	75	23.9		88	37.7		137	46.5	
5	38	9.6	*<0.001*	46	18.7	*<0.001*	84	34.7	*<0.001*

	2007			2012			2017		
	EBF (n)	**EBF (%)**	*p* value	**EBF (n)**	**EBF (%)**	*p* value	**EBF (n)**	**EBF (%)**	*p* value
Overall	581	33.0		616	42.6		813	53.5	
Sex of the child									
Male	299	32.0		307	42.4		381	52.1	
Female	282	34.4	*0.47*	309	42.8	*0.93*	432	54.8	*0.38*
Birth order									
First	175	26.8		197	36.7		223	49.5	
Second/later	406	37.0	*0.01*	419	46.9	*0.01*	590	55.2	*0.10*
Perceived birth size									
Larger than average	215	37.8		204	45.5		276	54.4	
Average	288	30.8		333	41.3		444	53.8	
Smaller than average	78	30.3	*0.18*	79	42.3	*0.62*	93	49.1	*0.59*
Mode of birth									
Vaginal birth	546	34.6		551	44.6		694	55.5	
Caesarean birth	35	20.3	*0.01*	65	32.4	*0.01*	119	44.1	*0.01*
Place of birth									
Home birth	346	35.3		201	39.3		166	58.2	
Public facility	104	48.2		187	44.3		366	53.7	
Private facility	131	26.0	*<0.001*	228	43.3	*0.55*	281	51.8	*0.41*

Table 7.3 shows the association between PLF and current EBF. After controlling for all covariables, any PLF was found to have a negative association with current EBF status. In other word, infants who received any PLF were less likely to be exclusively breastfed within 24 hours preceding the interview and this association was fairly consistent across the survey years. The adjusted PRs were 0.80 (95% CI 0.65-0.98) in 2007, 0.61 (0.51-0.72) in 2012, and 0.66 (0.58-0.75) in 2017.

The association with EBF status was most apparent and consistent for prelacteal formula than for the other PLF types. As was the case for any PLF, infants who received prelacteal formula were less likely to be currently EBF in 2007 (adjusted PR 0.70, 95% CI 0.56-0.88), in 2012 (adjusted PR 0.68, 95% CI 0.56-0.82), and in 2017 (adjusted PR 0.60, 95% CI 0.51-0.71) (**Table 7.3**). Prelacteal honey had the most inconsistent association with EBF across the survey years. After controlling for covariables, it showed no statistically significant association in 2007 (PR 1.01; 95% CI0.73-1.41), a negative association in 2012 (PR 0.54; 95% CI0.33-0.86), and a positive association in 2017 (PR 1.29; 95% CI1.04-1.59) (**Table 7.3**). Prelacteal water had a negative association with EBF, with adjusted PRs ranging between 0.57 and 0.78, but the adjusted PR was only statistically significant in 2012 (Table

7.3). In 2012 and 2017, mothers who gave prelacteal milk other than formula were less likely to exclusively breastfeed within 24 hours before the interview. This showed a similar pattern with any PLF and formula, but in 2007, there were too few babies in this group to run a meaningful statistical analysis (**Table 7.3**). The adjusted PR was 0.52 (95% CI 0.37-0.73) in 2012 and 0.68 (95% CI 0.55-0.85) in 2017. Sensitivity analyses (APPENDIX V) showed similar patterns and direction of association for any PLF, formula, honey, water, and other milk.

Table 7.3. Association between PLF and current EBF

Year	Variable		Current EBF		Prevalence ratio (PR) with 95% CI	
			n	%	Crude PR	Adjusted PR
2007	**Any PLF**	No	254	38.3		
		Yes	327	30.7	0.80 (0.64-1.00)	0.80 (0.65-0.98)
2012		No	333	57.8		
		Yes	283	33.2	0.57 (0.49-0.68)	0.61 (0.51-0.72)
2017		No	524	63.5		
		Yes	289	41.7	0.66 (0.58-0.75)	0.66 (0.58-0.75)
2007	**Formula**	No	369	38.6		
		Yes	212	27.9	0.72 (0.57-0.91)	0.70 (0.56-0.88)
2012		No	421	48.6		
		Yes	195	34.9	0.72 (0.60-0.86)	0.68 (0.56-0.82)
2017		No	664	59.2		
		Yes	149	37.5	0.63 (0.54-0.75)	0.60 (0.51-0.71)
2007	**Honey**	No	518	33.0		
		Yes	63	33.6	1.02 (0.72-1.43)	1.01 (0.73-1.41)
2012		No	597	43.4		
		Yes	19	21.7	0.50 (0.30-0.84)	0.54 (0.33-0.86)
2017		No	774	53.0		
		Yes	39	67.9	1.28 (1.02-1.61)	1.29 (1.04-1.59)
2007	**Water**	No	522	33.1		
		Yes	59	32.5	0.98 (0.67-1.44)	0.78 (0.55-1.12)
2012		No	594	43.5		
		Yes	22	25.0	0.58 (0.34-0.96)	0.57 (0.35-0.92)
2017		No	789	54.0		
		Yes	24	37.9	0.70 (0.47-1.06)	0.71 (0.48-1.04)
2007	**Other milk**	No	579	33.0		
		Yes	2	35.0	Number too small	Number too small
2012		No	570	44.7		
		Yes	46	25.9	0.58 (0.41-0.82)	0.52 (0.37-0.73)
2017		No	735	55.2		
		Yes	78	43.1	0.78 (0.63-0.96)	0.68 (0.55-0.85)

Adjusted PRs were PRs after controlling for maternal demographic and child-and birth related variables. PR<1 (blue font) indicates that PLF is associated with a lower prevalence of current EBF status.

7.4 Discussion

7.4.1 Summary of findings

The proportion of mothers with infants under 6 months who reported current EBF in Indonesia gradually increased from only about 33% in 2002 to more than 53% in 2017. However, a lot of infants did not receive six months of 'true EBF' as recommended by the WHO (2) i.e. receiving no other food or drinks except breastmilk for the first six months, as many of the infants who fall into the definition of current EBF will have received PLF in the first three days of birth. For example, in 2017, the weighted prevalence of current EBF was 53.5%, which is based on 813 of 1,552 (**Table 7.1)**. However, looking at **Table 7.2**, the number of infants who were both categorised as 'current EBF' and "No PLF" was only 524 out of 1,552. This indicates that the maximum proportion of infants who were 'true EBF' as per WHO recommendation could not be larger than 35%, as some of these may have had other fluids in the intervening time period (i.e. between the first few days after birth and the 24 hours preceding the survey).

Consistent with the findings in Chapter 6 on breastfeeding cessation, any PLF, particularly prelacteal formula and other milk, was associated with a lower likelihood of current EBF among mothers with an infant aged 0-5 months. In this chapter, the association between prelacteal honey and water and current EBF was less consistent. The prevalence of current EBF was generally lower among those who received prelacteal water, but the effect was not always statistically significant across all survey years. Meanwhile, prelacteal honey showed an unclear pattern of association with current EBF.

7.4.2 Association between any PLF and current EBF

Any PLF had a negative association with current EBF status in this context. This suggests that giving any PLF may be related with current non-exclusivity at 0-5 months. This chapter supports findings from those in Chapter 6 and studies from other countries reporting the association between PLF and breastfeeding outcomes (69, 136, 222-224, 228, 229). In my

study, any PLF was associated with shorter duration of any breastfeeding, especially in the first 6 months. The effect size was also close to that reported by the most recent systematic review, where any PLF was associated with higher risk of EBF cessation (RR=1.44, 95% CI 1.29-1.60) (69). Again, the association with current EBF was different across the different types of PLF, where it was consistently negative for prelacteal formula and other milk, but not for honey and water.

7.4.3 Association between prelacteal formula and current EBF

In my study, mothers who gave prelacteal formula were 30-40% less likely to exclusively breastfeed at 0-5 months. This was consistent with findings from the recent systematic review that found an association between milk-based PLF and a shorter duration of EBF with RR 1.40, 95% CI 1.24-1.58 (69). Similar to what was described in Chapter 6, the most plausible explanation was related to the nutritional properties of formula which can be disruptive to breastmilk production. An Indonesian qualitative study in a small city in Java (246), described an experience of a mother who was unable to EBF despite wishing to do so and one of the reasons was because she had to give formula due to a painful post-operative caesarean in the first few days and it made her milk “dry”. Another qualitative study discussing PLF (14) found that mothers had the intention to exclusively breastfeed, but multiple challenges often kept them from doing so and these include choice of infant feed in the first days as well as influence from older generations. This suggests a causal relationship between PLF and EBF is possible, but other factors are likely to play a role as well.

Another possibility might be related to the mother’s feeding intention. Since the reason for giving PLF was not captured by IDHS analysis, it is possible that mothers who gave prelacteal formula and did not breastfeed exclusively at the time of interview were the ones who might have intended to give mixed-feeding from the start. Moreover, prelacteal formula can also be an indicator for maternal and/or neonatal circumstances that are found at birth,

such as prematurity or illness, that require formula feeding either as the sole feeding or mixed with breastfeeding.

7.4.4 Association between prelacteal honey and current EBF

Prelacteal honey had an inconsistent association with current EBF across the three survey years. As described in Chapter 6, giving prelacteal honey might be less likely to have a causal effect on current EBF, and it is possible the association observed was more likely due to residual confounding related to socioeconomic, culture, or religion. In 2007, prelacteal honey was not associated with current EBF but was associated with a longer breastfeeding duration (Chapter 6). In 2017, prelacteal honey was associated with current EBF but was not associated with breastfeeding duration (Chapter 6). The inconsistent association across survey years might be due to the low prevalence of prelacteal honey, especially in 2012 and 2017, implying that the associations observed in this study may simply be due to chance.

Again, as discussed in Chapter 6, prelacteal honey is more likely to be given as a one-off traditional or religious ritual. Hence the amount might be too low to disrupt breastmilk production that can lead to mothers having to mixed-feed or stop breastfeeding. Nevertheless, this finding does not justify giving honey as a PLF due to the risk of infant botulism (49).

7.4.5 Association between prelacteal water and current EBF

There were not many studies that looked specifically at the impact of prelacteal water on breastfeeding. One study in Honduras found that prelacteal water was associated with lower odds of EBF (247) (OR 0.19, 95% CI 0.09-0.41). However, in my study, prelacteal water had no association with current EBF in most survey years. In 2012, it was associated with a lower prevalence of current EBF but considering the low prevalence of prelacteal water (4.7%), this statistically significant association might be likely due to chance. In

general, findings from this chapter are consistent with those from Chapter 6, suggesting that giving prelacteal water may have no major impact on breastfeeding outcomes, either exclusivity or duration. Nevertheless, the inconsistent findings across survey years and with other study requires further investigation.

7.4.6 Association between prelacteal milk other than formula and current EBF

Similar to prelacteal formula, mothers who gave other milk as PLF were less likely to exclusively breastfeed at 0-5 months. The size and direction of the association between prelacteal milk other than formula with current EBF was consistent in both 2012 and 2017 IDHS and was in line with findings from Chapter 6. Despite 'other milk' not being clearly described in the surveys, and there is a vast range of substances that constitutes it (13, 14, 243), these findings suggest that the impact of prelacteal milk on breastfeeding outcomes may share similar mechanisms with that of prelacteal formula.

7.4.7 Interpreting breastfeeding exclusivity

In addition to answering the study objective, this chapter also highlights how EBF was measured in this study and elsewhere (120, 123, 136, 137, 140, 248, 249). As described in **Section 7.4.1**, the reported EBF rates using DHS indicators and similar may be overestimated although this is probably the most practical and widely used way to measure EBF (144). As an example, a mother who gave PLF on the first day or even a mother who mixed-fed during the first month but later went back to EBF and was interviewed at month 3 was counted as EBF. Technically, this approach can only confirm that a child was exclusively breastfed at the day of interview but cannot confirm EBF status on the previous days or months.

Previous studies have discussed how EBF measurement using WHO indicators (144), which relied on 24-hr recall have led to misclassification of infant feeding practices and overestimated the prevalence of true EBF from birth (250-254). Consequently, in the more

recent guidance published in 2021, new indicators were added, including “exclusively breastfed for the first two days after birth” (EBF2D). Using both EBF and EBF2D in studies looking at EBF will help clarify the degree of exclusivity of the study population (255).

Meanwhile, even if it is assumed that the child was breastfed exclusively until the day of interview, the proportion of EBF was still not very high, given the WHO recommendation to EBF for six months. It is encouraging to see that current EBF continued to increase across the surveys in the last decade. However, in 2017, when EBF was highest among the three survey years, more than 50% of infants aged 4 and 5 months were no longer exclusively breastfed. This could also be one of the reasons why the median duration of any breastfeeding in Indonesia was considerably long (>20 months in 2002-2017) but the median EBF was only 1.6 months in 2002 and only three months in 2017 (1, 10-12). That means that although many children in Indonesia have ever been breastfed at any point, they may still not be getting the optimal health benefits from the six months of EBF.

7.4.8 Strengths and limitations

Since this study objective is an extension of the objective from the previous chapter, many of the strengths and limitations of this study have been described in Chapter 6. Among the strengths are the sources of data that are representative at the national level, differentiation of PLF types, and relatively large sample size compared with the previous studies in Indonesia. A limitation is that feeding intention and the reasons for giving PLF were not captured. Additionally, the sample size for this study was smaller compared to that of the other quantitative studies in this thesis and may not have been large enough to estimate reliably the association between honey, water and other milk and current EBF at all surveys.

7.5 Conclusion

Although the duration of any breastfeeding in Indonesia is generally close to 24 months for many mothers and there is an increasing trend over the surveys in the rate of ‘current EBF’

in children 0-5 months, the 6-month EBF WHO recommendation is not attained by at least 60% of infants in 2017. Therefore, these children are missing the optimal health benefits from the 6-months of EBF. PLF was found to be associated with non-exclusivity of breastfeeding under six months. Mothers who gave any PLF, particularly formula and other milk, were less likely to exclusively breastfeed than those who gave no PLF. This study further emphasises findings from the previous chapter where similar associations were found between any PLF and breastfeeding duration, and the effect was especially observed in the first six months. However, the association was less apparent for prelacteal honey and water, although issues with small sample size and residual confounding should still be taken into consideration and should not affect the current policy of avoiding PLF unless medically indicate

8 EXPERIENCE OF PRELACTEAL FEEDING PRACTICE IN INDONESIA FROM THE HEALTH PROFESSIONALS' PERSPECTIVES

8.1 Chapter introduction

As described in the literature review (Chapter 2), studies on PLF in Indonesia remain limited despite PLF being so prevalent. The previous chapters (4, 5, 6, and 7) of my thesis look at prevalence, determinants, and impacts of PLF on breastfeeding using IDHS data within the period of 2002 to 2017. Based on the findings from the previous chapters, formula has been the most prevalent PLF in Indonesia in the last two decades, and the practice of giving prelacteal formula is most frequent in the health care settings. The current law in Indonesia states that it is mandatory for all births to happen at a health facility (256) unless the facility is not accessible (257). Hence, the role of health facilities is vital in preventing inappropriate PLF practice.

This chapter corresponds to Objective 5 of this thesis, which is to understand the perception of PLF practice among health professionals and what they think about the role of the health care service in preventing inappropriate PLF practice in Indonesia. This chapter is a standalone study that is not part of the IDHS analyses. It is also intended to provide additional insights and relevant information to aid in the interpretation of the findings in Chapters 4, 5, 6, and 7.

8.2 Methods

8.2.1 Study design

This is a qualitative descriptive study (258, 259) underpinned by a contextualist approach (260), which means that knowledge is produced by the interaction between participants' knowledge and the researchers' interpretation. It used semi-structured in-depth interviews

with health professionals to understand their perception about the role of health care service in preventing inappropriate PLF practice in Indonesia. Due to the COVID-19 pandemic, all interviews were conducted online.

8.2.2 Study settings

Data collection took place between May 2021 and January 2022 in the form of interviews using video-conferencing software. During all interviews, I was in Oxford, England, while all my participants were located in various provinces of Indonesia.

8.2.3 Researchers' background and reflection

I, the student researcher, am a native Indonesian, a mother, and a medical doctor with a master's degree in epidemiology. For this study, I have two supervisors, who are epidemiologists with expertise in infant feeding research, and one advisor, who is an experienced qualitative researcher with expertise in UK maternity services. All of them are mothers and of White British background. I have prior knowledge about breastfeeding and PLF which I acquired in medical school, personal experience, and my DPhil research. I acknowledge that according to WHO guidelines (4), PLF is not supposed to be given without medical indication but I also experienced myself difficulties in breastfeeding in the early days. I have never used any PLF for my own child or within a professional context as a health practitioner. I am aware that these backgrounds may affect the way data were interpreted, presented, and discussed. Hence, by holding this awareness, I am ensuring that the analysis was done as cautiously as possible to reflect what participants meant to the best of my knowledge.

8.2.4 Consideration for the methods

Midwives, paediatricians, and lactation counsellors were recruited because they were considered as the health care providers with the most intensive contact with mothers in the early postpartum period. Hence, they would have a broader experience related to PLF

practice in the facility settings. I am aware that not all lactation counsellors have a formal affiliation with health facilities, but many of them are working closely with health facilities, either as outsourced workers or as paediatricians/midwives with additional certification. Another reason to recruit these groups of professionals was to gain perspectives from different roles, with different approaches to patients, and potentially different points of view, which resulted in a more complete picture. For simplicity, in this study I refer to all participants as health professionals while acknowledging specific definitions provided by WHO (261, 262).

Suitability to the topic, practicality, and convenience are also part of the consideration. Semi-structured in-depth interviews allow a guided but rich conversation and provide a safe space for participants to talk about something that they may find sensitive (263). In this study, although I tried to keep my initial topic guide neutral, I still anticipated information containing personal views, conflict of interests, or unpleasant experiences. Interviews were conducted online using video call because travel restriction during the COVID-19 pandemic beginning early 2020 had made field visit and in-person interview no longer feasible (264, 265).

8.2.5 Sampling and recruitment

The initial plan was to recruit three different health professionals from each major island group plus an additional two from the capital city Jakarta, totalling 20 participants. However, data saturation (266) was reached more quickly than expected so recruitment stopped at the 15th participant. Target populations were practising midwives from the Indonesian Midwifery Association (*Ikatan Bidan Indonesia* – IBI), practising paediatricians from Indonesian Paediatrics Society (*Ikatan Dokter Anak Indonesia* – IDAI), and active members of a group of lactation counsellors named Indonesian Breastfeeding Mothers' Association (*Asosiasi Ibu Menyusui Indonesia* – AIMI).

Recruitment was completed using a combination of maximum variation and snowballing techniques. Each participant was invited to recommend one other and final selection was made to cover all three health professions, six major island groups, as well as urban and rural areas, where possible. The criteria are shown in **Table 8.1**.

Table 8.1. Recruitment criteria

Inclusion criteria	Exclusion criteria
- Female or male - Aged ≥18 or older - Literate - Had a professional certification and licence to practice as the assigned role (confirmed by either verified profiles or recommendation from previous participants), - Able to participate in an interview via Teams, Zoom, or phone	- Refused or did not respond after two weeks of follow-up - Did not have capacity to give consent - Never work directly/never have direct contacts with pregnant and/or nursing mothers for at least two years.

For the midwives' and paediatricians' group, recruitment was done directly from the first contacts without involving formal correspondence with the organisations. This route was chosen because organisational membership is a legal requirement to obtain a licence to practice, hence all practising midwives and paediatricians in Indonesia are members of IBI and IDAI, respectively. Moreover, I had known some members personally through work or study, so organisational contact was not necessary. The first contact in the midwives' group was a former co-worker who was a senior midwife and a former board committee in IBI. She had a vast professional network and was able to connect me with the subsequent participants. The first contacts in the paediatricians' group were an early-career paediatrician and a senior paediatrician. Both were introduced through a colleague and former co-worker.

A more formal approach was done for the lactation counsellors' group, AIMI, a non-profit non-governmental organisation (NGO) working in breastfeeding activism. There were other similar NGOs, but AIMI was chosen for this study because it was the first and the largest lactation counsellor organisation in Indonesia. I had no prior communication with them, so

official correspondence was done via e-mail from their organisational website. The committee gave me several contacts of the members that had agreed to be interviewed.

All the organisations' names were stated here for transparency of the target population only. Participants were interviewed on their own behalf and all views recorded for this study were not necessarily meant to represent their affiliated organisation(s).

8.2.6 Data collection

All interviews were conducted in Indonesian via either Microsoft Teams or Zoom between May 2021 and January 2022. Mean interview length was 01:25 hours (range 00:26-02:46). Before the interviews, participants were given an information sheet and at least two weeks to decide whether to participate. During that time, they were encouraged to ask me any questions related to the study. They signed an informed consent sheet stating that they fully understood and agreed with the study procedures. Participants could withdraw at any stage, but none chose to do so. All potential interviewees that I approached agreed to participate except three potential participants that did not respond for four weeks including follow-up reminders. I had another two that informally agreed but did not manage to find a suitable time before the end of the study recruitment period in January 2022 and were therefore not interviewed.

I did all the interviews then simultaneously translated and transcribed the transcripts because I speak both languages (native Indonesian and proficient academic English) and it was a useful step in the analysis. Interviews were mainly transcribed verbatim, with some editing to remove irrelevant material such as social conversation or to add explanation of Indonesian terms. Where word-for-word translation was not possible because of conceptual or linguistic differences between Indonesian and English, the relevant phrases were discussed with the supervisory team to ensure that meaning was translated accurately.

8.2.7 Topic Guide

To guide the interview, a topic guide was developed to cover the following areas and the probe questions can be found in APPENDIX VI.

1. Background profile
2. Knowledge about PLF
3. Attitude towards PLF
4. Practice of PLF/experience with PLF
5. Changes in PLF trends
6. Policy affecting PLF practice
7. Expectation and suggestions from health professionals

The topic guide was checked and updated after each interview. If there was a relevant point mentioned by interviewees, additional questions were added for the next interviews. For example, COVID-related policy and the use of donor milk were added after the third interviews.

8.2.8 Data Analysis

Transcripts were analysed using an inductive thematic analysis, following the steps described by Braun & Clarke (267, 268). Analysis was an iterative process that began after the first 11 interviews had been carried out and continued in parallel with data collection. Coding had started during each transcription but refined using NVivo software as data collection continued. I read the transcripts repeatedly. All transcripts were coded by me as the main coder, and to increase validity, my advisor independently coded half of the transcripts. The codes were discussed and agreed, and themes were developed. Data saturation was reached after the first 11 interviews as no new information was being added, but in order to achieve maximum variation, data collection continued with four additional interviews with health professionals in the rural areas.

8.2.9 Ethical Consideration

Ethical approval (APPENDIX VI) was obtained before formal recruitment commenced from both the University of Oxford (OxTREC) (ref: 505-21) and the local ethics committee at the Faculty of Public Health Universitas Indonesia (FKM UI) (Ket-37/UN2.F10.D11/PPM.00.02/2021).

8.3 Results

Fifteen participants were interviewed with the following characteristics (**Table 8.1**) and the themes were described in section 8.3.1 to 8.3.3. There were 5-7 participants for each profession. The number overlapped because some paediatricians and midwives were also certified lactation counsellors. One third of the participants were aged 35-44 and based in Java, including Jakarta, the capital city of Indonesia. The majority of them came from urban areas and almost all were female who mentioned having at least one child. In **Table 8.2**, profession, island group, sex, age range, and area of residence were background characteristics collected from the informed consent sheet, while characteristics related to child and PLF experiences were extracted from the conversation (transcripts).

The duration of work experience where participants had a contact with pregnant and nursing women varied and was not always comparable to each other because of the different nature of the qualifications. For simplicity, the longest duration reported was more than 45 years and the shortest was approximately five years. On average, participants had experience of working in this field for 16.5 years and the median duration was 11 years. Although some of the most relevant and richest information were quoted from the participants who were both a paediatrician and a lactation counsellor, all of the participants were informative and responsive in the interviews. I did not find that it made much difference to the interview process whether I had known the interviewee previously or not.

Table 8.2. Characteristic of study population

Characteristic	Number of participants
Profession	
Paediatrician	5
Paediatrician only	*3*
Paediatrician + lactation counsellor	*2*
Midwife	7
Midwife only	*5*
Midwife + lactation counsellor	*2*
Lactation counsellor	7
Lactation counsellor only	*3*
Lactation counsellor + midwife/paediatrician	*4*
Major island group	
Sumatera	2
Java	5
DKI Jakarta - the capital city of Indonesia	*2*
Other provinces in Java	*3*
Bali and Nusa Tenggara	2
Kalimantan	2
Sulawesi	2
Maluku and Papua	2
Sex	
Female	14
Male	1
Age range	
25-34	4
35-44	5
45-54	3
55-64	2
≥65	1
Area of residence	
Urban	10
Rural	5
Had child(ren)	
Yes	13
No/not mentioned	2
Reported having given PLF to their children	
Yes	4
No	4
Not mentioned/not applicable	7
Reported ever having given any PLF during their practice	
Yes	6
No	4
Not mentioned/vague answer	5
Reported having witnessed or heard of PLF practice	
Yes	15
No	0
Not mentioned	0
Total	**15**

There were no striking differences in the information given by participants from different island groups and profession types. Participants from urban and rural areas had many similar experiences but there was a slight difference in their observation of PLF types and

breastfeeding commitment in the community that they served. In rural areas, feeds other than formula were slightly more common and quite a lot of people were not aware of the importance of breastfeeding. Due to limited access to videoconferencing facilities, the number of participants from rural areas (who were available for online interview) was only half of that from the urban areas.

The three themes and their subthemes are shown in Figure 8.1. The themes are 1) Complexity of PLF practice in health care settings, 2) Health professionals' role and capacity, and 3) Changes in PLF practice. To a certain extent, the themes overlapped and connected with each other.

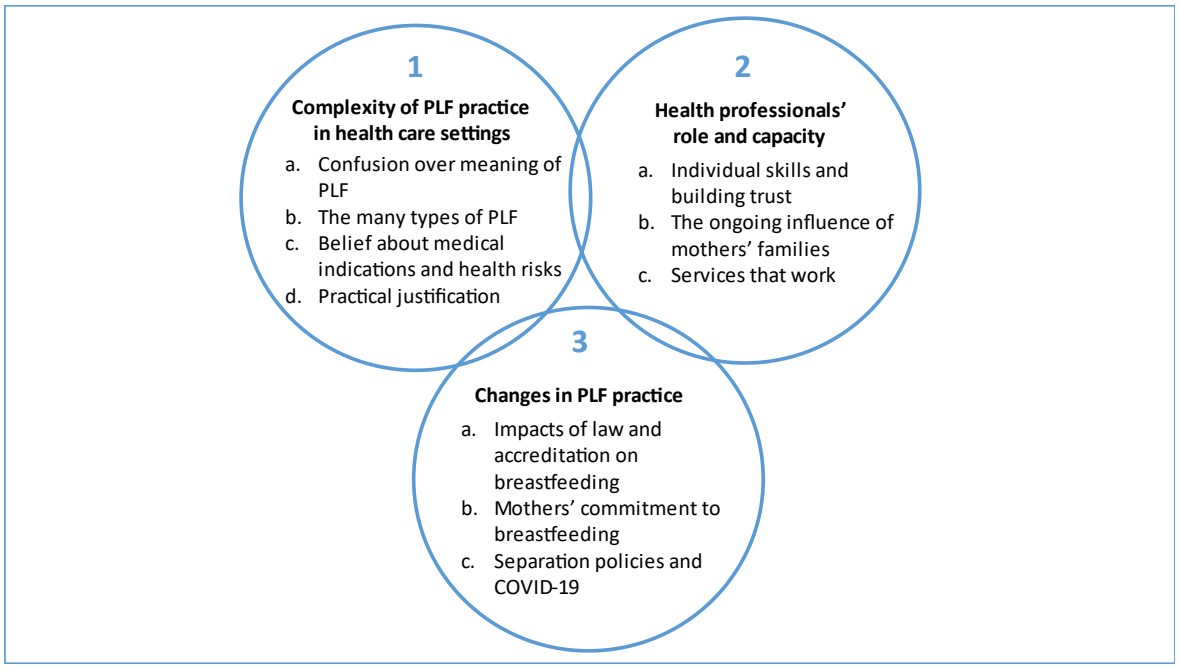


Figure 8.1. Themes and subthemes

8.3.1 Theme 1: Complexity of PLF practice in health care settings

This theme describes the variation of knowledge and practices of PLF among health professionals and the complexity surrounding it. It has four subthemes, 1) confusion over meaning of PLF, 2) the many types of PLF, 3) belief about medical indications and health risks, and 4) practical justification of PLF administration. The variation was seen in all groups of profession and island.

8.3.1.1 Subtheme 1a: Confusion over the meaning of PLF

The term PLF was not widely known and not strictly defined, as shown by participants' wide range of familiarity with PLF. Regardless of the profession and the area, the majority of the participants said that they had heard of it either firmly or vaguely.

Some recognised the term PLF immediately, while others did not, or gave different definitions of what it meant. For example, two paediatricians said that they never heard the term, but after reading the participant sheet, they understood what was being referred to (P6, P14). Some midwives referred to PLF as mixed feeding (P2) and complementary feeding (P12). Some participants shared a similar concept but differed in timing.

> *"…Actually, this is the first time I heard it. From your information sheet. When I read it, I thought, "Was I not up-to-date or something?". I also asked my colleagues, even those in Jakarta, they had no idea either. But when I went on to read it, oh I got what it means."* (P6, paediatrician)

> *"…exclusive breastfeeding is 0-6 months. While prelacteal feeding is 6 months until 2 years…, or known as complementary feeding."* (P12, midwife)

> *"It's any kind of food or drink given to babies before breastmilk comes in, usually starting from birth until 3 days."* (P5, paediatrician and lactation counsellor)

> *"….I'm not sure honestly. If we refer to the latest IYCF guide in 2021, there's an interesting terminology where in the first 2 days, baby is expected to only receive exclusive breastfeeding (EBF). …if we refer to that, if the baby is given something within 2 days, then we call it PLF. But before this new terminology, my understanding is it doesn't depend on days, just any time before she/he receives breastmilk, then it's PLF.*" (P9, paediatrician and lactation counsellor)

In addition to timing, there was also an uncertainty of what substances were classified as PLF. One of the unclear substances was donor milk. This will be described in the next subtheme.

8.3.1.2 Subtheme 1b: The many types of PLF

There was a wide range of PLF types mentioned by participants. The feeds differed in who, how, why, and where they were given. Some of the reasons for giving PLF are also explored in **Subtheme 1c: Belief/understanding about medical indications and health risks** and elsewhere in this study.

Infant formula milk (or formula for short) was the most frequently mentioned PLF in any settings. Formula was also the most common PLF to be given in a health facility, either by patients' or health professionals' initiatives.

> *"…. Formula, I guess. It's usually also given by the family as well. For same reason, breastmilk is not enough."* (P13, midwife)

Feeds other than formula, such as banana, honey, and water, were mentioned quite often but they were not normally given by health professionals. They also heard of animal milk like goat's and cow's. Dates, rice water, coconut water, sugar water, rice, tea, and coffee were also reported. Participants were aware of the existence of the feeds based on the common practice in the community outside the health facility (e.g. by traditional birth attendants), or noticed that those feeds were given in the health facility by patients or families. This issue about family influence will be explored further in the next theme (subtheme 2b).

> *"…. Banana and formula. …. They kind of share the same popularity. For banana, it's scraped using spoon, then fed to the baby. Other than that, porridge. Baby porridge but made very runny."* (P3, lactation counsellor)

> *"In a few cases that I met before, [babies were given] honey. ... If not honey, babies are given dates. Before breastmilk comes in, the most frequent is honey and dates. That [referring to giving dates] is part of Islamic teaching, as far as I know. … "Tahnik". The date has to be chewed first by either one of the baby's parents until it's soft and smooth, and rubbed in into baby's upper side of the mouth. They say it has to be slightly rotated, or massaged, until it gets into baby's gut. [It's given] just once right after birth."* (P5, paediatrician and lactation counsellor)

> "*Like honey or formula. … if there's no honey, sometimes people would give plain water instead."* (P7, midwife)
>
> *"Yes, usually is goat's milk. ... Some mothers think goat's milk is more noble and more suitable for baby compared to cow's. They give it as breastmilk substitute, but not limited to PLF."* (P9, paediatrician and lactation counsellor)

PLFs other than formula were more often mentioned by health professionals from the rural areas (P12, P13, P14, P15) or within their experience working in rural or remote areas (P2, P3). Occasionally, they were exposed to those feeds through the side effects that brought patients to the health facilities (more details shown in subtheme 1c).

Additionally, in relation to the first subtheme about confusion over definition, one participant considered donor milk as PLF. Their argument was related to their belief about health risk, which is highlighted in **Subtheme 1c: Belief/understanding about medical indications and health risks**.

> "*…. Not sure if this is right, but for me, donor milk is also PLF, because that doesn't come from own mother.*" (P11, lactation counsellor)

8.3.1.3 Subtheme 1c: Belief/understanding about medical indications and health risks

All participants showed support for breastfeeding and believed PLF should only be given with medical indication and standard. However, what they defined as medical indication varied among one another and depended on each case. They also had different stances of health risks.

For the medical indications, participants named a variety of mother's and baby's illnesses. Some mentioned general indications for formula use, such as maternal HIV/AIDS status, galactosemia, or maternal death, which was more intended to be permanent breastmilk substitute (P2-midwife, P3-lactation counsellor, P6-paediatrician). Fewer of them were specific about PLF indication, which included temporary sickness, use of medication, and

baby's weight loss. More detailed indications were mostly coming from participants who were both paediatrician and lactation counsellor.

> *"…for example, dehydration, 10% decrease of birth weight. We have to do something. It really depends on the mother and baby situation. Sometimes breastmilk really doesn't come in. Other example, if mothers are sick, mothers are sick for days, maybe receiving chemotherapy. We have to give formula. Then after she stops the medication, she can start breastfeeding".* (P5, paediatrician and lactation counsellor)

Milk not coming in, even without specific maternal or neonatal illness, was the most frequently mentioned. One participant specifically described delayed lactogenesis.

> *"I believe [PLF] should not be given. But indeed, there are mothers who cannot produce milk. It's very rare, but it happens. I just had one last week."* (P15, midwife)

> *"Medical indications where mother and baby are both fine include obesity, PCOS, and C-section. In C-section, lactogenesis II is delayed to day 4-5. In that case, we can tolerate and be sure that breastmilk will come in eventually. Unless there's [ductal] hypoplasia, where no breastmilk will be produced at all. On the other hand, waiting on day 4-5 is disadvantageous for baby."* (P9, paediatrician and lactation counsellor)

As highlighted in the first subtheme (1a) about PLF meaning, there are also inconsistencies about timing and justification. A few of them referred to WHO or local guidelines briefly, but the majority said medical indications for PLF highly depended on each case. Staff at the same facility may also use different approaches.

> *"I still use 72 hours [of wait time] but some of my colleagues would give formula within 2 days, because they are worried about jaundice."* (P5, paediatrician and lactation counsellor)

Most participants believed that when PLF is given with the appropriate medical indication and standard, PLF can be beneficial and equal to medication. The importance of communicating this is explored more in **Subtheme 2a: Individual skills & building trust**.

When talking about PLF without medical indication, participants' evaluation of the impacts ranged from no effect to catastrophic. Based on the following quotes, perception of risk varied a lot and was not entirely balanced i.e., honey not a big deal vs. the 'devil cycle' of formula.

> *"Well, people think that giving honey may interfere with baby's taste buds, but there's no effect in breastfeeding really. In my experience, it's just a few drops and after that baby can be breastfed well."* (P7, midwife)

> *"I think it's catastrophic. It's not useful and you don't need it. It disrupts breastfeeding like a devil cycle. Other than that, [formula] increases risk of infection. If the parents have no idea of the preparation, they may dilute it or use contaminated water."* (P10, lactation counsellor and midwife)

Their perception of risk was dependent on the type of feed, how or how much it was given, and the follow-up. The harmful impacts they were worried about were mostly related to breastfeeding disruption (especially formula) and gastrointestinal problems (mainly other feeds). Some spoke based on their knowledge while some others by first-hand experience.

> *"I think PLF is really detrimental to optimal breastfeeding from various aspects. The first aspect, it damages mothers' self-efficacy and confidence. Especially when mothers have background knowledge about what EBF is. So, when there's something else in the beginning, they will feel like a failure from the start. That's a burden for mothers.* (P9, paediatrician)

> *"…. PLF is not only negative but also very dangerous for babies. They are just born and need to adapt with everything in this world, but they are forced to feed on something which their intestines aren't ready yet."* (P2, midwife and lactation counsellor)

The majority of participants never witnessed or directly experienced cases of gastrointestinal problems during their practice, but a few who did reported fatalities.

> *"One of the most memorable was the one in town B [a rural area in Java]. We met people who were still into giving PLF. They gave banana to a two-day-old baby. …. it was memorable [for me] because there were three or four babies who died because of that [banana], they died due to ileus."* (P2, midwife and lactation counsellor)

> *"… [in 2020-2021], every month I would meet at least one of those (intussusception and problem with the intestines after PLF). They usually come from the remote area. This most often happen during the first week after birth (then milk did not come in). So, the baby would have eaten banana and many kinds of feed. Sometimes mixed with honey, coconut water. So, in the end I had patients come to me at the age of 2, 3 weeks, up to 2 months. They came with bloated stomach, obstruction, and invagination. .... We can't operate. So, we only decompress, stabilise, do fluid resuscitation, drugs, and antibiotics. … they usually came with sepsis. There was some delay too because before they decide to bring the child to hospital, the baby only seemed bloated, and it did not look very serious at first. Later and later the stomach gets bigger, so that's when the baby is finally brought to hospital."* (P14, paediatrician)

> *"...for premature babies under 35 weeks, their intestines are immature. … Giving PLF will increase the risk of necrotising enterocolitis (NEC). … In Indonesia, with 800,000 premature babies born annually, our NEC rate will keep increasing if PLF continues to be given like now."* (P9, paediatrician)

The specific impact of PLF on breastfeeding that many participants worried about included early cessation or mixed feeding. However, they also acknowledged that other factors, such as the use of bottle, breastfeeding support, and mother's intention to breastfeed can make a difference in breastfeeding continuation.

> *"…In my opinion, there's no harm yet. Because actually mothers here are fanatical about breastfeeding. So they usually stop breastmilk substitute once their milk comes out. I rarely see it makes breastfeeding stops because baby refuses to suck. … there's no clear evidence/studies about it [nipple confusion]. … If the nipples are anatomically fine, baby will not have a problem changing from teats/bottles to nipples. …I don't think it's because of the PLF per se. There must be something else. If you want the baby to feed directly, just stop the bottle. These days there are technologies like nipple shields, extension, etc. So, in my opinion, PLF is not extremely harmful."* (P1, paediatrician)

> *"…PLF ending in mixed feeding, but also because it will lead to [earlier] cessation as well. They fully stop. They switch to formula. Especially when there is nipple confusion [when using bottle]. … [relactation] happens … I had experience assisting someone to relactate. But it's so hard. It takes a lot of effort and huge determination as well as family support. [in my experience] There are more mothers who fail to resume breastfeeding (after PLF)."* (P11, lactation counsellor)

In relation to the perceived risk for breastfeeding disruption, P11, who considered donor milk to be PLF (see subtheme 1b), argued that without breastfeeding support, donor milk could pose similar risk as prelacteal formula or other PLFs.

"…. they give the (donor) breastmilk without breastfeeding support. …. in the end, it creates dependency. Just like PLF. After getting milk from donors, mothers still can't produce enough milk, and when they run out of donor milk, they will eventually go to formula." (P11, lactation counsellor)

8.3.1.4 Subtheme 1d: Practical justifications

Regardless of their beliefs and understanding about indications and risks, there were times where PLFs were given in health facilities. These situations could happen under the initiative of health professionals, patients' demand/request, or combination of both.

Second-hand experience such as colleagues' personal decision or permissiveness along with participants' own initiatives were equally reported. One participant said that the hierarchy of infant feeding selection was actually intuitive. However, in practice, they saw colleagues who took the shortcut because using prelacteal formula was so convenient that it often caused the hierarchy to not work. As shown in **Subtheme 2a: Individual skills & building trust**, P9 described it as *"the convenience we did not wish to have."*

"The first preference is of course direct breastfeeding. The second one is expressed milk. The third one is pasteurised donor milk. If all those aren't possible, then the fourth option is formula. So with such hierarchy, deciding to jump to the fourth alternative is not appropriate. But that often happens because it's so easy (to just use formula right away)." (P9, paediatrician and lactation counsellor)

Moreover, limited resources and facilities especially in a busy neonatal intensive care unit (NICU), were the common justification for health professionals to give prelacteal formula.

"…. for mildly sick babies, such as mild respiratory distress that is not severe, they're very cranky and thirsty. They keep crying. So even on the first day, if those babies keep crying, formula it is. And that is what parents want as well. They think sick babies will have to be taken care of by HCWs and so just let them get formula. It doesn't cross their (mothers/family's) mind to put an extra effort to express breastmilk and continue trying to breastfeed.

We have to really ask the parents to give us expressed breastmilk. If we forgot to ask them, they would just stay still and do nothing. Even if we already ask, sometimes it doesn't get to them either. They don't have the awareness of the

breastmilk importance. It's so much different from situation in Jakarta where I had my trainings.

"…. Lactation management is very overwhelming for health care workers (HCW) with limited resources, especially when the ward is full. So breastfeeding education and counselling is not a priority. I can imagine the nurses' workload. ... And formula is seen as an easy shortcut." (P14, paediatrician)

Insufficient breastmilk supply along with baby's hunger was mentioned in almost all interviews. It was either perceived by mother and family or it did really happen. As mentioned earlier in **Subtheme 1c: Belief/understanding about medical indications and health risks**, there was no clear underlying medical condition, but breastmilk just somehow did not come in and sometimes became a justification for giving prelacteal formula. Additionally, exhausted mothers can have difficulties in initiating breastfeeding and sometimes it may become a reason to compromise.

"I have three children. The first one got formula on the first day, because I had a very difficult birth and got extremely exhausted. So, I said, ok, just give formula. But that's just a day and I managed to breastfeed later." (P15, midwife).

8.3.2 Theme 2: Health professionals' role and capacity

This theme describes what participants thought of their roles and capacities in avoiding inappropriate PLF in health facilities, and what facilitated or limited those features.

8.3.2.1 Subtheme 2a: Individual skills & building trust

All participants were aware that the most common reason mothers gave PLF was fear that their milk/colostrum was not enough to feed their hungry, crying baby. Therefore, participants believed that each of them had a role and capacity in providing breastfeeding support, particularly by building mothers' self-efficacy. However certain circumstances may limit this role.

It is vital for health professionals to be able to gain trust from their patients and help develop confidence in breastfeeding. However, not all health professionals are equipped with such

competence during formal training. Many of them only realised how difficult breastfeeding can be when they had their first child. Some doctors and midwives in this study also took lactation counsellor certification because they found lactation counsellor helpful.

> *"Doctors aren't well taught about good latch-on. Baby's lips movement. Signs of sufficient breastmilk. Not many of them know. Health professionals aren't well equipped with the skill to help breastfeeding."* (P4, lactation counsellor)

> *"Breastfeeding is good and everyone can do that. But when I had my first child, it's not that easy. Yes, it's difficult. We doctors don't get comprehensive curriculum on breastfeeding. So having AIMI around is very helpful to educate public. Even I got my lactation counsellor certificate from AIMI."* (P5, paediatrician and lactation counsellor)

> *"My tasks [in the health centre] involved giving health counselling. So I somehow got to know that EBF is important. But, when I got pregnant, I realised something. … Breastfeeding wasn't as easy as what I saw in posters. … When my baby was born, I was super confused. … That's what I didn't get in the beginning of my early motherhood – fellow mothers peer support system."* (P3, lactation counsellor)

Additionally, some felt that an individual health professional's lack of training made them unable to resist a 'permissive' culture about giving PLF (as also described earlier in subtheme 1d) at their health facility.

> *"From the health professionals' side, there is also lack of knowledge. From the institutions and facilities, there's lack of good will. This issue is taken lightly. … here formula is so widely distributed. I think this is the convenience that we don't wish we had. Because it's so easy, especially for mothers who aren't confident, there's this permissiveness, "it's okay if you can't breastfeed". There is the tendency to do such justification. It's calming mothers down, but I think it's inappropriate."* (P9, paediatrician and lactation counsellor)

As mentioned in the previous theme (1b-1d), perceived insufficient breastmilk supply was still the most common reason prelacteal formula was given. Milk not coming in, milk not enough, or hungry baby was always mentioned in all interviews.

> *"This is a frequent complaint. What if mothers' milk doesn't come in for days? What if the baby gets dehydrated? This is the importance of having knowledge. Mothers should know that breastmilk is produced in their body since second trimester. And in the first 1-3 days, breastmilk is very little, about one teaspoon. But people think*

breastmilk has to be abundant, flowing, copious. It makes mother not confident, "My milk is not coming in"." (P3, lactation counsellor)

This misperception could come from the mother or her family or both. They were not confident the milk was enough. This is where the ability to convince mothers plays a major role. Participants were aware that some mothers deferentially trust in the expertise of health professionals and rely on their advice about feeding their babies'.

"I think the most important thing is to educate patients in a simple language that they understand. There is fear among women about her milk production and concerns about baby's getting hungry. But they don't know that [baby can survive 1-2 days without any food]. …. I've never seen anyone who doesn't have her milk come in after 3 days." (P8, midwife)

"Their roles to convince and reassure mothers are extremely vital. These days, patients who come to doctors are either so submissive towards HCW or so stubborn. There's nothing in between. Those who are submissive, they will listen to and do whatever doctors say, including rooming-in and direct breastfeeding. They trust that they're safe in the doctor's hand. Conversely if doctors recommend otherwise, then they will obey that too." (P9, paediatrician and lactation counsellor)

However, counselling certain groups of patients can indeed be very challenging. Some health professionals, especially those working in rural/remote areas, felt that the people in the community often did not see them as the first person to seek medical help. Sometimes it was due to access or preference of trust towards traditional birth attendants. Sometimes participants gave up educating because they felt that doctors were not even considered as the source of information for health in general.

"Mothers usually give birth attended by midwife or traditional birth attendant, but there are some who give birth by themselves, so even the midwives have no idea at all. They only meet the children when they get sick and are brought by the parents. … We (health professionals, especially specialists) are not the first person to seek by the patients. That is how much the delay is happening. …… Patients trust their traditional birth attendants more than the midwives so patients always go to them first. Even going to midwife is a hassle for them. Imagine they have to travel another two hours to reach the hospital. So that's sad. We're the last person to know what's going on and only get to hear the sad story from the patient." (P12, paediatrician)

"….tradition or religion is more influential. So, I let the parents decide. I only try my best explaining from my expertise, using evidence, but it's up to parents if they want

> *to follow the advice or not. Sometimes we have to compromise, because what else can we do? …some people from island X. They're like, uhm.. (laughs and shakes head). So difficult to educate. They will only listen to their 'kyai' (religious leader). Whatever he says, they will follow. But doctors… (they won't listen). Not at all!"* (P5, paediatrician and lactation counsellor)

Meanwhile, breastfeeding support requires effective and empathetic communication. Some motivating words could backfire and instead create unwanted pressure for mothers. This could sometimes be tricky even for lactation counsellors.

> *"We also learnt that language in breastfeeding campaigning has to be carefully crafted. We should be understanding. Not everyone can do it. Even sometimes lactation counsellors can be judgemental, like, "I can do it, so can you."* (P3, lactation counsellor)

On the other hand, the skill to build trust is not only about convincing mothers about their ability to breastfeed, but also communicating with them when PLF is indeed medically indicated. This is especially needed in a population with strong breastfeeding culture, where mothers find exclusivity very important. The fear of being unable to breastfeed can really trigger psychological stress for the mother. This phenomenon is mostly picked up by many participants who regularly met urban and well-educated mothers.

> *"In the situation where baby can't survive without it, (PLF) can be seen as medication. So, if in the future, the mother is making a big deal about it, "Oh I received formula once, does that mean I'm not giving exclusive breastfeeding (EBF)?", I would answer, I still say it's EBF, because that's medication. …. There's one view that says, if it's early limited formula (ELF) with continuous breastfeeding support, it will benefit mothers by improving duration, compared to mothers without ELF. We can use that as a reference, as long as we understand the goal and mothers are given thorough explanation about ELF."* (P9, paediatrician and lactation counsellor)

Occasionally, health professionals have to use a strategy or even incorporate non-medical approaches to help make patients listen to and trust them.

> *"I almost never met anyone who couldn't get their milk out within three days. There must be a few drops, even just very little. So we usually help mother by getting breastmilk out using 1 ml syringe. So it looks a lot and mother would feel motivated. Sometimes we exaggerate and say, "Look, it's a lot of milk!", to boost mother's confidence."* (P10, midwife)

"…Use sweet words to persuade like, "Mum, if God creates two babies for you then your breasts must be enough." (P1, paediatrician)

8.3.2.2 Subtheme 2b: The ongoing influence of mothers' families

Health professionals felt that their job in supporting mother to avoid inappropriate PLF became easier when they were on the same page with the mother and her family, but it's not always the case. Intervention from the mother's family and inner circle is one of the most common challenges for health professionals. This was mentioned in nearly all interviews, regardless of participants profession and island, but it was more prominent in rural and/or lower socioeconomic settings.

Of all family members, the baby's grandmothers (the mother's mother or mother-in-law) were the most mentioned by the majority of the participants. The husband and other relatives were also mentioned but less frequently. Grandmothers' dominance in decision making around infant feeding was attributed to power imbalance (especially for young mothers), experience, and their roles in helping mothers raise the baby. This issue covers infant feeding in general, where the formula feeding mindset played a role in the family decision. Nevertheless, this largely affects the decision to give PLF.

"My patients are often from lower middle social classes. Many underage mothers. The baby is often brought by their grandmother instead of their mother or parents. First time mothers, especially the young or underage ones usually only follow what their parents say. Many of them dropped out of school. They usually formula feed because they're not patient waiting for the breastmilk. But I don't want to scold them." (P12, midwife)

"Mother was forced by the environment, the parents (of mother). The mother had no power to say no, to say "This is my child, I'll take care of her/him, you can feed me but I'm the one who will feed her/him". She couldn't say that. Especially young mothers. The mother' parents, grandmothers were still dominant. "You were also given this when you're a baby! …. It crushed her hope, so they let her child be taken care by the child's grandmothers." (P2, midwife and lactation counsellor)

The continuous comments from her closest family members about the baby's hunger and/or not enough breastmilk could affect mother's self-efficacy, even after heath professionals'

attempt to convince her otherwise. This made the situation even worse when she was not confident at the start. Family members, especially the baby's grandmother, were usually the ones who accompanied the mother to the hospital. Sometimes they gave PLF on their own initiative, regardless of approval from the health professionals.

> *"….PLF is given by traditional birth attendants or family without us knowing. It's belief or tradition. If we found out, they'd say, the breastmilk was not enough and the baby was hungry and wanted to feed already. Usually after birth, midwives leave the room to make report or to take a lunch break. We don't stay in the room for 24 hours; we have to give some privacy. When we come back to the room, we would see a bottle of honey in the room. Sometimes swarmed by ants (because of the honey/sugar)."* (P13, midwife)

> *"… Especially when family, like the mother's parents and in-laws intervene. The thing is, formula is so very easily accessible here. You can buy it anywhere. So suddenly they can come up to the baby's room bringing in the milk [formula]. They will say, "Nurse, please give it [to the baby] if crying or thirsty". Or when we do rooming-in, sometimes we find formula milk carton (already in the room)."* (P1, paediatrician)

There were times when family members requested or demanded health professionals to give PLF to a newborn baby. Mostly it was prelacteal formula, but in a very rare case, it could even be other kinds of feed. The following quote came from a midwife who worked in a rural area.

> *"When I do have to give PLF, I personally would only choose formula, because of the ingredients. But some patients and their family are so against formula and insist to give something else. I already told them. But well, sometimes it's hard to argue with them. In such cases, I give a few drops of sugar water or honey in a gauze to the baby's tongue."* (P15, midwife)

The knowledge gap between generations was frequently reported to be a barrier. This was more challenging in rural areas, but it was still a problem even in urban areas when the family was not well informed.

> *"It's easier to educate urban mothers. In rural areas, family intervention is so strong that mother often has no power to make decision. And it's hard to educate older generations."* (P8, midwife)

"Again, older generations didn't have that much of idea about breastfeeding benefits. They would also say, "That's how you were raised and you turned just fine." So when we educate mothers, we try to do it in group. Not only mother, but also husband and parents if possible." (P10, midwife)

8.3.2.3 Subtheme 2c: Services that work

Participants described ways in which the organisation of services could help or limit their efforts to help mothers avoid inappropriate PLF. They all pointed out the importance of breastfeeding support and counselling at both antenatal care (ANC) and postnatal care (PNC), with occasional emphasis on either one.

Most of them felt that birth preparedness was key to promoting breastfeeding and thus avoid inappropriate PLF. Breastfeeding counselling at ANC visits is essential because educating mothers right after birth may be too late or when mothers are already feeling overwhelmed.

"Ideally, at 16 weeks of gestation, breasts have started producing milk. That means, physiologically, mother is ready. But psychologically or cognitively, she needs to be given the knowledge. The knowledge that when her baby is born, stimulation is needed to ensure breastmilk will come in. Colostrum will come in anyway. But such information is often not well conveyed. Thus, a lot of mothers think they can't produce breastmilk. When should this information be given? At antenatal care (ANC) visit." (P9, paediatrician and lactation counsellor)

"If I can summarise, pregnancy planning is vital to improve breastfeeding. Oh, we also encourage premarital counselling, so before ceremony, midwives will educate couples about pregnancy and birth preparedness, including breastfeeding, early initiation of breastfeeding (EIBF), and the first 1000 days of life." (P7, midwife)

Meanwhile, challenges to provide effective ANC emerged when patients arrived at the clinic unexpectedly and were not adequately counselled before (P15, midwife). On top of that, the COVID-19 pandemic that started in early 2020 had become an additional barrier, where frequency and duration of ANC were made shorter.

"Some mothers suddenly turned up at the facility when they were about to give birth. They didn't do ANC with us. They're not counselled about breastfeeding and so not ready." (P15, midwife)

> *"…especially during the pandemic, ANC is not going smoothly."* (P9, paediatrician and lactation counsellor)

Early initiation of breastfeeding (EIBF), which was part of PNC, was frequently acknowledged by most participants as the key to avoid inappropriate PLF. The risk of babies receiving inappropriate PLF could be minimised further when followed up by rooming-in. Additionally, PNC visits at the facility and home were helpful to promote as well as ensure correct breastfeeding position and technique after discharge.

> "…*premarital, antenatal, and postnatal (are important). Especially, the most important part is the birth, which is EIBF. If it fails, all the preparations will not be too meaningful."* (P7, midwife)

> *"I think postnatal is more impactful, because no matter how much you educate at ANC, when the baby is born and breastmilk doesn't come in, they must be panicking"* (P1, paediatrician)

Unfortunately, in certain circumstances, it was not always possible to facilitate EIBF and/or rooming-in. Workload in resource-limited settings (as mentioned in subtheme 1d) and separation policies (subtheme 3c) were some of the barriers. Furthermore, several patients would simply not come back at a scheduled PNC visit after discharge (for whatever reasons) or lived in a place where access to home visits by health professionals was difficult. Lastly, just like ANC, PNC visits were reduced, and breastfeeding support was not optimal during the pandemic.

> *"In each village, there's a village midwife. Ideally the midwife will visit the mother and baby on the day 1, 3, and 7 after birth. However, in the more remote areas like mountains, it's a bit harder for the midwives to do home visit, so they usually only see the patients after birth and then the next 10 days."* (P14, paediatrician)

> *"…because of the pandemic, we tend to discharge patients ASAP. That means we lose the opportunity to observe mothers and make sure breastfeeding is established."* (P9, paediatrician and lactation counsellor)

> *"…before the pandemic, there were quite a few. Two-three clients a week. Offline. But after the pandemic, there's only one a week, because AIMI rules say only online counselling now. So there are less clients now. They actually want to be*

visited. They want to be seen and checked if they're doing it right, but we are afraid." (P3, lactation counsellor)

One of the components of ANC and PNC services is maternal and child health (MCH) book. It is widely used in Indonesia, and many participants praised the quality and completeness of the book. It contains all the information on infant feeding, including avoidance of PLF. However, in some areas, it was not always used optimally, either by patients or even by fellow health professionals.

"….MCH book is a good way to communicate among HCWs. The book contains all information about pregnancy, birth, and breastfeeding. The most recent edition is even better and more detailed. Being pregnant without a MCH book is like being married without a marriage certificate (laughs). So yes, it's really important." (P7, midwife)

"I have told midwives to use MCH book to educate mothers about breastfeeding during ANC visit, like the importance and technique, but I don't think it's done. Midwives are focusing more on the pregnancy itself, like folic acid and iron supplement. But that's it. Latch on and position aren't really monitored. I once ask them if they have ever opened the MCH book. Do they know information on breastfeeding is available there? Some of them were surprised to know that on the first day, there's no need to rush to formula immediately and it's okay to wait for the breastmilk to come in." (P14, paediatrician)

All the discussion on ANC and PNC underlined the importance of providing comprehensive breastfeeding support for mothers. However, this service seemed to be less acknowledged by the system. One of the issues raised by participants was about the lack of incentives given to health professionals for providing breastfeeding support and counselling service. This service was not recognised as one specific service covered by national health insurance scheme. It was bundled in as one routine ANC or PNC visit service, while in reality, it took more time and specific skills to do it, outside the regular check-up. As a result, they often work for free if the patients could not afford it.

"Counselling support for breastfeeding cannot be claimed in BPJS (national health insurance). So for example, when a patient is using BPJS scheme in the health centre or referral hospital, there is no fee for breastfeeding counselling. While in fact, it is time consuming. For example, we gather mothers and their spouse, making

a small class. If the patients are BPJS patient, we can't charge them and we can't claim to BPJS that we do such service for our patient. So giving a breastfeeding counselling is not considered as [real] work." (P9, Paediatrician and lactation counsellor)

"Breastfeeding counselling's not covered by BPJS. I think that's really a problem. I wish the government would put breastfeeding counselling as part of the antenatal care (7+) covered by BPJS. I think it would be a game changer. But sadly it's not. AIMI charge IDR 150K (about GBP 8) for a maximum 2 hours of in-person consultation. Previously we charged IDR 100K for the first hour and IDR 50K for every next hour. But it was a lot of work honestly." (P10, lactation counsellor and midwife)

On the other hand, one of the participants argued that there was a strategy to handle that situation. However, it depends on the management of each facility.

"We should use BOK (local government funding for health). The reason it was covered by local funding instead of BPJS is because different area has different problem. It depends on the management strategy in the facility. In mine, I created cross subsidisation and created small classes for breastfeeding counselling. It is not enough to pay service for individual counselling, but for small classes, it can. So it's fair and nobody does free labour." (P15, midwife)

8.3.3 Theme 3: Changes in PLF practice

This theme describes participants' observation and experiences on how PLF practice has been evolving throughout their careers. Although there were some inconsistencies, the majority of them felt that inappropriate PLF was declining. The issues to which these changes were attributed are described in the following subthemes: 1) Impacts of law and accreditation on breastfeeding, 2) Mothers' commitment to breastfeeding, and 3) Separation policies & COVID-19.

8.3.3.1 Subtheme 3a. Impacts of laws and accreditation on breastfeeding

Of all participants who observed a declining trend in inappropriate PLF practice in health facilities, the majority of them attributed it to the laws on breastfeeding which were followed by facility accreditations such as the Baby-Friendly Hospital Initiative (BFHI).

> *"…In our hospital, and most hospitals nowadays I guess…, giving PLF is no longer practiced. Especially after Comprehensive Emergency Neonatal Obstetric Service (PONEK) accreditation in early 2000s. We are not allowed to give PLF anymore, because it's against baby friendly hospital principles… [accreditation works to make changes] because people don't want their facilities to get ranked down or get bad assessment."* (P10, lactation counsellor and midwife)

Breastfeeding laws also changed health professionals' training and standard procedures. One of the oldest participants compared how infant feeding practice these days was different to that forty years ago.

> *"…in 1974-1975, in the paediatric ward, we cared for the baby and we gave formula. I think it was the policy in that period. Even in midwifery school, we hadn't been taught that breastmilk is the best [feed]. That breastmilk is enough. So, at school, we were still giving bottle feeding to newborn babies. Not even one bottle for one baby, but one bottle for several babies."* (P2, midwife)

Nevertheless, certification of accreditation did not always guarantee good practice. This implementation was often dependent on leaders or local champions in the facility. Hence, standards might still vary among hospitals.

> *"Even in one of the hospitals... That was the champion of baby friendly hospitals… They don't provide EIBF support and breastfeeding counselling."* (P9, paediatrician and lactation counsellor)

BFHI accreditation was seen by some participants to have encouraged the implementation of 10 Steps of Successful Breastfeeding, particularly in breastmilk substitute marketing, where it has become more restricted than it was before. As a result, giving formula as PLF is no longer normalised.

> *"In around 1995 when I started practice, formula was more easily accessible but now it's more restricted and regulated."* (P8, midwife)

Although the majority felt that laws made a difference, a few thought that it could still be improved. For example, law enforcement in breastmilk substitute regulation remained weak and unclear. Regulations existed, but violations were not taken seriously.

> *"All the health professional organisation recommendations and codes have no law-enforcing power. They're just like suggestions. Well, I don't know about doctor's association, but not all regulations have clear punishment. For example, ministerial decree (SK), the punishment is just withdrawal of practice licence, or something like that. But only laws like government regulation and constitution have stronger and clearer consequence. Ethics codes are just like customary rules, if each other lets it slide, then we all run business as usual."* (P4, lactation counsellor)

Moreover, participants reported still having seen or heard of prelacteal formula given by health professionals, including their colleagues, who could be worried, more permissive, simply not knowing, and/or had a conflict of interest because they received funding from the formula industry. One participant reported receiving sales compensation from a formula company, although they said it did not affect their integrity.

> *"I do not support formula. I do have a contract with a formula milk company, but I feel guilty if I have to give it. So, I try my best to keep the mothers breastfeeding."* (P12, midwife)

8.3.3.2 Subtheme 3b: Mothers' commitment to breastfeeding

The changes in laws were followed by campaigns led by the government, which resulted in raised public awareness and commitment to breastfeeding. This was reported by nearly all participants to be one of the reasons inappropriate PLF was declining.

This attitude was reported to be more common among well-educated and informed mothers, especially in urban or more developed areas. Other than the laws, they also attributed this change to information access via the internet and social media. Many lactation counsellors reported that they or their colleagues joined or started an online breastfeeding support group because of their own breastfeeding struggle.

> *"I think it's improving over time. Because breastfeeding campaign is getting more intense nowadays. Also, mothers look up to the influencers, celebrities on social media."* (P7, midwife)

> *"…There's a change in public's mindset as well. It's a very significant change."* (P8, midwife)

> *"…My first child was born in 2005. I wanted to breastfeed so bad. But I was struggling. Not helped. Not supported. … So I sought information by myself. … I chatted with a friend who just gave birth. … She wrote the blog, I made the mailing list."* (P4, lactation counsellor)

The majority of participants felt that since the breastfeeding campaigning started, the breastfeeding culture in Indonesia has continued to develop over time. They met a lot of mothers who strongly intended to breastfeed and did not plan to give formula from the beginning. Exclusive breastfeeding is a crucial milestone for them. This is especially observed in urban and higher socioeconomic settings.

> *"Nowadays, breastfeeding [campaign] is so massive. They [my patients] tend to be so against giving formula before breastmilk comes in. Otherwise, they will really ask the doctors first. That's what's different from back then when I was doing my specialisation training [2010-2015]. Very rarely they chose to breastfeed, but now the trend has changed. They are so afraid of formula. So concerned about giving it. I think it's because of social media. That was the time when … the movement of lactation [support] group [started growing]. The government's programs were so intense around that period. …It's like the reverse sometimes. Now, even when the baby's weight is not gaining, breastmilk not coming in, they still refuse to give formula. It's the other way around if you compare to a few years before."* (P5, paediatrician and lactation counsellor)

The effect of breastfeeding awareness has changed belief about colostrum – it is no longer discarded. Furthermore, in more recent years, PLF was not being given as a cultural practice but more of the solution for perceived insufficient milk. Several participants also reported their own experience as mothers where their older children received "cultural PLF" while the younger ones did not.

> *"…[colostrum is] no longer discarded. Especially among health professionals, it's ensured to be given. But a while ago, during my early practice, I used to see a patient who discarded colostrum. The family thought it's some kind of dirt, because it was yellow. But now, after getting educated, they understand, they don't discard colostrum anymore. Now everyone has a cell phone (laughs), so it's easy to educate (them)."* (P13, midwife)

> *"…[giving prelacteal honey] was in the past though, because people are now educated. We no longer give it, because midwives tell not to. … it's improving over time. Because breastfeeding campaign is getting more intense nowadays. … My*

first two children were given honey (note: she was already a midwife at that time). Because it's a cultural custom here. … But my third born in 2014 was not [because I already knew it's not supposed to be given]." (P7, midwife)

A growing trend in the use of donor milk was reported by a few participants in urban areas, but none in rural areas. Participants appreciated this trend but at the same time also worried about potential risks because official regulation and facilities on human milk banks had not been established.

"… formula use as PLF in Jogja has decreased but donor breastmilk has increased so much." (P11, lactation counsellor)

"There's a wide variety of donor milk practice. In Indonesia, I think there's no hospital that officially claims to have donor milk bank. Why? Because there is no regulation yet. It should be in the form of ministerial decree. Because in breastfeeding law [PP 33] it is indicated that a decree about donor milk has to be issued. But we've been waiting for 8 years. it hasn't come in yet. I don't know what we're waiting for." (P9, paediatrician and lactation counsellor)

"No [donor milk is not formally screened]. It's based on trust, usually shared within family." (P10, lactation counsellor and midwife)

On the contrary, PLF was still practiced in some parts of the country. Participants in rural/remote areas reported that PLF practice was still common because formula feeding culture in their community had not changed much. Both patients and health professionals tended to be permissive with prelacteal formula. Some of them speculated that it might have something to do with level of education and information access in the area.

"Formula feeding is predominant here. And the saddest part is, even many of the HCWs, even nurses and midwives, don't breastfeed. Sometimes when I get patients that are HCW, … they know that breastfeeding is important, beneficial, cheaper, etc. … but again, the complaint is always "breastmilk won't come in". When breastmilk isn't coming in, they are so permissive with formula. There's no local champion or hospitals that are very breastfeeding minded. Even if there are, they're usually highly educated and well informed about infant feeding, and they're not local. It's ironic because here local people aren't so wealthy. Yet they buy formula, which is expensive. I think it's the mindset." (P14, paediatrician)

In general, the use of PLF other than formula was reported to be decreasing. The only type of feed reported instead to have gained popularity in more recent years was prelacteal

dates or ‘tahnik’. It was reported by a few participants and only practiced by a certain group of Muslims and did not appear to be a widespread movement. As highlighted in subtheme 1b, ‘tahnik’ was not normally given by health professionals, but they were aware that this PLF was often given by their patients in health facilities.

> *“More recently, there are more people who gave dates as “tahnik”. It’s chewed and given to the baby. Nowadays there is this ‘hijrah’ trend. It [‘hijrah’] means people’s change of behaviour to become more religious and following Prophet Muhammad’s teaching and practices.”* (P4, lactation counsellor)

Nobody raised issue about the increasing use of other milk as seen from IDHS analysis. When I explored this further, some participants mentioned the use of goat’s milk as a breastmilk substitute which seemed to have religious values. It was promoted on social media along with other milk products.

> *“Oh yes, goat’s milk. It’s somewhat trending with the hijrah trend. (laughs). And the promotional campaign is saying that goat’s milk is similar to breastmilk. …. I also see on of HL supplementation milk [a famous protein shake], given to baby.”* (P4, lactation counsellor)

8.3.3.3 Subtheme 3c: Separation policies & COVID-19

As part of breastfeeding promotion, rooming-in is generally encouraged more than it was in the past. However, some separation policies remained unchanged and the new one related to COVID-19 appeared. As reported by participants in Subtheme 2c, EIBF was key for avoiding inappropriate PLF and so rooming-in was frequently attempted in the first place. This was different from the practice in the past as mentioned in subtheme 3a, where there was a separate room for babies.

> *“Successful breastfeeding usually comes after successful EIBF. We have started this mandatory EIBF programme since 5 years ago. I only had the chance to EIBF with my third child, though. Because we didn’t know about it before and we did not have the policy. In the past, baby was just put on breast but was not waited until she/he can suck and was taken away immediately. But now they wait to ensure breastfeeding has been established. I only did this practice with my third, but not with my first two children.”* (P7, midwife)

Nowadays mother-baby separation does not happen by default, but only for certain conditions such as babies who are born through caesarean section or getting phototherapy for jaundice. These were reported by nearly half of the participants. Nevertheless, some of them questioned the logic behind the separation.

> *"In the hospital, there are separate rooms for mothers and babies who are born via C-section, so formula is more easily given. In caesarean delivery, EIBF is not the default, so mother has to specifically request for an EIBF."* (P7, midwife)

> *"…my own experience, which is post C-section. I was separated from my baby, and he was given formula. … I had no idea why we were separated immediately. We weren't roomed in. That's the policy, all caesarean babies have to be observed in NICU for two hours, so nobody gets roomed in with their mother. But in my case, I only saw my baby the day after. Even though when I asked my paediatrician, there's no indication. So I don't know. I'm still confused. … when we reunited, he got nipple confusion. I didn't succeed in breastfeeding. So, he got formula, full."* (P13, midwife)

> *"Especially when their baby needs phototherapy [for jaundice]. I think that's the main loophole. Because back then it could take up 1-3x24 hours of [baby-mother separation]. And 3x24 hours with bottled milk is enough [to fail breastfeeding]. But now, baby with phototherapy can be breastfed. In the past, it wasn't allowed."* (P11, lactation counsellor)

More recently, another issue raised repeatedly by participants was the separation between COVID-19-positive mother and her baby. This was because earlier in the pandemic, the national guidance recommended separation and expressed milk. There was concern for inadequate facilities for rooming-in and they did not want to take the risk. Moreover, the pandemic reduced antenatal visits, shortened the duration of doctor's visits, and reduced opportunity for counselling.

> *"In the beginning of the pandemic, the consensus in neonatology did not recommend skin-to-skin, right? It was forbidden, not encouraged. So that's why we did not do it and until now parents are still scared. In the delivery room, it's crowded. Nurses, patients, midwives. So parents are cautious and prefer the baby to be brought to the baby room [separated from mothers in delivery room]."* (P1, paediatrician)

> *"We have outdoor observation room, it's semi-permanent using large tent and air can circulate freely. We keep our COVID-positive mothers there. If the baby remains negative, I'll give prelacteal formula, because I cannot let the baby stay in that room with other COVID-positive mothers. And when it rains, it'll get a bit wet and cold, so I*

separate the babies. If within 1-2 days mother is stable, I'll discharge them home so mother and baby can reunite again. I'll educate that she can breastfeed directly under strict COVID protocol, such as masks, hand hygiene etc." (P6, paediatrician)

In the more extreme cases, expressed milk was not even seen as an option. The following quote came from a participant in a very remote rural area and possibly one of the least developed regions.

"Expressed breastmilk is also the problem. I'd rather not ask mother to express her milk to the baby because of hygiene issue. After delivery, she won't shower and in the observation room, there are so many COVID positive patients. It's so messy and there's higher risk of infection. So if mother and baby have to be separated, I decide to give prelacteal formula until mother and baby are ready to be discharged and sent home. She can wash up then start breastfeeding again at home. My advice to the OBGYN is to deliver safely, make sure mother and baby stable so they can be sent home ASAP." (P6, paediatrician)

8.4 Discussion

8.4.1 Summary of findings

The three themes summarise what health professionals think about the roles of health care services in preventing inappropriate PLF practice in Indonesia. First, the complexity of PLF practice contributes to inconsistent perceptions among health professionals of when PLF is considered inappropriate. Second, health professionals' acknowledgement of their role and capacity adds evidence that PLF is (supposed to be) preventable and some of its negative effects are reversible through current practice recommendations. Lastly, changes in PLF practice indicate that Indonesia has made significant improvements in breastfeeding practice which affects PLF, but there is still a lot of work to do and new challenges to tackle going forward.

8.4.2 Complexity of PLF practice: When is PLF inappropriate and why does it matter?

Health professionals know that PLF generally should be avoided whenever possible, but also acknowledge that in a small number of cases, it must be given. Despite multiple

interpretations, various types, and differing perceived risks from PLF, it is obvious for them that any substance that is not approved by the WHO as newborn food (269) is never appropriate to be given as PLF. Consequently, the practice of giving prelacteal banana, honey, or coconut water is rare in health facilities, hence it is of the lesser concern for this setting.

In this study, the complexity of PLF practice in health facilities largely comes from the discourse surrounding the justification of using infant formula milk and donor milk, including when it is right to give them. It is possible that some practitioners are not particularly up-to-date in their knowledge about PLF practice. However, some participants still express confusion about what defines PLF. This reflects inconsistencies across the existing guidelines, which occasionally differed in timing (1, 35), ingredients (2, 35, 41), and justification (5, 41, 79). These might have contributed to how PLF is understood and practiced in health care settings.

Whether the definition of PLF is confined to a number of days or any time between breastfeeding establishment, it is not technically wrong to define PLF as mixed feeding (2), as it is supplementation within the first six months. However, PLF might carry more health risks as it involves newborns. Meanwhile, the justification for giving PLF can be dilemmatic. Formula and donor milk are WHO-approved newborn feeds and supplementations (4), but their recommended use is conditional and comes with potential health risks. On the other hand, not giving PLF when it is necessary can also become a problem. In health facilities, health professionals have relatively more influence on the mother's decision to feed her infant. Therefore, it matters how they view, assess, give, and communicate the information to the mother.

Of all the reasons behind PLF practice in health facilities, participants felt that it was especially tricky to deal with perceived breastmilk insufficiency. This is one of the most

common breastfeeding problems worldwide (50, 52, 71, 75, 202, 270-273) and in Indonesia (220, 274). Perceived breastmilk insufficiency is not necessarily the same as actual breastmilk insufficiency, which is much rarer (270). Failure to distinguish between them in the first days of birth can cause PLF to be introduced too quickly and perhaps unnecessarily.

A permissive attitude appeared to be likely among health professionals who had little knowledge of breastfeeding support and/or take PLF consequences lightly. Sometimes they even applied that to themselves when they had a baby. In principle, they supported breastfeeding, but regardless of the long-term outcome, formula provided a quick solution to hungry babies, worried mothers, and demanding families. This was particularly convenient when there was inadequate staffing and/or excessive workload. Theoretically these are not justification for giving PLF (4) and health professionals were aware of that, but in low resource settings they often had no choice.

On the other hand, actual breastmilk insufficiency, including the one caused by delayed lactogenesis II (the onset of copious milk) does occur (275). Delayed lactogenesis II can happen to mothers who experience pain, stress, caesarean delivery, or difficult labour (276), but it is not listed in the WHO guidelines (5) as a medical indication of PLF. Some other guidelines from the Indonesian Paediatric Society (IDAI) and the Academy of Breastfeeding Medicine consider delayed lactogenesis II as a medical indication, but they are more recent (41, 79) and might not be as widely acknowledged. Not giving PLF when it is needed can put an infant at risk and add stress to the mother. In this study, all participants showed support towards breastfeeding but only a few addressed this issue in detail, including how to distinguish actual from perceived breastmilk insufficiency. Some also expressed concerns about their colleagues not having comprehensive knowledge on breastmilk insufficiency despite their well intention to support breastfeeding mothers.

Another concern arising from the inconsistency of the definition of PLF is about the use of donor milk. Globally, there is a growing use of donor milk (277), and Indonesia is no exception. To a certain extent, it is a positive movement, considering donor milk's protective effects against NEC (48) and the WHO recommendation of it over formula (4). Whether donor milk is a kind of PLF is disputable because statements from existing guidelines are inconsistent (2, 3, 41, 101, 278, 279), but careful consideration is needed when giving it as a supplementation to mother's own milk.

As one of the participants argued, donor milk can potentially be as harmful as any other feeds that are given as PLF. There are several reasons to support this concern. First, donor milk is usually mature milk (280), not colostrum, which means it is not the exact composition suitable for newborns. Second, there is no official regulation on donor milk and human milk banks in Indonesia, and unscreened and unpasteurised donor milk can lead to transmission of infections such as HIV and Hepatitis B and C (280). Third, without sufficient breastfeeding support, giving donor milk can disrupt the breastfeeding process just like any other supplementation does, because it makes the baby full without suckling to the mother's breast (35). Therefore, even though donor milk is essentially breastmilk, in certain circumstances, it can also be considered as inappropriate PLF.

Having the term PLF is helpful to raise awareness that it is a very particular form of mixed feeding that needs to be addressed specifically. Understanding the concept of PLF takes more than just knowing the definition, and a comprehensive protocol is needed to help health professionals support the mothers. The 2009 WHO guideline (5) on acceptable use of breastmilk substitutes was a good basic guideline to assess PLF appropriateness. However, it would benefit from some updates. The most current WHO document on implementation of BFHI released in 2018 (4) still refers to the 2009 guideline, but already acknowledges another protocol published by the Academy of Breastfeeding Medicine in 2017(41). Since the 2009 WHO guideline is likely to be referred to by many health

professionals, it might be more useful if it can be updated by including more extensive medical conditions for the justification of giving PLF.

8.4.3 Health professionals' role and capacity: PLF is generally preventable and its negative effects on breastfeeding are (supposedly) reversible

In many parts of Indonesia, where breastfeeding is the predominant culture, the main problem is not about encouraging mothers to breastfeed, because most of them already intend to do this. This study finds that the main problem is more about helping them to breastfeed optimally by overcoming breastfeeding difficulties. Consequently, in relation to PLF practice in health care settings, the challenge for health professionals is less about dealing with religious or traditional practice but rather about managing mothers' expectation about breastfeeding during the first days after birth.

Unlike infant feeding debate in some western countries (281-283), there was hardly any opposing view about breastfeeding expressed by health professionals, and none reported encountering mothers with such stance. This suggests that breastfeeding is the norm. But because it is seen as the norm, mothers might perceive that it is natural, easy, and everyone will be able to do it without much difficulty. Health professionals reported encountering mothers, including themselves, who struggled to breastfeed their child. Comments like, "My milk just won't come in", "It's not as easy as I thought!" or "It's nothing like in the campaign poster!" indicate that mothers are often unprepared for breastfeeding difficulties.

Participants generally believed that PLF could be prevented if current recommendations were fully implemented, as they did not suggest any new interventions other than what is already covered by the Ten Steps to Successful Breastfeeding (4). They especially agreed that successful initiation of breastfeeding (Step 4) is what it takes to avoid PLF (Step 6) and is key to successful breastfeeding outcomes. According to them, these steps will not be achieved without Step 3 (preparing for breastfeeding since ANC) because counselling right

at birth is too late – mothers are not always in a sufficiently composed state to process information and make decision. Nevertheless, this study found that the topics covered by breastfeeding counselling during antenatal care and the way it is given to mothers might make a difference to PLF practice.

The MCH book, which is received by women at the start of their pregnancy, is appreciated by participants as it contains some information about breastfeeding. At least since the 2009 version (217), it has advice against discarding colostrum and highlights the benefits of breastfeeding. However, there are no details mentioning breastfeeding difficulties except advice to consult health professionals. Meanwhile, this qualitative study finds that not all mothers are able to access breastfeeding counselling services due to payment issue or availability of providers. Even if they can, the providers' competency to give breastfeeding counselling varies widely and this unequally may affect mother's knowledge and expectation. This is similar to what Akuse and Obinya described in their study (75), where health workers in Nigeria routinely and unnecessarily gave PLF. For that reason, participants believe that staff training in breastfeeding counselling and support (Step 2) is urgent.

Following the previous discussion in Section 8.4.2, the repeated quotes about breastmilk insufficiency suggests that conversation surrounding breastfeeding difficulties is limited. In this study, mothers were reported to understand the importance and the concept of EBF. However, they particularly are often unaware of what breastmilk insufficiency is, what causes it, and how to deal with it. This issue is not specific to Indonesia, as it was also reported in qualitative studies from other countries such as Pakistan, Jordan, Bangladesh, and Kenya (52, 71, 202, 272, 273).

Mothers may not know that even without any underlying medical conditions, milk production can still be delayed (65). The expectation that breastfeeding will happen naturally right after

birth can become the source of maternal stress (275). When breastmilk is not flowing copiously in the first hour or day, mothers may perceive it as breastmilk insufficiency and start panicking. In addition to problems with latching and positioning, maternal perception of her own milk affects self-efficacy. Although further evidence is needed, it is not impossible that the psychological stress from perceived insufficiency can eventually lead to actual insufficiency, which in the end results in PLF.

This study adds evidence that without comprehensive information on breastfeeding, the combination of breastfeeding culture, extensive campaigns, and individual genuine intention to breastfeed can become a double-edged sword to breastfeeding outcomes. In this study, participants felt that the idea of having to give PLF can sometimes create psychosocial stress for the mother. As quoted by P9, exclusivity means so much for her that she perceives supplementing with formula as a failure. A mother usually knows about breastfeeding benefits, but she might not know much about breastfeeding challenges and that they can be resolved. The guidance only presents the best scenario but does not prepare for the worst. Rather than just promoting breastfeeding benefits, it might be more reassuring to inform the mother that breastfeeding in the first days can be tough for some mothers, but there are many ways to overcome it.

In addition, the pressure to give PLF is often coming from and/or amplified by the mother's closest circle, such as the baby's father, grandparents, relatives, and sometimes neighbours. However, the baby's grandmother was reported as the most dominant figure in the decision of giving PLF. This was not surprising. Grandmothers' dominance was commonly reported in studies about breastfeeding practice more generally and childcare in Indonesia (14, 231). Power imbalance in decision making related to PLF and/or infant feeding in general is similar to findings from other countries such as United Arab Emirates, Ghana, India, and Kenya (54, 72, 273, 284, 285), suggesting that this phenomenon is not unique to Indonesia.

Relactation (i.e., going back to breastfeeding after temporary formula-feeding)(286) can be difficult. That is why any disruption should be avoided in the first place. However, participants experienced that with strong maternal determination and continuous breastfeeding support (BFHI Step 5), relactation is possible. Additionally, some participants mentioned that nipple confusion, one of the common fears of mothers, can be prevented using the correct methods of feeding. For example, although debatable (287, 288), using cups instead of teats is one of the ways to minimise breastfeeding disruption. In short, even if PLF must be given, there are ways to minimise its negative effects.

The way health professionals help build maternal self-efficacy is important. The message delivered to the mother should be both positive and realistic. It should imply that breastfeeding is a natural but learned process (269) and it is achievable without disregarding potential difficulties. Sentences such as, “Everyone can do it, so can you” lack empathy and can instead demotivate mothers or make breastfeeding more like a pressure, as reported elsewhere (282, 289). Consistent with other studies, involving wider support systems is also helpful because partners and family (especially the baby’s grandmothers) are very influential to the mother’s decision (54, 231, 290).

8.4.4 Changes in PLF practice: Progress has been made but challenges remain

Most participants had seen changes in infant feeding practice within at least one decade and they felt that there had been a lot of improvement. Changes were observed more by participants who had more than two decades of practice experience. In relation to PLF practice, at least three main changes have been observed.

First, colostrum, which is often associated with PLF, is no longer discarded. There used to be a misconception that the first breastmilk was dirty and should be discarded (291). It was a common practice in other countries (57, 62, 292) and this change of practice was confirmed by participants, especially the older ones.

Second, traditional and/or religious PLF have become much less frequently practiced in health facilities This change is consistent with findings from the quantitative studies and will be discussed in Chapter 9. In some areas in Indonesia, prelacteal honey is given for cultural reasons. Some health professionals used to do it for themselves and their patients. Nowadays, they are aware of infant botulism (49), hence prelacteal honey is almost never seen in health facilities. Nevertheless, it is likely to still be practised in the community, just like the other non-standard newborn foods such as milk other than formula, banana, rice, coconut water, tea, or coffee. Despite impacts on breastfeeding outcomes of these feeds were not reported in this study, it remains a concern because death and illness related to prelacteal banana and/or PLF other than formula were reported by some participants. This suggests that such incidence is likely to occur elsewhere but underreported.

Interestingly, 'tahnik' was quoted a few times by participants who are based in more urban areas and serve mothers with relatively good knowledge on breastfeeding. 'Tahnik' is often practiced by certain groups of Muslims and usually involves dates or occasionally honey (22, 52, 233). To participants' knowledge, there has not been any fatality associated with it, perhaps because 'tahnik' is only given once in a very small amount, just a smear on the mouth. Additionally, breastfeeding disruption is also very unlikely because those who practice 'tahnik' are devout Muslims, and in the Al-Qur'an (the holy book), there is a well-known verse about advice to breastfeed for two years (154). It is unclear whether this is an old practice or a new trend following the 'hijrah' trend. Although most of the participants were Muslims, none expressed approval of this practice. However, in clinical practice, they would be cautious about recommending against it, as it might be a sensitive topic to argue about and negative effects of 'tahnik' are not seen in their own clinical practice or heard of among their work circles.

Third, prelacteal formula is no longer given by default. Although a permissive attitude to formula supplementation (by patients or health professionals' initiative) is still observed, it is less common than it was in the past. A study in 1989 (216), found that 81% of babies born in hospitals in Semarang, a city in Java, were kept in the nursery, separated from the mother, and 42% received formula in the first days. Another study in 1990 reported that only 50% of babies born in several hospitals in Indonesia were roomed-in with the mother (291). These were not national-scale studies, but were aligned with P2's experience in the mid-1970s, where newborns were kept in the baby's room and formula-fed by default.

Participants mostly attributed the declining PLF practice to the breastfeeding law in Indonesia, which has been followed by changes in health professional training and education, public campaigns, and regulation of formula marketing. The first law that advocated breastmilk over infant formula milk was set out in 1985 (156). It focused on the marketing regulation of breastmilk substitute and sent messages that breastmilk is the best nutrition for the baby and breastmilk substitute is only needed when mothers' milk is not enough. This has made formula use, including as PLF, more restricted in health facilities. In 2004, the law revised the recommendation of EBF from four (293) to six months and listed the 10 Steps to Successful Breastfeeding (157), where it includes an official recommendation against PLF, "…not giving anything else other than breastmilk to newborns".

Moreover, the passing of this law may have coincided with increasing use of the internet and social media in Indonesia. According to International Telecommunication Union (ITU) World Telecommunication/ICT Indicators Database displayed in World Bank website (294), in 2000, Indonesian internet users were less than 1%, but it gradually rose to 11% in 2010 and exceeded 53% in 2020. This is probably why many participants felt that they saw increasing breastfeeding awareness and intention among their patients, clients, and

community. Consequently, mothers who are well-informed may have intended to avoid formula supplementation from the beginning.

The growing use of the internet and social media may also explain participants' impression that young urban mothers with higher socioeconomic background and education level were the ones who had stronger breastfeeding preference over formula feeding. Consequently, there was a stronger aim to avoid PLF among them. These groups of mothers might represent the population served by my study participants, as institutional birth was more prevalent among the wealthier and urban mothers (295).

The tendency to use formula, either as PLF or as a preferred feeding method, is still observed by study participants but much rarer. It appears occasionally in communities that still perceive formula as a wealth symbol, a mindset that is associated with older generations. Ironically, as illustrated by P14's quote, this was more frequently seen in rural areas, where formula is more accessible than breastfeeding information, suggesting that there may be a delay in mindset change.

Meanwhile, the PLF-enabling practice that relatively remains the same over time is routine separation of mother and baby due to post-caesarean section and jaundice phototherapy. For caesarean-section, the indication is not always clear and/or communicated with mothers. Recently, the COVID-19 pandemic has added more reason for routine separation. The early national guideline recommends separating COVID-19-positive mothers from their baby (296). It was not in line with WHO recommendation (297) and often mentioned in the interviews as a barrier to early initiation of breastfeeding. It was revised in mid-2021 (298) and some of the in some facilities have updated their policy. However, routine separation due to COVID-19 is still common in many other facilities.

8.4.5 Strengths and limitations

To my knowledge, this is the first qualitative study that specifically tries to understand PLF practice in health care settings from different provinces in Indonesia. Drawing on three types of health professional gives informative perspectives, as does actively recruiting from different islands and urban/rural settings. Findings are likely to be transferable to low-middle income countries with relatively similar cultures in Asia and Africa. Confusion in PLF definition is generalisable to wider settings as it involves guidelines from the WHO. Additionally, all the interviews were conducted in Indonesian and then translated and analysed by a bilingual researcher, which minimises the risk of misinterpretation.

The IDHS datasets used in previous chapters are useful to analyse prevalence and determinants while findings from this study help to provide insights into why PLF is being practiced. Qualitative interviews help to unpick the practice of PLF due to feeding concerns versus PLF due to cultural or religious reasons. Furthermore, although the focus of the study is PLF practice in health facilities, it also gives some sense of how this practice differs from that in the communities served by the participants.

The timing of the study provides additional information on how the COVID-19 pandemic affected infant feeding practices, particularly (the initiation of) breastfeeding and PLF. The interviews started in mid-2021, roughly a year after the first SARS-CoV-2 case was reported in Indonesia (299). The study reports the perspectives of health professionals working to support pregnant and breastfeeding mothers throughout this period, including their reflections on how health facilities responded to COVID-19 policy. These findings may be used to inform further policy evaluation.

Additionally, nearly all participants are female and a mother. This gives an unintended advantage as they gave additional perspectives from their non-professional side, although these are not meant to replace patients' (mothers') point of views. The struggles that the

study participants describe show that even people with professional awareness of breastfeeding importance are not always well-informed and well-prepared for breastfeeding difficulties in the first days. It is plausible that women in general, who had no health background and/or have less information of what to expect in the first few days of breastfeeding, might face at least similar struggles.

One limitation of this study methodology potentially comes from the snowballing technique. Since my first contacts were teaching staff in hospitals or academic institutions, many participants came from an academic background or similar, who might be more likely to be aware of current good practice. The invitation to participate may have been less likely to reach health professionals who were openly permissive or oblivious towards inappropriate PLF practice and/or had a serious conflict of interest with formula industry. I attempted to overcome this limitation by purposively recruiting additional participants from rural areas and without academic backgrounds after data saturation had been reached.

Other potential limitations come from the study duration and mode of interview. Due to my deadline for study completion, I had very limited time to identify and wait for the response from potential participants that I expected to recruit. This means that I was unable to include as many participants from the rural areas as I had intended. Recruitment was easier in areas with better internet access. This led to the inclusion of more participants from urban than from rural areas.

Finally, this study focuses only on births in health facilities and where interviewees had access to videoconferencing facilities. Home birth is now uncommon in Indonesia and more likely to occur in very remote areas; there are also remote health facilities where telecommunication links are poor. A future study interviewing traditional birth attendants in remote rural areas might give different information that can complement this study.

8.5 Conclusion

This study identified three major themes related to the experiences of health professionals working with PLF: complexity in PLF practice in health care settings, the role and capacity of health professionals, and changes of PLF practice over time in Indonesia. First, although PLF practice in health facilities is generally decreasing, there was confusion among health professionals surrounding the meaning of PLF and the indication for supplementation using formula and donor milk in the first days of birth. There is a critical trade-off between giving the unnecessary PLF too early and not giving necessary PLF in time. Thus, inappropriate PLF is often difficult to recognise and avoid. The complexity of PLF practice, such as its practical justification, may partly be explained by the inconsistent information provided in the existing guidelines, as well as different levels of understanding and competency among health professionals.

Second, the key to preventing inappropriate PLF in health facilities lies in the role and capacity of health professionals to support mothers to overcome breastfeeding difficulties in the first few days after birth. In addition, the disruptive effect of PLF to breastfeeding can still be reversed into relactation by adequate breastfeeding support. Since breastfeeding is the norm in many parts of Indonesia, the main problem is not about advising mothers to breastfeed, but rather about supporting them to breastfeed optimally by overcoming potential difficulties. The BFHI 10 Steps to Successful Breastfeeding have provided breastfeeding guidance and health professionals are generally aware of it. However, in practice, there are unequal levels of competency across health professionals in providing breastfeeding support and the likelihood of breastfeeding difficulties is poorly communicated to new mothers. Breastmilk insufficiency, whether actual or perceived, is the most common reported reason for PLF practice in health facilities and is frequently made worse by intervention from the mother's family. One way to avoid this is by helping mothers to build their self-efficacy and ensure that they are well-informed about the existence of breastfeeding difficulties and how to treat them.

Lastly, this study found that many positive changes in PLF practice have been made in the last two decades: colostrum is no longer being discarded; cultural-related PLF is almost never advised by health professionals; and prelacteal formula is not routinely given in health facilities anymore. Establishment of the breastfeeding law followed by sustained campaigning, health professionals' curriculum to promote exclusive breastfeeding, and the growing use of the internet to obtain information on breastfeeding among the younger generation are thought to have contributed to these changes. Nevertheless, there remain obstacles to eliminating inappropriate PLF practices in Indonesia. These include the classic problems of perceptions of insufficient breastmilk supply and intervention from the mother's family, as well as routine mother-baby separation due to post-caesarean monitoring, jaundice phototherapy, and maternal COVID-19 status.

The next chapter, which is the Overall Discussion, will review findings from this study along with those from the quantitative analysis. The recommendations for clinical practice, policy, and further research will be elaborated in that chapter.

9 OVERARCHING DISCUSSION

9.1 Chapter introduction

As described in Chapter 1, my thesis aims to explain the determinants, impact on breastfeeding, and trends over time of prelacteal feeding (PLF) practice in Indonesia. These aims were divided into five study objectives presented in Chapters 4-8, respectively:

1. To describe the prevalence of PLF (any PLF and the predominant types of PLF, i.e. formula, honey, water, and other milk) in Indonesia in 2002, 2007, 2012, and 2017;
2. To identify the determinants of PLF (any PLF and the predominant types) in Indonesia and whether these have changed over time in 2002, 2007, 2012, and 2017;
3. To assess the association between PLF (any PLF and the predominant types) and breastfeeding duration in 2002, 2007, and 2017;
4. To assess the association between PLF (any PLF and the predominant types) and 'current EBF' in 2007, 2012, and 2017;
5. To understand the perception of PLF practice among health professionals in Indonesia and what they think about the role of the health care service in preventing inappropriate PLF practice.

This chapter summarises the main findings from each objective and describes how they are connected to one another. This chapter concludes with a discussion on the generalisability of the findings, and the potential impacts of my thesis on practice, policy, and research.

9.2 Summary of the main findings

This section describes the main findings of my thesis summarised in **Figure 9.1**, which follows the conceptual framework presented in Chapter 3 (Figure 3.1).

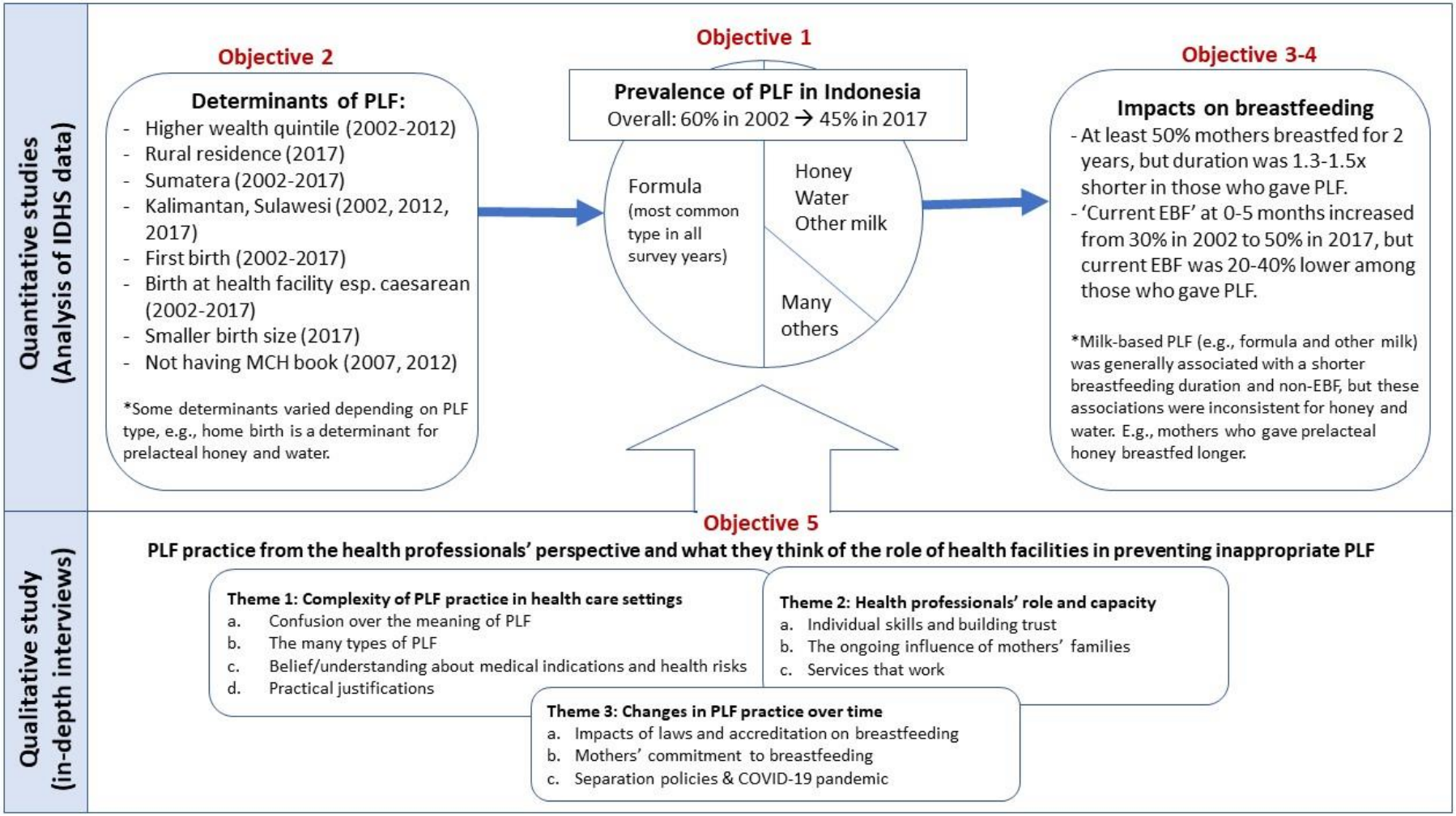


Figure 9.1. Summary of findings

The first four objectives were addressed by analysing the 2002-2017 Indonesia Demographic and Health Surveys (IDHS) while the fifth objective was addressed by conducting in-depth interviews with health professionals.

Objective 1 (Chapter 4) was a descriptive study involving 6,067-6,857 mothers whose last child had ever been breastfed and was 0 to 23-months-old at the time of the IDHS survey between 2002 and 2017. It showed that PLF prevalence in Indonesia was very high, although it has decreased from about 60% in 2002 to 45% in 2017. Formula was the most common PLF type throughout survey years, constituting at least half of overall PLF. The next most common types of PLF included honey, water, and other kinds of milk. The remaining PLF types such as semisolid food, sugar water, rice water, gripe water, juice, coffee, and tea were reported but less frequently. This chapter also highlights the variations in PLF prevalence across regions in Indonesia. For example, prelacteal formula was more common in Sumatera and prelacteal honey was more common in Sulawesi, while Bali-Nusa Tenggara had the lowest prevalence of either one across most study years.

Objective 2 (Chapter 5) was addressed by analysing the study population from Objective 1 to investigate potential determinants of any PLF and the four predominant types i.e. formula, honey, water, and other milk. This study found important risk factors for any PLF, which included higher wealth quintiles, rural residence, specific regions (e.g, Sumatera, Kalimantan), first birth (primiparity), perceived smaller birth size, caesarean birth at either private or public facilities, and no maternal and child health (MCH) book. It also highlighted that these determinants varied depending on the type of PLF. For example, higher wealth quintile was only a risk factor for prelacteal formula and other milk, but not for prelacteal honey or water. Meanwhile, place-mode of birth had opposite associations for different PLF types. Compared to mothers who had a vaginal birth at home, those who gave birth at a public or private health facility, especially via caesarean section, were more likely to give prelacteal formula but were less likely to give prelacteal honey or water.

Objective 3 (Chapter 6) was addressed by analysing the study population from Objective 1 to measure the association between PLF and duration of any breastfeeding, adjusting for the maternal demographic as well as child and birth-related factors explored in Objective 2. It showed that although at least half of the overall study population breastfed for nearly two years, mothers who gave any PLF were 1.3-1.5 times more likely to stop breastfeeding earlier than those who did not. However, the association with breastfeeding duration was dependent on the type of PLF. For milk-based PLF (prelacteal formula and other milk), the association was consistent with that of any PLF and appeared stronger in the first 6 months (HR 1.5-2.3). In contrast, mothers who gave prelacteal honey were about 50% less likely to stop breastfeeding earlier within the first six months than those who did not (2002, 2007). Meanwhile, giving prelacteal water had no association with any breastfeeding duration throughout the survey years.

Objective 4 (Chapter 7) was addressed by examining the association between PLF and current EBF at 0-5 months among 1,552-1,603 mothers whose last child had ever been breastfed and was 0 to 5-month-old in 2007, 2012, and 2017. Current EBF means that no food or drink other than breastmilk was given to the baby in the 24 hours prior to the IDHS interview. 'Current EBF' used here is not the same as the definition of WHO's recommendation of EBF, which is strictly no food or drink other than breastmilk for the first 6 months. The prevalence of current EBF at 0-5 months in Indonesia gradually increased from about 30% in 2002 to more than 50% in 2017. However, this definition did not take into account that many of these babies would have received PLF in the few first days after birth, and therefore the EBF rates according to the strict WHO definition were certainly lower. Furthermore, even in the more recent survey years, more than half of the babies aged 4-5 months were no longer breastfed exclusively at the time of interview. Similar to the study addressing Objective 3, this study also found that mothers who gave any PLF were 20-40% less likely to exclusively breastfeed at 0-5 months than those who did not (PR 0.6-0.8 in all survey years), but the size and direction of effect depended on the PLF type.

A similar association applied to prelacteal formula (PR 0.6-0.7 in 2007-2017) and other milk (PR 0.5-0.7 in 2012-2017). However, the association with EBF status was inconsistent for prelacteal honey (PR 0.5 in 2012 and 1.3 in 2017) and prelacteal water (PR ranged from 0.6-0.8 but was only statistically significant in 2012).

Objective 5 was addressed using a qualitative study presented in Chapter 8. The study used thematic analysis of transcripts from in-depth interviews with 15 health professionals (midwives, lactation counsellors, and paediatricians) in Indonesia. Three themes developed. The first one was “Complexity of PLF practices in health care settings”, which had four subthemes: 1a) confusion over the meaning of PLF; 1b) the many types of PLF; 1c) belief/understanding about medical indications and health risks; and 1d) practical justifications. The second theme was “Health professionals’ role and capacity”, which had three subthemes: 2a) individual skills & building trust; 2b) the ongoing influence of mothers’ families, and 2c) services that work. The third theme was “Changes in PLF practice over time”, comprising: 3a) impacts of laws and accreditation on breastfeeding; 3b) mothers’ commitment to breastfeeding; 3c) separation policies and COVID-19 pandemic.

9.3 Explaining determinants, impact on breastfeeding, and trends over time of various PLF types in Indonesia

My thesis shows the importance of acknowledging various types of PLF instead of seeing PLF as one entity. Different types of PLF are often given for different purposes, amounts, and circumstances, hence the impact on breastfeeding can differ across PLF types. Furthermore, PLF practice in health care settings is particularly complex. Although non-standard newborn food such as honey, rice water, tea, and banana, is not normally given by health professionals, prelacteal formula continues to be given in health care settings and often there are difficulties in distinguishing whether it is appropriate. This section explains how various types of PLF are practiced, what their determinants are, how they impact breastfeeding, and how these have changed over the past two decades.

9.3.1 Prelacteal formula

Prelacteal formula was consistently found to be the most common type of PLF in Indonesia in the quantitative studies, but there has been a decreasing trend over time. These findings were supported by the experience of participants in the qualitative study. Based on the in-depth interviews, the reason formula was the only PLF given at the facility was because health professionals considered feeds other than formula to be an unnecessary and/or inappropriate PLF. They believed that the main cause of the decreasing trend in prelacteal formula was the introduction of breastfeeding laws (157-159) in the early 2000s. The laws put stronger recommendations to breastfeed, led to wider campaigning on breastfeeding, and changed health professionals' curriculum and most hospitals' policy, making formula supplementation no longer a default feeding practice. Moreover, health professionals believed that the improved access to the internet in Indonesia and the rapid growth of social media and online fora in early 2000s allowed mothers from the younger generation to be more up to date with and keen to follow the current guidelines on infant feeding as set out by the WHO/UNICEF, including avoidance of PLF.

Increasing wealth quintiles, primiparity, and caesarean births were the most consistent determinants of prelacteal formula in 2002 to 2017. This resonated with health professionals' experiences in the qualitative study. Although they acknowledged the existence of other types of PLF in their community, formula was the most common type given at health facilities. Formula is a costlier type of PLF, so it is often given by mothers who can access and afford it, and it was shown in my study. In Indonesia, institutional birth is encouraged by law as part of MCH policy (256) and home birth is not a standard or legally recognised option as in the UK or EU countries like Denmark and Netherlands (300, 301). Between 2019-2021, Statistics Indonesia recorded that 85% of all births in Indonesia happened in health facilities (24). After adjusting for other factors, I found that mothers who gave birth in a facility were likely to be of higher socioeconomic status and therefore likely to have better access to formula than those who gave birth at home. This was echoed by

the health professionals, who noted that home birth was strongly related to poverty and limited access to health facilities. Additionally, most provinces in Bali-Nusa Tenggara and Maluku-Papua regions, except Bali, had relatively poorer socioeconomic and development indicators than Java (186, 187, 190), which may have contributed to the lower prevalence of prelacteal formula in these regions across the years.

Some socioeconomic determinants appeared to interact with each other, particularly wealth and living in an urban or rural area. In 2002-2012, prelacteal formula was more prevalent in urban than rural areas in the univariable analysis, although after adjusting for other variables, urban residence was not a statistically significant determinant. By 2017, this association had changed, and rural residence became a determinant for prelacteal formula. A sensitivity analysis showed that increasing wealth status was only a determinant among rural mothers but not urban mothers. Interviews with health professionals suggested that in the more recent years, mothers in urban areas were more exposed to information via the internet and social media. According to health professionals, mothers from urban areas and with higher socioeconomic had also generally become more committed to achieving EBF status as they viewed it as the better practice, to the point that it caused stress if the baby must receive prelacteal formula, even for medical reasons. In contrast, mothers in rural areas were less well-informed about breastfeeding than mothers in urban areas. Thus, they were less concerned about maintaining strict EBF status and perhaps whether prelacteal formula was given appropriately. The findings in the quantitative studies about prelacteal formula being more prevalent among rural mothers were also indicated by health professionals' experience that these mothers and their peers/families might still hold onto the concept of formula as wealth symbol, while urban mothers no longer saw it in this way.

The changes in the determinants of prelacteal formula as reflected in IDHS analysis were also experienced by health professionals. In 2002, the higher prevalence of prelacteal formula was observed among births at any facilities, regardless of birth mode, as compared

to home birth. Meanwhile in 2017, the higher prevalence was only seen among caesarean births, suggesting that formula supplementation in the first days has now become more restricted across the nation over time and targeted to those where its use may be warranted. Again, health professionals felt that this change was likely driven by the breastfeeding laws (157-159). Health professionals who had been in practice before the introduction of breastfeeding laws described how, at that time, babies born at hospitals normally received formula at birth, regardless of their condition.

The stronger association between caesarean birth and prelacteal formula observed by health professional in the more recent years indicated certain complications during pregnancy and/or birth that led to situations where medically indicated PLF was needed. Post-caesarean pain, exhaustion, delayed lactogenesis II, and mother-baby separation were widely cited in the literature (119, 214, 275, 276) and confirmed by health professionals' experience. Similarly, perceived smaller birth size was not a determinant in 2002-2012, but became one in 2017. This could be another indication that in the previous years, prelacteal formula was given to newborns regardless of their size, while now it is only given to smaller babies, which may indicate prematurity and/or small-for-gestational age. Additionally, the WHO warns that the COVID-19 pandemic might have increased the occurrence of separation between COVID-19-positive mothers and COVID-19-negative babies in many parts of the world (302), and similar concerns, including the risk of introducing inappropriate prelacteal formula, was expressed by some health professionals.

The most common reason that interviewees reported for mothers or their families giving prelacteal formula was breastmilk insufficiency, and this had been extensively cited in other studies globally (50, 52, 71, 75, 202, 270-273) and in Indonesia (220, 274). Although the reason for giving prelacteal formula was not specified, the fact that primiparity was a consistent determinant across all survey years is likely to be associated with maternal experience and self-efficacy. Health professionals frequently reported that many first-time

mothers panicked when breastmilk did not come in immediately, while multiparous mothers were usually more relaxed. Health professionals said that in their experience, breastmilk would come in eventually in most cases. However, they saw extremely common complaints from mothers about “not enough milk”. Interestingly, this situation was often experienced by mothers who actually intended to breastfeed, including health professionals themselves. Mothers were reported to understand the benefits of breastfeeding and no longer discard colostrum. However, mothers were not always well-informed about breastfeeding difficulties in the first days, including the fact that breastmilk does not always come shortly after birth. Mothers frequently struggled with positioning and latch-on, while not getting sufficient supervision and assistance from their health providers. When breastfeeding is not established, mothers who have sufficient understanding about infant feeding are more likely to choose formula, the only feed for newborn approved by the WHO/UNICEF, rather than anything else. This possibly explains why in my study, possession of the MCH book was not found to make a significant difference in terms of avoiding prelacteal formula.

Based on their experience, health professionals strongly believed that early initiation of breastfeeding, which is part of the WHO’s current recommendations, was key to minimising the unnecessary use of prelacteal formula. Since the majority of the mothers they saw intended to breastfeed, they usually did not bother to give formula if they were already able to breastfeed immediately. Such experience was in line with the finding from my sensitivity analysis where immediate skin-to-skin contact between mother and newborn after birth, which is part of early initiation of breastfeeding, reduced the likelihood of prelacteal formula.

My thesis adds further evidence that prelacteal formula tends to be detrimental to breastfeeding outcomes i.e. duration of any breastfeeding and exclusivity at 0-5 months. Health professionals observed this effect too, but they also said that it was modifiable and dependent on the mothers’ circumstances. They reported that relactation (restarting breastmilk production after it has stopped) was undoubtedly tough and it was better that

cessation of breastfeeding be avoided in the first place. Fortunately, relactation and/or returning to exclusive breastfeeding after PLF were reportedly possible, especially when there was strong maternal determination accompanied by support from partner and/or family and professional assistance, which was also reported elsewhere (288, 303). Nevertheless, health professionals said some mothers were not privileged enough to receive such support, because lactation counselling was not accessible or affordable for all. Additionally, they indicated that the act of searching for the latest information on infant feeding was done more intensely by mothers from the younger generations, particularly through online fora and social media. They saw the mother's partner, parents, and in-laws as often having a different mindset and different knowledge about breastfeeding, and this could make mothers struggle alone, especially if the closest family members did not understand her decision to try to start or continue breastfeeding again.

In terms of minimising the impacts of PLF on breastfeeding, Indonesia's settings can give both advantages and disadvantages. In general, Indonesia is religiously and culturally receptive towards breastfeeding. Hence, it is not surprising to see the median duration of breastfeeding was 23 months. A few days of prelacteal formula, although disruptive, is unlikely to cause enormous impact on the continuation of breastfeeding, particularly where (as reported by health professionals) many mothers in Indonesia had a strong breastfeeding intention. However, both breastfeeding norms and maternal intention to breastfeed could put pressures on mothers because it creates a mindset that EBF is something everyone should be capable of. Many mothers are not ready to deal with breastfeeding difficulties in the first days. Health professionals met mothers who felt like a failure if their baby's EBF status was "tarnished", and similar phenomenon of feeding guilt exists elsewhere (304-306). The pressure might have come from the interpretation of the WHO strict guidelines about EBF which mention "not even water". Health professionals said that breastfeeding difficulties, especially in the first days, were often underestimated and not addressed enough in the breastfeeding campaign. As a result, some mothers with

extremely strong breastfeeding intentions and/or who experience societal pressure might fear and eventually delay or even refuse medically indicated PLF, putting the newborns at risk of conditions like dehydration, hypoglycaemia, and jaundice.

9.3.2 Prelacteal honey

Although not as common as prelacteal formula, prelacteal honey used to be popular; in the early 2000s the prevalence was 13%. It was even given by health professionals in health facilities and to their own children as part of local traditions. The practice decreased to below 4% of babies by 2017, most likely in response to the breastfeeding laws and the specific warning against giving honey to babies under 12 months due to the known risk of infant botulism (49). Some determinants for prelacteal honey were different from those of prelacteal formula and the most distinct difference was seen in place-mode of birth. Other determinants were primiparity, smaller birth size, MCH book, and potentially religion.

In contrast with prelacteal formula, home birth was a consistent determinant for prelacteal honey in most survey years even after accounting for other risk factors. Meanwhile, some determinants were similar, such as primiparity and perceived smaller birth size, which potentially reflected breastfeeding difficulties as in prelacteal formula group. It is possible that mothers who gave birth at home experienced breastfeeding difficulties just like those who had institutional births, but honey was chosen instead of formula because it was simply cheaper and readily available. As mentioned earlier, home birth was related to poverty and difficulty in accessing health facilities. Those who chose to give prelacteal honey might not be well informed about the recommendation about avoiding PLF. This was potentially reflected by the lower prevalence of prelacteal honey among mothers who had the MCH book, which contained some information about EBF and advice to avoid PLF. Additionally, mothers who gave prelacteal honey might not be aware of the WHO's warning (49) about honey for babies under 12 months.

Nevertheless, the practice of giving prelacteal honey is rather more complex than formula because it also involves cultural and religious contexts. A health professional in Sulawesi said prelacteal honey was culturally popular. This anecdotal experience matches the quantitative analysis, in which prelacteal honey was notably more common in Sulawesi. Other health professionals mentioned the “hijrah” trend in the last decade, which describes a movement among some Muslims to try to become more devout and practice what they perceived as Islamic teaching. Some association between Islam and prelacteal honey was shown in my sensitivity analysis, although the evidence was weak and could not be explored in all survey years. “Tahnik” has been reported in some literature (22, 52) and is interpreted as giving sweet substances to newborns in the form of dates or honey, as practiced by the Prophet Muhammad. This trend was more commonly observed by health professionals among mothers in urban areas and not necessarily from lower socioeconomic status. This suggests that prelacteal honey might not be restricted to mothers from disadvantaged backgrounds

Interestingly, the impact of prelacteal honey on breastfeeding outcomes is not as detrimental as that of prelacteal formula. Despite some inconsistencies, prelacteal honey was even associated with longer breastfeeding duration and maintenance of current exclusivity in the first 0-5 months. There might be several explanations for this phenomenon. First, there was an economic component: mothers who intended to breastfeed might use honey as a more affordable PLF than formula and later continued to breastfeed because that was the more economic feeding option in the longer term. Second, some mothers who opted to give honey might do so as a one-off religious practice and were also more likely to continue to breastfeed for two years as advised by the Holy Quran (154).

None of the health professionals in my study reported any encounter with infant botulism cases related to prelacteal honey. Perhaps due to its purpose as a one-off practice, the amount of honey that potentially contains clostridium spores might have been too low to

cause illness. Despite the seemingly less harmful and even “protective” association with breastfeeding outcomes, my study does not justify giving honey to newborns.

9.3.3 Prelacteal water

The prevalence of prelacteal water decreased over time, from 10% of breastfed babies in 2002 to 5% in 2017. Similar to prelacteal formula and honey, the declining practice of prelacteal water was most likely related to the breastfeeding laws (157-159) and campaigns. In terms of determinants and impact on breastfeeding, prelacteal water showed more similarities to prelacteal honey than with prelacteal formula.

Determinants of prelacteal water that were statistically significant in at least two survey years were Sulawesi region, home birth, and primiparity. Lower education was shown to be a determinant despite inconsistent associations throughout survey years. There were no specific experiences or thoughts about the cultural aspects of prelacteal water reported by the health professionals. This may suggest that water is simply a cheaper and more accessible option than honey. Additionally, a midwife from Sulawesi, the region with a higher prevalence of prelacteal honey and water, said that water was known to be given in the absence of honey.

Prelacteal water had no association with breastfeeding duration and inconsistent association with breastfeeding exclusivity across all survey years. Although EBF means strictly breastmilk without even water, there was no reported experience from health professionals that giving prelacteal water could disrupt breastfeeding. Since plain water has no calories, it is unlikely that giving a small amount of it for a few days will significantly affect breastmilk production (241). To date, there is no evidence of either benefit or harm in giving plain water to breastfeeding duration (241, 307). Nevertheless, my study does not aim to change the current WHO guideline about EBF (4), as there remains concern about health

risks coming from the potentially contaminated water (241), especially in settings where access to clean water is limited.

9.3.4 Prelacteal milk other than breastmilk and formula

Prelacteal milk other than formula was the only type of PLF in IDHS analysis that increased over time. The reasons for the substantial jump from below 1% in 2002-2007 to 12% in 2012 that continued to 14% in 2017 are unknown. It is unclear whether this phenomenon was experienced or observed by health professionals across the country since none of the participants brought it up spontaneously. When asked, some health professionals did mention goat's milk as another common breastmilk substitute that had been promoted on social media and gained coincidental popularity with the "hijrah" trend, but there was little evidence in the existing literature to support this. Since in my study the breastfeeding laws and campaigns were seen as the major contributor for other PLF types to decrease, there must be other reasons for the increasing prevalence of other milk in Indonesia which had not been captured in my findings.

It is possible that there were changes in the interpretation of 'other milk'. For example, in earlier survey years 'other milk' might have been lumped in with formula because there was little awareness on the difference of milk types and infant formula. Condensed milk is a popular milk product in Indonesia (243) and was reported by health professionals to be given as PLF, which was in accordance with a previous study (13). Moreover, plant based milk such as coconut milk was also reported to be given as a PLF (14). Other dairy products such as traditionally processed ghee and yoghurt are eaten in Indonesia (201), although their use as PLF remains unclear.

Even though analysis was only conducted for 2012 and 2017 IDHS, determinants of prelacteal milk were similar to those of prelacteal formula, particularly the increasing wealth quintile, primiparity, smaller birth size, and birth at health facilities especially caesarean.

Regional variation was also similar with prelacteal formula. One slight difference was that having the MCH book appeared to be associated with the likelihood of prelacteal milk. Furthermore, the impact of prelacteal milk on breastfeeding outcomes was also similar to that of prelacteal formula. Giving other milk as PLF was associated with shorter breastfeeding duration and current non-EBF status at 0-5 months. These suggest that in general, prelacteal milk other than formula is most likely given for nutritional purpose, just like prelacteal formula.

9.3.5 Other types of PLF

Despite the fact that formula constituted approximately half of the overall PLF in 2002-2017, the rest was comprised of foods and drinks that were not designated for newborns as per WHO recommendations. This was consistent with findings from the qualitative study, where health professionals mentioned various types of feed given to newborns in the first days of birth. The prevalence of most of these feeds gradually decreased over time, which again, may be related to the breastfeeding laws and campaign that increased awareness on the recommended infant feeding practice among mothers and health professionals.

Based on my qualitative study, feeds other than formula were not said to be normally given in health care settings, especially in the more recent years. Nevertheless, some of the health professionals still recounted having observed cases of PLF-related neonatal fatalities. For example, one midwife and one paediatrician in my qualitative study reported seeing babies who became seriously ill and babies who had died after they were given banana or other non-newborn feeds. These unfortunate cases happened to babies from remote areas and/or low socioeconomic background and still occurred even in 2021. Similar anecdotal evidence has been reported in the literature, news, or social media (195, 197-199). Findings from my qualitative study were in concordance with some of the previous studies in Indonesia where banana has also been reported as a type of PLF (106).

In 2002 and 2007 IDHS, the prevalence of prelacteal semisolids was about 3-4% although it was unknown in 2012-2017. The practice of giving PLF other than formula including semisolid food may be caused by lack of information about infant feeding, as cited elsewhere (13, 14). This practice is decreasing over time, but it may still affect some babies from very disadvantaged backgrounds and is likely to be underreported. This suggests that despite the improving commitment to EBF and avoiding inappropriate PLF among most populations in the last two decades, a small proportion of newborns may still be at risk because their parents and community have not caught up with the current recommendations. It is also an uncomfortable reminder that the concern about PLF is not only about breastfeeding outcomes, but also morbidity and mortality.

Lastly, my thesis adds to the conversation about the growing interest in donor human milk in Indonesia. This comes solely from interviews with health professionals, since the IDHS does not have data about donor milk. There is some different perception in the literature about whether donor milk is considered PLF, since it is breast milk, but not the mother's own milk. The disagreement was not initially addressed in the previous WHO guidance for infant feeding indicators (144), but later the WHO clarified in the most recent one published in 2021 that being fed by donor human milk is classified as being fed breastmilk (255). Nevertheless, donor milk is usually mature breastmilk (280). Thus, it is different from colostrum, which is the type of breastmilk that is needed by the newborn in the first days after birth. Despite having many of the beneficial properties of breastmilk, donor milk is not risk-free. Concerns about safety arise because there is no established regulation of donor milk bank in Indonesia. Additionally, my study also highlights the fact that the use of donor milk as a substitute for mother's own milk without the provision of breastfeeding support may still have disruptive effects on breastfeeding outcomes.

9.4 Strengths and limitations of the thesis

The findings from this thesis may be relevant to countries in Asia which have a low-middle income level and a diverse population, and where breastfeeding is the predominant culture. To my knowledge, this thesis is the first study on PLF practice in relation to breastfeeding using a population representative of Indonesia as a whole, at four time points. IDHS have provided the overall prevalence of any PLF in each survey year, but the research presented in my thesis has helped to elucidate the role of many different types of PLF and how their individual use has changed over time.

The quantitative components of this thesis are the first study to use serial DHS data to describe prevalence, determinants, and impacts of different types of PLF on breastfeeding. Another paper that analysed the 2017 IDHS (86) shared similar findings with mine (85) but it did not separate different types of PLF. To date, I have only found one other study using national data other than DHS that differentiated the determinants of prelacteal formula and water, and that was conducted in Vietnam in 2013 (118). Another study from Maldives with a smaller sample size compared the determinants of prelacteal formula and ritual feeds (22). This suggests that other researchers have acknowledged that distinguishing between PLF types is a necessary step to understand the PLF practice in every country, but unfortunately this research has rarely been conducted. Another strength is the use of the mixed methods approach that added qualitative insights from the experiences of health professionals to the quantitative findings from IDHS analyses. A strength of the qualitative research was the inclusion of interviewees with a range of professional backgrounds from different parts of Indonesia and from both rural and urban areas. This means that the insights drawn from their experiences are likely to be relevant to midwives, lactation counsellors, and paediatricians in Indonesia, and may be of particular use to those who work in or close to teaching settings.

The research presented in my thesis has several limitations. The larger part of the limitations is related to the quantitative studies. First, the IDHS was not specifically designed to measure PLF in further details such as quantity, quality, frequency, and the exact reasons for giving it. Second, some potentially important variables were unable to be used due to large missing values, inconsistent measurement, and/or lack of details e.g. birthweight and prematurity. These variables issue limit the interpretation on how some determinants between prelacteal formula and honey, for example, are different. Third, information on PLF was collected retrospectively with the mother's report being the sole source of information. This means recall bias and anything beyond the mother's knowledge, which have been common issues in breastfeeding studies (168), may have contributed to potential inaccuracy and misclassification. For example, there is a possibility that mothers did not know if their babies were given PLF without their consent/knowledge, either by health professionals due to temporary separation at the facility, or by family at home. Fourth, although the sample size was large enough for addressing most of my study objectives, especially related to any PLF and formula, it might not have sufficient power to detect very weak association between some specific types of PLF and breastfeeding outcomes. Lastly, language and translation issues should not be overlooked when measuring breastfeeding practices in cross-national surveys like DHS. When comparing my thesis' results with DHS studies from other countries, it is important to consider the discrepancy between the translated Indonesian and English questionnaires, as the question used to ask about PLF is not worded exactly as the one in other countries' DHS.

The next part of my thesis' limitations was related to the qualitative study, particularly the study population. My interviews were confined to health professionals working in health care settings and who were more likely to adhere to the WHO's recommendation on infant feeding practice (4). Moreover, due to time limitation and challenges in recruiting participants with a traditional birth attendant background during the COVID-19 pandemic, experiences of the home birth setting could not be covered. Hence, the discussion on PLF

practice at home or outside health facilities was limited. Lastly, since the scope of this thesis was PLF in relation to breastfeeding, other topics have not been covered. For example, PLF-related infection and other health problems, as reported by some participants, were acknowledged in this thesis but not explored in the same depth as were PLF-related breastfeeding problems.

9.5 Implications for clinical practice and public health policy

In general, findings from my DPhil studies support the current infant feeding recommendations set out by both global and national (Indonesian) guidelines, which is to avoid PLF for breastfed infants unless medically indicated (4, 79, 308). My findings are also consistent with the evidence reviewed and referred to by these guidelines to support optimal breastfeeding. There are, however, some suggestions that I would propose to be added in the current guidelines about breastfeeding in relation to PLF practice.

For the global recommendation, my study is in line with the 2018 WHO's "Implementation guidance: protecting, promoting, and supporting breastfeeding in facilities providing maternity and newborn services: the revised baby-friendly hospital initiative" (4). This implementation guidance (4) was first published in 1989 (65) and the core messages covering the Ten Steps to Successful Breastfeeding remain unchanged in the current version, but there have been some modifications to the wording to align with the new evidence (4, 309). The 2018 WHO's implementation guidance (4) is much more comprehensive than the 1989 version (65). In the complementing document to explain the rationale for the revisions, the WHO draw on evidence from 18 studies conducted in Australia, Brazil, Canada, Ireland, Mexico, Russia, Sweden, Uganda, the UK, and the US (309). Although not specific to PLF, this review highlights complaints about poor antenatal education about infant feeding, inadequate institutional breastfeeding support, negative attitudes from some health professionals, as well as breastfeeding-biased information that does not discuss challenges or alternative feeding options (309). The 2018 WHO's

implementation guidance (4) now has more detailed points to implement the Ten Steps, which addressed the issue of breastfeeding difficulties (which are related, although not specific, to PLF) as well as milk insufficiency and balanced messaging about breastfeeding expectation. My thesis adds evidence from Indonesia that resonates with these studies and emphasises the importance of the modifications made in the 2018 guidance (4), particularly the ones related to PLF practice.

In relation to PLF practice, the 2018 WHO Guidance (4) referred to the 2009 WHO guidance on breastmilk substitutes (5), which listed medical reasons for temporary formula supplementation that technically covers appropriate PLF. The 2009 WHO guidance (5) could benefit from review and revision, as this guidance was expected to be updated by 2012 and is currently missing several details. Ideally, both birthweight loss criteria and delayed lactogenesis could be added as additional indications for considering prelacteal formula. This is important to improve consistency between the current documents (4, 5), especially since the clinical protocol that includes birth weight loss criteria (41) was already cited in the 2018 WHO implementation guidance (4), but it is not yet acknowledged in the list of acceptable uses for PLF. My study and others' (75, 76) indicated that the lack of understanding of medically indicated PLF among health professionals could lead to suboptimal breastfeeding outcomes. Indonesian breastfeeding laws are quite strict about any breastmilk substitute, which practically includes PLF. However, a strict order to avoid breastmilk substitutes might not be enough to prevent inappropriate PLF. A clearer and more detailed guideline will help inform health professionals about the conditions in which PLF is necessary and appropriate, so that they can give a more comprehensive explanation to the mothers.

For the national recommendations specific to Indonesia, I refer to the 2014 guidelines for midwives and nurses (308) and the 2020 MCH book from the Ministry of Health (MoH) of Indonesia (170). These documents were developed in accordance with the Indonesian

breastfeeding laws (157-159). In most cases, midwives are the first contact of most nursing mothers in Indonesia, hence their guidelines may reflect the initial information health professionals provide mothers about breastfeeding. The MCH book is a government product that is mass-produced, distributed to all mothers for free, and in my study, it was highly appreciated by health professionals as a means to improve breastfeeding outcomes.

Both the guidelines (308) and the book (170) have been successful in delivering the main message about achieving optimal breastfeeding and warning against PLF. There are also ample messages about prevention of complications during pregnancy and birth. However, these documents focus on the importance and benefits of breastfeeding while covering very little to no details about managing breastfeeding difficulties, including information on PLF. I suggest that the guidance is updated to be consistent with the 2018 WHO guidance (4) and consider additional revisions to the guidance based on my studies as listed in **Table 9.1**.

Table 9.1. Potential revisions to the Indonesian national guidelines to support breastfeeding in relation to PLF practice

Guidelines and recommendations	Comments and suggestions
Guidelines for Midwives and Nurses to improve MCH (2014) (308) This guideline contains information about definition, benefits, and importance of breastfeeding and EBF, and step by step of breastfeeding that midwives and nurses should be able to master, but it does not mention about managing potential breastfeeding difficulties.	Agree with the whole content, but consider adding recommended competencies in the current WHO implementation guidance (4) and suggested addition to breastfeeding counselling, e.g.: - counsel mothers and their families on breastfeeding difficulties in the first days, including examples and ways to overcome them; - inform mothers about what PLF is and its impact on breastfeeding and mother and baby's health; - identify medically indicated PLF and groups that are vulnerable to it e.g. primiparity, caesarean birth, and mothers at high risk of having smaller babies; - communicate to mothers and their families about the circumstances when medically indicated PLF is needed, including the risks and benefits; - help a mother to re-establish breastfeeding if they wish to and she and her baby can benefit most from breastfeeding. - address issues related to non-medical or cultural/religious PLF. - help mothers who already gave non-medically indicated PLF by mistake or out of ignorance, as they should be counselled using a context-sensitive approach, monitored, and assisted to continue breastfeeding if they wish to.

MCH book (2020 edition) (170) Since 2009, MCH book has included message about EBF and advice of not discarding colostrum and not giving anything else until 6 months. However, it does not mention anything about potential breastfeeding difficulties and management.	Agree with the whole content, but consider adding some brief information about: - potential breastfeeding difficulties in the first days, e.g. delayed milk, difficult latch-on, engorgement; - reassuring statement that there may be a delayed breastmilk production and that it is possible to wait under health professionals' supervision; - balanced statement that most mothers can breastfeed but acknowledge that some exceptions exist and what options are available.

My suggestions at the policy level, other than the points listed in **Table 9.1** include improving systemic access to breastfeeding support, ensuring that there is adequate staffing at maternity facilities. Moreover, as the government's current policy is to promote institutional birth whenever possible (256), it is crucial that health facilities are equipped with access to infant feeding support across Indonesia. Many health professionals expressed concern about mothers not being able to access the breastfeeding support that they need. By making provision in the national insurance scheme, more mothers can be helped to access breastfeeding support, with particular benefit to the most disadvantaged groups. Staffing shortages were given as a justification for providing prelacteal formula to newborns in the nursery or NICU (4), because it is more practical than supporting each mother to breastfeed or express milk when staffing is inadequate. My study found that PLF other than formula was still given the health facilities, but to a much lesser extent. Although there needs to be better education and support across all settings, this specific finding could become one potential reason to support the government's current policy on promoting births at health facilities, where preventing the non-medical PLF is likely to be more effective. Lastly, findings from my study can be used to identify vulnerable populations and explain to mothers about the impact of PLF on breastfeeding so they can make an informed decision.

9.6 Implication for future research

Based on my study, IDHS surveys (1, 10-12), and national records from Statistics Indonesia (155), there is a decreasing trend for PLF and increasing trend for current EBF at 0-5 months in Indonesia, but the trend is not completely consistent, and some fluctuations were

observed. Therefore, continued analysis of IDHS 2022 and beyond is necessary to monitor trends in PLF and breastfeeding practice in Indonesia. It is especially important because the COVID-19 pandemic in 2020-2021 was likely to have had an impact on these practices. Additionally, qualitative studies exploring PLF practice in non-facility settings and qualitative studies involving mothers and families will provide a more comprehensive picture of PLF practice in Indonesia.

Considering the variety of PLF practices in different parts of the world, it will be useful if PLF studies from other countries look at the determinants and practice experiences by PLF type. So far, most studies have looked at PLF as one entity and very few have separated it by type. The utilisation of DHS data will aid comparability of these results across many countries. If possible, questions in the DHS questionnaire could be added to include breastfeeding intention, several options for the common reasons for giving PLF, and the reason why breastfeeding stopped. This will allow better interpretation on the differences between PLF types and help distinguish whether mothers intend to breastfeed exclusively or plan to mix feed.

It is apparent that the term EBF used in the literature, including in the DHS studies, does not always accurately reflect the definition as set out by the WHO recommendation (70, 310), where it strictly says nothing other than breastmilk in the first six months. It is understandable that the definition of this indicator is designed to simplify measurement (144, 255). However, this suggests that EBF rates worldwide are overestimated, as they may have ignored PLF that is given in the first days of birth. For this reason, in a research study or survey that focuses on EBF, it is important to be clear in defining EBF and clarify how it relates to PLF. This can be achieved for example, by using the existing EBF indicator along with the EBF in the first two days (EBF2D) indicator, which has been introduced recently by the WHO in 2021 (255), to give the correct interpretation of EBF.

In relation to the impacts of PLF on breastfeeding, more prospective studies in Indonesia are needed to establish a causal relationship. It would also be possible to explore the effects of PLF using an RCT. To date, even globally there are very few RCTs comparing the guidelines of giving prelacteal formula with conservative waiting (for the production of breastmilk) on breastfeeding outcomes (146, 147, 230). It would be even more useful to have similar studies from Indonesia. Moreover, comparing the impacts of formula and donor milk supplementation in the first few days of birth is also needed.

Lastly, my thesis scope was designed to focus on PLF practice in relation to breastfeeding. Meanwhile, PLF is also known to have impacts on other outcomes, such as morbidity and mortality. It is possible to use IDHS data to explore the association between PLF and mortality, as was done previously by Dewi et al. in 2017 using the 2007 IDHS (311), where PLF was associated with greater chance of survival. Consequently, studies investigating the impacts of various types of PLF on neonatal mortality using IDHS from all available survey years would be the next step in explaining the impact of PLF practice in Indonesia within a broader framework. Similar investigations could also be carried out as prospective studies.

9.7 Conclusions

PLF practice in Indonesia is a phenomenon that is more complex than at first sight. It is very common nationally, but there is a noticeable variation among regions. PLF is not a single entity, but rather comprises various types of feed. Formula is the most common type but about a half of all PLF in Indonesia consists of feeds that are not designated for newborns such as honey, water and other milk. Determinants such as primiparity, maternal education, wealth, and rurality, are associated with various types of PLF, although each PLF type also has some unique determinants. Some determinants of prelacteal formula can even work in the opposite direction when applied to other types of PLF such as prelacteal honey. This implies that targeting vulnerable groups for that particular PLF type

is more likely to be effective in reducing inappropriate PLF practice. Furthermore, PLF in general is associated with poorer breastfeeding outcomes (shorter duration, non-EBF), but this impact is likely to be dependent on the type, frequency, and duration, as well as on efforts to continue or resume breastfeeding.

My DPhil thesis supports current recommendations to avoid PLF when there are no medical indications, but these indications need further clarification. Moreover, discussion about breastfeeding difficulties in the first days including ways to overcome them deserves more attention. This thesis provides a lesson about PLF practice from a setting where EBF is protected by law and breastfeeding for up to two years is favoured. Lastly, my thesis adds evidence that while PLF practice in Indonesia is decreasing over time, it remains common and therefore other impacts such as on morbidity and mortality, need further investigation. Understanding PLF practice is crucial to minimise inappropriate PLF and to ensure that medically indicated PLF is given in a sensible manner, without putting newborns at risk of dehydration/hypoglycaemia and disrupting breastfeeding outcomes.

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APPENDIX I CHAPTER 2: LITERATURE SEARCH RESULTS

Since several studies analysed the same countries' datasets and reported relatively similar prevalence estimates of any PLF, the estimate that I chose to be included in the summary table (**Table I.1**) was prioritised from studies that reported PLF types. If none of the studies reported prevalence by type, country estimates were taken from the more recent studies and/or multi-country studies that analysed the largest number of countries in all DHS regions.

Table I.1. Estimates of PLF prevalence globally from DHS datasets

Setting	DHS year	Author, publication year	Any PLF (%)	Formula milk (%)	Non-formula milk (%)	Milk-based (%)	Water-based (%)	Plain water (%)	Sugar water (%)	Gripe (%)	Honey (%)	Others (%)
Africa												
Angola (89)	2015	Neves, 2022	10.6	-	-	3.8	7.1	-	-	-	-	-
Benin (7, 18)	2006	Oakley, 2018	24.6	-	-	-	-	-	-	-	-	-
	2011	Berde, 2017	18.1		-	1.7	-	10.9	4.7	1.9	0.2	-
Burkina Faso (7, 18)	2010	Oakley, 2018	36.7	-	-	-	-	-	-	-	-	-
	2010	Berde, 2017	36.1	-	-	0.8	-	29.1	4.2	0.8	0.0	-
Burundi (7, 18, 109)	2010	Oakley, 2018	7.7	-	-	-	-	-	-	-	-	-
	2010	Berde, 2017	7.4	-	-	2.8	-	1.4	2.0	0.4	0.2	-
	2016-17	Teshale, 2021	5.4	-	-	-	-	-	-	-	-	-
Cameroon (7)	2011	Oakley, 2018	46.5	-	-	-	-	-	-	-	-	-
Chad (7, 89)	2004	Oakley, 2018	97.3	-	-	-	-	-	-	-	-	-
	2014	Neves, 2022	86.7	-	-	15.6	84.4	-	-	-	-	-
Comoros (89, 109)	2012	Teshale, 2021	39.2	-	-	-	-	-	-	-	-	-
	2012	Neves, 2022	37.7	-	-	7.5	32.4	-	-	-	-	-
Congo-Br (7, 18)	2005	Oakley, 2018	37.7	-	-	-	-	-	-	-	-	-
	2011	Berde, 2017	36.6	-	-	14.4	-	18.6	4.5	0.1	0.0	-
Congo-DR (7, 18)	2007	Oakley, 2018	17.0	-								
	2013	Berde, 2017	10.5	-	-	1.1	-	4.4	4.8	0.3	0.0	-
Cote d'Ivoire (18)	2011	Berde, 2017	67.0	-	-	1.6	-	58.5	2.2	0.2	2.2	
Egypt (7, 18)	2008	Oakley, 2018	48.9	-	-	-	-	-	-	-	-	-
	2014	Neves, 2022	61.2	-	-	8.8	55.7	-	-	-	-	-
	2014	Fadl	63.5	-	-	-	-	-	-	-	-	-
Ethiopia (7, 18, 21, 109, 113)	2011	Oakley, 2018	28.0	-	-	-	-	-	-	-	-	-
	2011	Berde, 2017	27.2	-	-	4.7	-	5.3	3.5	0.1	0.1	-
	2011	Belachew, 2016	28.9	0.4	4.2	4.6	12.1	5.1	3.8	0.1	0.1	Butter 14.8, sugar-salt solution 2.3, fenugreek 0.5, tea 0.8
	2016	Teshale, 2021	8.0	-	-	-	-	-	-	-	-	-
	2016	Merga, 2021	8.0	0.4	2.4	2.8	-	4.5	-	-	-	Juice 0.6
Gabon (7)	2012	Oakley, 2018	47.7	-	-	-	-	-	-	-	-	-

Setting	DHS year	Author, publication year	Any PLF (%)	Formula milk (%)	Non-formula milk (%)	Milk-based (%)	Water-based (%)	Plain water (%)	Sugar water (%)	Gripe (%)	Honey (%)	Others (%)
Ghana (7, 18)	2008	Oakley, 2018	17.9	-	-	-	-	-	-	-	-	-
	2014	Berde, 2017	15.1	-	-	1.1	-	7.4	0.8	0.4	0.0	-
Gambia (18)	2013	Berde, 2017	16.9	-	-	1.4	-	10.5	4.2	0.1	2.3	-
Guinea (7, 18)	2005	Oakley, 2018	73.0	-	-	-	-	-	-	-	-	-
	2012	Berde, 2017	59.8	-	-	3.4	-	34.8	13.6	2.1	0.6	-
Kenya (7, 18, 109)	2008-9	Oakley, 2018	42.9	-	-	-	-	-	-	-	-	-
	2014	Teshale, 2021	15.3	-	-	-	-	-	-	-	-	-
	2014	Berde, 2017	15.4	-	-	2.2	-	5.9	4.1	0.6	0.1	-
Lesotho (7)	2009	Oakley, 2018	31.8	-	-	-	-	-	-	-	-	-
Liberiav (7, 18)	2007	Oakley, 2018	25.6	-	-	-	-	-	-	-	-	-
	2013	Berde, 2017	10.2	-	-	0.8	-	5.3	3.1	1.1	0.0	-
Madagascar (7, 109)	2008-9	Oakley, 2018	26.0	-	-	-	-	-	-	-	-	-
	2008-9	Teshale, 2021	26.0	-	-	-	-	-	-	-	-	-
Malawi, 2010 (7, 18)	2010	Oakley, 2018	3.2	-	-	-	-	-	-	-	-	-
	2010	Berde, 2017	2.5	-	-	0.4	-	0.5	0.1	0.5	0.0	-
	2015	Teshale, 2021	3.1	-	-	-	-	-	-	-	-	-
Mali (7, 18)	2006	Oakley, 2018	47.7	-	-	-	-	-	-	-	-	-
	2012	Berde, 2017	21.1	-	-	2.3	-	10.5	4.0	1.6	1.7	-
Morocco (7)	2003-4	Oakley, 2018	67.3	-	-	-	-	-	-	-	-	-
Mozambique (7, 18)	2011	Oakley, 2018	7.1	-	-	-	-	-	-	-	-	-
	2011	Berde, 2017	5.7	-		2.3	-	10.5	4.0	1.6	1.7	-
	2011	Teshale, 2021	5.8	-	-	-	-	-	-	-	-	-
Namibia (7, 18)	2006-7	Oakley, 2018	19.4	-	-	-	-	-	-	-	-	-
	2013	Berde, 2017	10.3	-	-	4.0	-	2.1	0.4	0.8	0.0	-
Niger (7, 18)	2006	Oakley, 2018	80.5	-	-	-	-	-	-	-	-	-
	2012	Berde, 2017	49.5	-	-	14.4		23.0	14.3	0.3	0.8	-
Nigeria (7, 18, 20)	2003	Agho	66.4	-	-	-	-	-	-	-	-	-
	2008	Oakley, 2018	57.9	-	-	-	-	-	-	-	-	-
	2013	Berde, 2017	60.5	-	-	10.7	-	53.1	5.3	1.9	1.7	-
Rwanda (7, 109)	2010	Oakley, 2018	14.3	-	-	-	-	-	-	-	-	-
	2014-15	Teshale, 2021	4.3	-	-	-	-	-	-	-	-	-
Sao Tome & Principe (7)	2008-9	Oakley, 2018	13.6	-	-	-	-	-	-	-	-	-
Senegal (7)	2008	Oakley, 2018	54.0	-	-	-	-	-	-	-	-	-

Setting	DHS year	Author, publication year	Any PLF (%)	Formula milk (%)	Non-formula milk (%)	Milk-based (%)	Water-based (%)	Plain water (%)	Sugar water (%)	Gripe (%)	Honey (%)	Others (%)
Sierra Leone (7, 18)	2008	Oakley, 2018	61.5	-	-	-	-	-	-	-	-	-
	2013	Berde, 2017	21.2	-	-	3.8		17.5	1.6	0.7	0.0	
Swaziland (7)	2006-7	Oakley, 2018	24.3	NA								
Tanzania (7, 109)	2010	Oakley, 2018	32.1	-	-	-	-	-	-	-	-	-
	2015-16	Teshale, 2021	13.8	-	-	-	-	-	-	-	-	-
Uganda (7, 18, 109, 116)	2011	Oakley, 2018	42.0	-	-	-	-	-	-	-	-	-
	2011	Koire	40.3	-	-	-	-	-	-	-	-	-
	2016	Teshale, 2021	25.1	-	-	-	-	-	-	-	-	-
Togo (7)	2013	Berde, 2017	12.0	-	-	1.8	-	5.9	3.0	0.4	0.4	-
Zambia (7, 18, 109)	2007	Oakley, 2018	9.9	-	-	-	-	-	-	-	-	-
	2013	Berde, 2017	11.0	-	-	1.0	-	-	1.2	0.0	0.0	
	2018	Teshale, 2021	6.7	-	-	-	-	-	-	-	-	-
Zimbabwe (7, 18, 109)	2010-11	Oakley, 2018	14.6	-	-	-	-	-	-	-	-	-
	2010	Berde, 2017	13.1	-	-	3.4	-	-	0.4	0.3	0.0	-
	2015	Teshale, 2021	12.5	-	-	-	-	-	-	-	-	-
America												
Bolivia (7, 92, 110)	2008	Oakley, 2018	28.2	-	-	-	-	-	-	-	-	-
	2008	Boccolini, 2015	28.9	5.3	9.0	14.1	-	-	-	-	-	-
Colombia (7, 92, 96, 110)	2010	Oakley, 2018	38.6	-	-	-	-	-	-	-	-	-
	2010	Boccolini, 2015	36.3	27.0	0.9	27.8	-	-	-	-	-	-
	2010	Finnie, 2020	37.6	-	-	-	-	-	-	-	-	-
Dominican Rep (7, 92, 110)	2007	Oakley, 2018	60.2	-	-	-	-	-	-	-	-	-
	2007	Boccolini, 2015	55.2	31.7	19.2	50.7	-	-	-	-	-	-
Guyana (7, 92, 110)	2009	Oakley, 2018	23.1	-	-	-	-	-	-	-	-	-
	2009	Boccolini, 2015	18.0	5.9	7.2	12.1	-	-	-	-	-	-
Haiti (7, 92, 110)	2005	Boccolini, 2015	20.3	1.2	2.1	3.2						
	2012	Oakley, 2018	21.4	-	-	-	-	-	-	-	-	-
Honduras (7, 92, 110)	2005	Boccolini, 2015	44.3	30.8	0.1	31.0						
	2011-12	Oakley, 2018	45.7	-	-	-	-	-	-	-	-	-

Setting	DHS year	Author, publication year	Any PLF (%)	Formula milk (%)	Non-formula milk (%)	Milk-based (%)	Water-based (%)	Plain water (%)	Sugar water (%)	Gripe (%)	Honey (%)	Others (%)
Nicaragua (7)	2001	Oakley, 2018	27.5	-	-	-	-	-	-	-	-	-
Peru (7, 89, 92, 110)	2000	Oakley, 2018	29.6	-	-	-	-	-	-	-	-	-
	2007	Boccolini, 2015	33.4	28.8	1.5	30.2	-	-	-	-	-	-
	2017	Neves, 2022	45.0	-	-	44.0	1.4	-	-	-	-	-
Europe												
Albania (7)	2008-9	Oakley, 2018	20.7	-	-	-	-	-	-	-	-	-
Armenia (7)	2010	Oakley, 2018	12.7	-	-	-	-	-	-	-	-	-
Azerbaijan (7)	2006	Oakley, 2018	47.6	-	-	-	-	-	-	-	-	-
Moldova (7)	2005	Oakley, 2018	10.5	-	-	-	-	-	-	-	-	-
Turkey (7, 89, 104)	2003	Oakley, 2018	40.0	-	-	-	-	-	-	-	-	-
	2003	Yalçın, 2020	38.4	12.3	4.3	16.8	-	4.2	19.7	-	0.3	Tea 0.6, juice 0.2
	2008	Yalçın, 2020	29.3	15.9	1.4	17.3	-	5.4	6.0	-	0.1	Juice, 0.3 sugar-salt solution 0.3
	2013	Neves, 2022	35.0	-	-	28.1	8.8	-	-	-	-	-
	2013	Yalçın, 2020	34.4	26.6	1.0	27.6	-	1.8	4.7	-	0.2	Tea 0.2, juice 0.1
	2018	Yalçın, 2020	41.4	38.1	1.2	39.3	-	0.8	1.4	-	0.0	Tea 0.3, juice 0.1
Ukraine (7)	2007	Oakley, 2018	25.5	-	-	-	-	-	-	-	-	-
Asia												
Afghanistan (89)	2015	Neves, 2022	43.2	-	-	40.5	6.0	-	-	-	-	-
Bangladesh (7, 122)	2011	Oakley, 2018	39.3	-	-	-	-	-	-	-	-	-
	2017-18	Sultana, 2022	29.0	-	-	-	-	-	-	-	-	-
Cambodia (7, 89)	2010	Oakley, 2018	21.1	-	-	-	-	-	-	-	-	-
	2014	Neves, 2022	27.7	-		18.2	17.3					
India (7, 89)	2005-6	Oakley, 2018	58.2	-	-	-	-	-	-	-	-	-
	2015	Neves, 2022	21.1	-		14.5	9.6	-	-	-	-	-
Jordan (7, 89)	2007	Oakley, 2018	61.4	-	-	-	-	-	-	-	-	-
	2017	Neves, 2022	42.7	-	-	35.7	11.9	-	-	-	-	-
Maldives (7)	2009	Oakley, 2018	15.5	-	-	-	-	-	-	-	-	-
Myanmar (89)	2015	Neves, 2022	20.4	-	-	13.5	7.6	-	-	-	-	-
Nepal (7, 89, 101)	2011	Oakley, 2018	28.3	-	-	-	-	-	-	-	-	-
	2011	Khanal, 2013	26.5	-	-	-	-	-	-	-	-	-
Pakistan (7, 52)	2006-7	Oakley, 2018	68.7	-	-	-	-	-	-	-	-	-

Setting	DHS year	Author, publication year	Any PLF (%)	Formula milk (%)	Non-formula milk (%)	Milk-based (%)	Water-based (%)	Plain water (%)	Sugar water (%)	Gripe (%)	Honey (%)	Others (%)
	2012-13	Asim, 2020	64.7	13.5	24.5	38.0	-	5.4	21.8	2.3	Incl. in sugar water	Ghutti 15.0, fruit juice 5.0, rose water 4.6, green tea 4.6,ghee/butter/tea 3.2
Philippines (7, 89)	2008	Oakley, 2018	58.1	-	-	-	-	-	-	-	-	-
	2017	Neves, 2022	24.1	-	-	15.6	11.4	-	-	-	-	-
Timor Leste (7, 103)	2009-10	Oakley, 2018	13.6	-	-	-	-	-	-	-	-	-
	2009-10	Khanal, 2014	12.3	1.2	2.8	4.0	-	6.2	4.0	-	-	Sugar-salt solution 0.2
Yemen (89)	2013	Neves, 2022	67.1	-	-	22.5	57.5	-	-	-	-	-
Indonesia												
	2007 (7)	Oakley, 2018	67.9	-	-	-	-	-	-	-	-	-
	2017 (85)	Rahmartani, 2020	44.5	25.3	14.1	39.4	-	5.0	1.1	0.0	3.4	Tea 0.4, fruit juice 0.2, rice water 0.2
	2017 (86)	Nurokhmah, 2021	44.0	-	-	-	-	-	-	-	-	-
	2017 (179)	Neves, 2022	43.9	-	-	38.1	9.2	-	-	-	-	-

Table I.2. Determinants of PLF globally

Author, year, setting	De-sign	Sample size	Mea-sure	Risk factor	Any PLF	Formula Milk	Milk	Water/ water-based	Honey
Multi-continent									
1. Peven, 2020, multiple countries (107)	CS	41,431	OR for no PLF	Caesarean vs vaginal (skilled attendant)	0.31 (0.26,0.37)	-	-	-	-
				Vaginal (unskilled attendant)	0.67 (0.60,0.75)	-	-	-	-
				Richest (Q5) vs poorest (Q1)	0.55 (0.46,0.66) NS for Q2 only	-	-	-	-
				Birth interval <2yr vs 1st birth	1.21 (1.04,1.41)				
				Birth interval 2+yrs	1.34 (1.17,1.53)				
				Small baby vs average or large	0.87 (0.79,0.96)				
				ANC visits<4x	0.76 (0.69,0.83)				
				Urban-rural, child's sex, maternal age	*NS*	-	-	-	-
2. Neves, 2022, multiple countries (89)	CS		%, r	Private facility	Mostly highest	Mostly highest		Mostly lowest	
				Home	Mostly lowest	Mostly lowest		Mostly highest	
				Highest wealth index	Mostly highest	Mostly highest		Unclear	
				EIBF	-0.59 (-0.72,-0.42)	-0.41, (-0.58, -0.21		-0.34, (-0.53, -0.13)	
Africa									
1. Agho, 2016, Nigeria, (DHS)(20)	CS	6,416	OR	No education vs ≥2º	1.65 (1.33–2.03)	-	-	-	-
				Working vs not	1.26 (1.10–1.44)	-	-	-	-
				2nd/4th child vs 1st	0.80 (0.66–0.97)	-	-	-	-
				Home birth vs facility	1.45 (1.23–1.71)	-	-	-	-
				Caesarean vs vaginal	1.91 (1.17–3.13)				
				Regions	p<0.001				
				Rural, wealth index, primary edu, perceived birth size, child's sex, birth interval, ANC,	*NS*	-	-	-	-

Author, year, setting	De-sign	Sample size	Mea-sure	Risk factor	Any PLF	Formula Milk	Milk	Water/ water-based	Honey
				delivery assistant, media exposure (newspaper, radio, TV)					
2. Belachew, 2016, Ethiopia (DHS)(21)	CS	7,692	OR	Orthodox vs Protestant	1.82(1.32, 2.48	-	-	-	-
				Muslim	1.48 (1.07, 2.06)	-	-	-	-
				Richest vs poorest	0.72 (0.54, 0.98)	-	-	-	-
				Skilled birth assistance vs others	1.87 (1.28, 2.73)	-	-	-	-
				Late BF initiation	5.32 (4.65, 6.09)	-	-	-	-
				Caesarean vs vaginal	1.87 (1.28, 2.73)	-	-	-	-
				Perceived larger birth size vs small	0.80 (0.68, 0.95)	-	-	-	-
				High ANC utilization	0.58 (0.38, 0.87)	-	-	-	-
3. Berde, 2017, 22 Sub-Saharan countries (DHS)(18)	CS	95,348	OR	Age 20-34 vs <19	0·88 (0·83, 0·93)	-	-	-	-
				No education vs ≥2^{o}	1·22 (1·15, 1·29)	-	-	-	-
				Working vs not	*1·02 (0·98, 1·06)*	-	-	-	-
				Wealth index	*NS*	-	-	-	-
				Richest vs poorest	0·90 (0·84, 0·96)	-	-	-	-
				Rural	*1·00 (0·95, 1·05)*	-	-	-	-
				1st vs ≥4th birth	1·25 (1·17, 1·33)	-	-	-	-
				Male baby	1·04 (1·00, 1·08)	-	-	-	-
				Caesarean vs vaginal	2·25 (2·06, 2·46)	-	-	-	-
				Small vs large birth size	1·31 (1·25, 1·38)	-	-	-	-
				Home birth vs facility	1·78 (1·70, 1·87)	-	-	-	-
				Multiple birth	1·20 (1·05, 1·38)	-	-	-	-
4. Berde, 2017, Nigeria (DHS)(19)	CS	4172 (urban)	OR	Age ≤19 vs ≥35	NS	-	-	-	-
				No education vs ≥2^{o}	1.48 (1.07-2.04)	-	-	-	-
				Working vs not	0.88 (0.72-1.09)	-	-	-	-
				Wealth index	*NS*	-	-	-	-
				Zones	(p<0.001)	-	-	-	-
				Birth order	*NS*	-	-	-	-
				ANC visit<4x	*NS*	-	-	-	-
				Home birth vs facility	1.53 (1.24-1.89)	-	-	-	-
				Caesarean vs vaginal	1.87 (1.25-2.80)	-	-	-	-
				Multiple vs single birth	2.37 (1.14–4.95)	-	-	-	-

Author, year, setting	De-sign	Sample size	Mea-sure	Risk factor	Any PLF	Formula Milk	Milk	Water/ water-based	Honey
				Small vs large birth size	1.46 (1.10–1.94)	-	-	-	-
				Child's sex	*1.02 (0.85-1.21)*	-	-	-	-
		7637 (rural)	OR	Age ≤19 vs ≥35	1.35 (1.02-1.79)	-	-	-	-
				No education vs ≥2º	2.71 (2.11–3.48)	-	-	-	-
				Working vs not	1.13 (0.97–1.32)	-	-	-	-
				Wealth index	*NS*	-	-	-	-
				Zones	*(p<0.001)*	-	-	-	-
				Birth order	*NS*	-	-	-	-
				ANC visit<4x	*NS*	-	-	-	-
				Home birth vs facility	2.05 (1.72-2.43)	-	-	-	-
				Caesarean vs vaginal	1.21 (0.68-2.15)	-	-	-	-
				Multiple vs single birth	*1.20 (0.75-1.94)*	-	-	-	-
				Small vs large birth size	1.77 (1.44-2.17)	-	-	-	-
				Child's sex	*1.07 (0.96-1.21)*	-	-	-	-
5. Temesgen, 2018, Ethiopia (31)	SR, MA	28 studies	OR	ANC	0.25 (0.09-0.69)	-	-	-	-
				Feeding counseling	0.37 (0.22-0.63)	-	-	-	-
				Timely BF initiation	0.28, (0.21-0.38)	-	-	-	-
				Urban (31)	0.47 (0.26-0.86)	-	-	-	-
				Home birth vs facility	3.93 (2.17-7.10)	-	-	-	-
6. Takele, 2018, Ethiopia (112)	SR, MA	24 studies (18,828 participants)	OR	Home birth vs facility	5.16 (3.70-7.20)	-	-	-	-
7. Bergamaschi, 2019, (87)	CS	103,611 mothers	OR for no PLF	Facility vs home birth	1.75 (1.63-1.89)	30 countries in Sub Sahara			
				Private sector	0.89 (0.81-0.99)				
8. Abdel-Rahman, 2020, Sudan, MICS (115)	CS	5622	OR for avoiding PLF	Regions	p<0.001				
				25-34 vs 15-24	1.25 (1.04,1.51)				
				35+ vs 15-24	1.28 (1.02,1.61)				
				Secondary edu vs none	1.74 (1.34,2.27)				
				Planned pregnancy	1.51 (1.18,1.93)				
				Caesarean	0.57 (0.45,0.73)				

Author, year, setting	De-sign	Sample size	Mea-sure	Risk factor	Any PLF	Formula Milk	Milk	Water/ water-based	Honey
				Paternal education, skilled birth attendant, child's sex, birth order	*NS*				
9. Koire, 2021, Uganda (DHS) (105)	CS	4,774	OR	High vs low economic	2.15 (1.38-3.36)	-	-	-	-
				Unskilled birth attendant vs skilled	1.73 (1.04-2.88)	-	-	-	-
				No birth attendant	4.35 (1.01-18.67)	-	-	-	-
				Multiple birth	2.49 (1.04-5.94)	-	-	-	-
				BF initiation in 24 hr vs immediate	5.08 (2.98-8.64)	-	-	-	-
10. Teshale, 2021, 12 East Africa countries (DHS) (109)	CS	33,423	OR	Age	NS	-	-	-	-
				Education	NS	-	-	-	-
				Female baby	0.95 (0.87, 1.05)	-	-	-	-
				BF initiation in >1 hr vs<1hr	3.83 (3.48, 4.23)	-	-	-	-
				Media exposure	1.21 (1.07, 1.35)	-	-	-	-
				Parity	NS	-	-	-	-
				ANC visit	NS	-	-	-	-
				Facility birth vs home	0.44 (0.39, 0.49)	-	-	-	-
				Caesarean vs vaginal	1.63 (1.38, 1.93)	-	-	-	-
				Small birth size vs large	1.15 (1.01, 1.32)	-	-	-	-
				Distance problem with facility vs no problem	NS	-	-	-	-
				Rural	0.78 (0.67, 0.91)	-	-	-	-
11. Seyoum, 2021, Ethiopia (DHS 2016)(99)	CC	649 (case), 2596 (control)	OR	Primiparity vs multi	1.57 (1.20, 2.06)	-	-	-	-
				Average vs small birth size	0.71 (0.55, 0.91)	-	-	-	-
				Large vs small	*1.00 (0.77, 1.31)*	-	-	-	-
				Home birth vs facility	1.47 (1.10, 1.97)	-	-	-	-
				Caesarean vs vaginal	1.97 (1.19, 3.24)	-	-	-	-
				Regions	p <0.001	-	-	-	-
				ANC, birth interval, media exposure, wealth status, work status,	*NS*	-	-	-	-

Author, year, setting	De-sign	Sample size	Mea-sure	Risk factor	Any PLF	Formula Milk	Milk	Water/ water-based	Honey
				maternal/paternal education, rural,					
12. Merga, 2021, Ethiopia (DHS 2016)(113)	CS	5303 (0-36 mo)	OR	Poorest vs richest	1.50 (1.02, 2.22)	-	-	-	-
				Home birth vs facility	1.35 (1.01, 1.79)	-	-	-	-
				Agrarian vs pastoralist	0.15 (0.11, 0.20)	-	-	-	-
				BF counselling	1.33 (1.01, 1.75)	-	-	-	-
				BF intitiation >1 hr	4.52 (3.62, 5.64)	-	-	-	-
				Maternal age, education, rural, media access, ANC visit, child's sex, parity	*NS*	-	-	-	-
13. Birhan, 2021, 11 Eastern Africa (DHS) (108)	CS	120,112	OR	Rich vs poor	1.22 (1.10–1.34)	-	-	-	-
				Married vs single	0.68 (0.63–0.74)	-	-	-	-
				Facility vs home birth	0.58 (0.52–0.64)	-	-	-	-
				Assistant delivery	0.90 (0.83–0.98)	-	-	-	-
				Small vs large birth size	1.14 (1.03–1.26)	-	-	-	-
				Average vs large	0.84 (0.78–0.91)	-	-	-	-
				Media exposure	1.11 (1.02–1.21)	-	-	-	-
				Caesarean vs vaginal	2.61 (2.30–2.96)	-	-	-	-
				Female baby	0.92 (0.86–0.98)	-	-	-	-
				Birth interval	0.86 (0.78–0.94)	-	-	-	-
				Maternal/paternal education, maternal age, parity, ANC visit, rurality	*NS*	-	-	-	-
14. Fadl, 2021, Egypt(117)	CS	3,773	OR	Caesarean vs vaginal	1.44 (1.19–1.74)				
15. Sako, 2022, Ethiopia (mini-DHS) (114)	CS	2,054	OR	Multiple birth vs single	4.62 [1.63, 13.1]	-	-	-	-
				Caesarean vs vaginal	2.66 [1.63, 4.33]	-	-	-	-
				BF initiation >1 hr	3.17 [2.25, 4.47]	-	-	-	-
				Pastoralist vs city	2.12 [1.22, 3.68]	-	-	-	-
				Marital status, religion, parity, birth interval, birth order, ANC, place of birth, delivery assistant	*NS*	-	-	-	-

Author, year, setting	De-sign	Sample size	Mea-sure	Risk factor	Any PLF	Formula Milk	Milk	Water/ water-based	Honey
America									
16. Boccolini, 2015, Latin America-Caribbean (DHS)	CS	49,253	OR	Caesarean vs vaginal birth	-	-	2.64 (2.58-3.67)	-	-
				Caesarean in the wealthiest SES	-	-	2.17 (1.85-2.54)	-	-
				Caesarean in the poorest SES	-	-	2.94 (2.58-3.67)	-	-
17. Boccolini, 2013, Latin America-Caribbean (DHS)	CS	58,056	OR	Higher wealth	1.33 (1.24-1.46)				
				Higher education	1.46 (1.32-1.60)				
				Caesarean delivery	2.34 (2.28-2.41)				
				Hospital birth (vs. home)	0.72 (0.64-0.80)				
Europe									
18. Yalçın, 2020, Turkey (DHS) (104)	CS	4942	OR	Public hospital vs home	0.61 (0.46-0.80)	-	-	-	-
				Caesarean vs vaginal birth	1.51 (1.28-1.78)	-	-	-	-
				Breastfeeding initiation >2h	1.73 (1.42-2.11)				
				Breastfeeding initiation >24h	11.37(8.81-14.7)	-	-	-	-
Asia									
19. Nguyen, 2013, Vietnam (23)	CS	6,068	OR	Highest education	*0.94 (0.70-1.26)*	1.41 (1.08-1.86)	-	0.57 (0.44-0.73)	-
				Highest SES	1.98 (1.60–2.46)	3.31 (2.71-4.06)	-	1.06 (0.88-1.27)	-
				Urban	2.11 (1.68–2.65)	1.72 (1.44-2.06)	-	2.92 (2.49-3.43)	
				Vaginal birth + episiotomy vs vaginal	1.36 (1.17–1.58)	1.77 (1.54-2.04)	-	1.16 (1.02-1.32)	-
				Caesarean vs vaginal	2.94 (2.39-3.61)	5.64 (4.69-6.78)	-	1.24 (1.06-1.45)	-
				BF support at ANC	0.81 (0.71-0.93)	0.82 (0.72-0.93)	-	*1.10 (0.98-1.24)*	-
				BF support at PNC	0.84 (0.73-0.97)	0.85 (0.74-0.98)	-	*0.98 (0.87–1.12)*	
				High BF misconception	2.09 (1.74–2.50)	1.85 (1.58-2.17)	-	1.95 (1.69-2.24)	-
				High BF knowledge	0.49 (0.32–0.75)	0.42 (0.29-0.62)	-	0.50 (0.35-0.70)	-
				Media exposure, age, child's sex, maternal age	*NS*	*NS*	-	*NS*	-
20. Sundaram, 2013,	CS	24,992	OR	Passed year 9	0.8 (0.7, 0.9)	-	-	-	-
				Primigravidity	1.4 (1.3, 1.6)	-	-	-	-

Author, year, setting	De-sign	Sample size	Mea-sure	Risk factor	Any PLF	Formula Milk	Milk	Water/ water-based	Honey
Bangladesh (120)				Normal suckling	0.1 (0.1, 0.1)	-	-	-	-
				Birth at facility	0.3 (0.2, 0.3)	-	-	-	-
				ANC visit 1-3 vs 0	0.8 (0.7, 0.9)	-	-	-	-
				ANC visit ≥4 vs 0	*0.8 (0.7, 1.0) NS*				
				Maternal age, literate, birth size, child's sex, type of birth assistant,		-	-	-	-
21. Khanal, 2013, Nepal (DHS 2011) (101)	CS	3,948	OR	1º vs no education	0.45 (0.34, 0.59)	-	-	-	-
				2º vs no education	0.54 (0.40, 0.73)	-	-	-	-
				Middle SES vs low	1.63 (1.18- 2.26	-	-	-	-
				Not working	1.43 (1.06-2.03)	-	-	-	-
				Plain vs mountain	2.28 (1.46, 3.57)				
				Regions	P<001				
				ANC visit <4x	1.62 (1.24-2.10)	-	-	-	-
				2nd/3rd child vs 1st	0.59 (0.48-0.73)	-	-	-	-
				4th/subsequent child	0.72 (0.55, 0.96)	-	-	-	-
				Child's sex, higher education vs no, birth interval, birth size	*NS*				
22. Khanal, 2014, Timor-Leste (DHS) (124)	CS	4,821	OR	Age 35-39 vs 20-34	1.46 (1.20-1.77)	-	-	-	-
				Middle SES vs low	1.43 (1.12-1.82)	-	-	-	-
				Upper SES vs low	1.66 (1.21-2.27)	-	-	-	-
				Small (103)er birth size	1.67 (1.27-2.20)	-	-	-	-
				Urban	1.39 (1.05-1.83)	-	-	-	-
				Religion other than Roman Catholics	1.98 (1.16-3.41)	-	-	-	-
23. Benedict, 2014, South Asia (DHS) (111)	CS	1,383-10,830	OR for avoiding PLF	Smaller birth size vs large	↓, NS, ↓, NS, ↓	Order: Afghanistan, Bangladesh, India, Nepal, Pakistan ↓=associated with lower odds of avoiding PLF ↑=associated with higher odds of avoiding PLF NS= no association Note: APF and EIBF are separate outcomes, but similar dets			
				Average birth size	↓, NS, ↓, NS, ↓				
				Postnatal checkup ≤2 days vs none	↓, ↓, NS, NS, NS				
				ANC visit	NS all				
				TBA vs unskilled	NS NS NS NS↓				
				Health professional	NS ↑ NS NS NS				
				Facility	NS all				

Author, year, setting	De-sign	Sample size	Mea-sure	Risk factor	Any PLF	Formula Milk	Milk	Water/ water-based	Honey
				Caesarean	NS ↓, ↓,↓, NS				
				BMI	NS all				
				Gender conforming	↓ NS NS NS NS				
				Decision making	↓ NS NS NS NS				
				Current employment	NS NS NS ↑ NS				
24. Nguyen, 2019, Vietnam (119, 125)	PCS	2030 pregnant women	OR	Caesarean vs vaginal	13.91 (10.52-18.39)				
25. Asim, 2020, Pakistan (DHS)(52)	CS	1362	OR	No edu. vs higher	*1.53 (0.78, 1.91)*	-	-	-	-
				Primary education	2.28 (1.35, 3.85)	-	-	-	-
				Middle education	1.88 (1.02, 3.47)	-	-	-	-
				Secondary	1.80 (1.04, 3.09)	-	-	-	-
				Regions	p<0.001	-	-	-	-
				Home birth vs private facility	*0.99 (0.69, 1.37)*	-	-	-	-
				Public facility	0.46 (0.43, 0.95)	-	-	-	-
				BF initiation in 1 hr vs after 1 day	0.03 (0.01, 0.61)	-	-	-	-
				BF initiation 2-24 hr	0.07 (0.43, 0.95)	-	-	-	-
				Wealth index, child's sex, ANC, caesarean, birth order	*NS*	-	-	-	-
26. Young, 2020, India (125)	CS	1,838 women, 1,194 husbands, 1,353 mothers /mother-in-law		Woman's knowledge on EBF	0.29 (0.19, 0.45)	-	-	-	-
				Woman's high self-efficacy for BF vs low	0.45 (0.24, 0.82)	-	-	-	-
				Caesarean	3.84 (2.40, 6.15)	-	-	-	-
				Institutional birth	0.31 (0.20, 0.47)	-	-	-	-
				Education (woman, husband, mother/in-law), social norm	*NS*	-	-	-	-
27. Abdel-Rahman, 2020,	CS	5622	OR for avoidi	Regions	p<0.001				
				25-34 vs 15-24	1.25 (1.04,1.51)				
				35+ vs 15-24	1.28 (1.02,1.61)				

Author, year, setting	De-sign	Sample size	Mea-sure	Risk factor	Any PLF	Formula Milk	Milk	Water/ water-based	Honey
Sudan, MICS (115)			ng PLF	Secondary edu vs none	1.74 (1.34,2.27)				
				Planned pregnancy	1.51 (1.18,1.93)				
				Caesarean	0.57 (0.45,0.73)				
				Paternal education, skilled birth attendant, child's sex, birth order	*NS*				
28. Ali, 2020, Bangladesh (121)	CS	2768, child 12 m	OR	Place of birth, birth attendant, and birth mode	*NS*				
29. Jeyakumar, 2021, India (urban slum) (126)	CS	1443	OR	Caesarean vs vaginal	3.53 (2.65-4.68)	-	-	-	-
				Public vs private facility	0.42 (0.32-0.56)	-	-	-	-
				Maternal age at marriage and last pregnancy, education, caste, religion, family size, birth size, child's sex	*NS*	-	-	-	-
30. Bhandari, 2019, Nepal (DHS 2013) (123)	CS	1011	PR	Lower birth order	0.72 (0.60,0.86)				
				EIBF	0.5 (0.37,0.67)				
				Child fed colostrum	0.78 (0.65,0.93)				
				Predominant BF <6m	0.51 (0.36,0.72)				
				Child's sex, maternal age, wealth quintile, paternal and maternal education, ANC visit	*NS*				
31. Sultana, 2022, Bangladesh (DHS 2017) (122)	CS	4982 (0-36 mo)	OR	Regional division	p<0.01	-	-	-	-
				Mass media access	1.21 (1.06, 1.38)	-	-	-	-
				No ANC visit vs ≥4x	1.21 (0.97, 1.52)	-	-	-	-
				Facility birth vs home	1.17 (1.03, 1.32)	-	-	-	-
				Caesaean	1.63 (1.44, 1.85)	-	-	-	-
				Maternal age, rurality, education, occupation, wealth index, child's sex, birth order, birth weight	*NS*	-	-	-	-
Indonesia									

Author, year, setting	De-sign	Sample size	Mea-sure	Risk factor	Any PLF	Formula Milk	Milk	Water/ water-based	Honey
32. Rahmartani, 2020, Indonesia (DHS) (85)	CS	6127	PR	Increasing SES in rural	1.07 (1.03-1.11)	1.12 (1.06-1.19)	1.14 (1.04-1.24	-	1.12 (0.97-1.29)
				2nd vs 1st birth	0.82 (0.76-0.88)	0.77 (0.69-0.86)	0.77 (0.66-0.89)	-	0.60 (0.45-0.81)
				Perceived smaller birth size vs average	1.23 (1.12-1.35)	1.27 (1.11-1.47)	1.42 (1.15-1.75)	-	NS
				Vaginal birth at public facility vs home	NS	NS	NS	-	0.38 (0.26-0.56)
				Vaginal, private fac.	NS	NS	NS	-	0.22 (0.14-0.36)
				Caesarean, public fac.	1.27 (1.13-1.44)	1.54 (1.27-1.87	2.26 (1.70-3.00)	-	0.36 (0.17-0.74)
				Caesarean, private fac.	1.15 (1.01-1.31)	1.37 (1.12-1.68)	1.77 (1.31-2.41)	-	0.10 (0.04-0.23)
				Having ANC card	0.89 (0.80-0.99)	NS	0.73 (0.59-0.91)	-	NS
				No skin-to-skin contact at birth	1.32 (1.23-1.42)	1.44 (1.29-1.60)	1.49 (1.27-1.75)	-	1.52 (1.11-2.09)
				Maternal education, age, child' sex	*NS*				
33. Nurokhmah, 2021, Indonesia DHS (86)	CS	6455	OR	Lowest SES vs middle	0.72 (0.57-0.91)	-	-	-	-
				Urban area	0.76 (0.65-0.90)	-	-	-	-
				Parity >2 vs ≤2	0.83 (0.71-0.96)	-	-	-	-
				Early initiation of BF	0.24 (0.21-0.28)	-	-	-	-
				Caesarean birth	1.36 (1.14-1.63)	-	-	-	-
				Non-conforming gender role	1.15 (1.00-1.32)	-	-	-	-
				Child's age, sex, birth type, maternal age, education, occupation, place of birth	*NS*				

ANC=antenatal, BF=breastfeeding, CS=cross-sectional, CC=case-control, EIBF= early initiation of breastfeeding, MA= meta-analysis, OR=odds ratio, PR=prevalence ratio, care, PNC=postnatal care, SES=socioeconomic status, SR= Systematic review, TBA= traditional birth attendant

Additional search strategy using Google Scholar

By December 2018, there was no Indonesian study in Pubmed, Medline, or Web of Science that contained “prelacteal” or “pre-lacteal” in the title/abstract. Therefore, a slightly different search strategy was conducted on Google Search and Scholar. First, I used data from national-level surveys that reported PLF prevalence in Indonesia, i.e. IDHS and Basic Health Survey 2018. Three search objectives were: 1) to estimate prevalence of PLF (any PLF and by type), 2) to identify reasons and/or potential determinants of PLF, and 3) to investigate the association/relationship between PLF and breastfeeding outcomes in Indonesia.

There was no official entry of the term “prelacteal” in the Indonesian dictionary (kbbi.or.id), but the term “pralaktasi” and “prelakteal” have been used interchangeably in the academic writing. As shown in Figure 2.3, keywords ((“prelacteal” or “pre-lacteal”) AND “Indonesia”)) OR (“prelakteal” OR “pre-lacteal”) OR (“pralaktasi” OR “pra-laktasi”) were used. In December 2018, there were 309 studies containing any of these keywords in any part of the text and 16 studies containing any of these keywords in the title. As per May 2022, there were 593 studies containing any of these keywords in any part of the text and 41 studies containing any of these keywords in the title.

Since Google Scholar Search did not have the feature to filter keywords by abstract, articles containing any of the keywords in the text were sorted by relevance and manual screening was limited to the first 20 search pages, as articles shown in page 21 onwards were less likely to be relevant. The first search objective was addressed by selecting studies that had estimates of PLF prevalence in any region in Indonesia. The second search objective was addressed by selecting studies that reported determinants of PLF in Indonesia. The third search objective was addressed by selecting studies that reported any association between

PLF and breastfeeding outcomes. All types of study designs were considered. The results from search objectives 1, 2, and 3 are summarised in Figure 1.1.

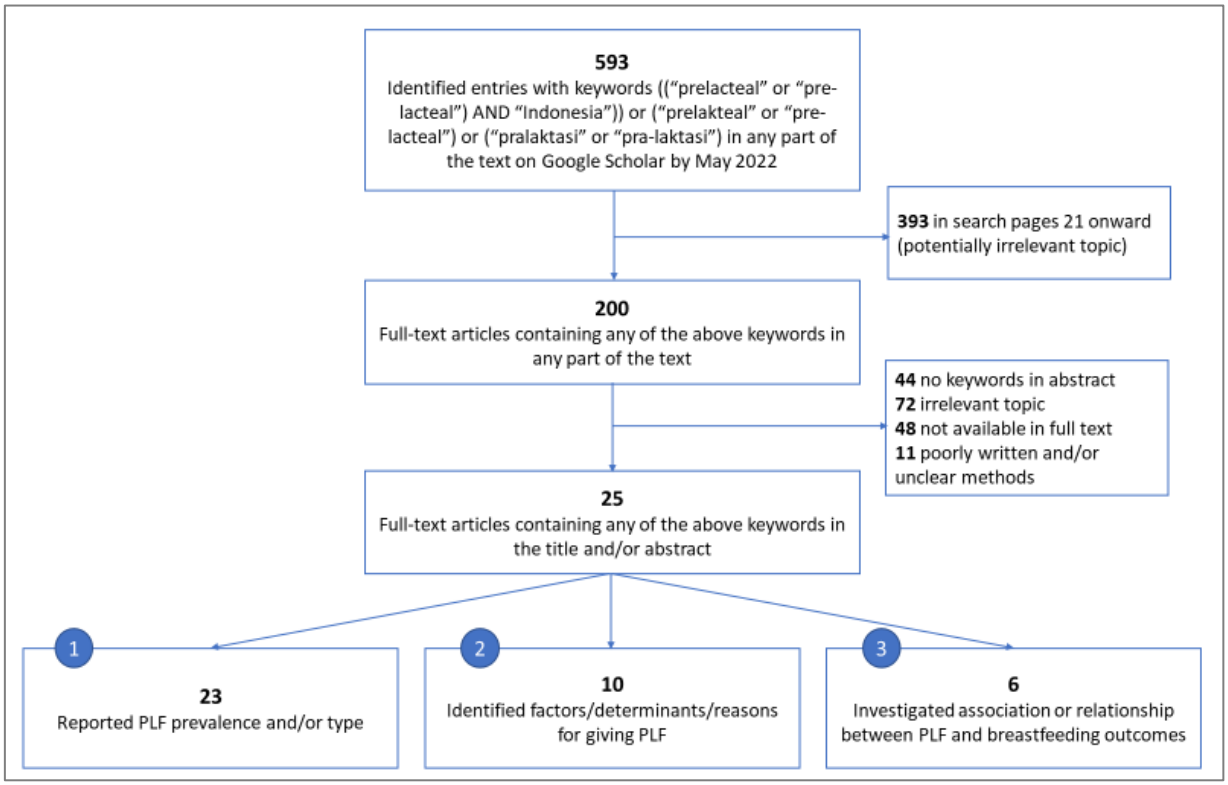


Figure I.1 Structured literature search strategies to fulfil three objectives. 1) to estimate prevalence of PLF (any PLF and by type), 2) to identify potential determinants of PLF, and 3) to investigate the association between PLF and breastfeeding outcomes in Indonesia

PLF prevalence and types in Indonesia

As per May 2022, the estimates of PLF prevalence were obtained from IDHS reports (1, 10-12), Basic Health Survey report (106), and 21 primary (community-based) studies (Figure 2.3, box 1). Of the community-based studies, most of the regions were in Java. Majority of the studies had small sample (<100). Most of the studies are cross-sectional, although some used mixed-methods or qualitative approach.

As shown in Table I.3 prelacteal feeding practice is relatively common and the prevalence varies among study settings (128, 180-183), ranging from 22.8% to 93.8%. The most common types of food or drink are not always the same across these studies, but infant

formula (181-183, 312), sugar water (181, 182), honey (182, 183, 312), plain water (182), and banana are frequently mentioned. IDHS reports provided overall estimates of PLF prevalence at the national level but did not specify types. Basic Health Survey only reported PLF prevalence and types in 2018. In general, the prevalence of any PLF in Indonesia decreased from 2002 to 2018.

Table I.3. Estimates of PLF prevalence in Indonesia

Author	Year	Study population (sample size and setting)	Study design	PLF prevalence (%)	
				Any	By common types
1. BKKBN, BPS, Kemenkes RI (MoH), ICF Int'l (1, 10-12)	2002	14,474 pairs of mother-child aged 0-59 months, 26 provinces in Indonesia	Cross-sectional, IDHS	62.9	NA
	2007	13,471 pairs of mother-child aged 0-59 months, 33 provinces in Indonesia	Cross-sectional, IDHS	64.6	NA
	2012	6,542 pairs of mother-child aged 0-23 months, 33 provinces in Indonesia	Cross-sectional, IDHS	60.3	NA
	2017	6,284 pairs of mother-child aged 0-23 months, 34 provinces in Indonesia	Cross-sectional, IDHS	43.9	NA
2. Ministry of Health (106)	2018	10,997 pairs of mother-child aged 0-23 months, 34 provinces in Indonesia	Cross-sectional, Basic Health Survey	33.1	Formula (26.9), honey (4.5), plain water (4.6), banana (1.2), rice, others
3. Rosha (313)	2013	91 mothers in Bogor, West Java	Cohort	44%	Not specified
4. Inayati (181)	2012	215 mothers of wasted children in Nias, North Sumatera	Cross-sectional with Qs + FGD, IDI	74%	- Sugar water - Formula
5. Barati (182)	2018	384 underfives mothers from farmer families in Central Java	Cross-sectional with Qs + FGD, IDI	60%	- formula (>50%), - honey, - sugar water, - plain water, - porridge
6. Wanda (180)	2001	100 post-partum mothers at hospital in Jakarta	Cross-sectional	66%	- formula (97%), - honey, - water
7. Rahmawati (183)	2016	638 infants, 554 U-2 in Malang, Central Java	Cross-sectional	52%	- formula (>80%) - honey 8% - fruits 4%
8. Hervilia (14)	2016	28 mothers in Palangkaraya, East Kalimantan	Qualitative	-	- Honey - Coffee - Coconut milk - Palm sugar - Formula
9. Utomo (13)	1997	400 mothers (36 mo post-partum) in Indramayu, West Java	Cross-sectional	60-83%	- Honey - Fruit

Author	Year	Study population (sample size and setting)	Study design	PLF prevalence (%)	
				Any	By common types
					- Sugar water
10. Triatmaja (314)	2016	82 mothers with child aged 7-12 mos, Bogor, West Java	Cross-sectional	34.1	- Formula (78.6) - water (7.0) - honey (14.4)
11. Sutayani (244)	2013	95 mothers with child aged 4-7 days old, Jember, East Java	Cross-sectional	87.4	- Formula (17.9) - Honey (7.4) - Sugar water (4.2) - Banana (3.2)
12. Herlina (315)	2018	135 mothers with child aged 0-6 months in Pekanbaru, Sumatera	Cross-sectional	58.5	- Formula (26.7) - Honey (15.6) - Water (11.1) - Rice water (4.4)
13. Chairani (316)	2017	73 mothers, child aged 0-12 mos in Padang, West Sumatera	Cross-sectional	63.0	- Formula (59.4), - water (21.9), - honey (9.4)
14. Pramartasari (317)	2014	173 mothers, child aged 0-6 mos, Madiun, East Java	Cross-sectional	46.2	- formula (42.7), water, honey
15. Illahi (318)	2016	62 underfives in Madura, East Java	Cross-sectional	59.7	NA
16. Felix (319)	2013	100 mothers, child aged 6-24 mos in West Kalimantan	Cross-sectional	50.0	NA
17. Ardiansyah (320)	2018	266 children 0-23 mo in South Kalimantan	Cross-sectional	36.8	NA
18. Muliyati (321)	2018	45 breastfeeding mothers in Central Sulawesi	Cross-sectional	22.8	NA
19. Sulistyowati (322)	2017	93 mothers, child aged 6-12 mos in Bangkalan, Madura, East Java	Cross-sectional	34.4	- Formula (59,4), - water, rice water, honey, banana, sugar water
20. Rohmah (323)	2022	30 children aged 1-3 yo in Banggai, Central Sulawesi	Case-control	36.6	NA
21. Handiawati (324)	2020	32 mothers, child aged 0-6 mos, Riau	Cross-sectional	93.8	NA
22. Triatmaja (127)	2021	41 mothers, child aged 6-12 mo in Kedici, East Java	Cross-sectional	48	NA

Determinants of PLF in Indonesia

Most of the entries retrieved on Google Scholar were not peer-reviewed and were in a form of undergraduate assignment so they had restricted access. There were not many studies investigating PLF determinants in Indonesia. Most of the PLF-related studies were descriptive and used Chi-square statistics to compare factors potentially associated with PLF. Using the search strategy described in Section 2.6.2, 8 articles reporting determinants

of PLF in Indonesia were found as per May 2022. Findings from these studies are summarised in Table 2.7.

Common reasons for giving PLF were related to insufficient milk, infant hunger, and advice from the health care providers. Cultural reasons include belief to bless the baby, clean the gut, or suggestion from others. Some studies using bivariable analyses found that primiparity and lack of knowledge on PLF were associated with PLF practices. However, as there was no multivariable analysis found, these association were not adjusted for other factors. Moreover, despite a huge variety of PLF types, none of the studies looked at different types of PLF (Table 2.7).

Table I.4. Determinants and reasons for giving PLF in Indonesia

Author	Year	Study population	Study design	PLF	Measure of association	Determinants/reason for giving PLF
1. Inayati (181)	2012	215 mothers of wasted children in Nias, North Sumatera	Cross-sectional with Qs + FGD, IDI	Any	-	- Newborn hunger - Perceived breastmilk insufficiency - Colostrum is believed to be harmful so it's not given
2. Barati (182)	2018	384 underfives mothers from farmer families in Central Java	Cross-sectional with Qs + FGD, IDI	Any	-	- Newborn fatigue, - Following advices from husband, mother/mother in-law, midwives
3. Rahmawati (183)	2016	638 infants, 554 U-2 in Malang, Central Java	Cross-sectional	Any	-	- healthcare provider initiative (84%) - mother-in-law (12%) - mother (12%).
4. Hervilia (14)	2016	28 mothers in Palangkaraya, East Kalimantan	Qualitative	Any	-	- Cultural tradition - Social influence - Panicking because breast milk not coming in - Perceived breastmilk insufficiency - Perceived neonatal hunger - To prevent seizure - Given by midwife - Inadequate information
5. Utomo (13)	1997	400 mothers (36 mo post-partum) in Indramayu, West Java	Cross-sectional	Any	-	- Perceived infant hunger (crying when BM hasn't come out)

Author	Year	Study population	Study design	PLF	Measure of association	Determinants/reason for giving PLF
						- Cultural tradition: belief to bless the baby, make them pretty, avoid bad spirits, accelerate BF, clean gut
6. Triatmaja (314)	2016	82 mothers with child aged 7-12 mos, Bogor	Cross-sectional	Any	Chi-square	Primiparity vs multiparity (75% vs 27%, p=0.001) Health worker's advice (91% vs 12%, p=0.001)
7. Chairani (316)	2017	73 mothers, child aged 0-12 mos in Padang, West Sumatera	Cross-sectional	Any	Chi-square	Poor vs good knowledge (74% vs 47%, p=0.03), primiparity vs multiparity (81% vs 53%, p=0.03)
8. Pramarta sari (317)	2014	173 mothers, child aged 0-6 mos, Madiun, East Java	Cross-sectional	Any	Chi-square	Knowledge about EBF decreases likelihood of PLF (p<0.001). Reason: not enough milk >70%
9. Sulistyow ati (322)	2017	93 mothers, child aged 6-12 mos in Bangkalan, Madura, East Java	Cross-sectional	Any	Chi-square	Education is not a statistically significant determinant
10. Nurbaya (325)	2021	67 mothers of underfives in West Sulawesi	Qualitative, FGD	Water, honey	-	Traditional birth attendants (TBA) plays a big role in trust and decision of giving traditional PLF.

APPENDIX II CHAPTER 4: PROVINCIAL TABLES

Table II.1. Prevalence of any PLF in Indonesia based on 2002-2017 IDHS: by province

Province	2002		2007		2012		2017	
	n	%	n	%		n	%	n
SUMATERA								
Aceh			132	58.0	144	66.7	196	53.5
North Sumatera	229	70.0	266	83.7	220	79.3	220	66.3
West Sumatera	167	67.3	166	65.4	129	61.5	58	40.0
Riau	205	78.6	151	63.6	177	80.5	90	61.8
Jambi	113	55.1	133	76.4	140	81.2	46	56.3
South Sumatera	119	61.5	139	69.3	145	69.3	81	49.7
Bengkulu	132	72.3	122	82.4	82	64.1	49	51.2
Lampung	122	65.7	131	67.0	123	62.9	95	64.3
Bangka Belitung	67	58.8	75	47.2	97	61.2	42	40.5
Riau Islands			135	78.7	106	63.8	59	44.3
JAVA								
Jakarta	240	71.7	240	74.8	158	55.8	65	29.9
West Java	159	47.6	188	57.7	183	58.9	224	36.6
Central Java	162	69.2	173	71.0	142	54.9	142	34.7
Yogyakarta	105	65.7	77	51.9	78	49.1	17	24.2
East Java	106	53.4	143	75.8	175	67.2	204	55.0
Banten	117	51.1	197	74.5	173	61.8	80	37.6
BALI AND NUSA TENGGARA								
Bali	93	39.6	96	48.5	105	64.7	32	48.6
West Nusa Tenggara	82	41.1	100	49.5	62	29.0	41	21.4
East Nusa Tenggara	119	38.2	74	28.3	56	27.4	117	29.0
KALIMANTAN								
West Kalimantan	108	52.8	101	56.1	147	65.8	56	46.9
Central Kalimantan	123	55.8	112	70.6	114	68.5	50	62.1
South Kalimantan	136	66.6	115	75.3	126	70.3	52	58.4
East Kalimantan	128	69.1	122	65.9	102	63.7	57	34.5
North Kalimantan							45	44.9
SULAWESI								
North Sulawesi	74	36.6	75	44.5	125	71.5	51	80.1
Central Sulawesi	181	81.2	132	64.5	127	65.5	122	77.2
South Sulawesi	151	68.9	221	83.7	138	54.6	111	47.6
Southeast Sulawesi	121	43.1	128	62.2	109	56.6	154	65.4
Gorontalo	145	64.4	123	74.8	109	71.5	69	70.4
West Sulawesi			95	44.3	99	49.7	79	35.0
MALUKU AND PAPUA								
Maluku			135	53.1	103	54.8	132	42.5
North Maluku			101	55.5	85	44.5	67	46.5
West Papua			80	49.6	92	44.5	27	31.9
Papua			51	39.4	63	36.4	23	17.7
Total	3,504	58.5	4,329	66.4	4,034	61.0	2,953	44.6

Table II.2. Prevalence of infant formula in Indonesia based on 2002-2017 IDHS: by province

Province	2002		2007		2012		2017	
	n	%	n	%		n	%	n
SUMATERA								
Aceh			78	34.9	69	31.3	127	33.6
North Sumatera	139	45.0	193	62.2	135	49.1	162	49.3
West Sumatera	108	45.7	119	46.9	93	43.9	45	30.9
Riau	161	61.3	127	53.0	161	72.0	64	45.5
Jambi	62	33.1	98	56.7	96	54.9	19	23.5
South Sumatera	96	48.4	97	46.0	114	54.3	41	23.5
Bengkulu	72	40.9	93	60.1	43	32.4	31	33.3
Lampung	84	42.5	102	52.4	92	47.8	65	42.0
Bangka Belitung	61	52.5	72	45.0	63	40.0	29	27.6
Riau Islands			132	77.0	52	30.6	32	23.0
JAVA								
Jakarta	227	66.7	233	72.8	116	39.7	51	23.2
West Java	66	20.6	129	37.8	86	27.6	81	13.6
Central Java	96	39.0	134	53.8	126	48.6	67	16.2
Yogyakarta	90	53.8	75	50.5	76	48.1	7	9.2
East Java	91	45.4	123	65.8	143	55.6	152	41.0
Banten	83	38.5	107	43.4	97	34.6	49	23.1
BALI AND NUSA TENGGARA								
Bali	85	36.2	93	46.8	68	41.5	30	46.3
West Nusa Tenggara	21	10.7	64	31.6	50	23.3	6	3.0
East Nusa Tenggara	20	4.7	27	9.4	23	10.1	49	11.3
KALIMANTAN								
West Kalimantan	63	29.3	90	50.9	91	39.9	22	17.7
Central Kalimantan	104	47.2	93	58.0	92	54.5	33	39.7
South Kalimantan	86	41.4	87	56.2	90	50.9	30	35.5
East Kalimantan	82	48.1	107	57.5	87	54.3	19	11.0
North Kalimantan							14	13.7
SULAWESI								
North Sulawesi	69	34.4	67	39.9	95	54.4	19	27.8
Central Sulawesi	56	27.0	71	33.7	76	37.7	94	60.3
South Sulawesi	64	40.6	103	39.8	78	30.5	41	17.9
Southeast Sulawesi	47	15.4	49	24.7	66	34.5	55	22.2
Gorontalo	14	6.0	32	19.6	40	26.0	25	24.7
West Sulawesi			32	15.8	24	12.0	25	10.8
MALUKU AND PAPUA								
Maluku			52	19.8	47	24.6	84	27.2
North Maluku			56	32.1	44	21.0	21	13.3
West Papua			39	29.2	66	32.0	23	27.3
Papua			28	24.9	14	7.4	16	12.3
Total	2,147	36.45	3,002	48.5	2,613	41.3	1,628	25.1

Table II.3. Prevalence of honey in Indonesia based on 2002-2017 IDHS: by province

Province	2002		2007		2012		2017	
	n	%	n	%		n	%	n
SUMATERA								
Aceh			24	10.9	14	6.5	7	2.2
North Sumatera	37	10.6	40	11.0	15	5.5	11	3.6
West Sumatera	57	19.2	15	5.6	4	2.2	3	2.0
Riau	62	24.1	27	13.4	24	10.8	9	6.4
Jambi	35	15.2	43	21.4	24	14.6	10	11.7
South Sumatera	17	8.2	23	11.8	4	2.1	13	8.6
Bengkulu	53	30.1	29	18.1	15	12.1	6	6.6
Lampung	32	19.6	20	10.0	10	5.2	11	8.3
Bangka Belitung	2	2.7	2	1.3	3	2.0	2	2.7
Riau Islands			5	3.5	3	0.9	1	0.9
JAVA								
Jakarta	30	10.9	17	5.5	8	2.8	2	1.0
West Java	54	13.9	35	11.9	18	5.9	11	2.0
Central Java	53	24.8	32	13.3	6	2.5	8	1.9
Yogyakarta	11	7.5	1	0.1	1	0.5	1	1.0
East Java	5	1.6	2	1.2	3	1.2	5	1.4
Banten	18	6.3	102	41.2	26	8.9	13	6.7
BALI AND NUSA TENGGARA								
Bali	0	0.0	1	0.5	0	0.0	0	0.0
West Nusa Tenggara	30	13.0	29	14.6	5	2.3	11	6.0
East Nusa Tenggara	14	3.6	8	3.3	6	2.6	5	1.3
KALIMANTAN								
West Kalimantan	20	10.3	1	0.9	3	1.5	0	0.0
Central Kalimantan	0	0.0	14	8.3	3	1.8	2	2.4
South Kalimantan	18	11.3	10	7.1	6	3.0	13	15.4
East Kalimantan	42	20.0	19	10.4	10	6.1	5	3.9
North Kalimantan							13	12.9
SULAWESI								
North Sulawesi	2	1.1	2	1.2	6	3.2	1	2.2
Central Sulawesi	65	31.0	48	23.7	32	16.9	9	5.3
South Sulawesi	23	8.4	27	10.4	15	6.0	2	1.0
Southeast Sulawesi	46	14.2	51	22.9	19	9.7	37	15.7
Gorontalo	95	40.7	65	40.4	38	25.1	28	28.2
West Sulawesi			10	3.6	15	7.3	11	5.2
MALUKU AND PAPUA								
Maluku			34	13.2	16	8.5	10	3.2
North Maluku			22	11.0	7	4.1	17	12.9
West Papua			13	7.4	1	0.3	2	2.2
Papua			3	2.1	1	0.5	0	0.0
Total	821	12.6	774	10.8	361	4.5	279	3.5

Table II.4. Prevalence of water in Indonesia based on 2002-2017 IDHS: by province

Province	2002		2007		2012		2017	
	n	%	n	%	n	%	n	%
SUMATERA								
Aceh			29	13.2	27	13.0	21	6.2
North Sumatera	53	11.8	93	27.1	24	8.5	14	4.7
West Sumatera	35	15.3	11	4.5	11	5.4	6	4.0
Riau	22	8.3	15	5.9	9	3.4	7	5.1
Jambi	12	4.4	20	11.2	6	3.7	8	10.3
South Sumatera	12	7.7	18	9.7	4	1.9	8	4.6
Bengkulu	11	4.8	17	13.4	9	7.5	5	5.8
Lampung	8	2.9	0	0.0	6	3.4	2	1.2
Bangka Belitung	0	0.0	6	3.9	19	12.2	2	2.1
Riau Islands			3	1.8	1	0.7	6	6.0
JAVA								
Jakarta	24	7.6	9	3.3	5	1.7	6	3.1
West Java	47	14.5	35	12.4	40	12.9	38	6.7
Central Java	22	9.7	19	8.2	3	1.1	12	3.0
Yogyakarta	33	21.4	9	6.0	3	1.6	9	14.0
East Java	2	0.7	0	0.0	1	0.4	10	2.7
Banten	19	12.5	32	12.9	26	9.0	5	2.2
BALI AND NUSA TENGGARA								
Bali	1	0.4	8	3.3	2	1.5	0	0.0
West Nusa Tenggara	10	3.1	5	2.6	4	1.8	3	1.3
East Nusa Tenggara	56	18.0	14	5.2	18	9.3	36	9.1
KALIMANTAN								
West Kalimantan	10	5.3	10	5.3	22	10.5	11	9.4
Central Kalimantan	41	18.5	11	5.3	9	4.8	3	3.6
South Kalimantan	44	19.0	27	18.2	16	8.5	13	14.4
East Kalimantan	22	8.7	7	3.2	9	5.5	7	4.5
North Kalimantan							13	13.8
SULAWESI								
North Sulawesi	3	1.4	2	1.4	2	1.0	1	1.5
Central Sulawesi	14	4.8	9	4.9	5	2.6	4	2.6
South Sulawesi	77	26.5	98	36.0	46	18.4	27	12.2
Southeast Sulawesi	29	10.5	25	13.6	21	11.1	16	6.6
Gorontalo	4	1.7	5	4.1	9	5.8	9	9.0
West Sulawesi			39	18.9	48	22.9	20	9.3
MALUKU AND PAPUA								
Maluku			10	5.3	14	7.3	12	4.0
North Maluku			5	2.8	7	4.0	8	5.1
West Papua			24	12.0	2	0.7	0	0.0
Papua			21	14.3	31	19.1	4	3.4
Total	611	10.4	636	9.7	459	6.4	346	5.0

Table II.5. Prevalence of any other milk in Indonesia based on 2002-2017 IDHS: by province

Province	2002		2007		2012		2017	
	n	%	n	%		n	%	n
SUMATERA								
Aceh			1	0.5	42	19.5	48	13.5
North Sumatera	0	0.0	1	0.4	64	22.9	52	14.9
West Sumatera	0	0.0	1	0.2	25	11.6	5	3.5
Riau	0	0.0	1	0.3	4	2.7	22	14.4
Jambi	1	0.3	0	0.0	24	13.8	23	30.4
South Sumatera	0	0.0	2	1.6	23	10.9	28	18.7
Bengkulu	3	2.5	2	2.1	26	21.2	8	7.7
Lampung	0	0.0	1	0.3	19	8.7	21	15.8
Bangka Belitung	1	0.5	1	0.9	31	19.4	13	12.9
Riau Islands			0	0.0	50	32.1	24	18.4
JAVA								
Jakarta	2	0.9	1	0.2	35	13.6	12	5.7
West Java	0	0.0	1	0.4	62	20.3	110	17.4
Central Java	2	0.9	0	0.0	7	2.9	67	16.4
Yogyakarta	0	0.0	0	0.0	0	0.0	5	7.4
East Java	0	0.0	0	0.0	23	8.5	42	11.4
Banten	2	1.0	2	0.8	63	23.1	23	10.2
BALI AND NUSA TENGGARA								
Bali	0	0.0	0	0.0	37	23.1	1	1.1
West Nusa Tenggara	0	0.0	0	0.0	3	1.3	24	12.5
East Nusa Tenggara	0	0.0	2	0.8	11	5.5	22	5.6
KALIMANTAN								
West Kalimantan	0	0.0	3	1.8	31	13.5	23	20.0
Central Kalimantan	1	0.2	0	0.0	8	4.6	15	19.7
South Kalimantan	1	0.7	0	0.0	21	11.2	7	6.8
East Kalimantan	3	0.6	0	0.0	2	1.4	32	18.7
North Kalimantan							14	12.5
SULAWESI								
North Sulawesi	0	0.0	1	0.2	26	14.9	35	55.1
Central Sulawesi	1	0.1	0	0.0	9	4.3	9	5.0
South Sulawesi	0	0.0	0	0.0	28	11.0	40	16.2
Southeast Sulawesi	5	2.9	3	1.4	13	6.6	53	23.6
Gorontalo	0	0.0	0	0.0	23	15.2	9	9.6
West Sulawesi			1	0.6	16	7.7	22	9.2
MALUKU AND PAPUA								
Maluku			0	0.0	14	7.8	26	7.8
North Maluku			0	0.0	20	10.7	6	4.2
West Papua			2	0.5	16	7.5	2	2.3
Papua			1	0.7	25	14.3	3	1.9
Total	22	0.3	27	0.3	801	12.2	846	14.0

APPENDIX III CHAPTER 5: SENSITIVITY ANALYSES

Table III.1. Multivariable models from main analysis vs sensitivity analysis for any PLF 2002-2007

	2002		2007	
	Main	**Sensitivity**	**Main**	**Sensitivity**
Maternal demographic				
Wealth quintile				
Q1 (least affluent)	1	1	1	1
Q2	1.06 (0.94-1.20)	1.01 (0.87-1.16)	1.06 (0.97-1.16)	1.06 (0.97-1.16)
Q3	1.09 (0.97-1.23)	1.07 (0.95-1.22)	1.15 (1.06-1.25)	1.15 (1.06-1.25)
Q4	1.08 (0.94-1.25)	1.05 (0.91-1.22)	1.02 (0.92-1.14)	1.02 (0.92-1.14)
Q5 (most affluent)	1.29 (1.14-1.47)	1.28 (1.12-1.46)	1.13 (1.03-1.25)	1.13 (1.03-1.25)
Major islands group[a]				
Sumatera	1.31 (1.19-1.45)	1.35 (1.22-1.5)	1.09 (1.02-1.16)	1.08 (1.02-1.16)
Java	1	1	1	1
Bali-Nusa Tenggara	0.76 (0.65-0.89)	0.87 (0.72-1.05)	0.64 (0.55-0.74)	0.64 (0.55-0.74)
Kalimantan	1.21 (1.08-1.36)	1.24 (1.11-1.40)	1.04 (0.96-1.14)	1.04 (0.96-1.14)
Sulawesi	1.21 (1.07-1.38)	1.23 (1.07-1.42)	1.08 (0.99-1.17)	1.08 (0.99-1.17)
Maluku-Papua			0.83 (0.73-0.94)	0.83 (0.73-0.94)
Religion				
Islam		1		
Christianity		0.86 (0.75-0.99)		
Hinduism		0.71 (0.55-0.92)		
Buddhism, confucianism, others		1.02 (0.77-1.34)		
Birth-related factors				
Birth order				
First	1	1	1	1
Second/later	0.88 (0.82-0.94)	0.87 (0.81-0.93)	0.89 (0.84-0.93)	0.88 (0.84-0.93)
Birth size				
Larger				
Average				
Smaller				
Place-mode of birth				
Home	1	1	1	1
Public-vag	1.05 (0.89-1.26)	1.05 (0.87-1.25)	1.03 (0.94-1.13)	1.03 (0.94-1.13)
Public-cs	1.16 (0.92-1.48)	1.18 (0.92-1.51)	1.40 (1.30-1.50)	1.40 (1.30-1.50)
Private-vag	1.09 (0.98-1.22)	1.10 (0.97-1.23)	1.08 (1.00-1.17)	1.08 (1.00-1.17)
Private-cs	1.29 (1.11-1.51)	1.30 (1.11-1.53)	1.21 (1.08-1.35)	1.21 (1.08-1.35)
MCH book				
No			1	1
Yes			0.94 (0.88-1.00)	0.94 (0.88-1.00)

Public-vag: vaginal birth at public health facility; Public-cs: caesarean surgery birth at public health facility; Private-vag: vaginal birth at private health facility; Private-cs: caesarean surgery birth at private

Table III.2. Multivariable models from main analysis vs sensitivity analysis for prelacteal formula 2002-2007

	2002 Main	Sensitivity	2007 Main	Sensitivity
Maternal demographic				
Education				
None/primary			0.90 (0.82-0.98)	0.90 (0.83-0.99)
Secondary			1	1
Higher			1.02 (0.93-1.11)	1.03 (0.94-1.12)
Wealth quintile				
Q1 (least affluent)	1	1	1	1
Q2	1.45 (1.17-1.79)	1.31 (1.05-1.63)	1.32 (1.16-1.5)	1.26 (1.10-1.46)
Q3	1.64 (1.33-2.02)	1.52 (1.23-1.89)	1.57 (1.38-1.79)	1.51 (1.32-1.72)
Q4	1.77 (1.42-2.21)	1.61 (1.28-2.03)	1.37 (1.19-1.58)	1.32 (1.14-1.53)
Q5 (most affluent)	2.13 (1.76-2.58)	1.97 (1.62-2.41)	1.51 (1.3-1.74)	1.46 (1.26-1.68)
Major islands group[a]				
Sumatera	1.62 (1.41-1.86)	1.62 (1.41-1.86)	1.18 (1.09-1.27)	1.18 (1.1-1.28)
Java	1		1	
Bali-Nusa Tenggara	0.55 (0.44-0.7)	0.58 (0.46-0.73)	0.58 (0.48-0.69)	0.59 (0.5-0.71)
Kalimantan	1.63 (1.40-1.91)	1.56 (1.33-1.83)	1.20 (1.08-1.33)	1.20 (1.08-1.34)
Sulawesi	1.27 (1.03-1.58)	1.23 (0.97-1.56)	0.99 (0.89-1.11)	1.00 (0.89-1.12)
Maluku-Papua	NA	NA	0.73 (0.62-0.86)	0.77 (0.65-0.91)
Birth-related factors				
Birth order				
First	1		1	
Second/later	0.82 (0.75-0.9)	0.82 (0.75-0.9)	0.86 (0.8-0.92)	0.86 (0.81-0.92)
Place-mode of birth				
Home	1		1	
Public-vag	1.5 (1.22-1.85)	1.48 (1.19-1.84)	1.27 (1.13-1.43)	1.22 (1.08-1.38)
Public-cs	1.66 (1.26-2.18)	1.62 (1.23-2.15)	1.70 (1.55-1.86)	1.67 (1.52-1.83)
Private-vag	1.54 (1.31-1.8)	1.50 (1.28-1.77)	1.28 (1.16-1.41)	1.26 (1.14-1.39)
Private-cs	1.87 (1.55-2.26)	1.83 (1.51-2.21)	1.45 (1.27-1.66)	1.42 (1.23-1.62)

Public-vag: vaginal birth at public health facility; Public-cs: caesarean surgery birth at public health facility; Private-vag: vaginal birth at private health facility; Private-cs: caesarean surgery birth at private

Table III.3. Multivariable models from main analysis vs sensitivity analysis for prelacteal honey 2002-2007

	2002 Main	Sensitivity	2007 Main	Sensitivity
Maternal demographic				
Major islands group[a]				
Sumatera	1.39 (1.06-1.82)	1.46 (1.11-1.92)	0.95 (0.73-1.24)	0.99 (0.76-1.29)
Java	1	1	1	1
Bali-Nusa Tenggara	0.43 (0.26-0.70)	0.89 (0.55-1.46)	0.41 (0.26-0.63)	0.54 (0.33-0.89)
Kalimantan	0.89 (0.62-1.28)	1.1 (0.76-1.6)	0.55 (0.37-0.83)	0.63 (0.42-0.95)
Sulawesi	1.18 (0.86-1.61)	1.3 (0.92-1.82)	1.03 (0.78-1.35)	1.09 (0.82-1.44)
Maluku-Papua	na	na	0.47 (0.30-0.73)	0.58 (0.37-0.92)
Religion				
Islam		1		1
Christianity		0.28 (0.17-0.46)		0.60 (0.37-0.99)
Hinduism		0.02 (0.03-0.18)		0.40 (0.11-1.54)
Buddhism, confucianism, others		0.52 (0.1-2.78)		0.50 (0.06-4.08)
Birth-related factors				
Birth order				
First			1	
Second/later			0.77 (0.61-0.98)	0.95 (0.73-1.24)
Birth size				
Larger	1.17 (0.93-1.46)	1.22 (0.96-1.55)		
Average				
Smaller	1.40 (1.09-1.81)	1.5 (1.12-1.99)		
Place-mode of birth				
Home			1	
Public-vag	0.28 (0.15-0.52)	0.25 (0.13-0.48)	0.43 (0.29-0.64)	0.95 (0.73-1.24)
Public-cs	0.62 (0.20-1.93)	0.61 (0.17-2.25)	0.71 (0.33-1.55)	0.95 (0.73-1.24)
Private-vag	0.61 (0.44-0.85)	0.64 (0.45-0.90)	0.39 (0.27-0.57)	0.95 (0.73-1.24)
Private-cs	0.43 (0.15-1.22)	0.49 (0.16-1.47)	0.80 (0.44-1.48)	0.95 (0.73-1.24)
MCH book				
No			1	
Yes			0.73 (0.59-0.90)	0.95 (0.73-1.24)

Public-vag: vaginal birth at public health facility; Public-cs: caesarean surgery birth at public health facility; Private-vag: vaginal birth at private health facility; Private-cs: caesarean surgery birth at private

Table III.4. Multivariable models from main analysis vs sensitivity analysis for prelacteal water 2002-2007

	2002 Main	Sensitivity	2007 Main	Sensitivity
Maternal demographic				
15-19			1.17 (0.76-1.80)	1.20 (0.75-1.93)
20-24			1.25 (0.95-1.63)	1.25 (0.93-1.69)
25-29			1	
30-34			0.99 (0.74-1.31)	0.99 (0.73-1.36)
≥35			1.50 (1.16-1.95)	1.50 (1.12-2.01)
Education				
None/primary	1.4 (1.04-1.90)	1.41 (0.99-2.01)		
Secondary	1			
Higher	0.78 (0.43-1.40)	0.81 (0.44-1.49)		
Major islands group[a]				
Sumatera	1.24 (0.85-1.80)	1.17 (0.80-1.73)	1.53 (1.18-2.00)	1.42 (1.08-1.88)
Java	1		1	
Bali-NT	0.67 (0.42-1.06)	0.65 (0.38-1.09)	0.32 (0.20-0.50)	0.26 (0.16-0.44)
Kalimantan	1.37 (0.96-1.95)	1.15 (0.78-1.69)	0.92 (0.65-1.30)	0.83 (0.56-1.24)
Sulawesi	1.78 (1.25-2.52)	1.78 (1.20-2.64)	1.72 (1.31-2.27)	1.65 (1.22-2.23)
Maluku-Papua			0.67 (0.41-1.11)	0.53 (0.31-0.90)
Religion				
Islam				
Christianity		1.13 (0.71-1.80)		1.59 (1.27-1.99)
Hinduism		0.07 (0.01-0.50)		1.42 (0.77-2.62)
Buddhism, confucianism, others		2.32 (0.87-6.14)		NA
Place-mode of birth				
Home			1	
Public-vag			0.69 (0.48-0.98)	0.64 (0.45-0.91)
Public-cs			0.47 (0.14-1.53)	0.49 (0.16-1.50)
Private-vag			0.57 (0.42-0.76)	0.58 (0.42-0.79)
Private-cs			0.46 (0.21-1.02)	0.43 (0.2-0.94)

Public-vag: vaginal birth at public health facility; Public-cs: caesarean surgery birth at public health facility; Private-vag: vaginal birth at private health facility; Private-cs: caesarean surgery birth at private

Table III.5 summarised the final models in the 2017 IDHS where the new variable immediate skin-to-skin was included for all outcomes. This variable was not available in the earlier surveys. An interaction was also between wealth quintile and residence, so I ran the model with the interaction term. The modification did not change effect measure of other variables. Immediate skin-to-skin was found to be associated with lower prevalence of any PLF, formula, and honey. However, this association was not statistically significant for water.

Table III.5. Special table for 2017 IDHS: Factors associated with any PLF, formula, honey, and water (skin-to-skin variable is included)

	Any PLF	Formula	Honey	Water	Other milk
Demographic factors					
Wealth quintile*area of residence					
WQ in urban area	0.99 (0.95-1.04)	1.00 (0.94-1.06)	0.89 (0.75-1.05)	0.82 (0.68-0.98)	1.03 (0.94-1.13)
WQ in rural area	1.07 (1.03-1.11)	1.12 (1.06-1.19)	1.09 (0.95-1.25)	0.94 (0.81-1.1)	1.12 (1.03-1.23)
Major islands group[a]					
Sumatera	1.41 (1.29-1.54)	1.73 (1.51-1.98)	2.69 (1.74-4.15)	1.18 (0.8-1.74)	1.35 (1.11-1.64)
Java	1	1	1	1	1
Bali-NT	0.76 (0.64-0.89)	0.73 (0.56-0.95)	0.81 (0.43-1.51)	0.66 (0.41-1.08)	0.50 (0.34-0.73)
Kalimantan	1.24 (1.08-1.43)	1.25 (0.99-1.58)	2.18 (1.22-3.90)	1.73 (1.1-2.72)	1.34 (1.00-1.79)
Sulawesi	1.39 (1.27-1.53)	1.41 (1.20-1.66)	2.64 (1.69-4.14)	1.78 (1.17-2.71)	1.51 (1.22-1.85)
Maluku-Papua	0.84 (0.70-1.02)	0.95 (0.74-1.23)	0.63 (0.32-1.21)	0.55 (0.28-1.05)	0.39 (0.23-0.64)
Birth-related factors					
Birth order					
First	1	1	1	1	1
Second/later	0.81 (0.75-0.87)	0.75 (0.67-0.84)	0.58 (0.43-0.78)	0.61 (0.46-0.79)	0.76 (0.65-0.89)
Birth size					
Larger than average	1.04 (0.97-1.12)	1.09 (0.98-1.22)			1.07 (0.91-1.25)
Average	1	1			1
Smaller than average	1.20 (1.09-1.31)	1.23 (1.07-1.42)			1.37 (1.11-1.68)
Place and mode of delivery					
Home	1	1	1	1	1
Public-vag	0.96 (0.86-1.07)	1.04 (0.87-1.24)	0.44 (0.30-0.65)	0.56 (0.38-0.81)	1.23 (0.94-1.60)
Public-cs	1.29 (1.14-1.45)	1.65 (1.37-1.98)	0.38 (0.18-0.77)	0.62 (0.34-1.13)	2.21 (1.67-2.93)
Private-vag	1.02 (0.92-1.14)	1.21 (1.02-1.45)	0.25 (0.15-0.41)	0.58 (0.38-0.88)	1.39 (1.07-1.81)
Private-cs	1.16 (1.02-1.32)	1.43 (1.18-1.74)	0.11 (0.05-0.25)	0.51 (0.26-1.03)	1.73 (1.28-2.33)
Immediate skin-to-skin contact					
No	1	1	1		1
Yes	0.77 (0.72-0.83)	0.73 (0.65-0.81)	0.72 (0.53-0.97)		0.77 0.62-0.97)

APPENDIX IV CHAPTER 6: SENSITIVITY ANALYSES

Table IV.1. Hazard ratio (HR) and the 95% CI of breastfeeding cessation for any PLF and each type 2002-2017 from the main and sensitivity analyses

		2002 – adjusted HR (95% CI)		2007 – adjusted HR (95% CI)		2017 – adjusted HR (95% CI)	
		Main analysis	Sensitivity analysis	Main analysis	Sensitivity analysis	Main analysis	Sensitivity analysis
Any PLF	HR 0-23 mo	0.90 (0.70-1.16)	0.92 (0.71-1.21)	1.33 (1.11-1.61)	1.34 (1.10-1.63)	1.47 (1.28-1.69)	1.48 (1.29-1.69)
	*p-value**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	HR 0-6 mo	1.12 (0.72-1.75)	1.12 (0.72-1.75)	2.13 (1.55-2.92)	2.16 (1.56-3.00)	2.07 (1.74-2.47)	2.03 (1.71-2.42)
	HR 7-12 mo	0.85 (0.55-1.33)	0.82 (0.51-1.33)	0.76 (0.56-1.03)	0.72 (0.52-0.99)	0.79 (0.58-1.08)	0.82 (0.60-1.13)
	HR 13-23 mo	0.70 (0.48-1.01)	0.76 (0.51-1.15)	1.18 (0.83-1.67)	1.19 (0.82-1.72)	0.91 (0.68-1.21)	0.93 (0.70-1.24)
Formula	HR 0-23 mo	1.07 (0.80-1.44)	1.09 (0.80-1.49)	1.19 (0.99-1.43)	1.17 (0.96-1.41)	1.58 (1.36-1.84)	1.59 (1.37-1.85)
	p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	HR 0-6 mo	1.58 (0.99-2.50)	1.52 (0.95-2.42)	2.34 (1.73-3.16)	2.25 (1.66-3.07)	2.13 (1.78-2.53)	2.11 (1.76-2.51)
	HR 7-12 mo	1.03 (0.64-1.66)	1.09 (0.65-1.82)	0.72 (0.53-0.98)	0.71 (0.51-0.97)	0.73 (0.50-1.06)	0.77 (0.53-1.13)
	HR 13-23 mo	0.60 (0.39-0.91)	0.63 (0.40-0.98)	0.71 (0.50-1.00)	0.69 (0.48-0.98)	1.02 (0.73-1.41)	1.04 (0.75-1.44)
Honey	HR 0-23 mo	0.74 (0.55-1.01)	0.77 (0.54-1.08)	0.96 (0.71-1.30)	1.03 (0.75-1.40)	0.83 (0.57-1.22)	0.86 (0.59-1.27)
	p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	HR 0-6 mo	0.55 (0.31-0.99)	0.56 (0.29-1.06)	0.47 (0.27-0.81)	0.50 (0.29-0.87)	0.82 (0.52-1.31)	0.85 (0.54-1.36)
	HR 7-12 mo	0.37 (0.19-0.70)	0.34 (0.17-0.68)	1.20 (0.71-2.02)	1.25 (0.72-2.18)	1.02 (0.49-2.13)	1.03 (0.48-2.22)
	HR 13-23 mo	1.33 (0.86-2.06)	1.46 (0.90-2.36)	1.53 (0.92-2.54)	1.70 (1.01-2.88)	0.71 (0.32-1.61)	0.75 (0.33-1.70)
Water	HR 0-23 mo	1.01 (0.72-1.42)	1.01 (0.69-1.46)	0.97 (0.72-1.30)	1.01 (0.74-1.38)	1.05 (0.76-1.45)	1.06 (0.77-1.47)
	p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	HR 0-6 mo	0.79 (0.39-1.62)	0.81 (0.38-1.74)	0.67 (0.41-1.09)	0.67 (0.40-1.11)	1.28 (0.89-1.84)	1.29 (0.90-1.86)
	HR 7-12 mo	0.84 (0.45-1.55)	0.64 (0.30-1.33)	1.10 (0.65-1.85)	1.15 (0.66-1.99)	0.67 (0.29-1.55)	0.70 (0.30-1.63)
	HR 13-23 mo	1.37 (0.83-2.24)	1.50 (0.89-2.52)	1.31 (0.78-2.22)	1.48 (0.85-2.57)	0.78 (0.39-1.55)	0.77 (0.39-1.54)
Other Milk	HR 0-23 mo	The prevalence of 'other milk' was too low in these study years for meaningful analysis to be conducted.				1.46 (1.21-1.76)	1.43 (1.18-1.73)
	p-value					<0.001	<0.001
	HR 0-6 mo					1.73 (1.39-2.15)	1.68 (1.35-2.09)
	HR 7-12 mo					1.32 (0.85-2.06)	1.32 (0.84-2.07)
	13-23					0.93 (0.60-1.46)	0.93 (0.59-1.46)

Sensitivity analyses 2002-2007: adjusted for covariables as in the main analyses plus religion and MCH book. **Sensitivity analysis 2017**: adjusted for covariables as in the main analysis plus immediate skin-to-skin contact.

APPENDIX V CHAPTER 7: SENSITIVITY ANALYSIS

Table V.1. Sensitivity analysis of the association between PLF and current EBF

		Sensitivity 1	Sensitivity 2
PLF	2007	0.79 (0.64-0.98)	0.86 (0.68-1.08)
	2012	0.60 (0.49-0.73)	0.64 (0.53-0.77)
	2017	0.66 (0.56-0.78)	0.68 (0.59-0.78)
Formula	2007	0.70 (0.56-0.88)	0.74 (0.57-0.95)
	2012	0.67 (0.54-0.83)	0.71 (0.58-0.87)
	2017	0.59 (0.48-0.72)	0.61 (0.51-0.73)
Honey	2007	0.99 (0.69-1.41)	1.06 (0.74-1.51)
	2012	0.44 (0.23-0.86)	0.50 (0.28-0.86)
	2017	1.48 (1.10-2.00)	1.26 (1.00-1.60)
Water	2007	0.81 (0.55-1.20)	0.84 (0.57-1.23)
	2012	0.63 (0.33-1.18)	0.55 (0.34-0.89)
	2017	0.64 (0.39-1.06)	0.70 (0.46-1.07)
Other milk	2007	*	*
	2012	0.55 (0.35-0.86)	0.59 (0.43-0.81)
	2017	0.73 (0.56-0.96)	0.72 (0.58-0.90)

Adjusted PRs were PRs after controlling for maternal demographic and child-and birth related variables. PR<1 (blue font) indicates that PLF is associated with a lower prevalence of current EBF status.

Sensitivity 1 model:

- In 2007 and 2012: adding religion and MCH book in the multivariable model as presented in the main analysis.
- In 2017: adding immediate skin-to-skin contact in the multivariable model as presented in the main analysis.

Sensitivity 2 model:

- For all years: adjusting for all confounders in sensitivity analysis and excluding child's age '0 month'.

APPENDIX VI CHAPTER 8: Ethics approval and qualitative study interview documents

Oxford Tropical Research Ethics Committee

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Dr. Lhuri Dwianti Rahmartani
National Perinatal Epidemiology Unit (NPEU)
Nuffield Department of Population Health
University of Oxford
Old Road Campus
Oxford
OX3 7LF

19 May 2021

Dear Dr. Rahmartani,

Full Title of Study: Experience of prelacteal feeding practice in Indonesia from the perspectives of health professionals: a qualitative study

OxTREC Reference: 505-21

Thank you for your letter of the 6 May 2021 requesting an amendment to the above study. The revised documents that you have submitted for consideration are as follows:

Documentation:	Version:	Date:
Minimal risk application form	V2.0	06/05/21
PIS	V2.0	06/05/21

I am pleased to inform you that this amendment has been approved.

Yours sincerely,

Ms. Sami Kelsh
Research Ethics Administrator, OxTREC

UNIVERSITAS INDONESIA
FAKULTAS KESEHATAN MASYARAKAT

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KOMISI ETIK RISET DAN PENGABDIAN KESEHATAN MASYARAKAT
FAKULTAS KESEHATAN MASYARAKAT UNIVERSITAS INDONESIA
THE RESEARCH AND COMMUNITY ENGAGEMENT ETHICAL COMMITTEE
FACULTY OF PUBLIC HEALTH UNIVERSITAS INDONESIA

SURAT KETERANGAN

ETHICAL APPROVAL
Nomor: Ket- 37/UN2.F10.D11/PPM.00.02/2021

Komisi Etik Riset dan Pengabdian Kesehatan Masyarakat Fakultas Kesehatan Masyarakat Universitas Indonesia, menyatakan dengan ini bahwa penelitian dengan judul :
The Research and Community Engagement Ethical Committee of Faculty of Public Health Universitas Indonesia states hereby that the following proposal:

Pengalaman terkait praktik pemberian makanan pralaktasi dari perspektif tenaga kesehatan: sebuah studi kualitatif

Experience of prelacteal feeding practice in Indonesia from the perspectives of health professionals: a qualitative study

Lokasi Penelitian *Location*	: Sumatera, Jawa, Kalimantan, Sulawesi, Bali, Nusa Tenggara, Maluku, Papua
Waktu Penelitian *Time schedule*	: 25 Februari 2021 – 25 Februari 2022 25 February 2021 – 25 February 2022
Responden/Subyek Penelitian *Respondent/Research Subject*	: Dokter, bidan, dan konselor laktasi Doctor, midwives, lactation counselors
Peneliti Utama *Principal Investigator*	: **Lhuri Dwianti Rahmartani**

Telah melalui prosedur kaji etik dan dinyatakan layak untuk dilaksanakan
Has proceeded the ethical assessment procedure and been approvedfor the implementation

Demikianlah surat keterangan lolos kaji etik ini dibuat untuk diketahui dan dimaklumi oleh yang berkepentingan dan berlaku sejak tanggal 26 Februari 2021 sampai dengan 26 Februari 2022
This ethical approval is issued to be used appropriately and understood by all stakeholders and valid from 26 February 2021 until 26 February 2022

26 February 2021
Chairman,

Prof. Dr. dr. Ratna Djuwita, MPH NIP195007251980032001

TOPIC GUIDE FOR IN-DEPTH INTERVIEW

Version 1

Topic area	Narratives	Probe questions
1. Background profile	- Please tell me about your career and current work	- How long have you been working in the area of maternal and child health, especially infant feeding? - Training or educational background? - Where do you work? - Which community you are working with? - Community or hospital/health facility setting?
2. Knowledge about PLF	- What do you know about PLF?	- Have you ever heard about PLF? - There are some definitions of PLF…. E.g…
3. Attitude towards PLF	- Please tell me what you think about PLF	- Are there situations where you think PLF is acceptable/necessary? (check if they mention certain medical conditions) - Do you see/think there's a negative effect of PLF? - Check if they mention duration, exclusivity, colostrum, cost, infection)
4. Practice of PLF/experience with PLF	- Could you share your experience about PLF practice among the mothers and families you support?	- Have you ever advised new mothers to give their babies any food or drink in the first few days of life? - If yes, what did you suggest and why was this needed? - When you are working with mothers, have you seen or been told that breastfed babies have been given anything other than breastmilk in the first few days? - If yes, what are they given, and do you know why women chose to give these? - When women tell you that they have given different foods or drinks, what do you tell them? - How does it impact on the mothers/babies/breastfeeding? - How do the mothers, families, providers behave towards this practice? - Do you see any good or bad effects of giving these types of early feeds? - Where do mothers get information about giving other foods and drinks before they start breastfeeding? For example, does it come from friends or family, or from their health care providers?
5. Changes in PLF trends	- How would you describe and compare PLF practice between now and when you first started practicing?	- Do you think mothers' attitudes and behaviours around using other feeds in the first few days has changed over the years? If so, what has changed? - How is PLF practice now different than before? - Is there difference in choice of types? - What do you think about the changes?

		- Are there any changes in characteristics of mothers/society/community/culture/health care system over time?
6. Policy affecting PLF practice	- Could you tell me about policies and rules in Indonesia regarding infant feeding, particularly breastfeeding?	- How does the policies related to infant feeding impact on breastfeeding practice? - Is there any rules/algorithm at the health facilities on PLF practice? - What procedure that have been applied in health facilities? - How does BF law impact on PLF practice? - How is the role of formula industry?
7. Expectation and suggestions from health professionals	- In your opinion, what should we do about PLF and breastfeeding in general?	- What can we do as health professionals to deal with PLF practice? - How can we help to improve optimal breastfeeding? - Do you have other things to convey about PLF practice?