First-time mothers' understanding and use of a pregnancy and parenting mobile application (The Baby Buddy app): a qualitative study using appreciative inquiry.

Abstract

Background

Internationally, there is an increasing emphasis on early support of pregnant women to optimise the health and development of mothers and newborns. To increase intervention reach, digital and app-based interventions have been advocated. There are growing numbers of pregnancy healthcare apps with great variation in style, function, and objectives, but evidence about their impact on pregnancy wellbeing and behaviour-change following app interaction is lacking. This paper reports on the qualitative arm of the independent multicomponent study that explored the use and outcomes of first-time mothers using the Baby Buddy app: a pregnancy and parenting support app, available in the NHS App library and developed by a UK child health and wellbeing charity Best Beginnings.

Objectives

To understand when, why and how first-time mothers use the Baby Buddy app and the perceived benefits and challenges.

Methods

This paper reports on the qualitative arm of an independent, longitudinal mixed methods study. An Appreciative Inquiry (AI) qualitative approach was used with semi-structured interviews (n = 17) undertaken with new mothers, either by telephone or in a focus group setting. First-time mothers were recruited from three study sites from across the UK. In line with the AI approach, mothers were prompted to discuss 'what worked well' and 'what could have been better' regarding their interactions with the app during pregnancy. Thematic analysis was used to identify emergent themes and the findings are presented as themes with perceived benefits and challenges.

Results

The main benefit, or 'what worked well', for first-time mothers when using the app, was being able to access new information which they felt was reliable and easy to find. This led to a feeling of increased confidence in the information they had accessed thus supporting family and professional communication. The main challenge was the preference for face-to-face information with a healthcare

professional, particularly around specific issues that they wished to discuss in depth. ‘What could have been improved’ included that there were some topics that some mothers would have preferred in more detail, but in other areas they felt well-informed and so did not feel a need to seek additional information via an app.

Conclusions

While this study included a small sample it elicited a rich dataset and insights on first time mothers app interactions. The findings suggest that easily accessible pregnancy information which is perceived as reliable can support first-time mothers in communicating with healthcare professionals. Face-to-face contact with professionals was preferred, particularly to discuss specific and personalized needs. Further research on maternal and professional digital support preferences post the COVID-19 global pandemic is recommended, and how they facilitate antenatal education and informed decision making. Especially as digital solutions remain a key element of pregnancy and early parenting care.

Keywords: pregnancy; antenatal support; antenatal education; communication; digital; pregnancy apps

Introduction

The widespread accessibility and ease of communication has underpinned the development of 'mobile applications' or apps which have led to a fundamental change in the methods that people use to access information [1]. Offcom [2] describe apps that present information in a "*streamlined way that allowed them to access details they needed quickly*". In 2021, the estimated number of global smartphone users was 6.4 billion, a 73.9% increase from 2016, and a growth rate that will mean that by 2023 more than half the people in the world will own a smartphone [3]. In 2020, 429 pregnancy apps were identified in the Apple App store and 1006 in the android equivalent platform Google Play [4]

Previous literature on the design, content and application of pregnancy apps highlights that, although there are a high number of apps targeting pregnancy, quality and usability is highly varied, as are the approaches and outcome measures used to evaluate their impact [5]. When the complexity of pregnancy is considered in the context of app design and interaction, it has been observed that most apps use a shallow functionality with static information framed towards a medical view of pregnancy care [6]. As pregnancy presents physical, informational, emotional and social needs, designers need to consider how to provide support beyond static information or direction to medical professionals. Five common 'types' of pregnancy app content have been identified [6] and include: 1) reference encyclopedias, 2) guides tied to pregnancy timelines or daily information, 3) trackers logs or countdowns, 4) heads up dashboards and 5) text or photograph journal functions. Following analysis of identified pregnancy apps where self-care, psycho-social peer support and partner/spouse support was largely absent, Peyton and Wisniewski suggest that app designers consider the social experience of pregnancy, beyond the medical and corporeal context [6].

In general, women seek to use perinatal health apps in a 'mix and match' approach, along with a wide range of other sources including friends, family, and healthcare professionals (HCPs)[7]. They seek information with a fine balance between awareness and information seeking, with the risk of increasing anxiety and confusion [7]. In accessing apps and digital information during pregnancy, women may be seeking to understand 'normality', to help them to check if their experiences or symptoms are to be expected, or something they should take action on [8]. Pregnant women often seek the experiences of others to support their decision making or to make them feel more informed when raising discussions with professionals [8].

The national child health and wellbeing charity, Best Beginnings, launched the Baby Buddy app in November 2014 [8]. The charity describes the Baby Buddy app as 'an electronically delivered health intervention' that is intended to support and guide women through pregnancy (antenatal) and the first six months of their child's life (postnatal). The app was co-designed with mothers to inform and empower women of all ages and from wide sociodemographic backgrounds so that all expectant parents could search for and benefit from high quality information and support during pregnancy. Best Beginnings worked closely with HCPs to ensure that the Baby Buddy app provided evidence-based information [8].

Best Beginnings have taken a universal proportionalism approach in designing the app and as a child health charity are committed to embracing the growing digital health space to support young families. The content of the Baby Buddy app is written so that it can be understood by anyone with a reading age of 11 years or above with a 'read aloud' element available and can be downloaded free of charge from the Apple app store and the Google Play app store by anyone with a suitable smartphone. The app uses a blend of the five common types of content identified by Peyton and Wisniewski but, in addition, offers a large amount of professional and peer-voiced video content across medical and social and emotional pregnancy and parenthood experiences. The app also allows for personalization at set up including the names of partners or supporters involved in the parent journey. Whilst the Baby Buddy app was developed to target young mothers it was also accessible to a wider range of mothers and families. This was evident from the demographic characteristics captured in Baby Buddy app downloads [9]. This study is one of the first to evaluate a UK based pregnancy app that provides dynamic information and behaviour change content, which has been widely embedded in NHS maternity services, and to further understand perceived benefits and challenges to its use.

An independent, longitudinal mixed method study of the Baby Buddy app was commissioned by Best Beginnings funded by the Big Lottery, U.K. [10]. This observational study assessed the effectiveness of the Baby Buddy app on improving maternal self-efficacy and mental wellbeing [10,11,]. It also involved a qualitative arm which aimed to understand when, why and how first-time mothers use the Baby Buddy app and the perceived benefits and challenges [10]. This paper reports on the qualitative arm of the study.

Methods

Appreciative Inquiry (AI) was chosen to underpin the mixed methods in order to add depth to the quantitative findings [12]. AI is an emerging research methodology that has theoretical and philosophical underpinnings in action research and organisational change [24] and has been used effectively within a variety of complex, structures including health and social care settings. It was useful because it focused on the positive *what works well* before moving on to *what could be improved.* It involves the systematic discovery of what is most effective [12,13].

Sample and Recruitment

Recruitment for the qualitative arm was from three maternity units participating in the main BaBBLeS study [10,11] (North West, South East and Midlands, England). Participant inclusion and exclusion criteria are provided in Table 1. Each woman received a participant information booklet combining the study invitation letter and information booklet.

Table 1 Inclusion and exclusion criteria for participants for the main BaBBleS study from which this sample was drawn [21,22]

INCLUSION/EXCLUSION	CRITERIA
INCLUSION	• Aged 16 years and over • No previous live child • Between 12-16 weeks + 6 days gestation
EXCLUSION	• Younger than 16 years old • Already has one or more children • Before 11 weeks + 6 days or after 17 weeks gestation

Women who participated in the longitudinal study [10], were also invited to a telephone interview or focus group and additional informed consent was obtained. Overall, 17 first-time mothers participated in the qualitative study via telephone interviews (n=9) or a focus group (n=8) across the three sites with women ranging from 12 weeks to 37 weeks (3-9 months) post-natal.

Data Collection Tools

One-to-one interviews and/or focus group interviews were offered and took place in the postnatal period. A total of 60 women agreed to be contacted for an interview across the recruitment sites. Of those women two declined, nine were interviewed over the telephone and eight attended the focus group. A breakdown is included in Table 2 below. The focus group was 'baby friendly' to accommodate additional needs including a sensory soft playroom. A flexible interview style with prompts was developed by the research team and telephone interviews were offered as these are less demanding upon the participants time [14]. Interviews were undertaken by experienced health researchers, including registered midwives.

Table 2 – Breakdown of qualitative sample by site and level of participation

	App users who had agreed to be contacted	*Refusals/ Non-contactable*	*Interviewed*	*Attended Focus group*	*Total Interviewed or attended the focus group*
Sites					
Site A North West	10	8	2	0	2
Site B Midlands	38	26	4	8	12
Site C South East	12	9	3	0	3
Total	**60**	**43**	**9**	**8**	**17**

Telephone interviews were flexible, which was particularly important when considering participants were first-time mothers and were interviewed by midwives who were best placed to discuss and question any concerns the participant was having. The interviews were audio-recorded, then anonymised and transcribed verbatim. In order to maintain consistency and to collect comparable data, the interview schedule for the telephone interviews was developed by the research team alongside the schedule used for the focus groups. Drawing on the AI approach, the interviews specifically explored when, why and how first-time mothers use the Baby Buddy app and the perceived benefits and challenges.

Using the same principles, focus groups were conducted by experienced health researchers, including registered midwives, over a two-hour period during which the first-time mothers were encouraged to work in groups and discuss amongst

themselves. In line with the AI approach [12] comment cards, sticky notes and coloured pens were used to discuss ‘what worked well’ and ‘what could have been better’. In practice, this meant writing or drawing bullet-points to help them to explain their thoughts. Visual prompts included laminated screenshots of the Baby Buddy app’s key features and sections. The Baby Buddy app was also made available on iPads in case they wished to remind themselves of any areas within the app.

Data Analysis

An inductive thematic analysis was undertaken drawn from the in-depth data collated. The thematic analysis was guided by a commonly practised process, described by Braun and Clarke [14]. Principally, this method involves manually sifting through the transcription data and the codes that come out of that data were related to the study objectives and the AI approach. Transcriptions were read and then re-read to ensure in-depth understanding of the meaning behind the written text and then relevant phrases were grouped, framed into grids and tables, categorised into themes and re-grouped into ‘benefits’ or ‘challenges’. Transcripts were reviewed independently by two members of the team with grouping discussed and final themes agreed on. Once all relevant text was coded into themes and substantiated with primary evidence, they were recorded in a finalised matrix (see sample matrix ‘Benefits’).

Ethics and governance

Ethical approval was obtained from the West Midlands - South Birmingham Research Ethics Committee (Reference number: 16/WM/002) via the online integrated Health Research Authority. Ethical approval was also sought and approved from the Research Ethics Committee at the Faculty of Health and Life Sciences, Coventry University (CU), where the ‘medium to high risk’ procedure was adhered to. All participants were anonymised with unique participant information numbers, and transcription undertaken to ensure total anonymity.

Results

In line with the AI approach, the findings are presented under two subheadings which reflect the structure of the focus group and interviews where the questions were posed according to these main questions. In terms of discovering when, why and how first-time mothers interacted with the app, what worked well was described to be linked to themes around accessibility of information including daily pop ups and a need to seek knowledge on certain aspects of pregnancy and birth. Themes around what could be improved were around individual preferences on app function and content. The perceived benefits were described in terms of how access to that information they thought was reliable, increased their sense of confidence to engage in further discussion with HCP and partners. First-time mothers also expressed a desire for greater face-to-face engagement with HCPs or peers as a need that the app would not be able to address.

Benefits

What Worked Well?

In describing what worked well, mothers discussed how they negotiated the app to increase their knowledge and understanding of pregnancy topics and app and some had been guided to do so by HCPs. While some would use this app along with a range of other sources of information to seek information about specific topics, the app would prompt them to discover topics they had not yet considered. There were four themes that emerged from the mothers account of what they thought worked well in using the app.

New information

Throughout the interviews and focus groups, first-time mothers spoke about how they liked acquiring the information they received from the Baby Buddy app and how this made them feel that they had increased their knowledge. They suggested it was just the right amount of information, topics were concise and easy to understand, and they were able to recall details they had learned in the focus group and interviews.:

“I like the information about what size it was and what to think about in terms of my health, and how the baby was growing and getting ready.” (P6)

The first-time mothers also discussed the fact that the information on the Baby Buddy app gave them more information about their pregnancy, particularly when engaging with HCPs. This was evident, specifically when accessing key words which they may have been unfamiliar with:

"So sometimes my midwife would say certain things, and I would like, if it was something medical, go and look at what was going on, and what words meant, and also like for areas, like GPs and different …. I'd go and look for information there..." (P33)

The information provided by the Baby Buddy app continued from pregnancy through to post-natal information and may have increased knowledge. First time mothers also suggested it was nice to still have notifications regarding their baby's development up to a month after birth. Breastfeeding was a particular feature from which first-time mothers felt they had learnt a great deal:

"Gosh there's loads, I think I learned that you can restart your milk supply, and different ways of feeding her so, I struggled a little bit at first because she was taking too much too quickly, but I read that if I leant back a little bit it would slow the flow down." (P102)

"from the community, the community one helped quite a lot, when the baby was first born I was told to look at it for like breast feeding bits and stuff, by my midwife and the breast feeding team…that was useful." (P103)

Quotes demonstrate how first-time mothers were not only actively using the information they had found to support their decisions in the postnatal period but also how HCPs and first-time mothers were interacting via the Baby Buddy app, which may have helped to keep lines of communication open. First-time mothers also learned about the size and development of their child throughout pregnancy via the Baby Buddy app which seemed to support engagement with the app and may improve first-time mothers' confidence and the feeling of being in control:

"How much is your baby, for example at 36, you see a picture and your baby, what is doing your baby, with the eyes, the mouth. For vomiting, it tells you when your vomiting will stop, or what you feel when your baby is coming in the last few months." (P104)

"Probably more about the foetus's growth, yes what it was actually doing at certain points, as opposed to the birth, because I think a lot of my friends already had children and I've done a lot of work with mothers and babies in my job, I think I was quite aware of certain stories and options, yes but it was definitely the fetus's growth.... Which is really exciting to know especially in a first pregnancy isn't it." (P105)

Overall, the data suggest that participants were using the Baby Buddy app both during the antenatal and post-natal periods to access knowledge and inform decision making along their journey as a first-time mother.

Reliability

The themes developed through extracted quotes, indicate that first-time mothers felt one of the clear benefits was that the information provided in the Baby Buddy app was provided by professional sources which conveyed reliability, as described in these extracts:

"and I think that the Baby Buddy one because you know that it's been tried and tested by midwives it's not just generic information, every day you're getting something to think about" (P58)

"Yes, because you feel confident knowing that it's tried and tested by midwives, in the videos you have the Midwives perspective, I liked that" (P66)

When first-time mothers compared the Baby Buddy app to other online sources of information, such as other maternity apps and sources like Google, they felt these may not be as reliable. Watching film footage of midwives providing information on topics such as breastfeeding, first-time mothers described feeling reassured that they were receiving reliable information. Mothers seemed to trust the information they were receiving which helped to reassure them:

"...and at the end of the week it would say the measurements of the child and what kinds of things you should be going through, so it really helped you in the pregnancy just to know what was happening, instead of like panicking about things, so like that's normal.." (P4)

These comments suggest that the Baby Buddy app acted as a source of comfort for some first-time mothers, helping them to stay calm and positive about their pregnancy. Participants appreciated the videos with accounts of experiencing motherhood:

"Thinking about it I did watch some of the films with the mums talking, about their experiences, I did watch those as well, a few of them, just interesting really, I don't think I necessarily got anything I didn't know from it, but it's nice to see, with other mums" (P14)

The Baby Buddy app can be used to set reminders for appointments, dates to remember and an exercise tool which participants reported using:

"You could use it to remind yourself to do things, like your pelvic floor exercises." (P29)

"Yes, and if you have appointment for my baby or my appointment, so I go to the application and I know." (P30)

In addition to the app providing information, it also included capabilities which allowed users to add information to the app such as appointments with midwives. This feature of the app encourages long-term engagement by providing first-time mothers the opportunity to use the app throughout pregnancy and post birth. This also suggests that the Baby Buddy app was being used as an organisational tool for first-time mothers, keeping lines of communication open between them and their HCP.

Using the Baby Buddy app – ease of access

In exploring when, how and why first-time mothers used the Baby Buddy app, the majority agreed that, once they had downloaded it, information was easily accessible. They were able to track their daily progress, read daily updates via pop ups and find information related to specific topics with ease. They particularly liked the daily pop ups, which were useful for women who worked and did not have time to search through information regarding their pregnancy as described below:

"*...the updates would come, and they didn't like override, some apps pregnancy things coming all the time, this one just gave you one simple answer a day, so nice and easy and not too much…*" (P26)

A steady flow of alerts and pop ups provided by the Baby Buddy app ensured women had easy accessibility and readily available information throughout their pregnancy, regardless of where they were. When more detail about a particular topic was required, this could be accessed via the app at a time that suited women:

"*.....because you're getting information every day, it will provide you with links, the app was the foundational platform for looking up more stuff, it would give you like a summary of what to expect, so one thing I liked about the app was, you didn't necessarily have to wait to say 7 months pregnant to tell you about pain relief options, it would make suggestions about that early on, so that when I did go to my antenatal classes where they teach you about that stuff I kind of had an idea and then you knew you could ask more questions*." (P36)

In turn, the alerts and pop-ups led to first-time mothers watching films about specific topics and accessing their customised character or 'Avatars', (where the appearance (hair, skin tone, clothes, body shape) can be altered to resemble themselves or designed to their preference to guide them through the app content). They also particularly enjoyed videos about breastfeeding, which provided another layer of depth of information:

"(talking about breastfeeding and latching) Yes, people can tell you how to do it, but actually seeing on the video it being done was much clearer," (P65)

In particular, some participants also used the Baby Buddy app to find out information about pregnancy related problems. One woman told us that as soon as she was diagnosed with pre-eclampsia she used the app for information which helped her as below:

, "..the videos I watched were mostly to do with pregnancy, it was actually like really helpful, cos I ended up really ill with the pregnancy, that's why I've got him now, I shouldn't have had him, he shouldn't have been here, he was 5 weeks early, I had pre-eclampsia.....yes, so that app did help me, it guided me a little bit" [P3], and also, *"yes I mean, some of the things that obviously I'm a 1st time mum, so, no matter how*

confident you feel going into it, once you've given birth its looking for answers to questions that you don't realise you're going to have beforehand if you know what I mean?" [P2].

In addition to being able to access daily information, films, updates and personalise avatars, the first-time mothers expressed approval for the Baby Buddy app's sharing capability, which allowed them to share 'tailor-made' information with partners and their families and friends:

*"I like the fact that the app allows you to put your husband's name in, so it says you can talk to "****" about this, and he could have downloaded the app, I thought it was really nice"* (P59)

"...and it refers about your husband or partner by name if you put that information in, I really like that. I would definitely recommend it to other people, my sister's just got pregnant and I recommended it to her." (P60)

These findings indicate that the Baby Buddy app prompts, short films and easily accessible information, may be particular features which encouraged women's engagement with the app. The sharing capability of the app also ensured women could provide information to their friends and partners, which may have further improved app engagement.

Increased confidence

A further clear benefit was that the more mothers felt the information they were accessing within the app was reliable, the more they used it to support their pregnancy and postnatal care. First-time mothers felt that being equipped with the knowledge they had accrued from the Baby Buddy app gave them more confidence to plan their care with a HCP:

"I think I used it to make choices, I used it together with parent-craft classes, I used them together because I liked that you had the video of the midwife explaining different types of pain relief options, and you had the script that you could read about the different options, so it just meant you could really think about it, one of the things I did was I downloaded the NHS birth-plan template and wrote mine out in pencil so

that when went to the actual classes, I could ask questions, I could change my plan, it gave you confidence that you weren't going off to something with nothing." (P37)

Participants from the focus groups also reported that they would use the information from the Baby Buddy app to support their discussions around choice with partners and family members; feeling knowledgeable and therefore having the confidence to do so. This may have provided women with more control over their choices and decisions, which in turn could empower them to feel more confident about the care they receive and the care they provide to their baby:

"I just thought it was a good platform, because as a new mum you know you're pregnant but you don't know what to expect, so it's always nice to have this foundational knowledge to make you feel confident about decisions that you are making. It wasn't complicated to use." (P64)

Challenges

What could be better?

An intervention that supports help seeking behaviour

Although first-time mothers valued and trusted the information provided by the app, they expressed a preference for face-to-face support from their HCPs. When they needed specific information about breastfeeding or general advice for their child, they would often seek out advice from a HCP in preference to accessing the Baby Buddy app's features:

"*but if we think we're doing something wrong then I tend to ring the doctors, or the health visitor…because we're first-time parents and we don't want to do anything wrong, and we don't want to go by the book, like, in case it's not the right decision, I think it depends on your baby's development as well I think."* (P80)

However, data also highlighted that, although first-time mothers enjoyed interacting with the Baby Buddy app, they still preferred reassurance from a HCP. This could be because they preferred face-to-face contact and may have needed further reassurance about the decisions they were making.

First-time mothers also spoke of their preference for antenatal classes towards the latter half of their pregnancy. One participant described the amount of Baby Buddy app use diminished once antenatal classes were attended:

"….towards the end when I started NCT classes I used it less, but it was definitely very helpful in the first 6 or 7 months I'd say." (P6)

Antenatal classes offer the opportunity for facilitated learning and social interaction with peers which is not available to women through the Baby Buddy app.

Where the need for App improvements was identified

Although first-time mothers spoke positively about the daily information, knowledge and support they received via the Baby Buddy app, there were particular areas throughout pregnancy and post-birth where participants would have liked more detail, including pregnancy and labour progress, birth plans, a check list of items to have ready for giving birth and longer post-birth support:

"The thing I was sad about with the Baby Buddy app was that it finished ……it would be nice if it followed you for one year after you've had your baby, because it's a really useful simple app" (P66).

First-time mothers suggested that expanding the detailed information for the week-by-week pregnancy journey would be beneficial, specifically further information about their child's development and what to expect:

"*the only things that I would have liked more of was like the week by week update, as they're growing, the foetus, a bit more detail in it*" (p92)

First-time mothers also suggested additional features for the Baby Buddy such as tools to make decisions for labour, a contraction counter and an accessible birthing plan template. Nevertheless, in over two thirds of interviews, the mothers did not think anything needed improving in the Baby Buddy app. Some first-time mothers reported downloading the Baby Buddy app but did not actively use its features. This may be due to individual differences between first-time mothers who participated in this study. This includes language considerations as some mothers struggled to fully interpret or understand the information as there was no option to change from English:

"*If you could put in this application the Greek language, or different languages, you know, because sometimes I can't read it, I can't understand it, sometimes I need to copy paste and translate. So put in more languages. I have friends from Poland, and they use this application and they tell me to translate for them, and I may be working or something like that."* (P96)

Mothers in this study may also not have used the Baby Buddy app after downloading it due to their existing knowledge and beliefs. This was particularly evident when they were asked if the information and films on breast feeding had helped guide their decisions around the topic area as described below:

"*I always knew that breastfeeding was what I wanted to do, but it set my mind in that mindset, this is what I'm going to do, I was determined to do it."* (P97)

Discussion

This is one of the first qualitative studies aiming to understand when, why and how first-time mothers use the Baby Buddy app* and the perceived benefits and challenges. By taking an AI approach, the questions of what worked well and what could be improved were explored with app users who were able to relate a range of experiences they had with using the app alongside their pregnancy to postnatal journey.

First-time mothers who participated in the qualitative arm of the study found that the Baby Buddy app worked well due to its accessibility and that the information was concise and easy to find. This made them feel they gained knowledge and felt the information was reliable due to its association with HCPs in the film and written content. They liked that information was linear but that different aspects could be accessed as and when needed. They particularly liked the personalised daily updates of the progress of their pregnancy and child development. This had a snowball effect in that it reassured these mothers that the information they were receiving was correct. This appeared to increase their confidence in using the app and encouraged them to continue using it throughout pregnancy and post-birth care with the HCP. These mothers were particularly reassured by the reliability of the sources of the videos in the Baby Buddy app that feature midwives. This gave them the confidence to ask more detailed questions from their HCPs, knowing that they could always refer to the Baby Buddy app if necessary. Time pressure is a known a

key barrier to effective discussion about the content of leaflets [16]; the Baby Buddy app offers women the opportunity to browse and explore information according to their own needs and interest. This mitigates against the selectivity of HCPs and may contribute to a sense of greater confidence in discussing birth options.

Our findings align with other work which has explored how women use digital information to enhance their candidacy for appropriate use and escalation of concerns to a HCP [17]. Similarly, we found women were more confident in discussing issues with HCPs when they felt they had some knowledge as a starting point. Candidacy in the context of maternity care has been described as a dynamic and continuous process subject to re-definition through interactions [18]. Eligibility for health care is determined by themselves and health services and there may be increased barriers for a more vulnerable population [18]. The concept of empowerment is one that is frequently referred to within maternity services, and external attributes of this concept include access and control over resources including reliable knowledge and information [19]. The nurturing of candidacy and empowerment within the maternity population is arguably critical as part of the transition to parenthood; the consequences can influence satisfaction with birth experiences, contribution to overall health of families, and the development of self-advocacy [19]. An interesting novel observation emerging from our findings was that women reported using the information from the app to support conversations with family members about birth and feeding choices. The influence of those in their immediate social sphere are known to have significant influence on mother's decision making [20]. The participants were recruited from the BaBBLeS cohort study [10,11], which had change in self-efficacy as the primary outcome. While the study reported no significant difference in change in self-efficacy scores from pregnancy to 3 months post-birth in app users, it is worth noting that average baseline self-efficacy (measured using Tool to Measure Parenting Self-efficiacy (TOPSE)) was high. mHealth adoption and engagement in users with high baseline self-efficacy has been reported in other studies into mHealth [21]. In our findings, women described how access to reliable digital information had provided *'a foundational knowledge to make you feel confident about decisions you are making'*. Self-efficacy theory [22] implies that the antecedents of self-efficacy include mastery and vicarious experience, both of which can be observed from the participants experiences of using the app. This aligns with previous research where women who engageed in online forums demonstrate increased health literacy and further confidence in raising questions with health care providers [23,24].

It should be noted that the first-time mothers who were interviewed were often using multiple sources to access information including other maternity apps, or web pages. They used a “pick and choose” technology consumer style approach to decide the type and particular type of information that they used from different apps. This is in agreement with an investigation into mHealth activities of disadvantaged pregnant women in the USA discovered that a high number of women (97%) engaged in pregnancy health information through a combination of websites and apps [25]. This is further evidence that women turn to a wide range of both online and offline resources for informational needs in pregnancy [7]. This again highlights the need for reliable and consistency of information in mHealth interventions in pregnancy as confusion and contradicting or false information could undermine the HCP relationship, lead to an erosion of candidacy and have negative impacts. Although first-time mothers appreciated the information received, many preferred in-practice supports via HCPs, such as their midwife. Whilst they felt the Baby Buddy app was reliable, as first-time mothers they wanted to seek face-to-face advice from a HCP to support their decision-making. This highlights the central importance of “a face” within the health system [26].

All data for this study were collected prior to the 2020 COVID-19 pandemic when, in order to limit contact with pregnant women, much of antenatal care provision became virtual. Feedback to evaluate a virtual antenatal clinic implemented at this time in the UK reported that 86% of service users were highly satisfied with the virtual clinic. Notably there were no differences by demographics of either age or ethnicity, but 56% still preferred face-to-face [27]. HCPs also reported a high level of approval for long-term use of virtual clinics with 78% rating their experience as the same or better than face-to-face clinics [27]. While the COVID-19 pandemic has pushed digital and remote solutions to the fore and were received well as a suitable crisis contingency, time will tell how much of a reduction in face-to face-contact is acceptable to women outside of the context of a global pandemic. While virtual clinics offer feasible advantages to women in terms of reducing travel, time away from work, childcare challenges etc., this must be considered in the context of those for whom digital exclusion is a reality, who experience language and context difficulties in virtual encounters and who may need face to face appointments to build a relationship of trust with their care team. As England rolls out a Midwifery continuity of carer model, with personalized and relationship-based care at its core [28], the place of digital and virtual care is already being considered with the roll out of the digital maternity transformation alongside. A key aspect of the application of mHealth to support

midwifery tasks has the potential to lead to efficiencies that free up time for relationship-building in face-to-face contacts.

One of the barriers was that some mothers made a conscious decision not to engage in some of the more ‘nerve wracking’ topics of information, such as labour or post-birth care. The extent to which users of online content can exert this avoidance selectivity should be considered by HCPs when discussing any online resource use. This may also help to increase discussion around any fears, worries or concerns they may have, highlighting mental health issues, and seeking further support if needed. It has previously been shown that pregnancy health app non-engagers had scored higher in the State Trait Anxiety Index than app engagers [5]. In the main cohort study from where the sample for this work was drawn, lower levels of self-reported social support was associated with poorer mental wellbeing scores [29]. In addition to this ,a negative association was seen between self-reported social support and socioeconomic status [29]. An investigation into how women narrate anxiety and depression in pregnancy found that women are highly conscious of the socially constructed imperative to be happy and positive to maintain the perception of a ‘good mother’ [30]. Women distanced themselves from the language of distress and wished to appear in control of their emotions [30]. This included using discursive strategies such as distancing from the depressed self, using codes to discuss issues around distress and seeking to portray balance and control of emotions to maintain the ‘happiness imperative’ [30]. Future app design and research into the human computer interaction in a pregnancy context, should explore this issue in more depth to understand how presentation of information can do so in a way to avoid increasing anxiety, feelings of social exclusion or perpetuation of societal ideal imagery.

The Baby Buddy app at this time lacked social engagement within its current features. First-time mothers felt that during the latter half of pregnancy antenatal classes were more engaging and so gave them the opportunity to speak to other first-time mothers about their decisions and worries as well as with HCPs. Having access to peer support via social groups, shared discussion and perspectives might increase the likelihood of mothers feeling ‘safer’ to interact in these topics. A recommendation for future use of any app would include conspicuous information on where to find group support sessions with other first-time mothers. Although the Baby Buddy app potentially has this feature, this study found that many mothers were not aware and so it was undiscovered. In addition, an interactive online group discussion feature to keep first-time mothers engaged throughout latter stages of pregnancy and post-birth may be particularly valuable to women during COVID-19 recovery but

would need additional resource for content moderation. Further research into women's preference for group antenatal education via digital platforms,face-to-face or a combination of both is also required for future service design, including full evaluation of innovations emerging from the pandemic [31]. It is worth noting that since this study took place, the Baby Buddy app is now on version 2.0 and has been developed further with additional content including increased information on local services, information for Dads and access to a maternity helpline.

Whilst this study only interviewed 17 women, the team gathered many rich and in-depth views and perspectives from first-time mothers. The extent to which these findings would apply to second- or third-time mothers is difficult to infer and while other studies have also found first-time mothers to be more frequent app users [5] they may have different needs and expectations, given previous experience with maternity services. The cohort study from which our sample was drawn [10] was typical of a UK pregnancy and digital health research demographic, in that it was predominantly white, well-educated and older women who volunteered for the study, despite the recruitment sites representing a broader demographic. Strategies to ensure engagement of broader ethnic and socio-economic and maternal age groups would provide greater understanding of the transferability of the findings. Research to focus on specific demographic groups and their interaction with digital services and interventions is required to produce a truly equitable future maternity service which undoubtedly will compose of a combination of digital and face-to-face delivery of care. Similar work exploring the experiences of fathers, and other parenting dyads in their perinatal mHealth needs, would be of value including the need for inclusion of LGBTQ+ communities in the perinatal digital space.

Conclusion

This paper adds to current literature on pregnancy app interaction and explores how women have engaged with a specific NHS approved app that was co-designed with service users and has sought professional validation of content for reliability. The insight gleaned builds on the understanding of how mHealth and digital interventions can contribute to women's sense of empowerment through access to information to use to negotiate health care choices both with health professionals and within families. Pre-COVID, first-time mothers preferred in-practice support from their healthcare professionals and engaged less with the app as they developed peer support in later pregnancy from antenatal groups. Further work is required to determine how these preferences evolve post-pandemic. Whilst the Baby Buddy app

was useful, multiple sources of online information were sought by first-time mothers when sections in the app were not available.

Findings presented here could support the design and development of interventions aimed to encourage first-time mothers' engagement with digital health management tools. In addition, these findings can lead to further understanding of mhealth behaviour during pregnancy and the relationship between digital technology and human interaction.

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Conflicts of Interests

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Abbreviations

NHS National Health Service

AI Appreciative Inquiry

HCPs Health Care Professionals

NCT National Childbirth Trust

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