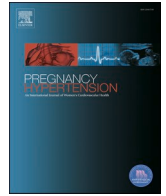




Contents lists available at ScienceDirect

# Pregnancy Hypertension: An International Journal of Women's Cardiovascular Health

journal homepage: [www.elsevier.com/locate/preghy](http://www.elsevier.com/locate/preghy)

## Perceptions and experiences of blood pressure self-monitoring during hypertensive pregnancy: A qualitative analysis of women's and clinicians' experiences in the OPTIMUM-BP trial

L. Pealing<sup>a</sup>, K.L. Tucker<sup>a,\*</sup>, B. Fletcher<sup>a</sup>, E. Lawley<sup>a</sup>, L.C. Chappell<sup>b</sup>, R.J. McManus<sup>a</sup>, S. Ziebland<sup>a</sup>

<sup>a</sup> Nuffield Department of Primary Care Health Sciences, University of Oxford OX2 6GG, UK

<sup>b</sup> Department of Women and Children's Health, School of Life Course Sciences, King's College London, London SE1 7EH, UK

### ARTICLE INFO

#### Keywords:

Pregnancy  
Hypertension  
Self-monitoring  
Blood pressure  
Qualitative  
Ethnography

### ABSTRACT

**Background:** Self-monitoring of blood pressure (BP) has been shown to be effective at improving BP control in the general population. The OPTIMUM-BP feasibility study was a prospective randomised controlled trial of self-monitoring of BP (SMBP) during hypertensive pregnancy.

**Objective:** To explore experiences, perceptions, and use of the OPTIMUM-BP self-monitoring intervention. Study design.

Qualitative study within the OPTIMUM-BP feasibility trial. Semi-structured interviews with a purposive sample of pregnant women with chronic hypertension ( $n = 24$ ) and their clinicians ( $n = 8$ ) as well as 38 ethnographic observations of antenatal visits.

**Results:** Women found self-monitoring of BP feasible and acceptable and were highly motivated and pro-active in their monitoring, reporting greater control and knowledge of BP and reassurance. Women's persistence with SMBP was driven by a perceived need to safeguard the pregnancy, particularly among those taking antihypertensive medication. Clinicians also described the intervention as acceptable, though BP variability could cause uncertainty. Clinicians used different heuristics to integrate home and clinic readings. Observations suggested close working relationships between women and clinicians were key for confident integration of self-monitoring.

**Conclusions:** Self-monitoring of BP was acceptable both to pregnant women with hypertension and their clinicians. More research is needed to understand BP variability within pregnancy to help interpret and integrate home BP readings for improved BP management. Clinical pathways that use BP self-monitoring should aim to maintain the continuity of care and relationships that are valued and appear pivotal for the confident and safe use of self-monitoring in pregnancy.

### 1. Introduction

Hypertensive disorders of pregnancy are common, complicating about one in ten pregnancies and are associated with substantial maternal and perinatal morbidity and mortality[1,2]. In the general population, self-monitoring of blood pressure (BP) has been shown to reduce blood pressure,[3] improve adherence to antihypertensive medication,[4] and reduce consultation rates at no additional cost.[5] Furthermore compared to clinic readings, self-monitoring provides a better estimate of underlying BP [6].

Self-monitoring of BP (SMBP) during pregnancy could improve BP

control and detect problems sooner. The OPTIMUM-BP trial examined the feasibility and acceptability of blood pressure self-monitoring by pregnant women with hypertension.[7] Here we describe the qualitative work completed within this trial which aimed to explore the acceptability of the intervention and how it was perceived and used by pregnant women and their clinicians.

This qualitative research used observations in clinics and interviews with women and their antenatal health care teams, to identify any complexities and challenges in undertaking and using SMBP readings during hypertensive pregnancy.

\* Corresponding author at: Department of Primary Health Care Sciences, New Radcliffe House, Woodstock Rd, Oxford OX2 6GG, UK.

E-mail address: [katherine.tucker@phc.ox.ac.uk](mailto:katherine.tucker@phc.ox.ac.uk) (K.L. Tucker).

<https://doi.org/10.1016/j.preghy.2022.09.006>

Received 5 April 2022; Received in revised form 12 September 2022; Accepted 15 September 2022

Available online 20 September 2022

2210-7789/© 2022 The Authors. Published by Elsevier B.V. on behalf of International Society for the Study of Hypertension in Pregnancy. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

## 2. The OPTIMUM-BP trial

The results of OPTIMUM-BP have been reported elsewhere (7). In brief, this was a mixed-methods randomised-controlled feasibility study of SMBP in the management of hypertensive pregnancy.[7] OPTIMUM-BP included women aged  $\geq 18$  years with a singleton pregnancy and chronic hypertension, without preeclampsia. Women were recruited from three UK maternity centres: Guy's and St Thomas' NHS Foundation Trust, Oxford University Hospitals NHS Foundation Trust and The Royal Wolverhampton NHS Trust. The women monitored their BP daily, using a traffic light system defined along BP thresholds to advise women when to make contact with clinical services. Clinicians were invited to use the home readings to help inform clinical and antihypertensive titration decisions.[7] There is no guidance around the use of SMBP in pregnancy within the NICE guidelines. The primary outcomes of the trial were around feasibility (recruitment, retention, adherence and persistence with the intervention) and the study suggested that a full RCT would be feasible.

## 3. Methods

### 3.1. Study design

We used a qualitative design to explore perspectives of the SMBP intervention among the women and clinicians participating in OPTIMUM-BP. A clinical researcher (LP) who has been trained in qualitative methods conducted semi-structured interviews with pregnant women and clinicians and ethnographic observations, in the three maternity clinic.[8] The interviews with women were conducted in their homes allowing them to demonstrate in situ how they enacted self-monitoring. Observations took place at 38 clinics (36 antenatal clinics and two maternity assessment clinics) between December 2015 to May 2017 and included 41 women who participated in OPTIMUM-BP (some over several encounters), and nine clinicians.

### 3.2. Sample

All the women who participated were involved in the OPTIMUM feasibility trial, and all clinicians were involved in the antenatal care of these women. Interviews were completed with 24 OPTIMUM-BP participants (19 of whom were in the intervention group) at one of the three NHS Trusts involved. Ethnographic observations and interviews were selected initially by convenience and then targeted to gain diversity in terms of age, parity, ethnicity, education level and Index of Multiple Deprivation (IMD) level (see Table 1).[9] Formal, recorded interviews were conducted with eight clinicians (Table 2) and 38 consultations were observed. In total 48 women were involved in the study (56 % of the 86 women with chronic hypertension that took part in the OPTIMUM trial).

We developed a topic guide based on our knowledge of the literature of SMBP together with input from the study team experienced in pregnancy hypertension. As new or unexpected topics arose, further observations and targeted interviews were sought to explore these further. Interviews and observations continued until we assessed that saturation on the main analytic categories was reached.

### 3.3. Data preparation and Analysis

Interviews were audio-recorded and transcribed verbatim, and field-notes were written during or immediately after the clinic. Data were analysed using an abductive process, exploring both anticipated and new themes using constant comparison. Interview transcripts and field notes were entered into NVivo v.12 software which was used to store and retrieve coded sections of the transcripts in preparation for analysis. A mind mapping approach, known as the one sheet of paper method (OSOP) was used to explore the coded data.[10].

## 4. Results

Key themes related to experiences of the self-monitoring intervention were: 1) acceptability of SMBP to women and clinicians, 2) use of SMBP by women and clinicians, 3) the importance of clinical relationships. These themes are described below with extracts (in boxes 1–3) from interviews with participants (PQ) and their clinicians (CQ) and field notes (FN) from observations.

### 4.1. Acceptability of SMBP to women and clinicians

Women who took part in the OPTIMUM trial, including those randomised to the usual care group, were often keen to self-monitor their BP and this attracted many to join the study. Those who perceived their pregnancies to be at increased risk due to hypertension and previous obstetric experiences, hoped that SMBP would reduce risks in their current pregnancy (See Box 1, PQ1).

Mostly, women were very positive about their experiences of SMBP and expressed a preference for self-monitoring over solely clinic BP measurement, with reasons including convenience, reassurance, a sense of control and the hope that it would lead to more valid measurements (PQ2). When the study was conceived, some clinicians had voiced concerns that self-monitoring or high readings may provoke anxiety. However, most accounts from pregnant women were positive, with many describing that they felt reassured and “*more calm*” measuring their BP at home (PQ3 and 4); in contrast, some women described heightened anxiety when BP was monitored in clinic (PQ5).

The word ‘control’ peppered most women’s accounts. These included practicalities of the circumstances and timing of their home BP readings together with the sense of control through increased awareness and knowledge. Some women also observed a shift in the clinician-patient relationship (PQ6). The value placed on being “in control” was evidenced by some women’s annoyance if they perceived control had been removed, for example when clinicians took clinic readings (and acted solely on these) or if home readings appeared to be overlooked (PQ7).

Women said that SMBP gave them improved knowledge of their own BP and health, particularly in the context of interpreting any symptoms (PQ8). Self-monitoring could also increase awareness of the variability of BP (PQ9). This awareness motivated women to self-monitor so they could keep track of any changes. Many women were surprised to find that their BP could vary considerably, and not always as they had expected (PQ10). This variability contributed to some scepticism about their clinic readings and the suspicion that home readings were more accurate and should trump the clinic readings.

The acceptability of SMBP was further borne out by several women continuing to monitor postnatally, as evidenced by their monitor downloads and accounts. When asked about their BP monitoring preferences for any future pregnancies: *all* women interviewed from the intervention group said they would choose to self-monitor in any future pregnancies. One woman from the usual care group said she would not plan to use SMBP; she had not needed antihypertensive medication and felt the clinic readings were sufficiently frequent. Several women stressed their preference for *both* home and clinic monitoring in any future pregnancy (PQ11).

Clinicians reported that the intervention was readily adopted and that women wanted to share and discuss their readings. *All* of the eight clinicians interviewed said that it was desirable to engage women in their own care, and that self-monitoring could also support more open discussion about BP and its management (CQ1). Clinicians did not perceive a change in their workload (CQ2) and some said they were used to incorporating patient self-monitoring when managing gestational diabetes.

Clinicians were reassured that in this study women were trained to use monitors that had been validated in pregnancy and advised when to seek care. However, some worried that women might be falsely reassured by ‘normal’ home readings and therefore ignore important

**Table 1**

Characteristics of pregnant women and clinicians included in the observations\* and formal interviews.

Identifier	Age (years)	SMBP/UC	Ethnicity	IMD	Educational qualification	Primip	AHTs	Brief clinical history	Observed	Formal interview
1	45–50	SMBP	Asian	2	Degree	Yes	Yes	Delivered early Pre-eclampsia (HELLP)	X	✓
2	35–39	SMBP	Black Caribbean	1	GCSE	No	No	First pregnancy Delivered early	X	✓
3	30–34	UC (own SMBP)	White British	3	A-Level	No	Yes	First pregnancy Postnatal hypertension	X	✓
4	30–34	SMBP	White other	3	Professional	Yes	Yes	Delivered early	X	✓
5	35–39	UC	Black Caribbean	2	A-Level	No	Yes	Previous hypertensive pregnancy gestational diabetes	✓	✓
6	30–34	SMBP	Black African	2	A-Level	No	Yes	Pre-eclampsia in previous pregnancy	✓	✓
7	30–34	SMBP	White other	1	Degree	No	No	Pre-eclampsia in previous pregnancy	✓	✓
8	40–44	SMBP	Black African	2	GCSE	No	Yes	Previous hypertensive pregnancy early delivery	✓	✓
9	35–39	SMBP	White other	4	Degree	Yes	Yes	Long-standing chronic hypertension	✓	✓
10	30–34	SMBP	Black African	1	Degree	No	Yes	Fourth pregnancy gestational diabetes long term hypertension	✓	✓
11	30–34	SMBP	White British	4	Vocational	No	Yes	Previous pre-eclampsia (IUGR) Gestational diabetes	✓	✓
12	30–34	UC	White British	4	Degree	No	Yes	Previous hypertensive pregnancy IUGR Gestational diabetes	X	✓
13	30–34	SMBP	White British	5	Professional	No	Yes	Hypertension in previous pregnancy	X	✓
14	40–44	SMBP	Asian	4	Postgrad	Yes	Yes	Recurrent early miscarriages Long-term hypertension	X	✓
15	30–34	SMBP	White British	4	Vocational	No	Yes	Pre-eclampsia in previous pregnancy, background of other illness/ disease	✓	✓
16	25–29	UC	White British	3	A-Level	No	No	Fourth pregnancy previous pre-eclampsia	✓	✓
17	35–39	UC (own SMBP)	White other	1	Postgrad	No	Yes	Previous pregnancy hypertension	✓	✓
18	40–44	SMBP	White other	4	Postgrad	Yes	Yes	Pre-eclampsia (IUGR)	✓	✓
19	40–44	SMBP	White British	1	Postgrad	No	Yes	Pre-eclampsia in previous pregnancy Delivered early	✓	✓
20	40–44	SMBP	Black African	3	A-Level	No	Yes	Previous stillbirth, Longstanding chronic hypertension Gestational diabetes	✓	✓
21	40–44	SMBP	Black Caribbean	1	Degree	No	Yes	Fourth pregnancy Longstanding chronic hypertension	✓	✓
22	30–34	SMBP	White other	1	Degree	Yes	Yes	Longstanding chronic hypertension delivered early pre-eclampsia	✓	✓
23	30–34	SMBP	White British	1	GCSE	No	Yes	Second pregnancy Longstanding chronic hypertension	✓	✓
24	30–34	SMBP	White British	1	Degree	Yes	Yes	Longstanding chronic hypertension family history of pre-eclampsia	✓	✓
25	35–39	SMBP	White British	3	Degree	No	Yes	Longstanding chronic hypertension	✓	X
26	35–39	SMBP	Black African	2	Vocational	No	Yes	Previous pre-eclampsia, early delivery	✓	X
27	40–44	SMBP	White other	4	Postgrad	Yes	No	Longstanding chronic hypertension previous SMBP	✓	X
28	30–34	SMBP	White British	1	A-Level	No	Yes	Second pregnancy, Longstanding chronic hypertension	✓	X
29	35–39	SMBP	Asian	5	Postgrad	Yes	Yes	Longstanding chronic hypertension, not needing treatment previously	✓	X
30	35–39	SMBP	Black Caribbean	1	GCSE	No	Yes	Third pregnancy, pre-eclampsia in previous pregnancy	✓	X
31	40–44	UC (own SMBP)	White other	2	Degree	No	Yes	Second pregnancy, Hypertension in previous pregnancy	✓	X
32	35–39	UC	White British	3	Vocational	No	Yes	Second pregnancy, longstanding chronic hypertension	✓	X
33	40–44	UC	Black Caribbean	2	A-Level	No	Yes	Third pregnancy, Background of previous illness/disease	✓	X
34	25–29	UC	White British	1	GCSE	Yes	No	Previous recurrent miscarriage, untreated chronic hypertension	✓	X

(continued on next page)

Table 1 (continued)

Identifier	Age (years)	SMBP/UC	Ethnicity	IMD	Educational qualification	Primip	AHTs	Brief clinical history	Observed	Formal interview
35	30–34	SMBP	Black African	1	Vocational	No	Yes	Previous pre-eclampsia, longstanding chronic hypertension	✓	X
36	30–34	UC	Black Caribbean	2	A-Level	No	Yes	Hypertension in previous pregnancy	✓	X
37	25–29	SMBP	White British	2	Vocational	No	Yes	Early delivery	✓	X
38	35–39	SMBP	White other	3	Degree	No	Yes	Previous pre-eclampsia, Longstanding chronic hypertension	✓	X
39	35–39	SMBP	White British	4	Postgrad	No	Yes	Hypertension in previous pregnancy	✓	X
40	45–50	UC	White other	2	A-Level	No	Yes	pre-eclampsia	✓	X
41	20–24	SMBP	White British	2	Degree	Yes	Yes	Third pregnancy, Hypertension in previous pregnancy	✓	X
42	30–34	SMBP	Black Caribbean	1	A-Level	No	Yes	Longstanding chronic hypertension	✓	X
43	40–44	SMBP	White British	4	Degree	No	Yes	Third pregnancy, recent diagnosis of chronic hypertension	✓	X
44	35–39	SMBP	Black African	3	Vocational	No	Yes	Fourth pregnancy, previous postnatal admissions for high BP	✓	X
45	30–34	SMBP	White British	1	GCSE	No	Yes	Second pregnancy, Recent diagnosis of chronic hypertension	✓	X
46	25–29	SMBP	White British	1	GCSE	No	Yes	Third pregnancy, Hypertension in previous pregnancy	✓	X
47	30–34	UC (own SMBP)	Asian	3	Degree	No	Yes	Second pregnancy, Hypertension in previous pregnancy	✓	X
48	25–29	SMBP	White other	2	A-Level	Yes	No	Third pregnancy, recent diagnosis of chronic hypertension	✓	X
								First pregnancy, longstanding chronic hypertension	✓	X

SMBP: self-monitoring blood pressure; UC: usual care; IMD: index of multiple deprivation quintile using Office of National Statistics for England data, 1 = most deprived; primiparous: delivered only one child (index pregnancy in the study); AHTs: required antihypertensive treatment(s) in index pregnancy.

Table 2

Characteristics of clinicians included in the observations and formal interviews.

Clinicians	Role
001	Midwife
002	Doctor
003	Midwife
004	Doctor
005	Doctor
006	Doctor
007	Doctor
008	Midwife
009	Doctor

symptoms. There was no evidence of this in our findings.

#### 4.2. How women and clinicians used the SMBP

Trial data showed that many women took additional readings to the once-a-day measurements they were requested to complete. In their interviews women described using SMBP proactively and often, to aid self-knowledge and self-care (PQ12). Self-monitoring was frequently reported as providing reassurance and confidence in interpreting bodily sensations that could seem altered during pregnancy (PQ13).

Some women described an almost constant vigilance during their pregnancy (PQ14). They reported using their home readings to monitor the impact of daily activities and ameliorative measures such as resting more, avoiding stressful situations, or (where feasible) starting maternity leave earlier. Several women told us that they experimented by taking their measurements at different times of day, before or after medication or clinic visits, as they sought to understand their BP better. Home readings could reassure women that their blood pressure

medication was working and beneficial (PQ15). A few women reported varying or limiting their medication use if their home readings appeared within target (PQ16). Some said they had attempted to recreate conditions that they believed had given them the “best” (lower) BP readings, or reported using repeated measurements, a practice they had seen in the clinic (PQ17).

A few women gave accounts of quite elaborate measuring routines, to fit SMBP into busy schedules juggling work and young families and challenging domestic circumstances (PQ18). Most women said it “became a habit” and they were able to incorporate measurements into their daily lives, usually first thing in the morning or last thing at night when they were less likely to be interrupted and near their monitors. Women set up reminders and often placed the monitor in a convenient and prominent place which would prompt them to measure while relaxing.

Women who reported forgetting to take their BP, tended to be those not taking medication, suggesting the activities might reinforce each other, and perhaps that those taking medication were more worried about their BP. Awareness that high BP also put their baby at risk was highly motivating (PQ19–20). BP monitoring appeared to be “less of an issue” for those whose BP had remained stable and within range throughout the pregnancy and had not required medication.

#### 4.3. Using the trial monitor and reporting system

Women reported finding it “very simple” to learn how to measure their BP. The majority also described the traffic light system instructions regarding BP thresholds as “simple, straight forward”, although a couple of women said the system took time to work out and could be burdensome. One clinician suggested there were occasional misunderstandings about how to record measurements within the different categories (such as normal or raised) (CQ3). Some women recorded readings in their

**Quotes Section 1: acceptability of SMBP to women and clinicians**

PQ1 *"I was very keen to monitor every day, if this was possible. ... I really wanted to try to keep this pregnancy safe."* (Participant 7 interview: pre-eclampsia in previous pregnancy with early delivery)

PQ2 *"I preferred being able to do it at home. Because it felt like there is something I can control... I can keep an eye on what's happening. So I'm not dependent on the snapshot moment where someone takes my blood pressure in clinic and it might be high, and when I know it's normal at home."* (Participant 16 interview: second pregnancy with chronic hypertension, usual care group and started her own SMBP)

PQ3 *"I mean, I'm a constant worrier... But I think being able to check on things myself at home made me worry much less. Yeah, it definitely helped me I think...be more calm."* (Participant 2 interview: previous pregnancy complicated by prematurity)

PQ4 *"I was less on edge all the time being able to take back this tiny bit of control."* (Participant 17 interview: high BP previous pregnancy)

PQ5 *"...whereas I'm going there (clinic) and I'm thinking like 'oh no, I hope it's going to be good, I hope it's going to be good'. Kind of that feeling like, 'I hope it's not going to be high...' Sort of worried..."* (Participant 9 interview: first pregnancy, friend with pre-eclampsia)

PQ6 *"But I was in control. I would go and see the doctor, report to them that after all it's [the BP] been stable. It's fine, I have no questions. I have the knowledge."* (Participant 4 interview: first pregnancy, SMBP previous to pregnancy)

PQ7 *"I felt that if I wanted to do the reading it should have been my choice as such. I felt like I wasn't in charge anymore..."* (Participant 2 interview: previous pregnancy complicated with prematurity)

PQ8 *"I would have been feeling 'Oh, I'm feeling this, I'm feeling that...let me just go and check'. I would have been going in too much to the hospital without the monitor."* (Participant 20: third pregnancy and previous intrauterine death).

PQ9 *"I got to really know more about blood pressure this way..... It really helps me if I have an understanding of my own blood pressure and why it changes, and that it fluctuates quite a bit during the day. I became quite the expert about me!"* (Participant 24 interview: previous pregnancy with gestational hypertension)

PQ10 *"But then I was quite surprised...I know from taking it at different times of the day in all sorts of situations, it varies a lot...So how - how do you get a true representation of whether the blood pressure is overall high, and you're not just managing it at the peak points like in clinic? I'm just not sure about it."* (Participant 19 interview: previous pregnancy complicated with high BP)

PQ11 *"I would say both [home and clinic monitoring] because obviously you have to get it checked at [um]...with the medical people you know, that's very important. But I personally, that's when I was doing it myself, preferred that way."* (Participant 23 interview: second pregnancy, first with hypertension)

CQ1 *"I think it really helped with engagement and empowerment, and shared decision making. Because the women had bought in to the whole self-monitoring...I would just present them [home readings] as additional useful bits of information that would help us to make treatment decisions together."* (Clinician interview 002)

CQ2 *"So I didn't notice any particular change in the dynamic or time. Other than it was just an extra bit of information I got from them."* (Clinician interview 007)

**Quotes Section 2: how women and clinicians used the trial SMBP**

PQ12 *"I wasn't just taking my blood pressure; I was actually noting it down and thinking generally more about my pressure and about more of how I felt. [um] So, I think it helped me; it helped me a lot, to be more pro-active in looking after myself – pregnancy and baby."* (Participant 1 interview: first pregnancy)

PQ13 *"I'd forgotten from the last time how different things feel when you're pregnant. Because if I didn't have the monitor, sometimes I used to feel.. 'Oh, maybe it's my blood pressure, maybe something's wrong'. So it was good for me to be able to just check (the BP), with the monitor it helped me to know what the body is doing..."* (Participant 7 interview: pre-eclampsia in previous pregnancy)

PQ14 *"I was always worried something might be wrong....and counting kicks and checking things were OK with the baby"* (Participant 9 interview: first pregnancy, friend with pre-eclampsia)

PQ15 *"But I can see it's [labetalol] worked, really. That when I'm checking every day this blood pressure that I knew that [um] this medication is working good for me now. That I'm doing something good for my baby."* (Participant 21 informal interview: did not require antihypertensives in previous pregnancies)

PQ16 *"But at times when maybe I've not taken the medication, and I check [home BP]. And it's, it's low. As in it's normal. I will not just want to take it. Because I would see that it's normal that time, so I wouldn't want to. I would maybe skip that particular medicine and wait until I see it's [BP] high again."* (Participant 8 interview: previous pregnancies without requiring antihypertensives and also stopped her rheumatoid arthritis medications in current pregnancy)

PQ17 *"I got to learn that if I didn't sleep enough, my pressure was higher. So when I was much more tired too after work as well, even taking it after medicine was not helping. I found the best time for me to get my best readings was to take it in the evening when I had that bit of time in front of the telly."* (Participant 8 interview: early delivery previous pregnancy due to high BP)

PQ18 *"It was when I, [er] all the time wake up. Between half past five, quarter six. When I wake up, go to toilet, and stay sit down for ten minutes to give body chance and check. It was in bathroom so to not get my husband up...Everything..it is ready on the bin..[laughing] and extra pen as he took them. After when I wake up, take my medication, sit in there and after that I check when ready."* (Participant 22 informal interview: first pregnancy, living in one bedroom hostel)

PQ19 *"I think once you got into the habit of it, doing it every day, after a week, it was just sort of like natural. Just a natural thing to do. I definitely got into a habit more after I started the tablets. Then it was like, it's important I get this right. It's for me and my baby and it's very important to get the right level of treatment."* (Participant 21 interview: previous pregnancies did not require antihypertensive treatment)

PQ20 *"It's because it's going to be for your health. And the baby of course. Probably this is [laugh] the main driving force. Yeah, even more diligent, because it was not just for me, but also for the baby."* (Participant 18 interview: previous pregnancy, needed early delivery with pre-eclampsia)

CQ3 *"Sometimes...the blood pressure wasn't in the box that you'd expect"* (Clinician 003 interview)

**Boxes 1–3. (continued).**



**Quotes Section2: continued.....**

FN1 *"Right. Yes, I can see there's been a few weeks now where this bottom figure is sitting in the 90s. There's a slow upward trend isn't there. And we might expect it to continue to creep up over the coming weeks."* (Field note: antenatal clinic with clinician 006)

CQ4 *"I think you're always anxious about a one-off reading in clinic...But if you've got recent home monitoring readings that do reflect a trend or a pattern, then that is all helpful information."* (Clinician interview 006)

CQ5 *"Yeah and I looked at more, an overall picture of an average of what level they were at. So I wouldn't pay particular attention to one-off highs.....So it was more of a reassurance for me that I'm classifying them appropriately. So single measurements that are high, I don't really – you know – that's just part of the parcel of variation of blood pressure."* (Clinician interview 007)

FN2 *"So your blood pressure is running a bit high [BP/152/93 at home]...and by next week it might have gone up to 160 as the BP tends to rise during this part of pregnancy.....we will keep monitoring as we want you and baby to get to the end of pregnancy safely...So, what we can do is increase the nifedipine..and you can keep checking your blood pressures daily as you have been....what do you think...should we try again with the nifedipine?"* (Field note: antenatal clinic with clinician 001)

CQ6 *"Usually I wouldn't go looking further [for home BP readings] unless there was abnormality on the page in front of me [clinic BP] to worry about."* (Clinician interview 005)

CQ7 *"We have a reasonably tight sort of safety net here, because – the clinic was set up because of the gap in care that ended with a woman having a stroke."* (Clinician interview 002)

FN3 *"And if ever the readings are high or even just a little raised and - especially if you have any symptoms, [um] any at all, please don't keep it to yourself...We want to hear from you if you have concerns, so we can check things are okay."* (Field note: antenatal clinic with clinician 003)

PQ21 *"They were very good. They always said 'please call us back'".* (Participant 18 interview)

PQ22 *"I was so grateful I was on this study. It was much calmer and all more straightforward than last time. I could see the readings had been in the amber range for about a week".* (Participant 19 interview: admitted with hypertension in previous pregnancy)

PQ23 *"Yeah, so if I check and I see oh, from – I'm on red, it scares me. That's why most times I didn't even want to be looking at the diary, I'm seeing I'm on danger....So I didn't even contact the hospital for one day. Not one."* (Participant 10 interview: fourth pregnancy, previous stillbirth)

**Boxes 1–3. (continued).**

phones and others found the monitor memory function *"very helpful"* and preferred to transpose readings into the diary before clinic appointments.

**4.4. Integrating home readings into consultations**

Clinicians in the OPTIMUM-BP study were advised to consider home readings when making antihypertensive titration and clinical management decisions. Clinicians and women were observed discussing patterns or trends in the home readings (FN1). Occasionally, outlier readings became a focus of the consultation, although some clinicians said they attached little significance to outlier readings (CQ4-5). In interviews clinicians described various strategies for integrating home readings into management decisions.

During the majority of observed consultations clinicians adopted a

shared decision making approach, often using home readings to initiate giving information about BP and medication use, and highlighting the shared goal of a healthy pregnancy and baby (FN2). During interviews, clinicians suggested they were aware that women valued their home readings, which could be actively acknowledged during consultations. However, despite the researcher's presence possibly acting to remind clinicians to discuss self-monitoring, there were several observed instances where clinicians did not enquire about home readings. One clinician said they only tended to ask about home readings if the clinic readings were high (CQ6).

Clinicians referred to a *"wide"* and *"tight safety net"* when describing clinic monitoring practices due to the higher risks associated with pregnancies complicated by hypertension (CQ7). Clinicians were sometimes observed to replace additional maternity assessment unit visits with self-monitoring, entrusting women to make contact if home

### Quotes Section 3: The importance of relationships

PQ24 “Dr [name] really knows me. I mean...they’ve seen me in my other two pregnancies. They know what my blood pressure does. I knew I could always ask about any symptoms...my [home] readings...[um]...they listened to my side of things.” (Participant 21 interview: fourth pregnancy under same maternity team)

FN4 “And it’s really good that we see you here regularly, because we want to get to know you, and your blood pressure.” (Field note: antenatal clinic early consultation with clinician 002)

CQ5 “And certainly for the women who I knew well, where I had evidence that they were good at self-monitoring...we would get into a pattern of maybe a couple of weeks of home monitoring...” (Clinician interview 004).

FN5 “But I thought we might have to admit you last week. So if things do change, we just need to be open to the fact things can change. And the one thing that has made such a difference is getting the right medication and you taking your medication...And it looks like you’re getting really good at this home monitoring, it’s fantastic and it’s really helpful.” (Field note: antenatal clinic with clinician 002)

PQ25 “And some of them, they were not really fully aware about the study as well, so. I had to explain about the three colours and the ranges. I had to tell them about my normal numbers, you know. But my feeling was ‘oh probably I should receive some extra information or guidance, something more focused about me’”. (Participant 18 interview)

PQ26 “There was a dedicated person....a direct number you can call and it’s somebody who knows you and your background. And they also contact you if they’ve not had any readings for a while or there’s a few high readings.” (Participant 20 informal interview: previous and current pregnancy complicated by gestational diabetes)

#### Boxes 1–3. (continued).

blood pressure became uncontrolled between clinic visits. On a couple of occasions, home monitoring in *addition* to frequent clinic visits was used instead of admission where women were very keen to remain at home as long as possible, e.g. when they had other children. As discussed below, these practices were only observed in the context of a close working partnership between the clinician and woman.

#### 4.5. Out-of-range home readings

Observations showed that clinicians repeatedly expressed the importance of making contact for *any* out-of-range readings, symptoms or concerns (FN3). During interviews, several women recalled recording BP readings that were persistently outside the target range, and described following the protocol and contacting maternity services. Most accounts were very positive about the reception received from MAU (PQ21). Based on advice received in previous interactions with MAU, some women said they had monitored their BP over several hours and only made contact if their BP remained raised.

A woman who was admitted for further assessment after reporting raised home readings and feeling “*just not quite right*”, had her medication increased and her delivery brought forward (PQ22). However, another woman told us she had reported symptoms and a high BP to the MAU and was told to remain at home and recheck after a few hours. Her BP did reduce, though was still raised (145/93 mmHg). She was induced a few days later at 37 weeks when her BP remained raised in clinic.

Another woman was reluctant to make contact despite high home readings and became fearful and demotivated (PQ23). Several reported reluctance to make contact for marginal (just above threshold) readings and “*not wanting to bother someone*”. Reluctance to react may have been

reinforced by clinician behaviour, as clinicians would sometimes explain they were just “*keeping an eye on*” borderline readings during clinic observations.

#### 4.6. The importance of relationships

From observations and interviews both with women and their clinicians, it was clear that successful use of SMBP hinged on the quality of the patient-clinician relationship. Observations suggested that discussions around home readings helped forge these relationships. There was considerable continuity of care across the three sites, and interviews with women and clinicians reinforced the impression that relationships were pivotal in safely managing hypertension and pregnancy (PQ24, FN4 & CQ5).

Observations illustrated how a close clinician-patient relationship could support SMBP. For example, a woman who was initially reluctant to take any medications in pregnancy, gradually moved towards confidently using the home monitoring and seeing the beneficial effect of taking medications for improved BP control. In turn, the clinician agreed to use home monitoring in place of admission and together they successfully managed the pregnancy up to a later gestation and healthy outcome (FN5).

The importance of relationships was sometimes made evident by the effects of its absence, for example if women were advised by an unfamiliar clinician when they contacted MAU with high readings or symptoms. This sometimes seemed to contribute to communication failures or inappropriate advice (PQ25). Several women expressed some disquiet that *they* were expected to instigate further contact if their readings were still raised, especially if the MAU midwife who took their



call appeared to have no detailed knowledge about their care or the study. One woman contrasted this with her experience of gestational diabetes care where there was a dedicated clinician, with whom she had a relationship and could contact between clinic visits (PQ26).

## 5. Discussion

This study found that SMBP during hypertensive pregnancy was acceptable both to pregnant women and their clinicians. Women were highly motivated, willing, and able to self-monitor even in difficult domestic circumstances. These findings accord with the high rates of recruitment, adherence, and persistence in the wider group of participants in the OPTIMUM-BP trial.[7] This qualitative study adds depth to the OPTIMUM findings by exploring what SMBP meant to women and clinicians, in relation to management, decision making and relationship building. Experimentation with SMBP increased women's awareness of BP variability, which also affected their perspectives on clinic readings. Clinicians used a range of heuristics to integrate home and clinic readings, but uncertainty remained around the specifics of *how* to interpret the two sets of readings and translate this into clinical decisions. Observations in the clinic showed that effective partnerships between women and clinicians underpinned the flexible and confident use of SMBP as an adjunct to clinical care.

### 5.1. Strengths and limitations

One strength is the use of a mixed methods qualitative study including both interviews with women and clinicians and observations in clinics. To our knowledge, this is the first study to explore clinician perspectives of SMBP in pregnancy and to use ethnographic observations of clinical interactions with pregnant women who are self-monitoring their BP. The ethnographic design provided insights into some of the cultural practices and 'architecture' of clinical systems which affect how home readings are perceived and integrated. A further strength was the repeated clinic observations which informed our understanding of the importance of the relationships. The study included both teaching and district general maternity centres. A high level of uptake allowed purposeful sampling across the three study sites, including a range of ethnicities, occupational and socioeconomic backgrounds, and obstetric histories.

Potential limitations include that the participants in this qualitative study had all consented to a trial of self-monitoring and none of the women who were interviewed had discontinued the intervention. Clinical teams that are involved in research studies may be more predisposed toward the use of new interventions and ways of working, and a limited number of clinicians were involved. Our findings should be interpreted in light of possible selection and observer bias. Antenatal consultations frequently contain more than just the doctor and pregnant woman and are often observed by trainee doctors and midwives so although the presence of the researcher was announced their presence may not have been particularly noticeable. We also note that the observations included consultations in which home readings were not enquired about, and instances where women said they had stopped monitoring or were taking their medication irregularly. Finally, while we have achieved a sample with a broad range of demographic factors including a good mix of ethnicity, some women may have been excluded from our study due to translation services not being available. This should be addressed in future studies.

### 5.2. Comparison to the literature

While this study makes an original contribution there is a broader literature on self-monitoring in the general adult population with chronic hypertension managed in primary care. Common themes from participants include the perceived benefits of greater control over their health, empowerment from increased knowledge and involvement in

care, reduced BP-related anxiety, and preference for self-monitoring versus clinic monitoring.[11–14] There is evidence of similar active and volitional monitoring in other higher-risk populations,[15] including those monitoring after stroke.[16] These populations share the attribute of a strong intrinsic motivation for self-monitoring, which incorporates a sense of personal risk and the belief that self-monitoring will help reduce this risk.

Jongsma *et al* used a combination of questionnaires and interviews to explore the experiences of women at higher risk of hypertensive disorders of pregnancy in the Netherlands, taking part in the prospective SAFE@home study, which used a blended care approach of SMBP with a reduced clinic schedule.[17] The authors found that women described daily monitoring as over-burdensome if their blood pressure was well controlled on medication. This difference with our findings may be due to different populations (ours was a higher risk group) or might relate to the SAFE@home intervention protocol which required women to monitor at a fixed morning time. Women in our study could monitor at a time they preferred. Studies with clinicians treating other populations have reported similar benefits of self-monitoring including the extra contextual data given the dynamic nature of BP, higher risks and short time frames for decision making in pregnancy.[11,18,19].

Women and clinicians in our study found it difficult to interpret home and clinic BP readings that were not always closely aligned. BP variability has several dimensions, including beat-to-beat, visit-to-visit and clinic-home BP variability. This has been studied within the general adult population with chronic hypertension and variability has been linked to all-cause and cardiovascular disease mortality.[20–24] However, much less is known about the prevalence and impact of the different types of blood pressure variability during pregnancy.[25–27].

### 5.3. Clinical and research implications

Our data showed the importance of positive patient-clinician relationships for a successful BP self-monitoring. The importance of supportive clinician-patient relationships has previously been identified as a key factor in women's satisfaction with their maternity care.[28–31] Recent *meta*-ethnographic and systematic reviews of (digital) self-management interventions for long-term conditions have found that self-management *enhances* rather than replaces professional care.[32,33] The NHS Long Term Plan aims to increase continuity of care for the most vulnerable mothers and babies, hoping to realise the benefits that have been identified for reduced preterm delivery and hospital admissions.[34,35].

The COVID-19 pandemic has driven the rapid implementation of remote antenatal care, and The Royal College of Obstetrics and Gynaecology issued guidance on the use of BP self-monitoring at the start of the pandemic.[36] Analysis of the use of self-monitoring during this period of implementation together with findings from our qualitative study about the meaning and interpretation of SMBP should help future trials or implementation. There is currently insufficient evidence that SMBP in pregnancy is safe or effective, though large trials are underway.[37] More research into BP variability in pregnancy is needed, including white coat and masked hypertension, which will help define appropriate self-monitoring regimes including thresholds.

Unintended consequences are a common feature of new health care initiatives.[38] As SMBP enabled women to experience their blood pressure variability and to draw conclusions about the validity of home or clinic readings, an unintended consequence was that some women adapted their behaviours around their blood pressure variability, questioned the validity of their clinic readings and reduced or omitted their antihypertensive medication. This highlights the need to further explore women's perspectives on taking medication in pregnancy and their preferences for BP control. Developing this evidence base could help guide decision aids for pregnant women and their clinicians to jointly monitor and manage hypertension.

## 6. Conclusions

Self-monitoring of BP during hypertensive pregnancy is acceptable to women and their clinicians. Women were highly motivated and found that self-monitoring, if acknowledged in the clinic, gave a sense of improved engagement and control. More research is needed to understand BP variability within pregnancy and to help guide clinicians and pregnant women interpret and integrate home and clinic BP readings for improved BP management.

There is now a need to design and test pathways that benefit from the greater surveillance and contextual data offered by BP self-monitoring while maintaining the continuity of care and relationships that are valued and appear pivotal for the confident and safe use of this technology in pregnancy.

### Authors' Contributions

LP and RM conceived the study and gained funding. The protocols were developed by LP, with the advice and support of SZ, RM, LC and KT. Data was collected by LP. Analysis was carried out by LP with support from SZ, LC, and RM. The first draft of the paper was written by LP, KT and EL, and subsequently edited and approved by all co-authors. All authors have read, provided critical revision and approved the final version of the manuscript. RM will act as guarantor.

### Funding

This research was funded by the NIHR Collaboration for Leadership in Applied Health Research and Care Oxford (CLAHRC Oxford) now recommissioned as NIHR Applied Research Collaboration Oxford and Thames Valley (ARC-OxTV). KT and RM also receive funding from the ARC-OxTV. RM and LC are supported by Research Professorships from the National Institute for Health Research: (NIHR-RP-R2-12-015 and RP-2014-05-019 respectively). The views expressed in this publication are those of the authors and not necessarily those of the NHS, the National Institute for Health Research or the Department of Health and Social Care.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Acknowledgements

This work would not have been possible without the participation of pregnant women and their antenatal care teams in England.

### References

- [1] M. Knight, et al., Saving lives, improving mothers' care : lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2013–15, National Perinatal Epidemiology Unit, Nuffield Department of Population Health, University of Oxford, 2017.
- [2] K.S. Khan, D. Wojdyla, L. Say, A.M. Gulmezoglu, P.F. Van Look, WHO analysis of causes of maternal death: a systematic review, *Lancet* 367 (2006) 1066–1074, [https://doi.org/10.1016/S0140-6736\(06\)68397-9](https://doi.org/10.1016/S0140-6736(06)68397-9).
- [3] E.P. Bray, R. Holder, J. Mant, R.J. McManus, Does self-monitoring reduce blood pressure? Meta-analysis with meta-regression of randomized controlled trials, *Annals of medicine* 42 (2010) 371–386, <https://doi.org/10.3109/07853890.2010.489567>.
- [4] G. Ogedegbe, A. Schoenthaler, A systematic review of the effects of home blood pressure monitoring on medication adherence, *J Clin Hypertens (Greenwich)* 8 (2006) 174–180, <https://doi.org/10.1111/j.1524-6175.2006.04872.x>.
- [5] R.J. McManus, J. Mant, E.P. Bray, R. Holder, M.I. Jones, S. Greenfield, B. Kaambwa, M. Banting, S. Bryan, P. Little, B. Williams, F.D.R. Hobbs, Telemonitoring and self-management in the control of hypertension (TASMINH2): a randomised controlled trial, *Lancet* 376 (9736) (2010) 163–172.
- [6] J. Hodgkinson, J. Mant, U. Martin, B. Guo, F.D.R. Hobbs, J.J. Deeks, C. Heneghan, N. Roberts, R.J. McManus, Relative effectiveness of clinic and home blood pressure monitoring compared with ambulatory blood pressure monitoring in diagnosis of hypertension: systematic review, *BMJ* 342 (jun24 1) (2011) d3621.
- [7] L.M. Pealing, K.L. Tucker, L.H. Mackillop, C. Crawford, H. Wilson, A. Nickless, E. Temple, L.C. Chappell, R.J. McManus, A randomised controlled trial of blood pressure self-monitoring in the management of hypertensive pregnancy. OPTIMUM-BP: A feasibility trial, *Pregnancy Hypertens* 18 (2019) 141–149.
- [8] N. Britten, Qualitative interviews in medical research, *BMJ* 311 (1995) 251–253, <https://doi.org/10.1136/bmj.311.6999.251>.
- [9] Statistics, O. f. N. *Population by Index of Multiple Deprivation (IMD), England, 2001 to 2019*, 2020).
- [10] S. Ziehlend, A. McPherson, Making sense of qualitative data analysis: an introduction with illustrations from DIPEX (personal experiences of health and illness), *Med Educ* 40 (2006) 405–414, <https://doi.org/10.1111/j.1365-2929.2006.02467.x>.
- [11] B.R. Fletcher, L. Hinton, J. Hartmann-Boyce, N.W. Roberts, N. Bobrovitz, R. J. McManus, Self-monitoring blood pressure in hypertension, patient and provider perspectives: A systematic review and thematic synthesis, *Patient Educ Couns* 99 (2) (2016) 210–219.
- [12] B.R. Fletcher, L. Hinton, E.P. Bray, A. Hayen, F.D.R. Hobbs, J. Mant, J.F. Potter, R. J. McManus, Self-monitoring blood pressure in patients with hypertension: an internet-based survey of UK GPs, *Br J Gen Pract* 66 (652) (2016) e831–e837.
- [13] A.E. Cairns, K.L. Tucker, C. Crawford, R.J. McManus, J. Powell, Implementing self-management: a mixed methods study of women's experiences of a postpartum hypertension intervention (SNAP-HT), *Trials* 21 (2020) 508, <https://doi.org/10.1186/s13063-020-04394-z>.
- [14] L. Hinton, K.L. Tucker, S.M. Greenfield, J.A. Hodgkinson, L. Mackillop, C. McCourt, T. Carver, C. Crawford, M. Glogowska, L. Locock, M. Selwood, K.S. Taylor, R. J. McManus, Blood pressure self-monitoring in pregnancy (BuMP) feasibility study; a qualitative analysis of women's experiences of self-monitoring, *BMC Pregnancy Childbirth* 17 (1) (2017), <https://doi.org/10.1186/s12884-017-1592-1>.
- [15] R.J. McManus, J. Mant, M.S. Haque, E.P. Bray, S. Bryan, S.M. Greenfield, M. I. Jones, S. Jowett, P. Little, C. Penaloza, C. Schwartz, H. Shackelford, C. Shovelton, J. Varghese, B. Williams, F.D.R. Hobbs, Effect of self-monitoring and medication self-titration on systolic blood pressure in hypertensive patients at high risk of cardiovascular disease: the TASMIN-SR randomized clinical trial, *JAMA* 312 (8) (2014) 799.
- [16] S. Ovaisi, J. Ibison, M. Leontowitsch, G. Cloud, P. Oakeshott, S. Kerry, Stroke patients' perceptions of home blood pressure monitoring: a qualitative study, *Br J Gen Pract* 61 (590) (2011) e604–e610.
- [17] K.R. Jongma, J.F.M. van den Heuvel, J. Rake, A.L. Bredenoord, M.N. Bekker, User Experiences With and Recommendations for Mobile Health Technology for Hypertensive Disorders of Pregnancy: Mixed Methods Study, *JMIR Mhealth Uhealth* 8 (2020) e17271.
- [18] J. Hanley, J. Ure, C. Pagliari, A. Sheikh, B. McKinstry, Experiences of patients and professionals participating in the HITS home blood pressure telemonitoring trial: a qualitative study, *BMJ Open* 3 (2013), <https://doi.org/10.1136/bmjopen-2013-002671>.
- [19] M.I. Jones, S.M. Greenfield, E.P. Bray, F.D.R. Hobbs, R. Holder, P. Little, J. Mant, B. Williams, R.J. McManus, Patient self-monitoring of blood pressure and self-titration of medication in primary care: the TASMINH2 trial qualitative study of health professionals' experiences, *British Journal of General Practice* 63 (611) (2013) e378–e385.
- [20] Stevens, S. L. et al. Blood pressure variability and cardiovascular disease: systematic review and meta-analysis. *BMJ* 354, i4098, doi:10.1136/bmj.i4098 (2016).
- [21] G. Parati, G.S. Stergiou, E. Dolan, G. Bilo, Blood pressure variability: clinical relevance and application, *J Clin Hypertens (Greenwich)* 20 (2018) 1133–1137, <https://doi.org/10.1111/jch.13304>.
- [22] M.R. Pioli, A.M. Ritter, A.P. de Faria, R. Modolo, White coat syndrome and its variations: differences and clinical impact, *Integr Blood Press Control* 11 (2018) 73–79, <https://doi.org/10.2147/IBPC.S152761>.
- [23] J.B. Cohen, M.J. Lotito, U.K. Trivedi, M.G. Denker, D.L. Cohen, R.R. Townsend, Cardiovascular Events and Mortality in White Coat Hypertension: A Systematic Review and Meta-analysis, *Ann Intern Med* 170 (12) (2019) 853.
- [24] P.M. Rothwell, S.C. Howard, E. Dolan, E. O'Brien, J.E. Dobson, B. Dahlöf, P. S. Sever, N.R. Poulter, Prognostic significance of visit-to-visit variability, maximum systolic blood pressure, and episodic hypertension, *Lancet* 375 (9718) (2010) 895–905.
- [25] J.V. Vermunt, S.H. Kennedy, V.D. Garovic, Blood Pressure Variability in Pregnancy: an Opportunity to Develop Improved Prognostic and Risk Assessment Tools, *Curr Hypertens Rep* 22 (2020) 10, <https://doi.org/10.1007/s11906-019-1014-z>.
- [26] S.A. Kim, J.D. Lee, J.B. Park, Differences in visit-to-visit blood pressure variability between normotensive and hypertensive pregnant women, *Hypertens Res* 42 (2019) 67–74, <https://doi.org/10.1038/s41440-018-0112-7>.
- [27] L.A. Magee, J. Singer, T. Lee, R.J. McManus, S. Lay-Flurrie, E. Rey, L.C. Chappell, J. Myers, A.G. Logan, P. von Dadelszen, Are blood pressure level and variability related to pregnancy outcome? Analysis of control of hypertension in pregnancy study data, *Pregnancy Hypertens* 19 (2020) 87–93.
- [28] M. Vidler, L.A. Magee, P. von Dadelszen, E. Rey, S. Ross, E. Asztalos, K.E. Murphy, J. Menzies, J. Sanchez, J. Singer, A. Gafni, A. Gruslin, M. Helewa, E. Hutton, S. K. Lee, T. Lee, A.G. Logan, W. Ganzevoort, R. Welch, J.G. Thornton, J.-M. Moutquin, Women's views and postpartum follow-up in the CHIPS Trial (Control of Hypertension in Pregnancy Study), *Eur J Obstet Gynecol Reprod Biol* 206 (2016) 105–113.
- [29] A. Srivastava, B.I. Avan, P. Rajbangshi, S. Bhattacharyya, Determinants of women's satisfaction with maternal health care: a review of literature from developing

- countries, *BMC Pregnancy Childbirth* 15 (2015) 97, <https://doi.org/10.1186/s12884-015-0525-0>.
- [30] S. Vedam, K. Stoll, D.N. McRae, M.o. Korchinski, R. Velasquez, J. Wang, S. Partridge, L. McRae, R.E. Martin, G. Jolicoeur, Patient-led decision making: Measuring autonomy and respect in Canadian maternity care, *Patient Educ Couns* 102 (3) (2019) 586–594.
- [31] A. Tinkler, D. Quinney, Team midwifery: the influence of the midwife-woman relationship on women's experiences and perceptions of maternity care, *J Adv Nurs* 28 (1998) 30–35, <https://doi.org/10.1046/j.1365-2648.1998.00769.x>.
- [32] K. Morton, L. Dennison, C. May, E. Murray, P. Little, R.J. McManus, L. Yardley, Using digital interventions for self-management of chronic physical health conditions: A meta-ethnography review of published studies, *Patient Educ Couns* 100 (4) (2017) 616–635.
- [33] S.J.C. Taylor, H. Pinnock, E. Epiphaniou, G. Pearce, H.L. Parke, A. Schwappach, N. Purushotham, S. Jacob, C.J. Griffiths, T. Greenhalgh, A. Sheikh, A rapid synthesis of the evidence on interventions supporting self-management for people with long-term conditions: PRISMS – Practical systematic Review of Self-Management Support for long-term conditions, *NIHR Journals Library* 2 (53) (2014) 1–580.
- [34] NHS. *NHS Long Term Plan*, <<https://www.longtermplan.nhs.uk/publication/nhs-long-term-plan/>> (2019).
- [35] J. Sandall, H. Soltani, S. Gates, A. Shennan, D. Devane, Midwife-led continuity models versus other models of care for childbearing women, *Cochrane Database of Systematic Reviews* (2016), <https://doi.org/10.1002/14651858.CD004667.pub5>.
- [36] L. Chappell, Self-monitoring of blood pressure in pregnancy, *Royal College of Obstetricians and Gynaecologists (RCOG), Information for healthcare professionals*, 2020.
- [37] G. Dougall, M. Franssen, K.L. Tucker, L.-M. Yu, L. Hinton, O. Rivero-Arias, L. Abel, J. Allen, R.J. Band, A. Chisholm, C. Crawford, M. Green, S. Greenfield, J. Hodgkinson, P. Leeson, C. McCourt, L. MacKillop, A. Nickless, J. Sandall, M. Santos, L. Tarassenko, C. Velardo, H. Wilson, L. Yardley, L. Chappell, R. J. McManus, Blood pressure monitoring in high-risk pregnancy to improve the detection and monitoring of hypertension (the BUMP 1 and 2 trials): protocol for two linked randomised controlled trials, *BMJ Open* 10 (1) (2020) e034593, <https://doi.org/10.1136/bmjopen-2019-034593>.
- [38] S. Ziebland, E. Hyde, J. Powell, Power, paradox and pessimism: On the unintended consequences of digital health technologies in primary care, *Soc Sci Med* 289 (2021), 114419, <https://doi.org/10.1016/j.socscimed.2021.114419>.