Paediatric and Perinatal Epidemiology
Affiliated to the Society for Pediatric and Perinatal Epidemiologic Research

doi: 10.1111/j.1365-3016.2012.01286.x

Development of a Prenatal Psychosocial Screening Tool for Post-Partum Depression and Anxiety

Sheila McDonald[a], Jennifer Wall[e], Kaitlin Forbes[a], Dawn Kingston[d], Heather Kehler[c], Monica Vekved[a,c] and Suzanne Tough[a,b]

Departments of [a]Paediatrics and [b]Community Health Sciences, Faculty of Medicine, University of Calgary, [c]Public Health Innovation and Decision Support, Population and Public Health, Alberta Health Services, Calgary, [d]Faculty of Nursing, University of Alberta, Edmonton, Alberta, and [e]Faculty of Law, University of Toronto, Toronto, Ontario, Canada

Correspondence:
Sheila McDonald, Child Development Centre, Alberta Children's Hospital, c/o 2888 Shaganappi Trail, NW, Calgary, Alberta, Canada T3B 6A8.
E-mail: sheilaw.mcdonald@albertahealthservices.ca

Abstract

McDonald S, Wall J, Forbes K, Kingston D, Kehler H, Vekved M, Tough S. Development of a prenatal psychosocial screening tool for post-partum depression and anxiety. *Paediatric and Perinatal Epidemiology* 2012; **26**: 316–327.

Background: Post-partum depression (PPD) is the most common complication of pregnancy in developed countries, affecting 10–15% of new mothers. There has been a shift in thinking less in terms of PPD *per se* to a broader consideration of poor mental health, including anxiety after giving birth. Some risk factors for poor mental health in the post-partum period can be identified prenatally; however prenatal screening tools developed to date have had poor sensitivity and specificity. The objective of this study was to develop a screening tool that identifies women at risk of distress, operationalized by elevated symptoms of depression and anxiety in the post-partum period using information collected in the prenatal period.

Methods: Using data from the All Our Babies Study, a prospective cohort study of pregnant women living in Calgary, Alberta (N = 1578), we developed an integer score-based prediction rule for the prevalence of PPD, as defined as scoring 10 or higher on the Edinburgh Postnatal Depression Scale (EPDS) at 4-months postpartum.

Results: The best fit model included known risk factors for PPD: depression and stress in late pregnancy, history of abuse, and poor relationship quality with partner. Comparison of the screening tool with the EPDS in late pregnancy showed that our tool had significantly better performance for sensitivity. Further validation of our tool was seen in its utility for identifying elevated symptoms of postpartum anxiety.

Conclusion: This research heeds the call for further development and validation work using psychosocial factors identified prenatally for identifying poor mental health in the post-partum period.

Keywords: *screening*, *psychosocial*, *prenatal*, *post-partum depression*, *post-partum anxiety*.

Post-partum depression (PPD) is a non-psychotic depressive disorder occurring in women during the post-partum period. The *Diagnostic and Statistical Manual*[1] classifies post-partum-onset depression as beginning within 4 weeks of childbirth; however, most researchers classify PPD as beginning within the first 6 months or the first year post partum.[2] Population-based studies examining PPD in the first 6 months after birth report a prevalence of 10–18% using a variety of standardised and validated assessment tools.[3] However, recent Canadian data from the Maternity Experiences Survey report a prevalence of <10%, defined as scoring >13 on the Edinburgh Postnatal Depression Scale (EPDS).[4] Differences across studies in methodology, diagnostic criteria, period vs. point prevalence estimates, and timing of assessment exist, yielding wide ranges in prevalence rates[5] and rendering it difficult to make comparisons across populations. Other issues concern timing of onset of symptoms; for example, a recent study found that among women presenting with PPD within the first post-partum year, 11.5%, 66.5% and 22% had symptom onset during

pregnancy, early post-partum (<6 weeks) and late post-partum (>6 weeks), respectively.[6] PPD constitutes an important public health issue as it is associated with morbidity for women, children and families in both the short and the long term.[7]

Post-partum depression can negatively impact a woman's quality of life, intimate relationships, maternal–infant interaction patterns, infant attachment, and child developmental outcomes from infancy through school age.[8–11] In terms of the latter, the most robust associations have been reported for child cognitive outcomes, with smaller effect sizes seen on behavioural outcomes.[8] Some studies have demonstrated that one mechanism mediating the association between disturbances in maternal mood and adverse child outcomes is impaired maternal–infant/child interaction patterns in infancy.[8,12] Given PPD's short- and long-term sequelae, early detection and intervention are essential to ensure optimal well-being for mothers, children and families.[13,14]

Some researchers have shifted their research to include other symptoms of distress in addition to depression in the post-partum period, such as anxiety and transitioning difficulties specific to parenting.[15–18] Indeed, both anxiety and depression, as co-morbid conditions and conditions in their own right, are recognised as important mental health morbidities among the perinatal population, leading to a revised clinical and research agendas in perinatal mental health. Although minor distress and parenting stress are common to mothers in the early post-partum period, there is the potential for exacerbation if left undetected and untreated, or if symptoms occur in conjunction with other disadvantages such as low socio-economic status (SES) and poor social support.[19] Although the majority of postnatal depressions are self-limiting, a number of women go on to experience recurrent or chronic episodes.[7,20,21]

Risk factors for PPD

The aetiology of PPD is multifactorial. Recent systematic reviews and meta-analyses have established the following risk factors: stressful events during pregnancy, prenatal depression, prenatal anxiety, poor social support, a tense marital relationship, a history of depression, low self-esteem, unwanted pregnancy and low SES.[3,19,22,23] There is some evidence to suggest that screening for adult depression in primary care settings is effective,[24] yet only limited evidence exists to suggest the same for antenatal and/or postnatal screening for PPD.[25,26]

Throughout the prenatal period, most pregnant women are in contact with the health care system, with many undergoing routine prenatal care visits with family practitioners or obstetricians/gynaecologists. Given that the key risk factors for PPD are identifiable during pregnancy, there is an opportunity for health professionals to identify women at risk in the prenatal period for poor mental health outcomes and transitioning difficulties in the post-partum period as part of routine prenatal care.[17,27] The health care needs of pregnant women lead to increased service use during the prenatal period compared with the postnatal period; for this reason, screening for postnatal health issues and concerns during prenatal visits is one way health care providers can mitigate the burden of disease on women and potential burden on the system at later time points by taking a preventive approach to the significant public health issue of post-partum mental health difficulties. Developing a method of predicting PPD is important because of the low rate at which women seek treatment and the limited opportunities of health professionals to identify symptoms of PPD by virtue of fewer interactions with women in the postnatal period.[28,29] Many women with PPD are reluctant to admit their symptoms and to seek help from friends, family and health care providers.[30,31] A predictive screening approach that can be implemented in the prenatal period by primary health care providers is an essential first step in prevention and intervention initiatives for postnatal depression.[25] As a number of the known risk factors for postnatal depression are either present or can be assessed during pregnancy, prenatal intervention may help prevent the development of PPD and its adverse sequelae. Prenatal screening could also identify women at risk for less extreme mental health issues such as adjustment or coping difficulties in the postnatal period.[32] There is a call for routine screening across the perinatal period, with some advocating for prenatal screening,[33] postnatal screening[34] or both.[35]

Approaches to screening

Screening for mental health difficulties during the perinatal period most often occurs via single screening measures that assess symptomatology (depression or anxiety) in a short time frame, usually the past week or month. Research using brief symptom-based measures during pregnancy such as the EPDS has clearly dem-

onstrated inadequate sensitivity and specificity for predicting PPD.[17] Given their short time frame for assessment, these instruments are most useful for identifying current distress.[17] A recent systematic review undertaken to examine the validity of the EPDS for detection of perinatal depression found wide ranges for sensitivity (0.34 to 1.0) and specificity (0.44 to 1.0).[36] As noted by the authors, such heterogeneity in performance indicators was mainly due to methodological issues and differences across studies included in the review. The authors concluded that when used in the general population, EPDS screening would generate large false-positive and false-negative rates.[36,37] An earlier systematic review that examined prenatal screening tools (study-specific instruments and standard tools including the EPDS) corroborates these more recent findings and concluded that among those screening instruments reviewed there is none that has sufficient sensitivity or positive predictive value to form the basis of a routine screening programme.[25]

Psychosocial risk factors for PPD have received increased attention in the literature, with a number of studies advocating for routine psychosocial assessment during the perinatal period.[17,32,38,39] A number of studies have reported on screening tools that group antenatal psychosocial risk factors; examples include the Antenatal Psychosocial Health Assessment (ALPHA),[40] the Pregnancy Risk Questionnaire[41] and, most recently, the Psychosocial Risk Index.[17] Despite the shift in focus to address psychosocial health status using a combination of measures and/or more comprehensive assessment strategies, there is little evidence to support their universal implementation. There is a call for additional validation studies and outcomes research that examine the feasibility and utility of using combined tools and more comprehensive approaches to screening.[17]

The purpose of the present investigation was to develop, assess and internally validate a prenatal screening tool for distress in the post-partum period, operationalised as having a score of 10 or above on the EPDS. This cut-off has been used in antenatal screening to identify distress in general population samples and to identify risk of minor postnatal depression.[17,37] To this end, we set out to: (1) develop a prenatal screening tool for general distress in the post-partum period based on known risk factors for PPD, (2) examine the performance indicators of the screening tool and compare its performance with the EPDS, (3) validate the tool internally on a subsample not used in tool derivation, and (4) examine the tool's utility in also predicting self-reported anxiety symptomatology, another indicator of distress in the post-partum period.

Variable selection for inclusion in the prenatal screening tool was based on established risk factors for PPD as identified in the literature,[19,23,32] factors measured during pregnancy in the present study, and feasibility/utility issues. The latter consideration was deemed important given that the tool's ultimate purpose would be implementation during routine prenatal visits.

Methods

A community sample of women <24 weeks pregnant in Calgary, Alberta was recruited as part of an ongoing longitudinal cohort study known in the community as the All Our Babies Study (AOB; $n = 1578$). Participants completed three questionnaires: one prior to 24 weeks gestation (t_1), one between 34 and 36 weeks gestation (t_2) and one at approximately 4 months post partum (t_3). Women were recruited through promotional materials in the community, local laboratory services, and both on-site and telephone recruitment at low-risk maternity and high-risk obstetrics clinics. The study had an 89% completion rate. Ethical approval for the AOB study was granted by the University of Calgary's Conjoint Health Research Ethics Board.

The AOB study collected the following types of information across the perinatal period: sociodemographics, SES, physical health, psychosocial health and emotional well-being, life style, breast-feeding experiences, life-course information on abuse and mental health, and health care utilisation. Validated instruments were used during data collection where possible; other questions were specific to the objectives of the AOB study. For the present analysis, the following validated instruments were used: the EPDS,[42] the Cohen Perceived Stress Scale (PSS),[43] the state anxiety scale of the State-Trait Anxiety Inventory (STAI)[44] to measure depression, stress and anxiety, respectively. Other variables of interest for the present study included sociodemographic and socio-economic factors, history of abuse, history of depression, perceived social support from partner, family and friends, and perceived relationship quality from partner. These variables were assessed mainly using single items developed for this study, but loosely based on questions used in other national cohort studies[45] and a local randomised trial.[46] See Appendix 1 for a description of

select standardised tools as well as phrasing and coding for single item measures.

Tool derivation

The prenatal screening tool was derived via development of a best fit multiple logistic regression model predicting PPD, operationalised as scoring at least 10 on the EPDS at the 4-month post-partum data collection point. The final model included those factors significant at the bivariate level and known risk factors identified in the literature. Candidate variables were drawn from both data collection points during pregnancy. Factors from the first data collection assessment (<24 weeks of pregnancy) included sociodemographic factors (marital status, maternal age, ethnicity, immigration status), socio-economic factors (maternal education, family income level), history of depression, history of abuse, and relationship quality (tension). Factors drawn from the late pregnancy data collection point (34–36 weeks of pregnancy) included maternal psychosocial health (depression, anxiety and stress in the third trimester), maternal optimism and perceived social support. Using a regression coefficient-based scoring algorithm[47,48] applied to the final regression model, a single screening score was developed. Receiver Operating Characteristic (ROC) analysis was then used to determine the sensitivity, specificity, positive and negative predictive values (PPV and NPV, respectively) for different cut-offs of the screening score. In the regression coefficient-based method, the sum of the two smallest regression coefficients multiplied by 2/5 sets the criterion value. Each regression coefficient is then divided by the criterion value and rounded up to the nearest integer to produce a point score. Point scores are then summed in order to derive a final screening score for each participant. As seen in the recent literature for screening tools for other conditions, such as sleep apnoea and coronary heart disease,[47,49] we adopted the regression coefficient-based method to derive our screening score, as opposed to an odds ratio-based method.

Internal validation and comparison with a standard screening approach

We derived the screening tool on approximately 2/3 of the study sample, and used the remaining 1/3 for internal validation.[50,51] The samples were selected using a random mechanism that selected 67% of the full sample ($n = 1578$) to form the derivation sample, leaving the 'non-selected' participants (33% of the full sample) to form the validation sample. This approach consisted of comparing performance indicators (sensitivity, specificity, PPV and NPV) of the tool across the two samples (derivation sample and validation sample). Once derived and internally validated, we compared our tool's performance with the EPDS in late pregnancy to assess the extent to which the new tool performed worse, as well as, or better than standard practice for screening for suboptimal post-partum mental health. As for our tool, we performed an ROC analysis of the EPDS in late pregnancy using a cut-off of 10 or more.

Anxiety as outcome

Our final analysis examined the tool's performance in predicting an additional suboptimal mental health outcome: anxiety symptomatology. We operationalised anxiety using a previously identified cut-off score to classify individuals as having high anxiety (40 and above) on the state anxiety scale of the STAI.[44] Performance indicators according to the outcome of state anxiety were examined in the derivation sample.

All analyses were performed using SPSS version 15.0 (SPSS Inc., Chicago, IL, USA).

Results

Sample characteristics are presented in Table 1. The AOB cohort is well educated and has above average affluence, and is comparable with the target population of women who plan to become pregnant and parent in Canada.[52,53] The full sample was randomly split for the purposes for tool derivation ($n = 1011$; approximately 2/3 of the sample) and internal validation ($n = 567$). There were significant differences between the two samples on all characteristics with the validation sample more likely to fall in the 'risk' category for all variables that were compared. That is, women in the validation sample were more likely to have lower SES, be not married or living in a common-law relationship, be non-Caucasian and be new arrivals to Canada, compared with women in the derivation sample (Table 1). The prevalence of depression according to a score of 10 or above on the EPDS at 4 months post partum was approximately 13% in both the derivation and validation samples. Although 'missingness' was comparable in terms of sociodemographics

Table 1. Characteristics of the All Our Babies sample[a]

Characteristic	Total sample ($n = 1578$) n (%)	Derivation sample ($n = 1011$) n (%)	Validation sample ($n = 567$) n (%)	P-value
Education				0.005
High school or less	177 (11.4)	99 (9.8)	78 (14.5)	
Some postsecondary education	206 (13.3)	123 (12.2)	83 (15.5)	
Graduated postsecondary	910 (58.8)	617 (61.1)	293 (54.6)	
Postgraduate	254 (16.4)	171 (16.9)	83 (15.5)	
Age (years)				0.001
≤24	126 (8.5)	64 (6.6)	62 (12.0)	
25–34	1059 (71.3)	711 (73.2)	348 (67.6)	
35+	301 (20.3)	196 (20.2)	105 (20.4)	
Married or common-law	1432 (92.9)	960 (95.3)	472 (88.4)	<0.001
Caucasian ethnicity	1141 (73.9)	773 (76.6)	368 (68.8)	0.001
Household income <$40 000/year	158 (10.6)	77 (7.9)	81 (15.5)	<0.001
Lived in Canada 5 years or less	168 (10.9)	96 (9.5)	72 (13.5)	0.02

[a]Because of missing information for some women, the denominator varied for the full sample and both subsamples.

between the two subsamples, the validation subsample had a higher proportion of missing data for the outcomes in question at 4 months (depression and anxiety, respectively).

The best fit multiple logistic regression model predicting post-partum EPDS scores of 10 or above in the derivation sample included the following independent variables: depression in pregnancy, perceived stress in late pregnancy, history of abuse, and poor partner relationship quality in pregnancy. No sociodemographic or socio-economic variables were significant predictors at the multivariable level. Other variables of interest that did not remain significant in the final model included anxiety in late pregnancy, perceived social support and history of depression. Our scoring algorithm produced a screening score based on the regression coefficients of the significant independent variables that ranged from 0 to 6, with higher values on the tool suggesting increased distress (according to the four variables that comprise the score). Depression, stress, abuse history and poor relationship quality were dichotomous variables; 'risk' categories were coded as 1 and reference categories were coded as 0. Women were classified into 'risk' categories for depression and stress according to cut-off scores of 10 or above on the EPDS and 19 or above (i.e. the 80th percentile of the sample distribution) on the PSS, respectively. Table 2 depicts the final regression model and assigned score values for each variable in the model.

Receiver Operating Characteristic (ROC) analysis of the screening tool showed optimal performance indices for a cut-off score of 2. That is, being either depressed or stressed (according to the EPDS or PSS, respectively) was sufficient to score at or above the screening threshold for 'at-risk' status in late pregnancy. Indeed, at-risk status as conferred by the screening tool would be reached by any of the following combinations: depressive symptoms in late pregnancy

Table 2. Final regression model predicting post-partum depression and assigned screening score values

Independent variable	β (SE)	OR [95% CI]	Assigned integer-based point score[a]
Depression	1.20 (0.27)	3.33 [1.95, 5.70]	2
Stress	1.08 (0.27)	2.94 [1.73, 4.97]	2
History of abuse	0.68 (0.22)	1.98 [1.30, 3.01]	1
Poor relationship quality	0.58 (0.22)	1.79 [1.17, 2.75]	1

[a]A point score for each predictor variable was assigned by dividing the regression coefficient by the sum of the two smallest coefficients in the model multiplied by 2/5 (criterion value). The overall score for each participant was assigned by summing across component scores.

Table 3. Performance indices by subsample for the screening tool and the EPDS

Index	Derivation sample ($n = 1011$)		Validation sample ($n = 269$)[a]	
	Screening tool	EPDS	Screening tool	EPDS
Area under the ROC curve [95% CI]	0.77 [0.72, 0.82]	0.80 [0.76, 0.84]	0.71 [0.61, 0.82]	0.73 [0.62, 0.83]
Sensitivity [95% CI]	0.60 [0.52, 0.68]	0.43 [0.35, 0.51]	0.44 [0.29, 0.60]	0.41 [0.27, 0.61]
Specificity [95% CI]	0.84 [0.81, 0.87]	0.91 [0.89, 0.93]	0.86 [0.77, 0.87]	0.88 [0.82, 0.91]
Positive predictive value [95% CI]	0.36 [0.31, 0.41]	0.42 [0.34, 0.50]	0.31 [0.17, 0.40]	0.34 [0.20, 0.49]
Negative predictive value [95% CI]	0.93 [0.91, 0.95]	0.91 [0.89, 0.93]	0.91 [0.86, 0.94]	0.91 [0.87, 0.95]

[a]The validation sample size was 567. However, ROC analysis was based on only 269 cases because of missing information for the outcome. There was a greater proportion of missing data for the outcome in the validation sample compared with the derivation sample.
EPDS, Edinburgh Postnatal Depression Scale; ROC, Receiver Operating Characteristic.

alone or in combination with any other factor, stress symptoms in late pregnancy alone or in combination with any other factor, having a history of abuse AND current relationship tension, or combinations involving any of the above. Having only a history of abuse or only current relationship tension would not confer 'at-risk' status according to our tool. These factors must occur in combination with the other or in combination with stress or depression in late pregnancy in order to reach the screening tool's threshold. Despite these constraints, that is, that neither abuse history nor current relationship tension alone has added-value, these two factors in combination may capture some previously unidentified subgroups of women who may go on to develop poor mental health outcomes after giving birth.

Table 3 presents the performance indices of the tool for a cut-off score of 2 in both the derivation and validation samples. In the derivation sample, the area under the ROC curve was 0.77 [95% confidence interval (CI) 0.72, 0.82] indicating moderate discriminative performance of the tool in predicting post-partum distress. In the validation sample, the area under the ROC curve was 0.71 [95% CI 0.61, 0.82]. Performance indices of the EPDS alone, in both samples, are shown for comparison purposes. In the derivation sample, the screening tool had a higher sensitivity and NPV than the EPDS, but lower values for specificity and PPV. The difference between the two tools for sensitivity was significant at the 5% level as seen by their non-overlapping CIs. Although the screening tool had significantly higher sensitivity, the EPDS had better specificity ($P < 0.05$). In the validation sample, the screening tool had similar performance indicators as the EPDS alone, with overlapping CIs seen for all indicators.

When applied to the outcome of anxiety at 4 months post partum in the derivation sample, the screening tool had similar performance indices. Its area under the ROC curve was 0.77 [95% CI 0.73, 0.82]. At the same cut-off score, the tool's sensitivity and specificity were 0.56 and 0.84, respectively. As was the case for PPD, the tool had significantly better sensitivity than the EPDS alone for predicting post-partum anxiety.

Comments

In this study we derived a simple screening tool based on prenatal psychosocial risk factors for suboptimal mental health in the post-partum period, operationalised as depression and anxiety symptoms. The tool comprised only four indicators. Two of the indicators were brief, validated scales (EPDS and PSS). The remaining two indicators were single questions on abuse history and relationship quality. The tool performed as well as the EPDS alone in terms of its area under the ROC curve had significantly better sensitivity in predicting both depression and anxiety in the post-partum period. The higher the sensitivity of a tool, the wider the net cast; that is, not many women with the outcome in question would be missed although there may be a number of false-positives. The ultimate utility of a screening tool depends on the cost–benefit weighing of false-positives to false-negatives. The value added by our simple screening tool compared with the EPDS alone is its higher sensitivity and broader focus. It also displayed more than adequate specificity, despite performing significantly worse than the EPDS in this regard. For our purposes, that is, casting a wide net for capturing distress, we deem that outperformance in sensitivity outweighs our tool's underperformance in specificity, compared with the

EPDS in late pregnancy. Our tool asks about not only depressive symptoms, but also stress, history of abuse and relationship quality. Our scoring algorithm and identified threshold would capture women at risk of poor mental health outcomes even if they did not currently (i.e. in pregnancy) report symptoms of depression. Similarly, women would be identified at risk if they only reported high levels of perceived stress in the absence of current depressive symptoms. Our tool can capture information on key factors in a pregnant woman's environment and how she is interacting with these factors (perceived stress, relationship quality) to provide a broader picture of a woman's risk profile, as opposed to only assessing current depression.

The goal of screening is to identify individuals at higher risk that could benefit from early intervention and prevention initiatives. Although a high sensitivity increases the false-positive rate, if an intervention is simply increased monitoring and referral of women as part of routine prenatal care, all women identified by the screening tool would benefit from the increased attention, even if a number do not develop any mental health or transitioning difficulties in the postnatal period. Furthermore, it is possible that women identified as false-positives according to this model may become true positives, should assessment occur at a later time point – even just weeks later, given that the depression and anxiety measures used in the present study assess current and recent symptomatology. There is evidence to suggest that symptoms of emotional well-being are not constant during the perinatal period, as this is a transitional time for many women.[54] Critics of screening for PPD tend to focus on the false-positive rate of the different approaches and the lack of evidence for the cost-effectiveness of current tools in the general population.[36,55,56] Although this argument is justified in terms of costs attributed to follow-up and treatment of false-positively identified cases of PPD, other important outcomes, such as anxiety, could be missed. Our tool's performance in identifying both depression and anxiety in the post-partum suggests that this might be the case. Indeed, of the false-positives for depression according to our screening tool, about 17% had anxiety and 23% reported high levels of perceived stress according to cut-offs used to classify high anxiety and high levels of perceived stress, respectively.

Consistent with previous research, PPD was found to be significantly associated with several known risk factors and psychosocial factors in this sample.[3,19,23,32,57,58] Although previous efforts at developing predictive tests for PPD have not focused on antenatal stress,[25] stress was identified as an important component of our screening tool. We also found that history of abuse and partner relationship tension were important predictors of PPD. This is in line with previous studies incorporating questions on abuse and relationship quality in their psychosocial assessment tools.[17,32] Furthermore, the impact of intimate violence experiences on PPD is receiving increased attention in the literature.[59–61] Given that our tool includes a question on tension in a woman's intimate relationship, we are following this line of investigation to address how this understudied factor confers risk for post-partum distress. Relationship tension was strongly correlated with a history of abuse and low satisfaction with partner support. It remained an independent predictor in our final model, suggesting that our indicator of relationship tension may, indeed, reflect more insidious relationship dynamics and a new phenomenon independent of history of abuse, and in lieu of, perception of social support. Further examination of this hypothesis is required. Overall, we included psychosocial risk factors in derivation of our tool in an attempt to heed the call for increased validation work and research on psychosocial assessment and screening for post-partum distress.

Although our tool was developed to aid in the prediction of suboptimal mental health in the post-partum, we would be remiss to discount its utility in identifying current distress, a feature of screening underscored by Matthey and colleagues.[32] Given that two of the indicators were validated scales that assess distress in the past 7 days (EPDS) and in the past month (PSS), and that depressive symptoms in pregnancy can compromise the developing fetus and affect birth experiences and outcomes,[62–68] depression during pregnancy is an important issue to address in its own right.[69] Given the indicators that comprise our tool, we can identify women at risk for both current and later distress. Indeed, a common route for achieving 'at-risk' status according to our tool was through scoring above the respective cut-off on the EPDS and PSS administered at the 34–36 weeks data collection time point. Although other screening tools used in pregnancy also confer this advantage, particularly if the assessment tool identifies current symptomatology, our tool can identify symptoms and histories other than current depressive symptoms alone, because of its broad, psychosocial focus.

A comprehensive screening programme depends not only on the performance indicators of the screening tool employed but also on the tool's acceptability to women and health care professionals, its feasibility and ease of administration, and whether treatments and referrals are in place to accommodate the outcomes of the screening tool. Acceptable criteria should also include evidence from high-quality randomised controlled trials that the screening programme is effective in reducing morbidity and mortality.[55] In line with previous work on psychosocial screening during pregnancy,[17,32,40,70] our tool has the potential for implementation in clinical practice settings as part of routine prenatal care. Following further validation work, next steps could include piloting our tool in low-risk maternity clinics. Routine screening could be a low-cost alternative for health care professionals with limited resources for supporting women during the perinatal period. Our tool could help to streamline or triage the process for post-screening treatment and follow-up procedures already in place, which include targeted written materials, referral resources, parenting groups and peer-support groups, for example. Previous empirical and qualitative work has shown that increased responsiveness on the part of health professionals in terms of detection, awareness and appropriate referral was more likely in those practices that actively incorporated a screening programme or tool as part of routine clinical examinations.[71–73] Although these studies focused on screening in the post-partum, there is no reason to expect differences in responsiveness on the part of the health care provider during routine prenatal care for the purposes of secondary prevention.

Our internal validation sample differed significantly from the derivation sample on a number of sociodemographic and socio-economic factors. As the tool performed better in the derivation sample, generalisability issues are raised. Our results suggest that the tool has better utility in samples with higher SES, which is more comparable with the pregnant and parenting population in Canada and other high-income countries.[52,74] Given that our tool performed no better than the EPDS in the lower SES subsample, other indicators may be of more use. It could be that indicators of SES outweigh those of a psychosocial nature for this demographic. Indeed, among disadvantaged women, indicators of low SES (unemployment and financial strain) are important risk factors for PPD.[75–77] Tool derivation in different subgroups of pregnant women is an issue that requires further investigation, one that will be explored in using the AOB data and for different subgroups characterised not only by indicators of SES but also by ethnicity, immigration status, age and parity, for example. A recent cross-sectional study among low-income urban mothers in the US that compared screening tools for depression as diagnosed by psychiatric interview found that the EPDS required alteration of its cut-off score for accurate identification of depression for this demographic.[78] We used validated cut-off scores for the EPDS both prenatally and postnatally; examination of different cut-offs for different subgroups of women could be a further avenue of investigation.

In addition to its different sociodemographic profile, the validation sample also comprised a greater proportion of women with missing data for PPD and postpartum anxiety compared with the derivation sample. As a sensitivity analysis, we reran the tool derivation and validation using subsamples derived from only those participants for whom there was no missing data on the mental health standardised scales in late pregnancy. By design, these scales had not been administered for a period of time during data collection in an attempt to minimise response burden, but were later re-employed. While our original tool derivation and validation work showed clear differences among the two subsamples in terms of sociodemographic profile and missingness, the subsamples employed in the sensitivity analysis were similar in both. Interestingly, the tool had similar performance indicators for both subsamples in the sensitivity analysis, which, in turn, was similar to the derivation subsample in the original analysis. Taken together, the results suggest that our tool outperforms the EPDS in late pregnancy among those women with a middle to affluent sociodemographic profile, especially in terms of sensitivity.

To our knowledge, only a handful of previous research examining antenatal screening has incorporated internal and external validation samples in their studies.[79–81] As we plan to further validate our tool in larger samples, we are incorporating a necessary component for tool development in our work. Furthermore, the methodological challenges encountered within our validation sample (missing outcome data, different sociodemographic and SES composition) have the additional benefit of driving further hypothesis testing for comprehensive tool development. Our sensitivity analysis was a first step in this direction and points to the need for further work in this area across all subgroups of a screening target population.

The AOB study is ongoing, and will eventually comprise approximately 3000 women and infant pairs. Advantages of the current data source include its longitudinal and prospective design, its generalisability to the pregnant and parenting population in Canada, and its richness in terms of the type and number of variables assessing maternal well-being and associated factors across the perinatal period. Limitations include its reliance on maternal self-report compared with gold standard diagnostic psychiatric assessments for depression and anxiety. The strength of association among established risk factors has been found to differ according to whether the outcome is defined as a clinical syndrome diagnosed through interview or as assessed through self-report.[82] Therefore, our results must be interpreted in terms of depressive and anxious symptomatology as assessed through self-report at 4 months post partum. We employed the STAI in the AOB study to assess symptoms of anxiety at 4 months post partum. The STAI comprises both a state anxiety scale and a trait anxiety scale, with the latter asking about general symptoms of anxiety as compared with the former, which assesses current and recent symptoms of anxiety. Given that the present analysis reported on state anxiety only, we cannot draw conclusions as to general symptoms of anxiety, which may be a better indicator of risk for anxiety disorder. Finally, although a large proportion of study participants reflects the local demographic of pregnant and parenting families, the overall proportion of ethnic minorities, single mothers and low-income households is low, which decreases the power to examine subgroups as noted above. With a larger sample size as the AOB study continues, increased power for subgroup analyses for tool development is possible.

There is a lack of current evidence regarding longer-term outcomes of screening approaches that incorporate psychosocial assessment in addition to standard tools.[17] We hope to further internally validate our tool in a larger sample and to examine the tool's utility in predicting other transitioning outcomes and psychological states for women and children, such as parenting stress and maternal–infant interaction, in addition to child developmental outcomes as the cohort matures. We anticipate that the high false-positive rate of the screening tool for PPD and anxiety may capture difficulties that surface after the post-partum data collection point. Given the negative consequences of poor maternal mental health in the post-partum period, short-term investment in screening and mitigation of risk through early intervention may have long-term health and development benefits for new parents and their children.

References

1 American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders IV-TR*. Arlington, VA: American Psychiatric Association, 2000.

2 Driscoll JW. Postpartum depression: the state of the science. *Journal of Perinatal & Neonatal Nursing* 2006; **20**:40–42.

3 O'Hara MW, Swain AM. Rates and risk of postpartum depression – a meta-analysis. *International Review of Psychiatry* 1996; **8**:37–54.

4 Public Health Agency of Canada. *What Mothers Say: The Canadian Maternity Experiences Survey*. Ottawa, 2009. http://www.phac-aspc.gc.ca/rhs-ssg/pdf/survey-eng.pdf [last accessed 27 February 2012].

5 Dennis CL. Influence of depressive symptomatology on maternal health service utilization and general health. *Archives of Women's Mental Health* 2004; **7**:183–191.

6 Stowe ZN, Hostetter A, Newport DJ. The onset of postpartum depression: implications for identification in obstetrical and primary care. *American Journal of Obstetrics and Gynecology* 2005; **192**:522–526.

7 Warner R, Appleby L, Whitton A, Faragher B. Demographic and obstetric risk factors for postnatal psychiatric morbidity. *British Journal of Psychiatry* 1996; **168**:607–611.

8 Grace SL, Evindar A, Stewart DE. The effect of postpartum depression on child cognitive development and behaviour: a review and critical analysis of the literature. *Archives of Women's Mental Health* 2003; **6**:263–274.

9 Avan B, Richter LM, Ramchandani PG, Norris SA, Stein A. Maternal postnatal depression and children's growth and behaviour during the early years of life: exploring the interaction between physical and mental health. *Archives of Disease in Childhood* 2010; **95**:690–695.

10 Murray L, Cooper P. Postpartum depression and child development. *Psychological Medicine* 1997; **27**:253–260.

11 Tough SC, Siever JE, Leew S, Johnston DW, Benzies K, Clark D. Maternal mental health predicts risk of developmental problems at 3 years of age: follow up of a community based trial. *BMC Pregnancy and Childbirth* 2008; **8**:16. DOI: 10.1186/1471-2393-8-16.

12 Murray L, Fiori-Cowley A, Hooper R, Cooper P. The impact of postnatal depression and associated adversity on early mother-infant interactions and later infant outcome. *Child Development* 1996; **67**:2512–2526.

13 Dennis CL. Psychosocial and psychological interventions for prevention of postnatal depression: systematic review. *British Medical Journal* 2005; **331**:1–8.

14 Goodman SH, Tully E. Depression in women who are mothers: an integrative model of risk for the development of psychopathology in their sons and daughters. In: *Women and Depression*. Editors: Keyes CLM, Goodman SH. New York: Cambridge University Press, 2006; pp. 241–283.

15 Austin MP. Antenatal screening and early intervention for 'perinatal' distress, depression and anxiety: where to from here? *Archives of Women's Mental Health* 2004; **7**:1–6.
16 Matthey S, Barnett B, Howie P, Kavanagh DJ. Diagnosing postpartum depression in mothers and fathers: whatever happened to anxiety? *Journal of Affective Disorders* 2003; **74**:139–147.
17 Priest SR, Austin MP, Barnett BB, Buist A. A psychosocial risk assessment model (PRAM) for use with pregnant and postpartum women in primary care settings. *Archives of Women's Mental Health* 2008; **11**:307–317.
18 Wenzel A, Haugen E, Jackson L, Brendle J. Anxiety symptoms and disorders at eight weeks postpartum. *Journal of Anxiety Disorders* 2005; **19**:295–311.
19 Robertson E, Grace S, Wallington T, Stewart D. Antenatal risk factors for postpartum depression: a synthesis of recent literature. *General Hospital Psychiatry* 2004; **26**:289–295.
20 Kumar R, Robson KM. A prospective study of emotional disorders in childbearing women. *British Journal of Psychiatry* 1984; **144**:35–47.
21 Horwitz SM, Briggs-Gowan MJ, Storfer-Isser A, Carter AS. Persistence of maternal depressive symptoms throughout the early years of childhood. *Journal of Women's Health* 2009; **18**:637–645.
22 Beck CT. A meta-analysis of predictors of postpartum depression. *Nursing Research* 1996; **45**:297–303.
23 Beck C. Predictors of postpartum depression: an update. *Nursing Research* 2001; **50**:275–285.
24 Pignone MP, Gaynes BN, Rushton JL, Burchell CM, Orleans CT, Mulrow CD, *et al*. Screening for depression in adults: a summary of the evidence for the U.S. Preventive Services Task Force. *Annals of Internal Medicine* 2002; **136**:765–776.
25 Austin MP, Lumley J. Antenatal screening for postnatal depression: a systematic review. *Acta Psychiatrica Scandinavica* 2003; **107**:10–17.
26 Dennis CL. Detection, prevention, and treatment of postpartum depression. In: *Postpartum Depression: Literature Review of Risk Factors and Interventions*. Editors: Stewart DE, Robertson E, Dennis CL, Grace SL, Wallington T. Toronto, ON: University Health Network Women's Health Program, 2003; pp. 71–196.
27 Mishina H, Takayama JI. Screening for maternal depression in primary care pediatrics. *Current Opinion in Pediatrics* 2009; **21**:789–793.
28 Small R, Brown S, Lumley J, Astbury J. Missing voices: what women say and do about depression after childbirth. *Journal of Reproductive and Infant Psychology* 1994; **12**:19–22.
29 Woolhouse H, Brown S, Krastev A, Perlen S, Gunn J. Seeking help for anxiety and depression after childbirth: results of the Maternal Health Study. *Archives of Women's Mental Health* 2009; **12**:75–83.
30 Brown S, Lumley J. Physical health problems after childbirth and maternal depression at six to seven months postpartum. *British Journal of Obstetrics and Gynaecology* 2000; **107**:1194–1201.
31 Dennis CL, Chung-Lee L. Postpartum depression help-seeking barriers and maternal treatment preferences: a qualitative systematic review. *Birth* 2006; **33**:323–331.
32 Matthey S, Phillips J, White T, Glossop P, Hopper U, Panasetis P, *et al*. Routine psychosocial assessment of women in the antenatal period: frequency of risk factors and implications for clinical services. *Archives of Women's Health* 2004; **7**:223–229.
33 Josefsson A, Berg G, Nordin C, Sydsjo G. Prevalence of depressive symptoms in late pregnancy and postpartum. *Acta Obstetricia et Gynecologica Scandinavica* 2001; **80**:251–255.
34 Lee DTS, Yip ASK, Chiu HFK, Leung TYS, Chung TKH. A psychiatric epidemiological study of postpartum Chinese women. *American Journal of Psychiatry* 2001; **158**:220–226.
35 Locicero AK, Weiss DM, Issokson D. Postpartum depression: proposal for prevention through an integrated case and support network. *Applied & Preventive Psychology* 1997; **6**:169–178.
36 Gibson J, McKenzie-McHarg K, Shakespeare J, Price J, Gray R. A systematic review of studies validating the Edinburgh Postnatal Depression Scale in antepartum and postpartum women. *Acta Psychiatrica Scandinavica* 2009; **119**:350–364.
37 Matthey S, Henshaw C, Elliott S, Barnett B. Variability in use of cut-off scores and formats on the Edinburgh Postnatal Depression Scale – implications for clinical and research practice. *Archives of Women's Mental Health* 2006; **9**:309–315.
38 Buist AE, Barnett BEW, Milgrom J, Pope S, Condon JT, Ellwood DA, *et al*. To screen or not to screen – that is the question in perinatal depression. *Medical Journal of Australia* 2002; **177**:S101–S105.
39 Coyle B, Adams C. The EPDS: guidelines for its use as part of a maternal mood assessment. *Community Practitioner* 2002; **75**:394–395.
40 Carroll JC, Reid AJ, Biringer A, Midmer D, Glazier RH, Wilson L, *et al*. Effectiveness of the Antenatal Psychosocial Health Assessment (ALPHA) form in detecting psychosocial concerns: a randomized controlled trial. *Canadian Medical Association Journal* 2005; **173**:253–259.
41 Austin MP, Hadzi-Pavlovic D, Saint K, Parker G. Antenatal screening for the prediction of postnatal depression: validation of a psychosocial Pregnancy Risk Questionnaire. *Acta Psychiatrica Scandinavica* 2005; **112**:310–317.
42 Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry* 1987; **150**:782–786.
43 Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *Journal of Health and Social Behavior* 1983; **24**:385–396.
44 Spielberger C, Gorsuch R, Lushene R. *Test Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologist's Press, 1970.
45 Statistics Canada and Human Resources Development Canada. *National Longitudinal Survey of Children: Overview of Survey Instruments for 1994–1995, Data Collection, Cycle 1*. Ottawa, ON: Ministry of Industry, 1995.
46 Tough SC, Johnston DW, Siever J, Jorgenson G, Slocombe L, Lane C, *et al*. Does supplementary prenatal nursing and home visitation support improve resource utilization in a

system of universal health care? Results from a randomized controlled trial in Canada. *Birth* 2006; **33**:183–194.
47 Moons KG, Harrell FE, Steyerberg EW. Should scoring rules be based on odds ratios or regression coefficients? *Journal of Clinical Epidemiology* 2002; **55**:1054–1055.
48 Takegami M, Hayashino Y, Chin K, Sokejima S, Kadotani H, Akashiba T, *et al*. Simple four-variable screening tool for identification of patients with sleep-disordered breathing. *Sleep* 2009; **32**:939–948.
49 Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. *Circulation* 1998; **97**:1837–1847.
50 Cadarette SM, Jaglal SB, Kreiger N, McIsaac WJ, Darlington GA, Tu J. Development and validation of the Osteoporosis Risk Assessment Instrument to facilitate selection of women for bone densitometry. *Canadian Medical Association Journal* 2000; **162**:1289–1294.
51 Wasson JH, Sox HC, Neff RK, Goldman L. Clinical prediction rules. Application and methodological standards. *New England Journal of Medicine* 1985; **313**:793–799.
52 Chalmers B, Dzakpasu S, Heaman M, Kaczorowski J. The maternity experiences survey: an overview of findings. *Journal of Obstetrics and Gynaecology Canada* 2008; **30**:217–228.
53 Gracie S, Lyon A, Kehler H, Pennell C, Dolan S, McNeil D, *et al*. All Our Babies Cohort Study: recruitment of a cohort to predict women at risk of preterm birth through the examination of gene expression profiles and the environment. *BMC Pregnancy and Childbirth* 2010; **10**:87. http://www.biomedcentral.com/1471-2393/10/87 [last accessed 13 March 2012].
54 Teixeira C, ueiredo B, Conde A, Pacheco A, Costa R. Anxiety and depression during pregnancy in women and men. *Journal of Affective Disorders* 2009; **119**:142–148.
55 Hewitt C, Gilbody S. Is it clinically and cost effective to screen for postnatal depression: a systematic review of controlled clinical trials and economic evidence. *British Journal of Obstetrics and Gynaecology* 2009; **116**:1019–1027.
56 Paulden M, Palmer S, Hewitt C, Gilbody S. Screening for postnatal depression in primary care: cost effectiveness analysis. *British Medical Journal* 2009; **339**:b5203.
57 O'Hara MW. Social support, life events and depression during pregnancy and the puerperium. *Archives of General Psychiatry* 1986; **43**:569–573.
58 Watson JP, Elliott SA, Rugg AJ, Brough DI. Psychiatric disorder in pregnancy and the first postnatal year. *British Journal of Psychiatry* 1984; **144**:453–462.
59 Beydoun HA, Al-Sahab B, Beydoun MA, Tamim H. Intimate partner violence as a risk factor for postpartum depression among Canadian women in the Maternity Experience Survey. *Annals of Epidemiology* 2010; **20**:575–583.
60 Garabedian M, Lain K, Hansen W, Garcia L, Williams C, Crofford L. Violence against women and postpartum depression. *Journal of Women's Health* 2011; **20**:447–453.
61 Tiwari A, Chan KL, Fong D, Leung WC, Brownridge DA, Lam H, *et al*. The impact of psychological abuse by an intimate partner on the mental health of pregnant women. *British Journal of Obstetrics and Gynaecology* 2008; **115**:377–384.
62 Dayan J, Creveuil C, Marks MN, Conroy S, Herlicoviez M, Dreyfus M, *et al*. Prenatal depression, prenatal anxiety, and spontaneous preterm birth: a prospective cohort study among women with early and regular care. *Psychosomatic Medicine* 2006; **68**:938–946.
63 Hedegaard M, Henriksen TB, Sabroe S, Secher NJ. Psychological distress in pregnancy and preterm delivery. *British Medical Journal* 1993; **307**:23–29.
64 Paarlberg KM, Vingerhoets AJ, Passchier J, Dekker GA, Heinen AG, Van Geijn HP. Psychosocial predictors of low birthweight: a prospective study. *British Journal of Obstetrics and Gynaecology* 1999; **106**:834–841.
65 Pagel MD, Smilkstein F, Regen H, Montano D. Psychosocial influences on newborn outcome: a controlled prospective study. *Social Science & Medicine* 1990; **30**:597–604.
66 Steer RA, Scholl TO, Hediger ML, Fischer RL. Self-reported depression and negative pregnancy outcomes. *Journal of Clinical Epidemiology* 1992; **45**:1093–1099.
67 Stewart RC. Maternal depression and infant growth – a review of recent evidence. *Maternal & Child Nutrition* 2007; **3**:94–107.
68 Zuckerman B, Amaro H, Bauchner H, Cabral H. Depressive symptoms during pregnancy: relationship to poor health behaviors. *American Journal of Obstetrics and Gynecology* 1989; **160**:1107–1111.
69 Henry AL, Beach AJ, Stowe ZN, Newport DJ. The fetus and maternal depression: implications for antenatal treatment guidelines. *Clinical Obstetrics and Gynecology* 2004; **47**:535–546.
70 Karatas JC, Matthey S, Barnett B. Antenatal psychosocial assessment: how accurate are we in determining 'low-risk' status? A pilot study. *Archives of Women's Mental Health* 2009; **12**:97–103.
71 Evins GG, Theofrastous JP, Galvin SL. Postpartum depression: a comparison of screening and routine clinical evaluation. *American Journal of Obstetrics and Gynecology* 2000; **182**:1080–1082.
72 Fergerson SS, Jamieson DJ, Lindsay M. Diagnosing postpartum depression: can we do better? *American Journal of Obstetrics and Gynecology* 2002; **186**:899–902.
73 Schaper AM, Rooney BL, Kay NR, Silva PD. Use of the Edinburgh Postnatal Depression Scale to identify postpartum depression in a clinical setting. *Journal of Reproductive Medicine* 1994; **39**:620–624.
74 Whitehead NS, Brogan C, Blackmore-Prince HA, Hill HA. Correlates of experiencing life events just before or during pregnancy. *Journal of Psychosomatic Obstetrics and Gynaecology* 2003; **24**:77–86.
75 Lee DT, Yip AS, Leung TY, Chung TK. Identifying women at risk of postnatal depression: prospective longitudinal study. *Hong Kong Medical Journal* 2000; **6**:349–354.
76 Patel V, Rodrigues M, DeSouza N. Gender, poverty, and postnatal depression: a study of mothers in Goa, India. *American Journal of Psychiatry* 2002; **159**:43–47.

77 Seguin L, Potvin L, St Denis M, Loiselle J. Depressive symptoms in the late postpartum among low socioeconomic status women. *Birth* 1999; **26**:157–163.
78 Chaudron L, Szilagyi P, Tang W, Anson E, Talbot N, Wadkins H, *et al*. Accuracy of depression screening tools for identifying postpartum depression among urban mothers. *Pediatrics* 2010; **125**:609–617.
79 Cooper PJ, Murray L, Hooper R, West A. The development and validation of a predictive index for postpartum depression. *Psychological Medicine* 1996; **26**:627–634.
80 Posner NA, Unterman RR, Williams KN, Williams GH. Screening for postpartum depression. An antepartum questionnaire. *Journal of Reproductive Medicine* 1997; **42**:207–215.
81 Forman DN, Videbech P, Hedegaard M, Salvig JD, Secher NJ. Postpartum depression: identification of women at risk. *British Journal of Obstetrics and Gynaecology* 2000; **107**:1210–1217.
82 Robertson E, Celasun N, Stewart DE. Risk factors for postpartum depression. In: *Postpartum Depression: Literature Review of Risk Factors and Interventions*. Editors: Stewart DE, Robertson E, Dennis CL, Grace SL, Wallington T. Toronto, ON: University Health Network Women's Health Program, 2003; pp. 9–70.

Appendix 1

Select variables assessed in the All Our Babies (AOB) study used to derive screening tool[a]

Candidate variable	Source/phrasing	Scoring and/or coding information
Standardised scales		
Depression in late pregnancy/4 months post partum	Edinburgh Postnatal Depression Scale	10-item questionnaire. Each item rated on a 4-point Likert scale from 0 to 3. After reverse scoring for some items, a total score is derived (range 0–30). Higher scores reflect increased depression. Standard cut-offs include 10 or above (general distress) or 13 and above (major depression) as per the literature.
Anxiety in late pregnancy/4 months post partum	State-Trait Anxiety Inventory (state anxiety scale)	20-item questionnaire. Each item rated on a 4-point Likert scale from 1 to 4. After reverse scoring for some items, a total score is derived (range 20–80). Higher scores reflect increased anxiety. We used an established cut-off of 40 or more to classify women as anxious.
Stress in late pregnancy	Perceived Stress Scale	10-item questionnaire. Each item rated on a 5-point Likert scale from 0 to 4. After reverse scoring for some items, a total score is derived (range 0–40). Higher scores reflect increased stress. A cut-off at the 80th percentile of the sample distribution was used to classify women as stressed.
Single item questions		
History of depression	Single item question: 'Have you ever experienced feeling sad, blue, depressed or down for most of the time for at least 2 weeks?'	Yes/No
History of abuse	Five questions (with subquestions) developed for this study that assessed a history of physical, emotional, sexual and financial abuse, and neglect	Yes/No to five questions on history of different types of abuse. A final 'presence of abuse' variable was derived by summing across the five types.
Social support in late pregnancy	Questions developed for this study on a woman's satisfaction with emotional and practical support from partner, friends and family (4-point Likert scale)	Satisfaction with social support from partner, friends or family was examined individually and collectively. Final variables were dichotomised into satisfied or unsatisfied.
Relationship tension	Single item question: 'How would you describe your relationship with your partner?'	3 response choices: a lot of tension, some tension, no tension. Final coding combined choices 'some' and 'a lot' vs. 'none'.

[a]Candidate variables are just some of the variables assessed in the AOB study across three data collection points.