



ORIGINAL RESEARCH – QUANTITATIVE

An Australian survey of women's use of pregnancy and parenting apps

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ABSTRACT

Background: There are now many pregnancy and parenting apps available on the market for both pregnancy and parenting.

Aims: To investigate how Australian women use pregnancy and parenting apps, their attitudes about the information provided and data privacy and security related to such use, and what features they look for in these apps.

Methods: An online survey was completed by 410 women who were pregnant or had given birth to at least one child in the past three years, were aged between 18 and 45 and were competent in English.

Findings: The use of pregnancy and parenting apps was common among the respondents. Almost three quarters of respondents had used at least one pregnancy app; half reported using at least one parenting app. Respondents found the apps useful or helpful, particularly for providing information, monitoring foetal or child development and changes in their own bodies and providing reassurance. Yet many users were not actively assessing the validity of the content of these apps or considering issues concerning the security and privacy of the personal information about themselves and their children that these apps collect.

Conclusion: Apps are becoming important as a source of information and self-monitoring and for providing reassurance for Australian pregnant women and mothers with young children. Midwives and other healthcare professionals providing care and support for pregnant women and women in the early years of motherhood need to take women's app use into account and recognise both the potential and limitations of these apps.

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Summary of relevance:

Issue

The paper reports on original findings from a survey focusing exclusively on how and why a non-random sample of 410 women around Australia are using pregnancy and parenting apps.

What is already known

Women in western countries often use digital media for information and support during pregnancy and the early years of motherhood and find these very helpful.

What this paper adds

The use of pregnancy and parenting apps was common among the respondents. Almost three quarters of respondents had used at least one pregnancy app; half reported using at least one parenting app. Yet many users were not actively assessing the validity of the content of these apps or considering issues concerning the security and privacy of their personal information.

1. Introduction

Many women in western countries are now turning to digital sources for information and support during pregnancy and early motherhood more than at any other time of their lives.¹ This is a life phase when women are adjusting to their new status as

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mothers. They may be dealing with uncertainty, anxiety and isolation, as well as learning how to care for their newborn infants. The advent of the Internet allowed pregnant women and those experiencing early motherhood to use websites and online discussion boards to seek information about conception, pregnancy and motherhood and engage in discussion with other women. In recent times, newer digital technologies such as social media (for example, Facebook, Instagram, YouTube and Twitter), apps and self-tracking devices have brought with them different practices for self-monitoring and the sharing of personal information. These novel technologies provide expanded opportunities for women to create and comment on online content, monitor their bodies and those of their foetuses and infants with increasing quantitative precision and to share their personal experiences about their pregnancies or mothering experiences on social media networks.

In this article, we focus on pregnancy and parenting apps as one of these new digital media forms. Many pregnancy and parenting apps for smartphones and other mobile devices are on the market – more than one thousand for pregnancy alone.² Healthcare and public health professionals have observed that many women seeking maternity care and child health services are using these apps and that app use should be considered in the future planning of care provision.^{3,4} Despite the prevalence and apparent popularity of these apps, as yet little research has been published that has focused in detail on how women use them, particularly in the Australian context.

The research reported here is drawn from an integrated research programme on digitised pregnancy and parenting involving: (1) a critical content analysis of pregnancy-related apps^{2,5}; (2) an online survey of 410 Australian women's use of pregnancy and parenting apps; and (3) focus groups with Sydney women about their use of apps and other digital media for pregnancy and parenting. The present article reports the findings of the online survey. Our aims were to investigate how Australian women use pregnancy and parenting apps, their attitudes about the information provided and data privacy and security related to such use, and what features they look for in these apps.

2. Background

2.1. Pregnancy and parenting apps

Australians have a very high rate of smartphone ownership and app use: estimates of ownership of smartphones in Australia based on the latest data (from 2014) range from 74%⁶ to 89%.⁷ However, it should be noted that the ownership of smartphones and use of the internet are considerably lower among certain population groups, such as older people, those with disabilities, low-income groups and those with lower levels of education.^{8–10} Of those Australians owning smartphones in May 2014, three-quarters had downloaded an app in the previous six months.¹¹ Pregnancy apps are popular in the health and fitness category: a market research report showed that pregnancy apps were used more often than fitness apps.¹²

One of us with Gareth Thomas conducted a critical discourse analysis of all pregnancy apps offered in the two major online app stores (Google Play and the Apple App Store) in June 2015.^{2,5} The analysis found that the App Store offered 1141 pregnancy apps while Google Play had 665 pregnancy apps available for download (many of the same apps were available in both stores). The vast majority of apps were in three main categories: 'entertainment', 'pregnancy and foetal monitoring' and 'pregnancy information'. The prevalence of pregnancy apps for entertainment – the largest category of apps – is worthy of note. Included in this category were games, pregnancy test and ultrasound pranks, shopping for pregnancy-related products, quizzes to test pregnancy knowledge,

gender predictors, and baby name generators. The second largest category of apps was those that provided functions that encourage women to monitor and survey both the foetus and the pregnant body. This includes tracking weight and waist measurements, diet, water consumption, symptoms, moods, medications, cravings, energy levels, and appetite. Other apps in this category allow women to input due dates and appointments, record foetal heartbeat and movement, write journals and create scrapbooks, and share ultrasound images and biometric data (for example, kicks, heartbeats) with health professionals as well as friends and family members via social media. The third category provides a range of information about pregnancy, including details about foetal development, nutrition and exercise in pregnancy and substances and behaviours that pregnant women should avoid in the interests of maintaining their health and promoting the health and optimum development of their foetus. Some information apps offer women online forums in which to connect with other pregnant women (for example, to share and compare stories and experiences).

Pregnancy and parenting apps regularly feature among the most popular in the health and fitness and medical categories (the apps appearing in the top charts for each week can be viewed on each website under app categories). The Google Play app store (which, unlike Apple, lists downloads for apps) shows that the most popular of the pregnancy and parenting apps have been downloaded by millions of users. For example, the 'I'm Expecting – Pregnancy App' attracted 1 to 5 million downloads from the Google Play store alone. The Apple App Store's list of popular health and fitness apps in June 2015 featured several pregnancy-related apps such as 'Period Diary' (a fertility and ovulation tracker), 'My Pregnancy Today', 'Pregnancy & Baby – What to Expect' and 'Baby Names'.

Academic research is beginning to show that pregnant women and new mothers commonly download pregnancy and parenting apps and find them useful sources of information and support. For example, a study of women using maternity services in Ireland in 2015 found 76% of respondents had a smartphone and 59% of those used a pregnancy app. The researchers suggest that websites and apps may be particularly helpful for women from socioeconomically disadvantaged groups, who may lack access to other sources of information and advice.¹³ Other research involving African-American first-time mothers found that they were more engaged with apps on pregnancy and parenting than with the pamphlets they received from their health carers.¹⁴ A large-scale national online survey conducted with American women who had recently given birth found that 56% of first-time mothers rated pregnancy apps as providing very valuable information, as did 47% of experienced mothers. However, only 35% rated apps as completely or very trustworthy.¹⁵ Other researchers have found that women note the difficulty of assessing the credibility of information provided. They are more likely to invest their trust in the advice and information given by healthcare providers and in the online information provided by such providers or medical institutions.^{16–18}

A series of focus groups carried out with pregnant women in the US state of Pennsylvania in 2013 elicited the women's views on online technologies related to pregnancy.¹⁹ This study found that over 80% of the women reported using social media sites at least once a day. The participants said that they used online sites and apps for pregnancy information because prenatal care was not meeting their needs, particularly when they wanted information early in their pregnancy when few prenatal visits are scheduled. The women in this study, the majority of whom were white, referred to using apps to track their foetus's growth and development and social media sites like Facebook to share their experiences. They also found videos on childbirth that were available on the Internet to be useful sources of information.

However, they sometimes became anxious about something they had read on a site or app and found that no advice was provided on what to do.

Australian-based research on women's use of online and other digital media for pregnancy and parenting remains scarce, limited to specific geographical areas and discussing app use only briefly. Wen and colleagues investigated sources of online health information for first-time mothers in southwest Sydney, Australia, finding that women who were of lower socioeconomic status were less likely to seek such information.¹⁰ They focused only on websites, however, as their research predated the expansion of the use of smartphones, apps and social media. Hearn and colleagues conducted a more recent study, which included a survey and focus groups with perinatal women in Western Australia and was focused on developing apps and other online resources as interventions for a weight-management program.¹⁶ This study found that women wanted apps linked to trustworthy websites containing short answers to everyday concerns and personalised tools to assess their weight, nutrition and fitness.

Another project involved conducting qualitative interviews with pregnant women in South Australia about their use of mobile phones and the internet for information.¹⁷ Participants were self-selecting, and the majority of the women interviewed were white; 66% of interviewees lived in a low socioeconomic area. This research found that 40% of the women reported using at least one pregnancy-related app. A small Sydney-based study involved interviews with perinatal women about a range of experiences in pregnancy and early parenting.²⁰ Some of the participants spontaneously raised the issue of using apps and remarked that they appreciated the convenience offered by apps for accessing information about the development of their pregnancy.

2.2. *Validity, privacy and security issues*

At the same time as the use of apps for medical and health-related purposes is becoming more common, several researchers are beginning to express concern about the validity and credibility of the information that the developers of health and medical apps provide.^{21,22} Despite the authority that many such apps seek to convey, there are no industry standards in place to monitor the content of pregnancy- or any other kind of health-related apps.⁴ There is little independent regulation for the development and publication of health and medical apps in many countries, including Australia. The globalised nature of the app economy and the continuing proliferation of apps (thousands of new apps each day) into the marketplace render such regulation very difficult.

There are also significant concerns related to privacy and security around health and medical apps. Personal data have become highly valuable in the digital data knowledge economy. These details are frequently harvested by companies and used for marketing purposes.²³ It can be very difficult for app users to delete their personal data from apps or opt out from apps collecting their details. Most app developers require, at the minimum, users to agree to terms and conditions when downloading an app that involve access to the user's geolocation, social network profiles and contact details. This has been described as 'over-permission': asking for personal details when these details are not required to use the app itself. This practice often leads to data leakage, where the data obtained are used for commercial purposes by the app developers or agencies to which they on-sell the data.²⁴ Many of the most popular health and medical apps send data unencrypted, thus rendering personal data open to hacking.²⁵

The lack of app regulation and data security and privacy issue particularly affect pregnant women or women with young children. Members of this demographic have been identified as

the most lucrative demographic group for marketers, as they are purchasing many new goods and services. Their personal data are therefore very valuable to commercial entities.²⁶ One assessment of ten popular free apps relating to maternal and child health found significant variation in the quality of content, functionality and security.²² Only three of the developers of the parenting and pregnancy apps that were studied had implemented a security mechanism to guarantee privacy and confidentiality. Women may be particularly vulnerable if they come from less advantaged backgrounds, with lower levels of education or expertise in engaging with digital technologies. People in general who come from marginalised social groups or lower socioeconomic backgrounds tend to have lower levels of digital literacy and opportunities to protect their personal data.²⁷

2.3. *Aims*

Previous research has revealed the importance of pregnancy and parenting apps for many women in western countries. However, this research does not focus explicitly on app use. Instead, it incorporates questions about apps into a broader overview of digital media use. Nor have many studies focused on the Australian context. Our study was directed specifically at pregnancy and parenting app use among Australian women who were pregnant or who had given birth in the past three years. We placed a particular focus on what they used apps for their attitudes about the information provided and data privacy and security related to such use, and what features they look for in these apps.

3. *Methods*

An online survey was undertaken in November 2014 using a questionnaire devised by the first author. The questionnaire included questions on whether the respondents had ever used apps related to pregnancy and parenting, for what purposes they had used the apps, what they found most useful or helpful about these apps and whether they had checked the credibility of information provided by the app developers or were concerned about data privacy and security issues in relation to using the apps. An open-ended question was included as the final questionnaire item, in which the respondents were asked to identify the features they would ideally like to see in a pregnancy or parenting app.

3.1. *Recruitment*

The online questionnaire was administered by a market research company to members of the company's research panels. These panels include members of the public who voluntarily register with the market research company to participate in research. They are provided with financial incentives for participation based on a structured incentive scheme developed by the company. The market research company was asked to recruit eligible participants from their panels and to calculate survey participant numbers based on the first author's specifications. The sample recruitment guidelines were purposively designed based on the following criteria for inclusion: women living in Australia who were either currently pregnant or who had given birth within the past three years; aged between 18 and 45; and proficient in reading and writing English. Sub-quotas were established to ensure that respondents would be recruited from all Australian territories and states and from urban and rural areas in proportions that accorded with Australian Bureau of Statistics (ABS) census data. The market research company calculated that a total of 410 respondents would be required to fill these sub-quotas. They sent targeted requests to their panels to reach the sub-quotas specified until this total of completed questionnaires was achieved.

3.2. Ethical considerations

The human ethics committee of the University of Canberra approved the study. Respondents were provided with participant and consent to participate information by the market research company using the format specified by the committee. They demonstrated their agreement to participate using an online check-box on the first page of the survey before continuing with the survey questions.

3.3. Data analysis

The market research company provided the survey responses to the authors in the form of raw counts and percentages for each survey item. Both authors analysed the respondents' written answers to the open-ended questions using content analysis, by going through all the comments and collaboratively identifying the major themes.

4. Findings

4.1. Demographic characteristics

The demographic characteristics of the total of the 410 respondents are presented in Table 1. As it shows, the majority of respondents (85%) were aged between 25 and 40. As directed by the sub-quota sampling, the respondents came from all states and territories of Australia, with larger numbers coming from the most populous states of New South Wales, Victoria and Queensland. Most of the respondents (over two-third) lived in a city, although a third lived in towns or rural or remote regions. These proportions reflect ABS statistics.²⁸ More than half the respondents identified themselves as having British/Irish ancestry, but the remainder were diverse in their ethnic backgrounds. The respondents as a whole were well educated, with half having completed a university degree and a further one in five having some uncompleted university education. This level of education is higher than levels in the Australian adult population, where only one-quarter have completed a university degree.²⁹ As the respondents were women who had volunteered to be part of the market research panels and were rewarded financially for completing the survey, this may have influenced their responses in some (unknown) ways.

4.2. Use of pregnancy apps

Almost three-quarters (73%) of the respondents said that they had used a pregnancy app. Of these respondents, 37% had used only one app, 57% had used between 2 and 4 and 6% had used 5 or more apps. Those women who used apps tended to do so often during their pregnancy: 27% of these respondents had used a pregnancy app a few times a week during their pregnancy; 26% had used one

Table 2

Reasons pregnancy apps are used (respondents could nominate more than one reason), frequency of respondents nominating ($n = 298$).

Reason for use	<i>n</i>	%
Information about foetal development	255	86
Information about changes in body in pregnancy	212	71
Tracking own body	98	33
Online discussions with other pregnant women	79	27
Tracking foetus	54	18
Keeping tracking of medical information/appointments etc.	53	18
Keeping a pregnancy journal	43	14
Uploading/storing pregnancy photos	27	9
Uploading/storing foetal ultrasound images	12	4
Other	15	5

daily; 22% every week or so; 11% a few times; 8% every month or so; and 4% only once or twice.

Table 2 shows the respondents' reasons for their use of pregnancy apps. The most popular use of an app was for information about foetal development (86%), although information about changes in women's bodies related to pregnancy (71%) was also a frequent reason to use an app. Other uses of apps included tracking aspects of the user's body during pregnancy, such as weight gain or diet (33%); online discussions with other pregnant women (27%); tracking aspects of their foetus, such as its heart rate (18%); keeping track of information about their medical appointments, test results and so on (18%); for keeping a pregnancy journal (14%); for uploading and storing photos of themselves while pregnant (9%); for uploading and storing foetal ultrasound images (4%); other (5%).

The vast majority of respondents who had ever used a pregnancy app (92%) said that they found the apps useful or helpful. As shown in Table 3, they responded that apps gave useful information (83%); they helped the women monitor their foetus's development (70%) or changes in their own body (59%); and they provided reassurance (58%). Some apps provide in-app opportunities to contribute to discussion boards with other pregnant women, and 24% found this feature useful or helpful. Less common features of pregnancy apps that were considered useful or helpful were allowing women to keep track of their medical appointments and other medical details (16%); share information about their pregnancy with friends and family (14%); store photographs or videos of their changing body (9%); and store ultrasound images of the foetus (3%).

The respondents who used pregnancy apps were asked if they ever thought to check where the pregnancy app developers obtained the information that they used in the apps that they used. It was evident from the results that this group of women was not very concerned about checking the validity of the information presented in the pregnancy apps that they used. Almost three-quarters of those who had ever used pregnancy apps (74%) had not checked the sources of the information. Only 8% said that they had

Table 1

Respondent demographics ($n = 410$).

Age (%)	State/territory (%)	Residence (%)	Education level (%)	Ethnicity (%) ^a
18–24: 3	NSW: 33	City: 68	<Final high school: 10	British/Irish: 54
25–30: 25	VIC: 24	Large town: 20	High school: 18	Asian: 14
31–34: 30	QLD: 20	Small town: 10	Some uni: 21	West. European: 10
35–40: 30	WA: 8	Rural/remote: 2	Completed uni: 51	South. European: 9
41–45: 12	SA: 6			North. European: 5
	ACT: 5			Middle Eastern: 3
	TAS: 3			Aboriginal/TSI: 2
	NT: 1			Maori/Sth Pacific: 2
				Other: 10

^a Respondents were able to nominate more than one category of ethnicity.

Table 3

Features of pregnancy apps that are helpful or useful (respondents could nominate more than one feature), frequency of respondents nominating ($n=274$).

Useful or helpful features	<i>n</i>	%
Gave useful information	227	83
Monitored foetal development	193	70
Monitored changes in pregnant woman's body	162	59
Provided reassurance	159	58
Facilitated connection with other pregnant women	66	24
Helped keep track of appointments and medical details	44	16
Shared pregnancy information with family/friends	37	14
Stored photos or videos of woman	25	9
Stored foetal ultrasound images	9	3

done this for all the apps that they had used while 13% had done so for at least one of the apps they had used. Nor were the women who had used pregnancy apps concerned about how their personal information may have been used by the developers of the apps: only 9% were very concerned while 19% were somewhat concerned and 28% were not at all concerned. A further 33% said that the app they used did not involve them uploading personal information while 11% said that they were unsure or did not know.

4.3. Use of parenting apps

Of the entire respondent group, 87% of the respondents had given birth in the past three years: of these, half (49%) had used a parenting app. Those women who had used a parenting app had mostly used only one (59%) while 39% had used between 2 and 4 apps and only 2% had used 5 or more. Parenting app use was also less frequent compared with pregnancy app use. These respondents who had ever used parenting apps said that they used the apps only a few times (21%), every week or so (20%), daily (19%) or every month or so (19%), while 15% said that they used the app/s a few times a week, and 5% used them only one or twice.

As shown in [Table 4](#), the most common use of parenting apps was for obtaining general information about caring for babies or toddlers (67%), followed by tracking or monitoring their child's growth, milestones and development (51%), obtaining feeding advice (43%) and diet and nutrition information in relation to their child (35%), tracking and monitoring their child's feeding habits (34%). Apps were also used for tracking and monitoring the child's sleep habits (25%), keeping track of their medical information, illnesses and treatments (22%), interacting with other parents (17%), keeping other information and records about the child such as their first words (11%), for use as a baby sleep monitor (10%), keeping a parenting journal (7%), uploading and storing images and

Table 4

Reasons parenting apps are used (respondents could nominate more than one reason), frequency of respondents nominating ($n=175$).

Reason for use	<i>n</i>	%
Information about caring for babies/toddlers	118	67
Tracking children's growth and development	90	51
Feeding advice	76	43
Diet and nutrition advice	62	35
Tracking children's eating/feeding habits	60	34
Tracking children's sleep habits	44	25
Tracking children's medical details	38	22
Interacting with other parents	29	17
Recording other details of children	19	11
Using as a baby sleep monitor	18	10
Keeping a parenting journal	12	7
Storing images and videos of children	12	7
Sharing information about children on social media	12	7

videos of the child (7%) and sharing information about the child on social media (7%).

The majority (88%) of those respondents who had used parenting apps said that they found them useful. [Table 5](#) shows that, of these respondents, 64% said that the apps provided information about their children and parenting issues, 58% said that they helped them monitor their children's growth and development, 49% said they gave reassurance about their parenting, 24% said they helped them to connect with other mothers, 19% said they helped keep track of their children's medical appointments and other medical details and 7% that they helped them store photos or videos of their children.

For those who answered that they did not find the apps helpful, time demands or boredom with the apps were major factors: 33% said that they became tired of using them and 29% that they did not have enough time to use them. A further 14% said that the information was inaccurate, 14% that the information was not relevant to themselves or their children, 14% that the apps made them feel too anxious or worried and another 14% could not remember.

The respondents who had used parenting apps were asked if they had ever checked where the parenting app developers obtained the information they used in the app. Here again, there was little evidence that the respondents engaged in this checking process, despite the popularity of using apps for providing information about children's care and development. Most of the respondents who had ever used a parenting app (68%) said that they had not checked whether the information came from, while only 8% said that they did this for all the apps they used, 17% said they had for at least one of the apps that they had used, 3% said they were unsure or could not remember and 3% that they did not use parenting apps to find information. When asked if they were concerned about how their or their children's personal information or images may have been used by the apps developers, 27% said that they were not at all concerned, 19% that they were a little concerned, 10% very concerned, 9% that they were not sure and 35% said that they were not concerned because the app they used did not involve them uploading personal data or images.

4.4. Use of other online media

All respondents were asked what online media other than apps they used for pregnancy or parenting information or support. Only 9% of respondents said that they used no other online media. The answers from the other respondents demonstrated that websites remain very popular (57% used them for pregnancy, 66% for parenting), followed by online discussion groups (26% for pregnancy, 28% for parenting) and Facebook (pregnancy 22%, parenting 33%). YouTube (8% pregnancy, 9% parenting) and Twitter (2% pregnancy, 3% parenting) were rarely used. Ten percent said that they had used other online media.

Table 5

Features of parenting apps that respondents found helpful or useful (respondents could nominate more than one feature), frequency of respondents nominating ($n=154$).

Useful or helpful features	<i>n</i>	%
Gave useful information about children and parenting	99	64
Gave reassurance about child's health/development	95	62
Helped monitor children's growth and development	90	58
Provided reassurance about parenting	76	49
Facilitated contact with other mothers	37	24
Helped keep track of child's appointments/medical details	29	19
Helped share child details with family and friends	20	13
Stored photos or videos of child	11	7

4.5. Ideal features in a pregnancy or parenting app

A final open-ended question in the survey asked respondents 'If you could design a new pregnancy or parenting app for your own use, what features would you like it to have?'. Nineteen percent of respondents did not answer this question, with many of these stating that they were happy with the apps that were available and could not think of any innovations or changes that they would want. An additional 3% of respondents made it clear that they did not need and did not use apps. However, the majority of our respondents (78%) did use this opportunity to outline their requirements of a pregnancy or parenting app. We post-coded their responses and found that they could be divided into four general themes: information, data storage, advice and support.

The most mentioned requirement for an app was information on foetal/baby/child development (30%). Many of respondents specified that the information on foetal development should be provided weekly or even daily and that about babies and children on a monthly basis at least. As one respondent put it, she would like to see: 'Week by week progress during pregnancy, tips from other Mums, up to date info on foods to avoid, physical activities which are safe – countdown to D [delivery] Day.' The need for photographs or videos to illustrate this information was frequently mentioned. Several respondents also wanted information about changes that happen to the mother's body during pregnancy. Again we see that the most important use of such apps for our respondents was to provide information about the women's own bodies during pregnancy and on baby or child development: or in the words of one respondent, 'what is happening with your body and your baby'.

It is clear that our respondents perceived an ever-increasing need for information about how their baby and child should develop. There was frequent use of the term 'milestones' or even 'goals' in their response to this open question, as well as a requirement for an app to inform respondents of when certain developmental milestones should have been met by their child – and what to do if this did not happen. Several respondents indicated a need for information about 'everything', but there was also an indication that current apps might not be providing information related to less usual issues: 'not only the obvious but also issues less common', as one of our respondents phrased it.

In addition to baby and child development, information was required on a wide range of subjects. The most frequently mentioned topic was related to food: feeding and nutrition, menus and recipes and information on what pregnant women should eat. Another popular subject for information was sleep habits in infants. One respondent, for example, said that she would like: 'Info on feeding interval times with breast feeding or formula or solids. How much you should feed your baby as they grow. Sleeping times and tips on how to get them to sleep without rocking them to sleep.' Some respondents required links to useful sites for further information.

The ability to use apps to generate, store and share personal data of some type was also popular (mentioned by 28% of those who suggested features for apps). This might be photo storage or the use of the app as a tracking device for a variety of different purposes, including monitoring infants' development, growth and achievement of developmental milestones and their sleep and feeding patterns. For example, one woman wanted an app that allowed 'simple entry of feeding and sleeping times to make tallying hours easy for those times when you're worried they're not getting enough sleep etc.'. Some women wrote that they would like to use a mood and symptom tracker app for pregnancy as well as apps that could monitor their ovulation patterns and blood pressure, fluid intake, health and weight during their pregnancy. Respondents also suggested using apps as appointment diaries or

immunisation reminders. Here again, only a small number of respondents mentioned that they had privacy concerns related to recording their personal data in these types of apps.

Using apps for advice was mentioned by 18% of respondents. Advice was sought on a number of topics, including child developmental issues and potential pregnancy problems. One respondent, for example, wanted an app with 'a don't worry area so if your baby is late developing something you can look it up and have advice on when you should look at going to see a professional'. Some respondents were specific about from where such advice should come, stating that they wanted expert, credible and up-to-date advice while others noted that they would like to see more Australian-specific or locally-based information in apps or apps that were not linked to the manufacturers of pregnancy or baby products. Direct access to a health care professional, doctor, emergency helpline was identified as suggestions for apps, while others preferred information and advice from other mothers.

This desire for advice from other mothers links to the final general topic we identified, that of support (raised by 10% of respondents). Given the high use of platforms such as parenting websites and forums that we identified above, most respondents are likely to be receiving support on those sites, and, therefore, did not identify apps as an avenue to such support. Some respondents wanted the app to offer access to a discussion forum. Several specified that they wanted to use the app to access other mothers in their local area. This was articulated by a respondent as her desire to see: 'a feature to meet other parents "right now" in your area for coffee/chat/socialisation.'

5. Discussion

Our findings suggest that the use of pregnancy apps has become an integral part of the experience of pregnancy for many of the women who completed our survey (although we emphasise again that our respondent pool included a much higher percentage of highly educated women than the general Australian population). Many of our respondents also used parenting apps (although far fewer respondents than those who used apps for pregnancy). Such reduced use could be the result of women having less time to spend using apps following the birth of their infants, and also their increased use of mother-baby groups and internet sites for information and support.¹⁴

Sourcing relevant information about pregnancy and foetal and child development was the most important aspect of using apps for our respondents. The respondents also commonly used apps to regulate and monitor both their bodies and those of their developing fetuses and children. Whether the data related to height and weight or sleeping and feeding, the respondents appreciated the more interactive apps for their ability to store and manage data and therefore 'personalise' the outputs of the app. Other researchers have also identified the desire of women to use apps that provided personalised information tailored to their needs.^{17,20,30} The emphasis on visual aids could be part of a need for 'titbits' of information on the part of busy mothers who do not have time to read pamphlets or books to pick out the pieces of information relevant to their needs, but might also be attractive to women who have literacy difficulties.

The survey revealed that nearly all the respondents used some form of online media for pregnancy or parenting information and support. App use ranked highly as a form of digital engagement during pregnancy and the early years of parenting. Only websites competed with apps regarding popularity, while social media sites were less frequently used.

The type of information entered into many of pregnancy and parenting apps, both about women themselves and about their fetuses or children, is often very intimate and detailed. Details

such as pregnant women's body weight, diet, mood, exercise patterns, their due date, their first name, the name they have chosen for their child, the foetal stage of development, foetal movements and heart rate, infant development and achievement of milestones, ultrasounds, images of women and their children and so on are collected by a multitude of apps.² Pregnant women and parents are not only uploading information about themselves to apps but also about their unborn or infants and small children. They are therefore constructing a digital profile of their children, in many cases even before birth. However, the survey revealed a low level of concern about issues relating to privacy or security of personal data. This suggests that privacy concerns were secondary to the benefits offered by uploading personal details into apps to provide the type of customisation they seek. As other researchers have found, pregnant women and parents of infants and small children are only just beginning to realise or confront these issues.³¹ Our survey did reveal some qualms among respondents relating to the quality of information offered by the apps: in particular, to the need to have contextualised Australian information and to be assured that the sources are expert.

It is also notable that many of the features that the respondents identified that they would like to see in pregnancy and parenting apps are already available on the market. There are numerous apps for self-tracking and providing information about pregnancy and foetal development, for foetal monitoring and tracking and recording infant growth and development.² This suggests that while our respondents reported a high use of apps for (especially) pregnancy and parenting, their knowledge of the types of apps that are currently available for their use is limited.

The wider implications of pregnancy and parenting apps also need to be considered. Previous critical researchers of mothers' blogs and online forums for pregnant women and mothers have contended that such interactions and other site content tend to reproduce dominant notions of 'good motherhood' without offering many alternatives for women.^{32,33} Pregnancy apps similarly reproduce limited concepts of female reproduction and embodiment. They represent the pregnant body as vulnerable and a site of risk, open to a range of threats and dangers. The ideal reproductive female subject in these apps is portrayed as willing to take responsibility for monitoring and managing her fertility and to devote great attention to the welfare and wellbeing of her unborn. These responsibilities include the expectation that women will closely regulate and discipline their bodies in the interests of their unborn. Conventions such as encouraging women to give names to their fetuses represent these entities as already people in their own right, whose rights tend to be privileged over those of the pregnant woman.²

These types of apps may incite feelings of anxiety, self-responsibility and blame in women who feel as if they do not subscribe to the expectations therein. This may particularly be the case of women who are from lower socioeconomic backgrounds and thus already often portrayed as less likely to be knowledgeable and responsible, and may not have the economic and cultural resources to achieve these ideals. These apps tend not to acknowledge the possibilities of women who may be ambivalent about their pregnancy or being a mother, who choose not to take on detailed self-monitoring, who are unpartnered or in same-sex relationships, or who do otherwise not subscribe to heteronormative stereotypes or ideals of reproductive citizenship and good motherhood.

6. Conclusions

The survey reported here provides some insights into how women use pregnancy and parenting apps. Although the respondents were representative of the geographical location of

the Australian population, the survey was not completed by a random sample, and thus is not generalisable to the general population of women experiencing pregnancy and early motherhood. Nor is such a survey able to provide detailed insights into the ways in which women use pregnancy and parenting apps. There remains much scope for further research, both quantitative and qualitative, to be directed at determining how women select the apps they use, how they go about evaluating their quality, validity and usefulness, how apps are compared with each other and which apps are used for a long time and which are rapidly discarded. Research investigating how different groups of women are engaging with apps would also complement this study of a sample of mainly highly-educated women who are fluent in English. Studies into how midwives and other healthcare professionals are engaging with apps as part of their professional practice and how they negotiate app use with pregnant women and new mothers and their partners would also contribute to the body of knowledge around pregnancy and parenting apps. Does app use replace interaction with a health professional for some purposes or is it used as a supplement to face-to-face support? Finally, a continuing focus on the apps themselves – including the ways in which they represent pregnant women, their partners and new parents, the validity and accuracy of the information that they offer users and data privacy and security issues – is important to inform this area of research.

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