Self-monitoring blood pressure in pregnancy

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Self-monitoring blood pressure in Pregnancy: Evaluation of health professional experiences of the BUMP trials

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ABSTRACT

Background: The BUMP trials evaluated a self-monitoring of blood pressure intervention in addition to usual care, testing whether they improved detection or control of hypertension for women at risk of hypertension or with hypertension during pregnancy. This process evaluation aimed to understand healthcare professionals' perspectives and experiences of the BUMP trials of self-monitoring of blood pressure during pregnancy.
Methods: Twenty-two in-depth qualitative interviews and an online survey with 328 healthcare professionals providing care for pregnant people in the BUMP trials were carried out across five maternity units in England.
Results: Analysis used Normalisation Process Theory to identify factors required for successful implementation and integration into routine practice. Healthcare professionals felt self-monitoring of blood pressure did not overmedicalise pregnancy for women with, or at risk of, hypertension. Most said self-monitored readings positively affected their clinical encounters and professional roles, provided additive information on which to base decisions and enriched their relationships with pregnant people. Self-monitoring of blood pressure shifts responsibilities. Some healthcare professionals felt women having responsibility to decide on timing of monitoring and whether to act on self-monitored readings was unduly burdensome, and resulted in healthcare professionals taking additional responsibility for supporting them.
Conclusions: Despite healthcare professionals' early concerns that self-monitoring of blood pressure might overmedicalise pregnancy, our analysis shows the opposite was the case when used in the care of pregnant people with, or at higher risk of, hypertension. While professionals retained ultimate clinical responsibility, they viewed self-monitoring of blood pressure as a means of sharing responsibility and empowering women to understand their bodies, to make judgements and decisions, and to contribute to their care.

1. Introduction

1.1. Background

Raised blood pressure (BP) is a leading cause of maternal mortality and morbidity, affects 10 % of pregnancies worldwide and is a contributory factor in 14 % of maternal deaths and 15 % of stillbirths globally [1,2].

BP monitoring is a key component of antenatal care, typically undertaken by clinicians. Self-monitoring involves BP readings being taken by the individual outside clinical settings and supports the detection and management of hypertension in the non-pregnant population [3–5]. Self-monitoring of BP (SMBP) in pregnancy allows more frequent monitoring than usual care, with the potential to detect hypertension

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between antenatal appointments, providing a more rounded view of fluctuations in BP between antenatal visits and illuminating where self-monitored and clinic readings differ. Recent estimates suggest 20 % of pregnant people in the UK, and 50 % of pregnant people with hypertension, self-monitor their BP [6]. Despite the hype surrounding telemedicine, the evidence base for self-monitoring in the antenatal period is still maturing. [7–11].

A self-monitoring intervention with telemonitoring was developed and piloted for use in pregnancy [12,13] and evaluated in two linked clinical trials, the BUMP trials [14]. Participants randomised to the intervention submitted self-monitored BP readings via an application (app) or text. The telemonitoring system advised them to contact their local maternity unit if, on a single occasion, they took three high readings, or if they took three low readings and were on antihypertensive medicine and felt unwell. The BUMP1 trial aimed to test whether, in addition to usual antenatal care, the SMBP intervention improved detection of hypertension in pregnant people at higher risk of hypertension. The BUMP2 trial aimed to examine its effectiveness in controlling BP in people with pregnancy hypertension. The trials revealed that the self-monitoring intervention did not result in earlier clinic detection of hypertension in BUMP1 or reduce systolic BP in BUMP2 [14–16].

This article reports the evaluation which aimed to understand healthcare professionals' experiences of the BUMP1 and 2 trials and how they incorporated self-monitored BP readings into routine clinical care. A linked study was carried out to examine women's perspectives on self-monitoring BP in the trials [17].

Normalisation Process Theory (NPT) identifies the ingredients required for successful implementation and integration of interventions into routine practice at the professional and team level [18–20]. It was used in this study to inform data collection and to organise the findings.

2. Methods

A mixed-methods approach was used to understand in depth the views and experiences of a sample of healthcare professionals through semi-structured interviews, as well as to explore, through a survey, the extent to which their views were reflective of the wider healthcare population. The survey's larger sample size would allow detection of differences between professional groups. NPT informed the interview topic guide, the survey and analysis.

In-depth telephone interviews were carried out with obstetricians and midwives from five BUMP trial sites purposively selected to capture diversity in terms of maternity unit size, and the socio-demographic characteristics of the pregnant people. Community midwives were included as well as maternity unit midwives because the antenatal care and BP monitoring of many of the women at risk of hypertension in the BUMP1 trial was provided predominantly by community midwives, and the study aimed to understand the views and experiences of midwives in both settings. The interviews were carried out by a social scientist with expertise in maternity research. They were carried out remotely by telephone to allow flexibility of time and place in order to maximise the opportunity for healthcare professionals to take part alongside heavy workloads. The interviews were undertaken after the trial had finished and lasted between 20 and 45 min. Snowball sampling [21] was employed to reach other healthcare professionals involved in the care of participants in the BUMP trials (Table 1).

The thirteen-item online survey was developed by the research team composed of social scientists, statisticians and clinicians. It was distributed via staff email lists by research midwives at seven BUMP trial sites. No reminders were sent. The survey took place during the same period as the interviews (Appendix 1).

Findings are reported under the NPT theoretical constructs of *coherence* (whether and how healthcare professionals made sense of SMBP as meaningful, achievable and desirable, and for whom); *cognitive participation* (securing buy-in of those needed to deliver the intervention); *collective action* (the work of implementing SMBP into care); and *reflexive monitoring* (ongoing appraisal and adjustment of the SMBP intervention).

Table 1
Participant characteristics.

Interview Participants	N	%
Consultant obstetrician/obstetric physician	9	41
Midwife (predominantly hospital-based)	10	45
Midwife (predominantly community-based)	3	14
SURVEY RESPONDENTS	**N**	**%**
Role		
Obstetrician/ obstetric physician	51	16
Midwife (predominantly hospital based)	189	58
Midwife (predominantly based in community)	78	24
Other clinician*	10	3
Total survey respondents	328	100
Years since qualified		
Less than 1 year	7	2
1–3 years	38	12
3–5 years	50	15
5–10 years	61	19
10–15 years	54	16
More than 15 years	118	36
Involved in research		
Consultant obstetrician/ obstetric physician	17 (17/51)	33
Midwife (predominantly hospital based)	39 (39/189)	21
Midwife (predominantly based in community)	3 (3/78)	4
Other clinician[a]	4 (4/10)	40

[a] Other = 4 research midwives, 2 midwives in other settings, 1 physicians associate, 1 nurse, 1 specialist trainee and 1 GP trainee.

Ethical approval was gained from the West Midlands - South Birmingham NHS Research Ethics Committee: ref 17/WM/0241. All participants gave informed consent.

3. Analysis

Interviews were audio-recorded, transcribed verbatim and thematic analysis undertaken [22]. Familiarisation was achieved by reading through the interviews and writing narrative data summaries. This stage was followed by a second phase of analysis that employed both deductive (theory-driven) and inductive approaches to the thematic analysis. Deductive coding, generating initial a priori codes, and inductive coding, noting salient emergent themes [23,24], were used in combination. All data were then coded in NVivo using these emergent themes and the constructs derived directly from NPT as it applied to this field of study (See Table 2) [23]. Two additional codes (one *a priori* and one emergent) were introduced. First, the potential for medicalisation, defined as a process "*by which nonmedical problems become defined and treated as medical problems*" [25], arose as an important issue in the intervention development [12] and was explored in this analysis as an *a priori* code within the *coherence* domain of NPT. Secondly, an emergent theme touched on the social scientific literature of responsibilisation, the process whereby responsibility shifts from institution or state to the individual [26,27] (Table 2).

The four domains of NPT were not all equally relevant and applicable to this analysis. This has been the case elsewhere when NPT is used [19]. In this case, the first theme of "coherence" was particularly rich and therefore the analysis in this domain is deeper. Within "collective action," the issue of managing divergent home and clinic readings was salient because it is an area where the introduction of home readings to a consultation has potential to present a dilemma for the BP management. This is explored in more depth in Table 6.

For the survey, basic statistics and significance values were calculated using Fisher's Exact in Stata [28]. Survey results are reported

Table 2
How the interview data mapped onto NPT domains.

NPT theme/domain	Application of NPT theme to interview data
Coherence: making sense of SMBP as meaningful, achievable and desirable - for whom?	• Does SMBP make sense and can it be trusted? • Who is it suitable for SMBP and who benefits? • Does it lead to over-medicalisation of pregnancy? • Does it shift locus of responsibility?
Cognitive participation: securing buy-in of those needed to deliver	• How do healthcare professionals' colleagues feel about women SMBP? • Does it encroach on healthcare professionals' roles? • Do they see it as likely to become part of normal care?
Collective action: the work of implementing SMBP into care	• Capacity • Managing divergent readings and white coat hypertension (WCH)
Reflexive monitoring: ongoing appraisal and adjustment of SMBP	• Potential improvements

alongside relevant interview data under the NPT themes.

4. Results

Nine obstetricians and 13 midwives (three predominantly community-based, eight predominantly hospital-based) from five sites were interviewed between August and December 2020. 328 survey responses were received between September and December 2020 from an estimated sample of 2908 healthcare professionals (Table 1). The number of antenatal care professionals at sites was combined to estimate the total number who could have responded to the survey, producing an estimated response rate of 11 %. Results are presented using the four constructs from NPT (Table 2). Survey findings are summarised in Table 3. Other findings are derived from the interviews. Supporting quotes are available in Tables 4–7.

The survey results show that on each measure, obstetricians tended to report more favourable experiences and attitudes towards SMBP than hospital or community-based midwives.

4.1. Coherence

Coherence relates to how participants made sense of an intervention as meaningful, achievable and desirable, and for whom.

4.1.1. Does SMBP make sense and can it be trusted?

Survey results showed most healthcare professionals valued SMBP and trusted self-monitored readings, obstetricians more than midwives (Table 3). Interviews revealed SMBP intuitively made sense as a means to: detect hypertension earlier in at-risk women; manage BP in people with existing diagnosis of pregnancy hypertension; reduce hospital admissions. SMBP had potential to engage pregnant people more closely in their care (see Table 4 for supporting data).

In the trial, a monitor validated for use in pregnancy was used and most healthcare professionals trusted the accuracy of self-monitored trial readings. Many judged SMBP readings as more typical of 'real' BP values and therefore more valid than clinic readings. Although one consultant said they would only trust very recent self-monitored readings. Others stressed the validity and value of both self-monitored and clinic readings, reflecting the range and patterns of an individual's BP in different circumstances.

4.1.2. Are readings honestly reported?

Most healthcare professionals trusted women, particularly those with hypertension, to report self-monitored BP readings honestly and act on elevated BPs as instructed by the app. Some did not fully trust

Table 3
Survey results.

	Obstetrician (n = 51)	Hospital Midwife (n = 187)	Community Midwife (n = 78)	Other clinician (n = 10)	All HCP (n = 326)
I value the effects that using women's self-monitored blood pressure readings have had on my work					
Strongly disagree	0 (0 %)	2 (1 %)	0 (0 %)	0 (0 %)	2 (1 %)
Disagree	1 (2 %)	6 (3 %)	4 (5 %)	0 (0 %)	11 (3 %)
Neither agree nor disagree	9 (18 %)	78 (42 %)	27 (35 %)	2 (20 %)	116 (36 %)
Agree	30 (59 %)	79 (42 %)	29 (37 %)	7 (70 %)	145 (44 %)
Strongly agree	11 (22 %)	22 (12 %)	18 (23 %)	1 (10 %)	52 (16 %)
	Obstetrician (n = 51)	**Hospital Midwife (n = 189)**	**Community Midwife (n = 78)**	**Other clinician (n = 10)**	**All HCP (n = 328)**
How much do you trust women's self-monitored blood pressure readings?					
Not at all	0 (0 %)	6 (3 %)	2 (3 %)	0 (0 %)	8 (2 %)
To some extent	8 (16 %)	57 (30 %)	18 (23 %)	2 (20 %)	85 (26 %)
Quite a lot	34 (67 %)	107 (57 %)	52 (67 %)	8 (80 %)	201 (61 %)
Completely	9 (18 %)	19 (10 %)	6 (8 %)	0 (0 %)	34 (10 %)
	Obstetrician (n = 51)	**Hospital Midwife (n = 189)**	**Community Midwife (n = 78)**	**Other clinician (n = 10)**	**All HCP (n = 328)**
I have confidence in my colleagues' ability to use women's self-monitored blood pressure readings					
Strongly disagree	0 (0 %)	3 (2 %)	1 (1 %)	0 (0 %)	4 (1 %)
Disagree	1 (2 %)	11 (6 %)	2 (2 %)	1 (10 %)	15 (5 %)
Neither agree or disagree	4 (8 %)	39 (20 %)	12 (15 %)	1 (10 %)	56 (17 %)
Agree	36 (71 %)	113 (60 %)	50 (64 %)	7 (70 %)	206 (63 %)
Strongly agree	10 (20 %)	23 (12 %)	13 (18 %)	1 (10 %)	47 (14 %)
	Obstetrician (n = 51)	**Hospital Midwife (n = 186)**	**Community Midwife (n = 78)**	**Other clinician (n = 10)**	**All HCP (n = 325)**
Sufficient resources are available in my organisation to support the use of women's self-monitored blood pressure readings.					
Strongly disagree	3 (6 %)	8 (4 %)	7 (9 %)	0 (0 %)	18 (6 %)
Disagree	8 (16 %)	36 (19 %)	21 (26 %)	1 (10 %)	66 (20 %)
Neither agree nor disagree	15 (29 %)	82 (44 %)	29 (37 %)	4 (40 %)	130 (40 %)

(continued on next page)

Table 3 (*continued*)

	Obstetrician (n = 51)	Hospital Midwife (n = 187)	Community Midwife (n = 78)	Other clinician (n = 10)	All HCP (n = 326)
Agree	18 (35 %)	45 (24 %)	19 (24 %)	4 (40 %)	86 (26 %)
Strongly agree	7 (14 %)	15 (8 %)	2 (3 %)	1 (10 %)	25 (8 %)

pregnant people to remember to take their BP or to act on prompts from the intervention. One consultant obstetrician thought women who wished to avoid the consequences of reporting a high reading would be more likely to not monitor their BP, or not report raised readings, than to fabricate false readings.

4.1.3. Who is suitable for SMBP and who benefits?

Those considered most suitable for SMBP were pregnant people diagnosed with chronic or gestational hypertension or normotensive people with risk factors for developing hypertension-related complications in pregnancy, sufficient to be eligible for prescribed aspirin. SMBP was seen to have value postnatally after pre-eclampsia, to reduce the need for daily visits to clinic. Some questioned its suitability for people with "chaotic" lifestyles, although one midwife speculated that for some, SMBP might be more accessible than attending clinic for BP monitoring.

For some, SMBP was a "win–win," benefitting women at risk of hypertension either by reassuring them that their BP stayed normal or by detecting elevated BP early. Most felt self-monitored readings could provide a valuable picture of the range of an individual's BP. SMBP could benefit those who actively engaged in their care and were interested in monitoring and measurement.

One healthcare professional described 'how' a pregnant person brings their readings to clinic (for example, whether they take pride in it or find it a chore) provided insight into the responsibility they were willing to take for meeting their health needs. Another said telephone contact with women about self-monitored readings improved the therapeutic relationship, which could reduce anxiety and potentially lower BP.

4.1.4. Does SMBP risk over-medicalising pregnancy?

Given the prevalence of SMBP in pregnancy [6] and the general population [29], some argued concerns about "medicalisation" were misplaced. Encouraging people with high-risk pregnancies to self-monitor could be empowering, reducing their clinic visits and giving them confidence to understand their bodies and make judgements and decisions.

Where self-monitored readings were used to titrate medication, healthcare professionals felt pregnant people benefited from playing an active role in their BP management.

4.1.5. How does SMBP shift responsibility for monitoring and acting on BP readings?

Many healthcare professionals found women were keen to be proactively engaged in managing their BP, since they were more invested than anyone in a good pregnancy outcome. But some were concerned that for some pregnant people, responsibility for interpreting self-monitored readings and deciding on appropriate action introduced stress. While a clinician would accept some fluctuation as normal and look at the overall picture, women might become fixated with variations in their readings. The burden this placed on pregnant people to interpret fluctuations placed additional responsibility on their healthcare professionals to support interpretation, although over time, fluctuations tended to concern women less.

SMBP could generate additional work. In the BUMP trials, SMBP was carried out alongside usual care. Healthcare professionals therefore maintained existing monitoring responsibilities, plus potentially additional responsibility for interpreting self-monitored readings. Some research midwives felt responsible for checking for any SMBP readings visible on the central telemonitoring system that needed follow-up (particularly vulnerable pregnant people).

Table 4
Coherence.

Can SMBP be trusted?	*I think there was probably a reluctance to, to take it seriously perhaps beforehand because there was a lot of talk about women who bought their own monitors, and how accurate they were, and whether we could track them… I, I think the community midwives certainly were happy to know that the women were using blood pressure cuffs, that were calibrated, and they knew they could trust.* (Hospital midwife, site 3) *Yeah certainly… women on the BUMP trial they had a knowledge of how to use the equipment correctly and … what their parameters were. Cos we also have women who just buy blood pressure machines, over the counter and what was good with the BUMP trial was they were educated, they knew the parameters, and therefore when they rang up it was easier to like you know, to take, not to take them seriously, but like you know, like you know, we were more alerted to their readings, if you like.* (Day Assessment Unit (DAU) midwife, site 3)
Are readings honestly reported?	*I'm no less likely to accept those* [home readings] *as a true reflection than I am of the slightly dodgily taken ones in clinic… We have a lot in clinic that end in a nought.* (Consultant obstetrician, site 1) *They're not in the game to make it lower. If they're not well they're going to speak up. You know they're not going to falsify the results. I can't see that women would … say that their blood pressures are lower than what they are… I don't think so because they've got a baby on board* (Community midwife, site 2)
Who is suitable and who benefits?	*Women love taking their blood pressure actually. I find sort of it made them more interested in their care… they sort of take control, not control but they are part of the management and that increases their enthusiasm and they feel very positive about it as well.* (Consultant obstetrician, site 5) *We tend to get to know them more, cos obviously they're ringing us quite a lot. Some of the ladies [……] we do have a good relationship with them [….] I think it helps with the rapport if you're giving them a direct phone number to yourself, and they can pick up the phone. So that's going to make them less anxious and hopefully lower their blood pressure in itself. (Research midwife, site 1)*
Risk of over-medicalisation	*I'm sure if you talk to people they will tell you in the general population a lot of them have blood pressure monitors at home. I think it's all, they see that taking control of their health rather than being medicalised.* (Consultant, site 5) *I think they do, they like, yeah, I think they, they see it as a positive… They like taking you know taking ownership of their care and… they don't want to have high blood pressure.* (*Research midwife, site 1*)
Shift in responsibility	*They like to quite take control of their blood pressure.* (Midwife, site 5) *Patients taking their blood pressure at home will take more ownership of their health* (Consultant, site 3)

4.2. Cognitive participation

Cognitive participation describes securing the buy-in of those needed

Table 5
Cognitive participation.

Enhanced discussions	*If I felt that blood pressure in the clinic was quite high and I wanted to increase medication knowing that that blood pressure at home wasn't too low, was kind of useful… Knowing that their blood pressure at home was actually normal and, and they'd had a blood pressure in the clinic that was perhaps borderline meant it was more useful.* (Consultant obstetrician, site 1)
	I just think it's part of, it's another piece of information which helps you, in my view anyway, helps you to manage and understand the woman and understand her understanding and her approach to her own health needs really…. Self-monitoring offers lots of interesting insights I think into the woman's relationship with her own health. (Consultant obstetrician, site 1)

to deliver an intervention. In the BUMP trials, this meant whether healthcare professionals felt SMBP encroached on their professional role, and whether they believed it was likely to become a normal part of care.

4.2.1. Colleagues' perceived views about SMBP

Survey results suggest respondents felt confident in their colleagues' ability to use self-monitored readings. This confidence was more pronounced in consultants than in midwives. Healthcare professionals did not feel SMBP encroached on their professional judgement or role. Rather, self-monitored readings provided added richness alongside clinic readings. Discussions between women and healthcare professionals were enhanced by participants' self-monitored readings and knowledge of their own bodies. As long as the monitor could be trusted, SMBP was seen to enable a positive contribution by pregnant people to managing their care.

The intervention did not always allow for professional discretion about the thresholds for reporting and action. For example, for some participants with chronic hypertension, action might be needed only if their BP reached a higher threshold (See Table 5 for supporting data).

4.3. Collective action

Collective action refers to the collective work and capacity (time, resources and support) of implementing and integrating an intervention into care; how SMBP was used in practice to help manage white coat hypertension (WCH) and to understand divergent self-monitored and clinic readings.

4.3.1. Capacity

Survey results suggest healthcare professionals, particularly community midwives, were not yet confident they have the support needed to incorporate SMBP into routine care (Table 3). In the trials, participants were instructed to contact their maternity team if they had raised self-monitored readings. Taking these phone calls could add to workloads and be time consuming. Midwives reported this was balanced by a perceived reduction in women coming into triage, which helped manage pressure on clinics, and reduced admissions.

4.3.2. Managing divergent self-monitored and clinic readings

Many welcomed increased awareness of discrepant self-monitored and clinic readings as a way to broaden the basis on which clinical decisions could be made, rather than presenting a dilemma or conflict. Views about understanding and managing such discrepancies varied. In the trial the guidance was that self-monitored BP readings should be interpreted as if another clinic reading. Some healthcare professionals reported that where a clinic reading was high and self-monitored reading normal, they would trust recent self-monitored readings over clinic readings, while others said they would act on clinic readings. Bringing normal self-monitored readings to a consultation, if the healthcare professional took them into account, reassured participants and were thus believed to reduce the white coat effect. Where participants had raised clinic readings, but no other symptoms and normal self-monitored readings, SMBP enabled some healthcare professionals to feel comfortable with pregnant people going home to self-monitor in circumstances where they would otherwise have recommended admitting them for BP monitoring. None described increasing medication in cases where home readings were raised but clinic readings normal (see Table 6 for supporting data).

4.4. Reflexive monitoring

Reflexive monitoring refers to the ongoing appraisal and adjustment of an intervention once it has been introduced. Healthcare professionals would have liked to be able to adjust the BP thresholds that prompted action. Concerns were raised about how the system could be made to work for women whose English was not fluent to ensure that instructions were clear and did not result in potentially dangerous misunderstandings. Others speculated that using SMBP to *replace* some elements of usual care might increase convenience for pregnant people, relieving the need for clinic visits where they could be replaced by virtual consultations with self-monitored BP readings (See Table 7 for supporting data).

5. Discussion

5.1. Main findings

SMBP provided healthcare professionals with a means of sharing responsibility with women, empowering them to understand their bodies, make judgements and decisions and contribute to their care. Obstetricians' more favourable experiences and attitudes towards SMBP than hospital or community-based midwives may be attributed to greater professional autonomy and familiarity with clinical ambiguity where home and clinic readings were discrepant. Some would have liked to exercise professional discretion over the thresholds set for reporting and action for individuals.

Healthcare professionals trusted the reliability and validity of the trial-issued monitor, which was validated for pregnancy. However, outside the trial pregnant people will not always use validated monitors and healthcare professionals may therefore have less trust in their SMBP readings. Healthcare professionals felt SMBP could reduce pressure on triage, clinics and hospital admissions. As in studies in the non-pregnant population [30], although the onus was on women to act on raised readings, some healthcare professionals felt an additional responsibility for checking self-monitored readings. Clarity on liability and responsibility for responding to high readings is required if SMBP interventions are to avoid adding to healthcare professionals' workload and responsibility.

Undertaking SMBP within the BUMP trials gave participants additional responsibilities [31] and some healthcare professionals felt this additional judgement and interpretation could be burdensome to pregnant people. Supporting women with these judgements became an additional responsibility for healthcare professionals. But pregnancy *normally* requires pregnant people and healthcare professionals to interpret ambiguous symptoms, sensations and physiological changes and to make judgements about whether professional intervention is required [32]. SMBP positively brings extra information to a pregnancy and can be seen as an extension of existing responsibilities. Healthcare professionals described relationships with women that were enriched by SMBP, allowing pregnant people and healthcare professionals to interact on a more level playing field. These judgements could be further supported by guidance about appropriate BP thresholds, pathways and optimal management.

Table 6
Collective action.

Issue	Interview data
Recent home readings trusted over clinic readings	*"..you can become hypertensive quite quickly so if they'd had a couple of readings or a week's readings three weeks ago that were normal and then high blood pressure in clinic, it doesn't make any difference, they've got a high in clinic. But if yesterday or, you know, this morning or whatever, their BPs were okay then that would make me feel a bit, you know, more relaxed… I mean generally speaking… we will look for the thing that's normal as affirmation that everything's okay rather than the other way round."* (Consultant midwife, site 2)
	"But I mean we do, we do put a lot of emphasis on the home readings, and we do kind of trust them and so yeah I mean if, if they were still high in clinic I think the doctors would still trust the home readings… and not ignore it, but kind of you know usually we, we then say well we'll phone you tomorrow, or we'll phone you in a few days and see how your home reading ones are going." (Research midwife, site 1)
Clinic readings trusted over home readings, especially if woman has PE symptoms	*"pre-eclampsia can come on in a matter of hours and so even though somebody's had a beautiful reading last night and then they got soaring blood pressure the next day, you've got to take that on face value and use, you know, start from there. So, you know, they in that, in that situation where they were symptomatic, I would just ignore the home readings and do what I would normally do."* (Consultant obstetrician, site 2)
	"I suppose, cos *you're doing it, I mean you're not saying that theirs aren't true, but I suppose if you're the one doing it there and then, you've physically done it and that's your result, you would obviously want to go with that one… I would probably trust I suppose what I've done,* cos *I've done it… I can't ignore what's just been presented in front of me."* (Midwife, site 5)
Titrating medication and avoiding hospital admission	*"Not uncommonly there would be quite a disagreement between what readings women had got at home, and what readings they have in the clinic, and that was certainly considered in, in changing medication and putting women on and off medication… the office readings were still considered and acted upon, but I would say they were acted upon you know with, in the context of what the other readings had been like… And obviously that would depend a little bit on how many readings women had got and how compliant they'd been with their monitoring, and, how kind of confident you were that they were taking their medication anyway… There's a lot of morbidity from additional admissions and I think for those women where you could see evidence of blood pressures in target at home, we were just much more relaxed about accepting those readings."* (Consultant obstetrician, site 1)
Relieving the need for clinic visits or admissions	*But for our specialist group of ladies in our clinics, so my clinic being the blood pressure clinic, it definitely gives us the reassurance that whereas normally we'd bring them in probably every few weeks. We'd maybe say, "Right, we'll see you in say four weeks and I'll ring you in two." So, it might reduce that appointment if it was just for an antenatal check or just for a blood pressure check and she wasn't coming for anything else, we could do it over the phone.* (Research Midwife, site 1)
	I think it's cut down admissions to the antenatal ward for blood pressure monitoring. [….] I've been on the antenatal ward for five years and actually, yeah, I think it has because whereas before, if I, if I think if like [um] we saw a woman in clinic, [um] and her blood pressure readings were okay, but not ideal, she'd be [um] depending on all the other factors going on, she'd either be admitted for blood pressure monitoring [….] as opposed to actually let's give her a call on Friday morning, check how she's getting on, depending on what the readings are then, we can then talk about an admission or continuing outpatient management. (Midwife, site 4)

Table 7
Reflexive Monitoring.

Concern for women whose English was not fluent	*… there are some that you just, you know that you're worried about, or maybe that English isn't their first language, or something like, and you just think they probably wouldn't necessarily pick up the phone.* (Research midwife, site 1)
Professional discretion	*We do have ladies sometimes that we change it again, sometimes with ladies that we know are going to run a lot higher than the target.* (Research midwife, site 1)

5.2. Strengths and limitations

This study is enriched by a broad sample drawn from diverse sites and the use of NPT [20] to inform implementation and integration of a new pregnancy intervention. Most fieldwork took place after SMBP in the trial had ended and the Covid 19 pandemic had begun. [33] Healthcare professionals were asked to report their experiences during the trial, but their accounts may have been influenced by experiences of SMBP during the pandemic. The online survey response rate was relatively low and may not have captured views representative of all relevant healthcare professionals, so caution is required in generalising from the results. Considering the pressure on NHS staff during the pandemic the relatively low rate is unsurprising.

Interviews with participants in the trial [17] included accounts of healthcare professional reluctance to take their self-monitored readings into account when making clinical decisions. Similar reluctance to use SMBP readings was not expressed by the healthcare professionals, suggesting the sample may not have included healthcare professionals sceptical of SMBP. This may have been a consequence of the snowball sampling technique.

5.3. Interpretation

The trial results showed that SMBP did not result in earlier clinic detection of hypertension or reduced systolic BP in women with hypertension [34,35]. SMBP detected raised BP earlier, but the level of prescribing antihypertensive medications was not different between participants in the control and intervention groups. Evaluation data suggest in some cases healthcare professionals may not have raised medication where home readings indicated masked hypertension, which may go some way to explaining these results. The effects of the intervention are difficult to unpick given the high levels of SMBP in the pregnant population outside the trials [6].

In contrast to studies from outside pregnancy [36], discrepancies between self-monitored and clinic readings were often welcomed as widening the basis for making good clinical decisions rather than as presenting dilemma or conflict. The self-monitored readings could have been viewed as having greater legitimacy because they were taken using a validated monitor within the trial.

Clinically, elevation of BP indicates the need for medical management of pregnancy to protect the health of the pregnant person and their baby [37,38]. Our data suggest that the same intervention that might lead to a sense of *over-medicalising* a low-risk pregnancy by introducing monitoring technology, might, in contrast, serve to *reduce* the medicalisation of a higher-risk or already hypertensive pregnancy by giving women the capability to adopt some tasks and gain insights that were previously the domain of healthcare professionals. Healthcare professionals were concerned that the work of deciding whether and when to self-monitor and to interpret and act on the results, could further responsibilise pregnant people, and add to the "burden of treatment" [39]. These concerns link to contemporary debates. Health policy that encourages people to manage their health via digital technologies such as health apps also renders individuals more responsible for managing their own health. The research presented in this paper contributes to the evidence base on self-monitoring, and these shifts in responsibility, in antenatal care. This transition currently looks like a relay race where the "baton" being passed is responsibility for monitoring and managing BP in pregnancy [38,40]. Although evaluations of the rapid implementation of self-monitoring of blood pressure during the Covid-19 pandemic have been broadly positive about monitoring to reduce clinic visits and give women more control [41,42]. At this stage of the race, it appears some on both sides are concerned they might drop the baton at certain points. This concern could potentially be mitigated by clearer models of care.

5.4. Conclusions

Initial concerns expressed by healthcare professionals that SMBP might over-medicalise pregnancy [12] were not borne out from a healthcare professional perspective. Rather, SMBP supported the sharing of power and responsibility with women. SMBP empowered women to understand their bodies, to make judgements and decisions and to contribute to their care. The intervention did not relieve healthcare professionals of their overall responsibility towards antenatal care and indeed added a task of supporting pregnant people in interpreting their readings [38,43,44]. Our findings are in keeping with the observation that "self-care" interventions and policies encouraging patients to take greater responsibility for their health care can be both burdensome and empowering [39,45].

Ethics approval

The study was approved by the Research Ethics Committee (West Midlands - South Birmingham: ref 17/WM/0241), host institutions and Health Research Authority. All participants gave written informed consent before taking part.

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Authors' contributions

RM, LC, KT, JH, PL and LH conceived the study and gained the funding. AC carried out the interviews, AC and LH carried out the analysis. AC, LH and JH designed the survey with support from all authors and KT completed the survey analysis. AC and LH wrote the first draft of the manuscript. The manuscript was subsequently edited and approved by all co-authors. All authors have read, provided critical revision and approved the final version of the manuscript.

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.

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Appendix A. Supplementary data

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