



Yourtime: The development and pilot of a perinatal mental wellbeing digital tool using a co-design approach

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ABSTRACT

Introduction: Maternal anxiety and depression are major public health issues with prevalence as high as one in five women. There is a need to focus on preventative strategies to enable women to self-monitor their mental health status during pregnancy and postnatally.

Aim: To co-design and test a perinatal mental health digital tool to enable women to self-monitor their mental wellbeing during pregnancy and early parenting and promote positive self-care strategies.

Methods and ethics: A sequential mixed methods study utilising two stages 1) co-design workshops; 2) fit for purpose pilot with women through a purpose designed survey to evaluate acceptability, useability, functionality, and satisfaction.

Findings: Mothers, midwives, design researchers and students, participated in co-designing a digital tool and prototype application, *YourTime*. Fourteen participants engaged in the pilot, with all women agreeing that the tool would be beneficial in alerting them to changes in mental wellbeing. Seventy-seven percent agreed that this prototype had the potential to positively affect wellbeing during the perinatal period.

Discussion: The need to develop a perinatal mental health digital tool that enables women to self-monitor their wellbeing was identified. Women reported the *YourTime* app offered an acceptable and effective means to self-assess and monitor their wellbeing.

Conclusion: The *YourTime* app responds to the growing agenda for digital approaches to address perinatal mental health challenges. The pilot study demonstrated that the app offered potential to alert women to changes in mental wellbeing, but functionality need further development.

1. Background

Globally, the burden of perinatal mental health is increasing and poor maternal mental health is recognised as a major public health challenge with prevalence as high as 25 % (World Health Organization, 2017). In Australia, approximately 300,000 women give birth each year, with 20 % (60,000) experiencing depression and/or anxiety before or after the baby is born (Price Waterhouse Coopers, 2019). Notably there has been a significant increase since the global pandemic Covid-19 with one study citing that, two thirds of women reported poorer mental

health following the outbreak (Martin-Key et al., 2021). The impact of interruptions to maternal mental health is well-documented and has far reaching impact not only on the mother but also on development and long-term mental wellbeing of the child (Steen et al., 2013). The Price Water House (Price Waterhouse Coopers, 2019) commissioned report on perinatal mental health estimated that perinatal depression and anxiety cost the Australian economy \$877 m. There is a growing emphasis both internationally and within Australia on developing strategies to promote psychosocial well-being of mothers during pregnancy and after birth (Austin et al., 2017; Government of South Australia, 2017; World Health

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Organization, 2022).

The introduction of perinatal screening tools has greatly assisted in identifying women experiencing anxiety and/or depression, however challenges with universal routine screening have been raised including the potential for screening to increase the medicalisation of childbirth and that routine screening occurs at a single time point in pregnancy and/or after birth, and only provides a snapshot of maternal mental health. It has been widely established that prevention of mental health

issues is not only more cost effective but also more sustainable, yet there has been less focus on developing strategies that are preventative or enable women to self-monitor their own mental wellbeing (World Health Organization, 2022). As many as one in three women indicate a decline in mental wellbeing on at least one occasion from pregnancy to four years postpartum (Woodhouse et al., 2014). Developing strategies that focus on prevention of mental health disorders and promote psychosocial well-being of women during pregnancy and after birth in the

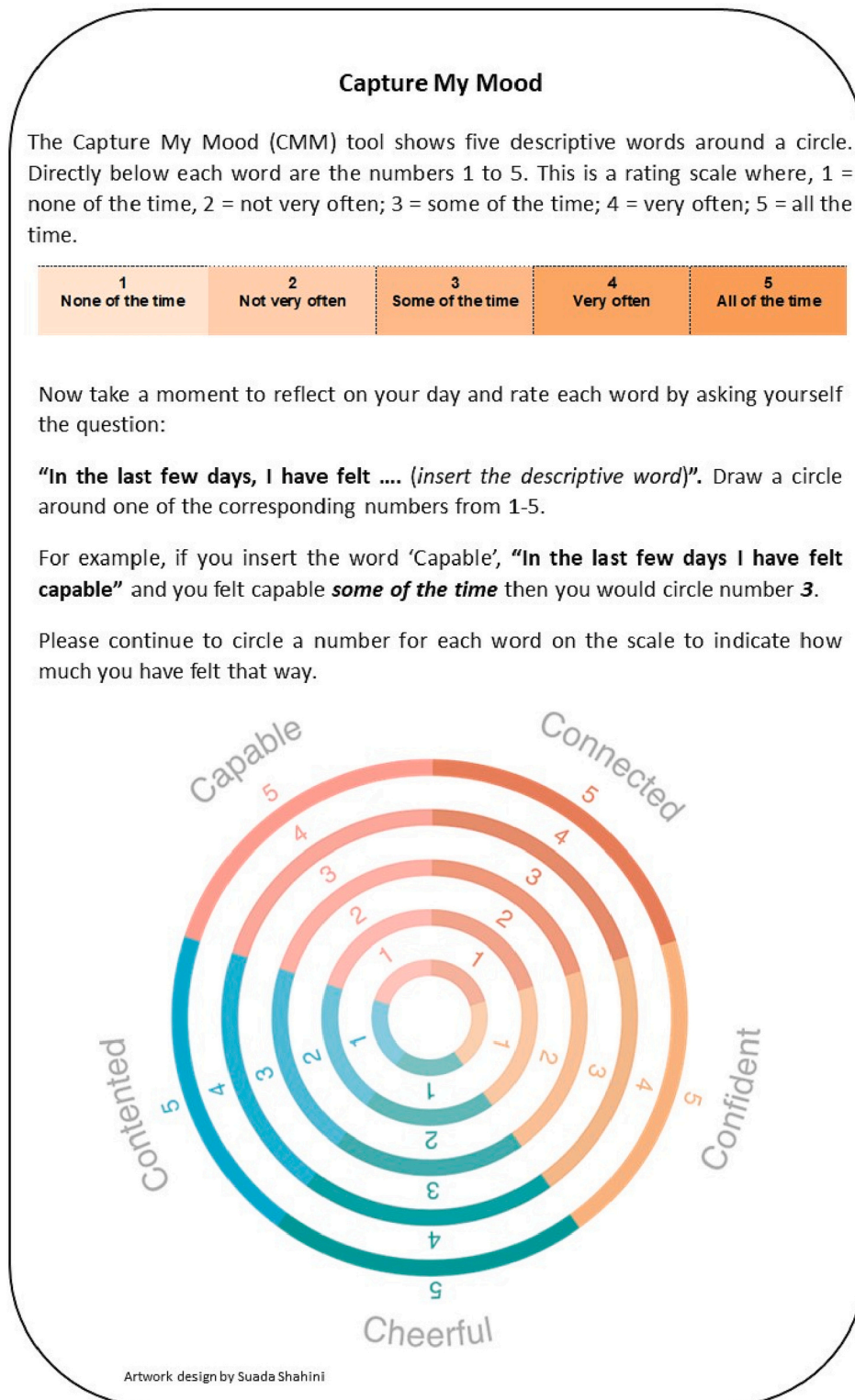


Fig. 1. Paper-based tool.

perinatal period is important (World Health Organization, 2017; World Health Organization, 2022). In response to this, the authors (LM, MS) developed a visual scale which focussed on measuring mental wellbeing.

The paper-based visual scale, titled 'Capture My Mood' (CMM) incorporated five descriptors which align with the core concepts of the Warwick Edinburgh Mental Wellbeing Scale (WEMWBS). The WEMWBS is a validated questionnaire used to ascertain population mental wellbeing (Stewart-Brown et al., 2009). The descriptors used in CMM tool are: Connected (satisfying interpersonal relationships), Confident (positive functioning), Cheerful (positive affect), Contented (hedonic perspective) and Capable (eudemonic perspective). The paper-based tool presented the five descriptive words around the edge of a hexagon which was modified to a circular design. It required the user to rate each descriptor by asking themselves the question "in the last few days I have felt (insert the descriptive word)" then circle a number from 1 to 5, where 1 = none of the time and 5 = all of the time (Fig. 1).

A pilot feasibility study undertaken with women established initial correlation between the paper-based version of the CMM tool and the WEMWBS (McKellar et al., 2017). Further, correlation undertaken as part of a larger study with 135 participants who completed both the CMM and the WEMWBS, confirmed a strong correlation between the two tools (Pearson correlation coefficient, $r = 0.8179$ with statistically significance level at $p < .01$) (unpublished data).

There is a growing focus on using digital resources to support women during pregnancy and childbirth and a variety of applications (app) exist which focus on tracking pregnancy symptoms, months pregnant, contractions in labour, as well as support women, such as the 'baby2body' fitness app, 'Positive Pregnancy' which is a collection of meditation activities, and 'Mom Life Pregnancy Tracker' is a networking app. However, these do not include a detailed focus on mental wellbeing or an ability to track mood. The research team have investigated a number of apps but found them broad and not suited or appealing to the maternal population, often there appears to be too much detail and not relevant/engaging for women during pregnancy and transition to motherhood. The research team found no specific mood app that was directed towards pregnant women or mothers or that have brought together supportive activity in one digital platform.

The overall aim of this study was to build on the original research to co-design and test a prototype digital perinatal mental health tool to enable women to track their mental wellbeing over time, alert them to changes and assist them to recognize early signs of deteriorating mental wellbeing. A secondary aim was to promote mental health by incorporating wellbeing prompts based on the 'five-ways to wellbeing'. (Aked et al., 2008) This study responds to the growing emphasis on developing digital strategies to support positive perinatal mental health (Price Waterhouse Coopers, 2019).

2. Methods

This study employed a sequential mixed methods approach undertaken in two stages 1) co-design workshops; 2) fit for purpose pilot undertaken late 2019 through to 2020. Co-design was employed as a key approach as it facilitates creativity and collaboration to respond to a topic of shared interest and draws on a variety of activities to explore this topic. Co-design provides a way to foster discovery and innovative interventions, with the public's 'lived' experience as the central focus (Boyd et al., 2012). In line with this, the workshop provided (LM, MS) opportunity to engage lived experience to inform the prototype tool and the pilot study facilitated further feedback from women which contributed to the ongoing prototype development.

2.1. Stage 1

Co-design workshops, facilitated through Match Studio (a creative research hub at the University of South Australia), brought together design researchers, midwives and women, to co-design a prototype tool.

In addition, an interdisciplinary student team (graphic design, IT and psychology) attended the workshop as observers. These students contributed to the first design schema for the prototype based on the outcome of the workshop. The workshop introduced the paper-based version of CMM to pre-empt idea generation for a digital tool. The purpose of the workshop was to consider the best way to digitalising the tool as well as identify the content, structure, and design for the prototype. The sessions were not recorded but field notes were collected by two attendees during co-design conversations. The project commenced towards the end of 2019 and further workshops were intended but due to the emergence of Covid-19 this did not occur. Follow up on the design concept was sought via email correspondence with the participants. Women were recruited via social media outlets Facebook and Twitter, as these were considered most likely to connect with mothers. A link to a research website was provided to enable women to access further information and explanations about the study. On registration of interest, a written information sheet and consent form were emailed to women. A follow up telephone conversation from a research assistant offered an opportunity to clarify what participating in the study would involve. Women were eligible to participate if they were >18 years of age, pregnant or had a baby in the last 5 years, able to read and comprehend English language. A signed consent form was collected.

2.2. Stage 2

A fit for purpose pilot was undertaken with a small purposive sample of antenatal and postnatal women to test the prototype app in August 2020. These women were recruited by a research assistant via a pregnancy/parent group and were not the same women who had engaged in the initial co-design process. Women were emailed a link to the prototype app with instructions for participation. An anonymous purpose designed questionnaire sought feedback on the tool in relation to acceptability, usability appropriateness, usefulness and satisfaction. Women were invited to participate if they were >18 years of age, pregnant or postpartum < 12 months, able to read and comprehend English language. Simple descriptive statistics and thematic analysis were used to analyse the data.

Ethical approval was gained from the University of South Australia Human Research Ethics Committee no. 202005.

3. Findings

3.1. Stage 1

Six women responded to the social media advertisement, of these four participated in the workshop. All women had babies within the last year, three attended the session with their baby. Three women were first-time mothers, three were Caucasian and one woman identified as being a Torres Strait Islander. The workshop ran for approximately 90 min during which morning tea was shared. The session commenced with an overview of the purpose of the research and offered an opportunity for the women to share their own lived experience. The women generously shared their experiences of being pregnant, birth and being new mothers. These stories were very honest, one woman disclosed birth trauma and several discussed mental health challenges, with one describing feeling better after birth. Following this, women engaged in an activity which introduced the paper-based tool, with time given to complete the scale and discussion on how a digital tool might be helpful to mothers. The remaining workshop focused what should be included in a digitalised tool. The women were very engaged with all participants agreeing that a mobile application (app) would be fitting, and ideas evolved around this concept. Key concepts from the conversations captured in the field notes included:

- Ease of use: Women described how the digital app should be useable with one hand. They commented that women are often breastfeeding when they engage with their mobile phones.
- Personalised: Some of the women suggested that being able to choose their own colour pallet for the app would be good. Women also recommended to have an avatar that would be able to guide them through the process. Collectively, all women suggested that a 'mother figure' or 'midwife avatar' would be a friendly approach for the app design. Consensus was reached through further discussion that a midwife avatar would be the best approach.
- Networks: Women suggested that having contacts within the app that they could text if they were feeling low would be helpful. Women also suggested the inclusion of a 'geomap' that showed which mothers were active at any time of the day. They felt this would help to give them a sense of connectedness and solidarity with other women and would be particularly useful during a night when some women feel isolated and lonely.
- Affirmations: There was discussion about including some mindfulness activities, such as affirmations. However, it was noted that this approach may be helpful for some women but not others, providing options was suggested.
- Journal: Suggestions for the capacity to journal was discussed, particularly if women scored low for their wellbeing. Writing and making notes as to why some women had a low mood and whether they were then able to identify any triggers or other causes.
- Flexible measures: The options for responding to the tool descriptors needed to be flexible. Women described not wanting to be forced to choose a certain number on the scale but rather to include a sliding bar that could sit between the scale points.
- Need to track: Women agreed it was important to keep track of their wellbeing over time.

Following the workshop, the researchers and Match Studio design team analysed and interpreted the workshop findings. From this, Match Studio produced a preliminary design schema flow chart for Version 1.0 of the prototype app (Fig. 2). During this analysis there was consensus to name the digital tool *YourTime* after recognising the importance of promoting selfcare strategies and the need for women to have time to care for themselves. The participants were provided an overview of the app design and agreed that this appeared appropriate.

3.2. Key design features

Based on the co-design process the functional objectives of the app were to: 1) encourage women to look after their mental health, 2) prompt women to check in on their wellbeing, 3) track their wellbeing over time: days, weeks, and months, 4) provide educational support to encourage selfcare and links to services when more help is needed, 5) connect pregnant women and new mums with peer networks. The key design features were, that the digital wellbeing tool should incorporate a sliding scale without fixed points, wellbeing results presented as either 'above average', 'average', 'below average' and 'very low wellbeing', a record of wellbeing over time to be visually shown in a graph format, inclusion of positive wellbeing activities, links to support services and access to a midwife avatar, clear instructions as to how to use the app.

An information technology service and consultancy company was contracted to produce a prototype app. However, as funding was limited the development of all features proposed by women were not possible and the application was only functional for use on mobile iPhone 7, 8 and 9 and not android phones. On completion of Version 1.0, the prototype app included the digital tool, ability to track and visualise the results, limited colour palette selection, limited appearances of the avatar midwife. Proposed activities such as journalling, networking and affirmations were included as icons but not functional. The education prompts also could not be sustained within the app, so these were included on a linked website for the women to access, along with help

seeking resources.

3.3. Stage 2

The prototype Version 1.0 of the *YourTime* app was tested with 14 end-users who were provided with a link to the *YourTime* app which was situated on the Apple Developer site and only accessible using limited versions of the iPhone with limited repeated access. This limited access was problematic and there were difficulties for some participants in downloading the app so that it would function on their iPhone. However, a research assistant provided additional support for these women to enable them to access the app.

The participants were all women, with the majority aged between 31 and 35 years (57.1 %) and well educated (Table 1). Two women were pregnant, five were first-time mothers, eight had previous babies and one did not respond. All women were born in Australia (Table 1).

The women were asked a series of yes/no questions regarding the app (Table 2).

Participants were asked for their suggestions on how to improve the mood scale, and most comments highlighted that they like the way the tool worked. However, one woman commented that the measurement options felt like a survey not 'something deeply personal'. Two women commented that some further explanations regarding the descriptors used in the tool would be beneficial.

Participants were also asked about personalising the app and most agreed that choosing their own colour pallet and personalising the midwife avatar would be helpful (Table 3).

Participants were asked rate statements regarding the *YourTime* app (Table 4).

Participants were asked if they would follow the education prompts in response to their wellbeing score, 9/11 (81 %) stated yes. Additionally, while 42 % of the women were unsure whether the list of services in the app were helpful, when asked if they would utilise any of the services in response to a 'low wellbeing' score, of the nine who responded, six (66.7 %) stated that they would.

When women were asked an open-ended question as to why they did not find the app easy to use, they reported compatibility issues with their iPhone. Two women reported that not all functions worked properly, another two reported that the app functionality was unclear and challenging to follow, i.e., too many layers to navigate on the app. One woman reported that the tool descriptors were a little unclear and more instructions on how to use the tool would be helpful.

Women were asked to indicate which of the proposed activities they thought they would use (Table 5). Suggestions for other ideas to incorporate as functions of the app included exercise, networking, and specific activities to promote wellbeing.

Women were asked how often they thought they would use the app each week. Eleven women stated they would use the app at least three times a week (Table 6).

All participants (100 %) agreed that the app would 'benefit women by alerting them to changes in mental wellbeing', with 10/13 (77 %) strongly agreeing/agreeing that this app had the potential to positively affect wellbeing for women during pregnancy and after birth, the remaining participants were unsure. Twelve (85.7 %) women agreed with the mood outcome they received while trying out and testing the app.

Participants were asked for their overall impression and feedback, comments included:

- "It is easy and quick to record and gave a good response in the insights sections"
- "Good start will be great to see it developed further"
- "As someone who had prenatal depression having this all-in-one app is great"
- "User friendly with the tracking function being particularly useful for me"



App Flowchart

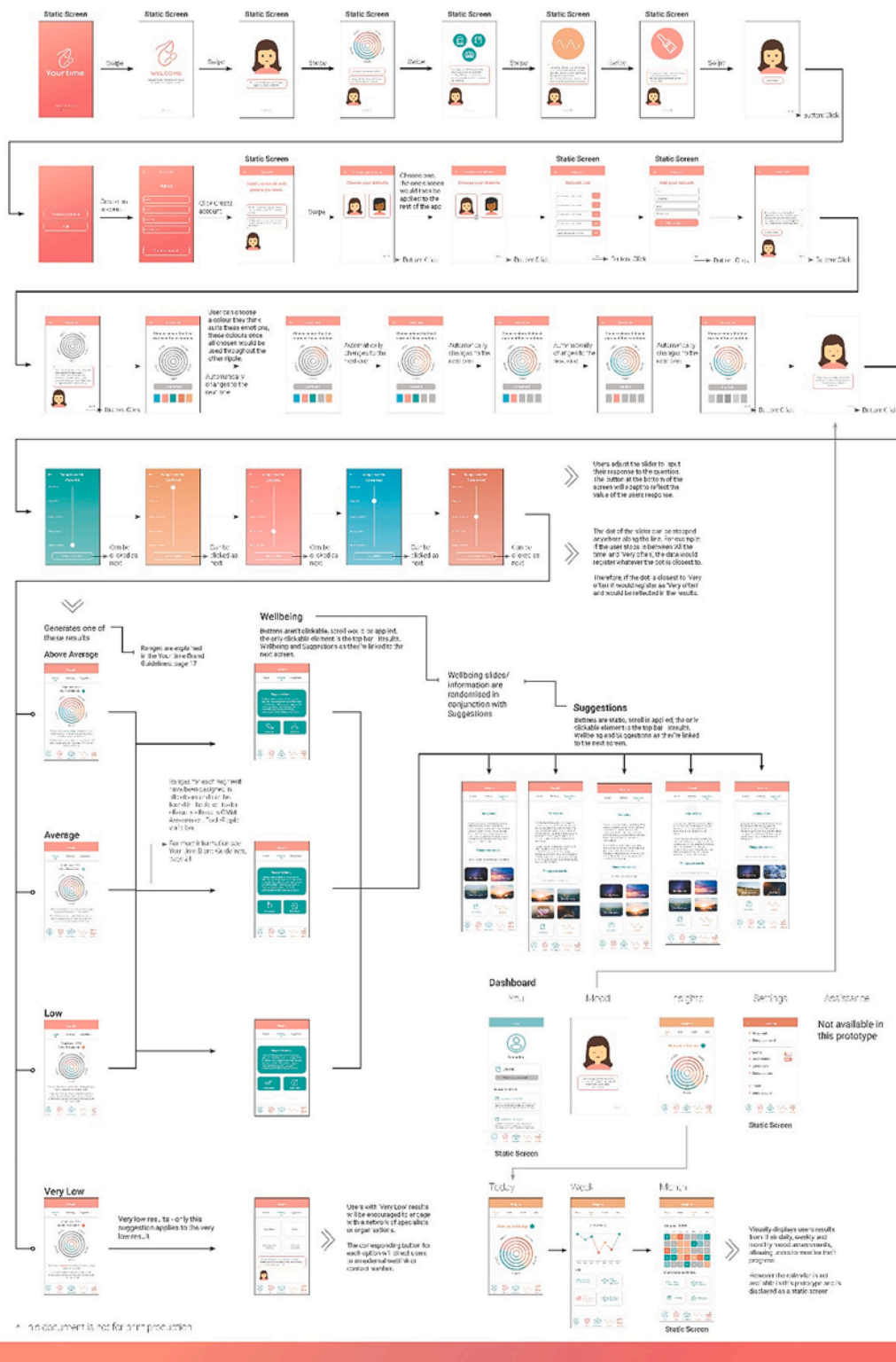


Fig. 2. Prototype version 1.0 design schema.

Table 1
Demographics of participants.

Age range	%	n = 14
20 years	0	0
20–25 years	0	0
26–30 years	14.29	2
31–35 years	57.14	8
>36	28.57	4
Highest education level		
High school	0	0
Completed year12	0	0
Vocation (Tafe)	14.29	2
University	50.00	7
Postgraduate	35.71	5

Table 2
Response to yes/no questions.

Statement/question	Yes		No		Total
	%	n	%	n	
I think the YourTime app is appealing	83.33	10	16.67	2	12
Did you like having a midwife avatar to guide you through the app?	85.72	12	14.29	0	12
I found the YourTime mood scale easy to use easy	75.92	10	23.08	3	13

- “Good app and I really like the concept – I needed something like this 6-months after birth”
- “Concept and components in app are a great idea, more development, detail and links are needed to make the app functional and beneficial”
- “I like the concept but it needs a few tweaks”

The participants were also asked for ways to improve the app.

- “More feedback, maybe a tracker to include if you do exercises or meditate and how these correlate to your mood”
- “Could link direct to service providers i.e. breastfeeding services, South Australia child and youth health services”
- “More ‘new’ mum focussed. Could users add a person they elect to monitor [their wellbeing]”
- “Less wordy, more friendly, actual links to information, services and support”
- “Less pages on pages, simpler navigation or home page”

Table 3
Personalising the YourTime app.

	Strongly agree		Agree		Unsure		Disagree		Strongly disagree	
	%	n	%	n	%	n	%	n	%	n
Being able to choose my colour pallet would help me personally connect with the app	14.3	2	42.9	6	14.3	2	21.4	3	7.1	1
Being able to personalise the midwife avatar would be helpful	21.4	3	50	7	7.1	1	14.7	2	7.1	1

Table 4
Response to statements regarding the YourTime app.

	Strongly agree		Agree		Unsure		Disagree		Strongly disagree		Missing
	%	n	%	n	%	n	%	n	%	n	
I thought YourTime app was easy to use	21.4	3	35.7	5	21.3	3	14.3	2	7.1	1	0
I thought the instructions within the YourTime app were adequate	14.3	2	57.1	8	7.1	1	14.3	2	7.1	1	0
I found the results of the mood scale easy to read	23.1	3	69.2	9	0	0	7.7	1	0	0	1
I think the YourTime app would be helpful in monitoring my mood	35.7	5	42.9	6	21.4	3	0	0	0	0	0
I found the prompts for actions to support wellbeing embedded in the YourTime app helpful.	0	0	53.8	7	23.1	3	15.4	2	7.7	1	1
I found the list of services provided in YourTime helpful in knowing where I could get help	8.3	1	25	3	41.7	5	16.7	2	8.3	1	2

- “By connecting to other mums going through similar things, recording your mood each day to reflect on your moods on the week”

Notably, one woman commented “very poor - as it didn’t work most of the time,” reflecting the iPhone compatibility challenge.

4. Discussion

This study responds to priorities in public health to promote mental wellbeing by developing and testing a digital tool as a means for women to self-monitor their mental wellbeing during pregnancy and early parenting. There is a growing agenda for digital approaches to addressing perinatal mental health challenges. Particularly, with the increase in virtual communication and ehealth applications during Covid-19 pandemic (Philippe et al., 2022). Digital strategies have potential to offer accessible support for women and to work alongside established service provision to deliver focussed resources and online consultations to manage perinatal depression and anxiety (Bakker & Rickard, 2018; Hussain-Shamsy et al., 2020; Novick et al., 2022; van den Heuvel et al., 2018). In a review of ehealth in perinatal care, van der Heuvel et al. (van den Heuvel et al., 2018) suggested that there is potential to revolutionise perinatal care by encouraging women in self-care and informed decision making. Hussain-Shamsy et al. (Hussain-Shamsy et al., 2020) undertook a scoping review and found that mobile health applications could be used to address the barriers to care for women

Table 5
Proposed features of the YourTime app participants would use regularly.

	%	n = 14
Mediation (paced breathing)	71.43	10
Breathing (relaxed breathing and deep breathing)	92.86	13
Journaling (keep a record of how you were feeling)	50.00	7
Affirmations (positive written statements)	85.71	12
Network (being able to add contacts)	57.14	8

Table 6
Participants expected weekly use of the YourTime app.

	%	n = 12
1	0.00 %	0
2	8.33 %	1
3	41.67 %	5
4	25.00 %	3
>5	25.00 %	3

experiencing perinatal mental illness and improve access to treatment. There is also opportunity to use digital strategies in health promotion and disease prevention. In 2021, the WHO released a Global Strategy on Digital Health with the vision to promote health and wellbeing for everyone, recognising the growing use of digital technologies as means of addressing health care needs (World Health Organization, 2021). Additionally, Novick (Novick et al., 2022) concluded that mHealth apps provided the most promise for preventative care and could also be used to provide psychoeducation which may help low risk women from further decline in mental wellbeing. The *YourTime* app was developed as a health promotion activity to enable women to self-monitor their wellbeing and may promote self-care activities to support their mood.

It was evident from the findings that there is significant potential for this app to alert women to a change in their mental wellbeing with all women agreeing with this. Importantly, the majority of participants agreed with the score they received and identified that they would seek help if it was below average. Over 80 % of participants also stated they would use the prompts for wellbeing. The majority of participants also agreed they would use the tool several times a week and believed that it would promote positive wellbeing. These findings are important, as self-monitoring may improve self-awareness which is an essential aspect in promoting self-care and help-seeking behaviours (Bakker & Rickard, 2018; van den Heuvel et al., 2018). In a study which reported on a mobile app in which women completed a mood questionnaire and completed a diary, increased self-awareness appeared to mediate a decrease in depression and anxiety and promote wellbeing (Bakker & Rickard, 2018). Interestingly, this approach was reported as more effective for women who were clinically depressed or anxious at the baseline assessment suggesting that further research needs to be undertaken. Offering a means for women to be cognisant of their wellbeing over time may increase self-awareness and encourage women to seek help early rather than later. In the report on the cost of perinatal mental illness it was identified that parents find it very hard to look after their own mental health with the competing demands of work and family (Price Waterhouse Coopers, 2019). Raising awareness of perinatal mental health and supporting people to identify changes and seek help was recommended. The *YourTime* app may complement existing screening programs by enabling women to easily monitor changes in their mental wellbeing early, across a continuum rather than one time-point, and encourage them to discuss their mental health and seek support/proactive interventions more quickly.

The participants found the *YourTime* app appealing and the wellbeing tool easy to use, however the prototype app was in a development stage and there were iPhone compatibility issues which meant that not all functions were able to be accessed properly or repeatedly. The women identified that mindfulness/meditation activities would be useful in future additions with around half of the women stating they would utilise a journal and networking capacity. While digital strategies have significant potential there are challenges for practitioners and researchers in developing these tools and enabling translation into practice (Novick et al., 2022). The cost of creating digital tools can be expensive, this project had limited funding which impacted on the degree of development. Most importantly though, there is a need for interdisciplinary collaborations across a broad range of disciplines to ensure appropriateness, uptake and sustainability (Evans et al., 2022; Martin-Key et al., 2021). This research provides an example of bringing together disciplines of design, midwifery and psychology. Utilising a co-design approach also ensures that all stakeholders, particularly women as the end-users, were able to inform early iterations and influence development from their perspective. In this pilot study there were aspects of design that may have been overlooked by researchers without end-user engagement, for example from the mother's perspective, it was important to have a tool where the measurement was not arbitrary. From the initial workshop the women identified that the tool needed to have no fixed measures, rather a sliding scale so they did not need to choose a particular point but could use a continuum approach to ratings

as needed. Additionally, women agreed that the *YourTime* app needed to be useable with one hand and flexible in how and when it was used. Simplicity was also advocated, noting that many resources are complex, provide too much information and can be overwhelming. Overall written feedback from the women was positive with participants agreeing that this type of app would be ideal for pregnant women and new mums. There were valuable suggestions for improvements which have been incorporated into a second prototype version.

5. Limitations

There are strengths and limitations to this study. The strength is the codesign approach, particularly collaborating with women as the end users in development and testing. There were limitations with the prototype app itself, including reduced functionality and limited accessibility. The study also had limitations, as it drew on a small homogenous sample and therefore cannot be generalised to all women. For example, the demographics for the pilot indicate that most participants were older than 30 years of age and had higher education qualifications. While this was unexpected, it may have influenced their responses to a digital application. A larger and more diverse sample size for both aspects of the study would have been beneficial. Additionally, the COVID-19 pandemic interrupted the initial co-design process and impacted on recruitment for the pilot study.

6. Conclusion

The *YourTime* app shows promise in providing a digital resource for women to self-assess and monitor their mental wellbeing over time and may promote self-care and help-seeking behaviour. Working with the end users of the digital resource is critical to better understand the needs and contexts in which these resources will be used. While acknowledging the potential of this resource, it is recommended that an evaluation is undertaken at completion of version 2.0 to ascertain the effectiveness of this tool in supporting women to identify a change in wellbeing, engage in supportive strategies and/or seek help. Beyond this, given the burden of interrupted perinatal mental health, there is a need for continuing research to develop digital resources to support women's mental wellbeing during pregnancy and after the birth of their baby.

Author agreement

This manuscript is the author's original work.

The manuscript has not been submitted or published elsewhere.

All authors have seen and approved the manuscript being submitted.

All authors agree to abide by the copyright terms and conditions of Elsevier.

The author of this paper declare that the work included has been complied in originality and there are no conflicts of interest in this paper.

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Ethics

Ethical approval was gained from the University of South Australia Human Research Ethics Committee no. 202005 on the 20/6/2019.

Authors' contribution statement

Lois McKellar: Conceptualisation, design and methodology, formal analysis, writing (lead) – original draft preparation, review and editing

(co-lead).

Mary Steen: Conceptualisation, design and methodology, formal analysis, writing (supporting) – original draft preparation, review and editing (equal).

Samantha Charlick: Conceptualization; design and methodology, analysis (supporting), Writing – original draft (supporting); review and editing (supporting).

Jane Andrew: Conceptualization; design and methodology, co-design analysis, writing – original draft (supporting); review and editing (supporting).

Benjamin Altieri: Conceptualization; design and methodology, co-design analysis, writing –review and editing (supportive).

Ian Gwilt: Conceptualization, design and methodology, co-design analysis; writing – review and editing (supporting).

The MMAT checklist has been completed and submitted.

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Declaration of competing interest

There are no conflicts of interest.

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References

- Aked, J., Marks, N., Cordon, C., & Thompson, S. (2008). Five ways to wellbeing: The evidence. London: New Economics Foundation (nef) . [cited 2022 August 20]. Available from <https://www.artshealthresources.org.uk/wp-content/uploads/2018/11/2008-Five-ways-to-wellbeing-NEF.pdf>.
- Austin, M.-P., M-P, Highet, N., & the Expert Working Group. (2017). *Mental health care in the perinatal period: Australian clinical practice guideline*. Melbourne: Centre of Perinatal Excellence. [cited 2022 August 21]. Available from <http://cope.org.au/wp-content/uploads/2017/10/Final-COPE-Perinatal-Mental-Health-Guideline.pdf>. [cited 2022 August 21]. Available from.
- Bakker, D., & Rickard, N. (2018). Engagement in mobile phone app for self-monitoring of emotional wellbeing predicts changes in mental health: MoodPrism. *Journal of Affective Disorders*, 2018(227), 432–442.
- Boyd, H., Mckernon, S., Mullin, B., & Old, A. (2012). Improving healthcare through the use of co-design. *The New Zealand Medical Journal*, 125(1357), 76–87.
- Evans, K., Donelan, J., Rennick-Egglestone, S., Cox, S., & Kuipers, Y. (2022). Review of mobile apps for women with anxiety in pregnancy: Maternity care professionals' guide to locating and assessing anxiety apps. *Journal of Medical Internet Research*, 24(3) (23). (e31831).
- Government of South Australia. (2017). South Australian Mental Health strategic plan 2017–2022. Government of SA: South Australian Mental Health Commission . [cited 2022 August 20]. Available from <https://samentalhealthcommission.com.au/wp-content/uploads/SA-Mental-Health-Strategic-Plan-2017%E2%80%932022.pdf>.
- Hussain-Shamsy, N., Shah, A., Vigod, S. N., Zaheer, J., & Seto, E. (2020). Mobile health for perinatal depression and anxiety: Scoping review. *Journal of Medical Internet Research*, 22(4). [2020]. [e17011 , cited 2022 August 20]. Available from <https://www.jmir.org/2020/4/e17011>. [2020]. [e17011 , cited 2022 August 20]. Available from.
- Martin-Key, N. A., Spadaro, B., Schei, T. S., & Bahn, S. (2021 Jun 4). Proof-of-concept support for the development and implementation of a digital assessment for perinatal mental health: Mixed methods study. *Journal of Medical Internet Research*, 23(6), Article e27132.
- McKellar, L., Steen, M., & Lorensuhewa, N. (2017). Capture my mood: A feasibility study to develop a visual scale for women to self-monitor their mental wellbeing following birth'. *Evidence Based Midwifery*, 15(2), 54–59.
- Novick, A. M., Kwitowski, M., Dempsey, J., et al. (2022). Technology-based approaches for supporting perinatal mental health. *Current Psychiatry Reports*, 24, 419–428.
- Philippe, T., Sikder, N., Jackson, A., Koblanski, M., Liow, E., Pilarinos, A., ... Vasarhelyi, K. (2022). Digital health interventions for delivery of mental health care: Systematic and comprehensive meta-review. *JMIR Mental Health*, 9(5), Article e35159. [cited 2022 August 20]. Available from <https://mental.jmir.org/2022/5/e35159>. [cited 2022 August 20]. Available from.
- Price Waterhouse Coopers. (2019). The cost of perinatal depression and anxiety in Australia. Price Waterhouse Coopers Consulting Australia. [cited 2022 August 20]. Available from <https://www.perinatalwellbeingcentre.org.au/Handlers/Download.ashx?IDMF=53aab8d3-c748-4818-abab-32a58d3c510f>.
- Steen, M., Jones, A., & Woodsworth, B. (2013). Anxiety, bonding and attachment during pregnancy, the transition to parenthood and psychotherapy. *British Journal of Midwifery*, 21(12), 768–774.
- Stewart-Brown, S., Tennant, A., Tennant, R., Platt, S., Parkinson, J., & Weich, S. (2009). Internal construct validity of the Warwick-Edinburgh mental well-being scale (WEMWBS): A Rasch analysis using data from the Scottish health education population survey. *Health and Quality of Life Outcomes*, 7, 15.
- van den Heuvel, J. F., Groenhof, T. K., Veerbeek, J. H., van Solinge, W. W., Lely, A. T., Franx, A., & Bekker, M. N. (2018). eHealth as the next-generation perinatal care: An overview of the literature. *Journal of Medical Internet Research*, 20(6) (2018;5; :e202).
- Woodhouse, H., Gartland, D., & Brown, S. (2014). Maternal depression from early pregnancy to 4 years postpartum in a prospective pregnancy cohort study: Implications for primary health care. *BJOG*, 122(3), 312–321.
- World Health Organization. (2017). Maternal mental health. Geneva: World Health Organization . [cited 2022 August 20]. Available from http://www.who.int/mental_health/maternal-child/maternal_mental_health/en/.
- World Health Organization. (2021). *Global strategy on digital health 2020–2025*. Geneva: World Health Organization. Licence: CC BY-NC-SA 3.0 IGO. [cited 2022 Sept 1]. Available from <https://www.who.int/docs/default-source/documents/gsdhdaa2a9f352b0445bafbc79ca799dce4d.pdf>. Licence: CC BY-NC-SA 3.0 IGO. [cited 2022 Sept 1]. Available from.
- World Health Organization. (2022). Recommendations on maternal and newborn care for a positive postnatal experience. Geneva: World Health Organization . Licence: CC BY-NC-SA 3.0 IGO. [cited 2022 September 1]. Available from <https://www.who.int/publications/i/item/9789240045989>.