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Emotional health screening of mothers, preliminary validation of a 3-item instrument: A research brief

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ABSTRACT

A number of countries now recommend population-wide depression screening for perinatal women, using validated tools. A stepped-approach to screening – involving universal screening with a brief measure, followed by targeted screening using a longer measure for those women identified as at greater risk – is used in some settings. This brief report describes the test performance characteristics of a 3-item mood screening instrument, developed for use within a digital parenting program. Participants ($n = 404$) in this cross-sectional study were mothers of children aged up to 3 years. The majority (65.5 %) were first-time mothers, and their mean age was 32.8 years. Data were collected using an online survey. The test performance of the brief 3-item mood screening instrument (possible score range = 0–300) was examined using Receiver Operating Characteristic (ROC) analysis, with a score of 13 or more on the Edinburgh Postnatal Depression Scale (EPDS) used as the reference standard. The mood screening instrument demonstrated excellent range when compared to the reference standard. Optimal balance between sensitivity (0.77) and specificity (0.78), was achieved at a cut-point of 160 or less. Analysis was limited by using only the EPDS as the reference standard. This preliminary data supports the use of this 3-item mood screening instrument to screen for postnatal depression symptoms and may be integrated into a mobile Health or online tool. Future research should examine the test performance of the 3-item mood screening instrument against a diagnostic tool.

1. Introduction

Mood disorders such as depression and anxiety are commonly experienced in the perinatal period (Dennis, Falah-Hassani, & Shiri, 2017). Prevalence varies widely across counties, in Australia it is estimated that 20 % of women experience depression and/or anxiety during pregnancy or in the 12 months following birth (Price Waterhouse Coopers, 2019). Screening across the perinatal period is crucial for facilitating timely identification, diagnosis and treatment for parents experiencing major depression (Milgrom, Mendelsohn, & Gemmill, 2011). The 10-item Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden, & Sagovsky, 1987) is recommended and widely used for this purpose in several countries, including Australia (Highet and The Expert Working Group and Expert Subcommittees, 2023). The United Kingdom's National Institute of Clinical Excellence (NICE) guidelines recommend routine perinatal depression screening using the 'Whooley' questions, with further exploration of symptoms using the EPDS or long Patient Health Questionnaire recommended for women who answer 'yes' to one or both of the Whooley questions (National Institute for Health and Care Excellence (NICE), 2022).

Acceptability of perinatal mental health screening among women is well-established (El-Den, O'Reilly, & Chen, 2015); with recent evidence demonstrating that online, self-report screening, including within a mobile smartphone application, is feasible and acceptable to women and in some cases is preferred over face-to-face screening (Eisner et al., 2022; Kingston et al., 2017). Importantly, incorporating perinatal mental health screening into digital technologies may increase the reach of screening, as both pregnancy and parenting mobile Health (mHealth) smartphone applications (apps) are increasingly popular (Lupton & Pedersen, 2016). An increasing number of apps exist for maternal and

infant health; a recent review found 741 apps available (Biviji, Vest, Dixon, Cullen, & Harle, 2020). An important consideration for app design is user experience (Dube & Helkkula, 2015). To address this consideration a brief screening tool is often more acceptable for users and aligns with this design objective. The aim of this paper is to report on the test performance characteristics of a brief 3-item mood screening instrument developed for use in a digital parenting program.

2. Materials and methods

2.1. Study design, participants and procedure

Data for this cross-sectional study was drawn from an online survey of a community sample of parents in Australia. The overarching aim of this survey was to pilot a series of measures for incorporation into a new app for parents of young children and infants. Parents of children aged 0–5 years who perceived that they were experiencing difficulties with their child/ren sleep were recruited in August 2019 via social media (Facebook, LinkedIn, Twitter) using both paid and unpaid advertising. Paid advertising (Facebook only) targeted adults living in Australia with young children. Participants self-selected by following a link in this advertisement and were provided with information about the study and provided consent before completing the online survey. The advertisement and survey were available only in the English language, so inclusion criteria required the ability to read and understand English. Inclusion in the current analysis was further restricted to survey respondents who were mothers of children aged 0–3 years (the 'index' child) and who completed the core study measures (brief 3-item mood screening instrument and EPDS).

2.2. Measures

The online survey collected demographic information about the parent and their family, including parent age, education and relationship status, number of children, age of the child or children and infant feeding pattern.

Brief 3-item mood screening instrument: The brief mood screening instrument asked about the participant's emotional state; how they felt 'most days' on a sliding scale with 3 or 4 anchor points from 0 to 100 across three domains: mood (anchor points: like crying most of the time – fine mostly, I have my moments – happy and upbeat), worry (anchor points: terrified – nervous at times – calm) and confidence (anchor points: overwhelmed – Like I'm coping – confident).

To respond to these three items participants moved a marker along a horizontal line with anchor points denoted at either end and in the midpoint of the line (for the mood the two middle anchors were equal distance from the midpoint). The total possible score range was 0–300, with a lower score indicating a less optimal mood state. These items were developed by a team of clinicians and researchers and aimed to capture key elements of the EPDS but writing in a more conversational tone.

Edinburgh Postnatal Depression Scale (EPDS): The EPDS is a commonly used and validated screening tool for perinatal depression (Cox et al., 1987). It consists of 10 items that ask about the intensity of depressive symptoms experienced in the previous seven days. Each item is rated on a four point (0–3) scale with a total possible score range of 0–30. A score of 13 or more is associated with moderate sensitivity (0.58–0.74) and high specificity (0.92–0.96) for detection of possible major depressive disorders in pregnant and postpartum women (Levis, Negeri, Sun, Benedetti, & Thombs, 2020).

2.3. Statistical analysis

Descriptive statistics were used to examine the demographic and clinical profiles of participants. Demographic characteristics, brief mood screening instrument score and EPDS score of those included

participants and those excluded participants were compared using t-tests and chi-square. Internal consistency reliability and convergent validity of the brief mood screening instrument and the EPDS were assessed using Cronbach's alpha and Pearson's correlations, respectively. Test performance characteristics of the brief mood screening instrument were examined using receiver operating characteristic (ROC) analyses, with a cut-off of 13 or more on the EPDS used as the reference standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and positive and negative likelihood ratios, and percentage correctly classified were determined for various cut-points on the brief mood screening instrument. Data were analysed using the Statistical Package for Social Sciences version 25 (IBM Corp, 2019).

2.4. Ethics

The study was approved by the Human Research Ethics Committees of the Sydney Local Health District (reference number X19-0069) and the University of Technology Sydney (reference number ETH19-3879).

3. Results

3.1. Participant characteristics

Overall, 636 parents responded to the survey. Of these, 404 women met eligibility criteria and were included in the current analysis. Appendix 1 provides a description of the included sample. There were some differences between participants who were included in the current analysis and those excluded however these differences in characteristics were expected given the age restriction in the current analysis. Importantly, there was no difference in EPDS and brief mood screening instrument scores between those included and excluded in this analysis (see Appendix 1).

3.2. ROC analysis

The average scores on the brief mood screening instrument was 185.6 (SD = 49.23; range 50–300) and the EPDS 8.01 (SD = 4.94; range 0–29). Overall, 18 % of women ($n = 73$) scored 13 or more on the EPDS. Cronbach's alphas for the brief mood screening instrument and EPDS were 0.86 and 0.88, respectively, and the total score for the screening instrument correlated in the appropriate direction with the total score on the EPDS ($r = -0.68$, $p < .001$).

The area under the curve for the brief mood screening instrument was in the excellent range when an EPDS score of 13 or more was used as the reference standard (AUC 0.841, 95%CI: 0.789–0.892; see Fig. 1). Additional test performance characteristics of the brief mood screening instrument, at a range of cut-off scores, are presented in Table 1. Using an example cut-off of 180 or less, the 3-item screening instrument demonstrated a sensitivity of 0.84 and specificity of 0.61 (PPV = 0.32; NPV = 0.94; LR+ = 2.15, LR- = 0.26). The greatest balance between sensitivity and specificity was achieved at a cut-point of 160 or less (sensitivity = 0.77, specificity = 0.78, PPV = 0.38; NPV = 0.94; LR+ = 2.73, LR- = 0.31). Of the score thresholds examined in Table 1, the percentage correctly classified was maximised at a cut point of 140 or less (83.5 %), reflecting the increasing capacity of the measure to correctly rule out 'non-cases' as scores on the brief mood screening instrument decreased (sensitivity = 0.56, specificity = 0.89).

4. Discussion

This study demonstrated that a brief 3-item mood screening instrument identified depressive symptoms in women with young children with good sensitivity and specificity, when compared against the established clinical cut-off for the longer EPDS.

A cut-point of 160 or less for this mood screening instrument provided the optimal balance between sensitivity – correctly identifying
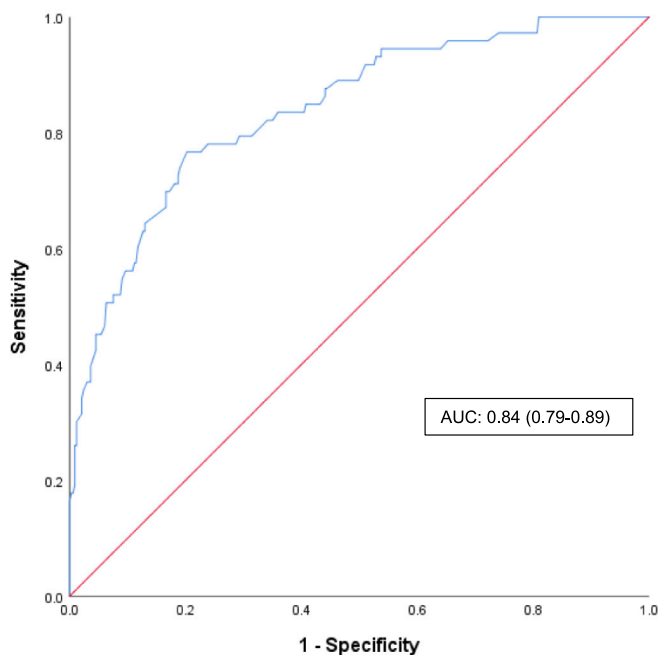
Fig. 1. ROC curve for the 3-item mood screening instrument.

true positive cases, and specificity – correctly identifying true negative cases. At this cut-off, this 3-item mood screening instrument performed with higher specificity than the 'Whooley' questions, which has previously shown to have high sensitivity (0.81–0.99) but low specificity (0.44–0.74) (Smith et al., 2022), although this comparison is limited by the EPDS as the reference standard in the current analysis.

Considering app design, a long screening questionnaire could impair the level of user engagement, therefore, to prioritise engagement with a program, a stepped approach to screening is most suitable. The brief 3-item mood screening instrument is administered first and any positive screen cases from this directed to a longer screening tool (e.g. EPDS). In such a stepped care approach, safety considerations and referral pathways for positive cases also need to be considered (Eisner et al., 2022; Spadaro, Martin-Key, Funnell, & Bahn, 2022). For example, options for sharing data or reports of the screening tool with health care providers to facilitate timely support, further assessment, and treatment (Spadaro et al., 2022).

This analysis identified that the brief mood screening instrument can detect symptoms of depression. However, anxiety and depression are often co-morbid and anxiety in the postnatal period is increasingly being recognised (Dennis et al., 2017). Future research should assess the accuracy of the brief 3-item mood screening instrument to detect symptoms of anxiety. Further, this analysis was limited by the use of the EPDS as the reference standard. Future research should examine the test performance of this brief mood screening instrument against a diagnostic tool (e.g. eMINI). Additional testing is also required to test reliability, ease of use and test-retest reliability of sliding scales. Future research should also examine use of the brief mood screening instrument within a more diverse sample of women, as this sample is limited by the recruitment method (online only) with corresponding selection bias with the sample more highly educated than the average population.

5. Conclusion

This study provides preliminary support for the use of this brief 3-item mood screening instrument to screen for postnatal depression symptoms. Particularly when used in a stepped approach, with positive cases from the brief screening instrument directed to complete a longer screening tool, it is ideal for integration into a mHealth or online tool.

Table 1
Test performance characteristics of the brief 3-item mood screening instrument, using EPDS total score of 13 or more as the reference standard, $n = 404$.

AUC	'Cases' (EPDS 13 or more)	Brief 3-item screening instrument cut-point[1]	Sensitivity	Specificity	PPV	NPV	LR+	LR-	% correctly classified[2]
0.84 (0.79–0.89)	N = 73 (18.1 %)	180 or less	0.84 (0.72–0.90)	0.61 (0.55–0.66)	0.32 (0.25–0.39)	0.94 (0.90–0.97)	2.15 (1.81–2.55)	0.26 (0.16–0.45)	65.2 %
		170 or less	0.78 (0.67–0.87)	0.71 (0.66–0.76)	0.38 (0.30–0.46)	0.94 (0.90–0.96)	2.73 (2.21–3.36)	0.31 (0.20–0.47)	72.6 %
		160 or less	0.77 (0.65–0.85)	0.78 (0.73–0.82)	0.43 (0.35–0.52)	0.94 (0.90–0.96)	3.49 (2.75–4.43)	0.30 (0.20–0.45)	77.8 %
		150 or less	0.67 (0.55–0.77)	0.83 (0.79–0.87)	0.47 (0.37–0.57)	0.92 (0.88–0.95)	4.05 (3.03–5.41)	0.39 (0.28–0.55)	79.0 %
		140 or less	0.56 (0.44–0.68)	0.89 (0.86–0.92)	0.54 (0.42–0.65)	0.90 (0.86–0.93)	5.33 (3.67–7.74)	0.49 (0.38–0.64)	83.5 %

[1] Lower scores on the 3-item emotional health measure indicate *greater* emotional distress.
[2] Percent correctly classified = true positives + true negatives / total N.

Ethics

The study was approved by the Sydney Local Health District Human Research Ethics Committee and University of Technology Human Research Ethics Committee. Participant consent was obtained prior to data collection.

Declaration of competing interest

This research was funded by a grant to Sleepfit and Tresillian from private health insurer HCF (Hospitals Combined Fund) for a partnership to develop and validate a digital parenting program. Jessica Appleton was a Tresillian employee at the time of conducting this research. All other authors declare that they have no conflicts of interest.

Analysis were performed by Nicole Reilly and Jessica Appleton. The first draft of the manuscript was written by Jessica Appleton and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apnr.2024.151812.

References

Biviji, R., Vest, J. R., Dixon, B. E., Cullen, T., & Harle, C. A. (2020). Factors related to user ratings and user downloads of mobile apps for maternal and infant health: Cross-sectional study. *JMIR mHealth and uHealth, 8*(1), Article e15663. https://doi.org/10.2196/15663

Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression: Development of the 10-item Edinburgh postnatal depression scale. *British Journal of Psychiatry, 150*, 782–786.

Dennis, C.-L., Falah-Hassani, K., & Shiri, R. (2017). Prevalence of antenatal and postnatal anxiety: Systematic review and meta-analysis. *The British Journal of Psychiatry, 210*(5), 315–323. https://doi.org/10.1192/bjp.bp.116.187179

Dube, A., & Helkkula, A. (2015). Service experiences beyond the direct use: Indirect customer use experiences of smartphone apps. *Journal of Service Management, 26*(2), 224–248.

Eisner, E., Lewis, S., Stockton-Powdrell, C., Agass, R., Whelan, P., & Tower, C. (2022). Digital screening for postnatal depression: Mixed methods proof-of-concept study. *BMC Pregnancy and Childbirth, 22*(1), 429. https://doi.org/10.1186/s12884-022-04756-2

El-Den, S., O'Reilly, C. L., & Chen, T. F. (2015). A systematic review on the acceptability of perinatal depression screening. *Journal of Affective Disorders, 188*, 284–303. https://doi.org/10.1016/j.jad.2015.06.015

Highet, N. J., & The Expert Working Group and Expert Subcommittees. (2023). *Mental health care in the perinatal period: Australian clinical practice guideline.* Melbourne: Centre of Perinatal Excellence.

IBM Corp. (2019). *IBM SPSS statistics for windows.* Armonk, NY: IBM Corp.

Kingston, D., Austin, M.-P., van Zanten, S. V., Harvalik, P., Giallo, R., McDonald, S. D., … Biringer, A. (2017). Pregnant women's views on the feasibility and acceptability of web-based mental health e-screening versus paper-based screening: A randomized controlled trial. *Journal of Medical Internet Research, 19*(4), 316–333. https://doi.org/10.2196/jmir.6866

Levis, B., Negeri, Z., Sun, Y., Benedetti, A., & Thombs, B. D. (2020). Accuracy of the Edinburgh Postnatal Depression Scale (EPDS) for screening to detect major depression among pregnant and postpartum women: Systematic review and meta-analysis of individual participant data. *BMJ, 371*, Article m4022. https://doi.org/10.1136/bmj.m4022

Lupton, D., & Pedersen, S. (2016). An Australian survey of women's use of pregnancy and parenting apps. *Women and Birth, 29*(4), 368–375. https://doi.org/10.1016/j.wombi.2016.01.008

Milgrom, J., Mendelsohn, J., & Gemmill, A. W. (2011). Does postnatal depression screening work? Throwing out the bathwater, keeping the baby. *Journal of Affective Disorders, 132*(3), 301–310. https://doi.org/10.1016/j.jad.2010.09.031

National Institute for Health and Care Excellence (NICE). (2022). Antenatal and postnatal mental health: clinical management and service guidance. Retrieved from https://www.nice.org.uk/guidance/cg192.

Price Waterhouse Coopers. (2019). *The cost of perinatal depression and anxiety in Australia.* Price Waterhouse Coopers Consulting Australia.

Smith, R. D., Shing, J. S. Y., Lin, J., Bosanquet, K., Fong, D. Y. T., & Lok, K. Y. W. (2022). Meta-analysis of diagnostic properties of the Whooley questions to identify depression in perinatal women. *Journal of Affective Disorders, 315*, 148–155. https://doi.org/10.1016/j.jad.2022.07.026

Spadaro, B., Martin-Key, N. A., Funnell, E., & Bahn, S. (2022). mHealth solutions for perinatal mental health: Scoping review and appraisal following the mHealth index and navigation database framework. *JMIR mHealth and uHealth, 10*(1), e30724. https://doi.org/10.2196/30724