ELSEVIER

Journal of Affective Disorders 108 (2008) 101 – 111

Journal of Affective Disorders

www.elsevier.com/locate/jad

Research report

Maternal anxiety during the transition to parenthood: A prospective study

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Received 23 April 2007; received in revised form 2 October 2007; accepted 3 October 2007
Available online 14 November 2007

Abstract

Background: This prospective study used both self-report (STAI) and clinical diagnostic interview (MINI-Plus) to examine the course of maternal anxiety across the transition to parenthood. The study also assessed i) the validity of the STAI for antenatal use in an Australian sample and ii) the relative utility of the MINI-Plus and STAI scales as antenatal measures of risk for postnatal anxiety and mood disorders.
Methods: Participants were 100 women recruited during routine antenatal assessment at a major obstetric hospital in Sydney. An antenatal screening instrument (ANRQ) identified half the sample as being at "high risk" for developing postnatal anxiety and/or depression. Participants completed the STAI during the third trimester of pregnancy and the MINI-Plus was administered during pregnancy and during the seventh postnatal month to assess anxiety and depression meeting DSM-IV criteria.
Results: The data indicated considerable stability in anxiety and depression from pregnancy through the postnatal period, as assessed by both diagnostic interview and maternal self-report. Antenatal anxiety meeting diagnostic criteria and antenatal trait anxiety exceeding a cut-off score of 40 on the STAI were both found to be significant predictors of postnatal anxiety and mood disorders (p-values $< .05$). Further analyses revealed that the measures were equivalent in their predictive utility. Finally, the STAI state and trait anxiety scales demonstrated a reasonable estimation of antenatal clinical state when tested against the MINI-Plus diagnostic interview during pregnancy.
Conclusions: The findings from this study suggest that antenatal anxiety as assessed by either clinical interview or maternal self-report is an important predictor of postnatal anxiety and mood disorders. The validity of the STAI scales for use during pregnancy was also demonstrated for the first time in an Australian sample.

Keywords: Anxiety; Depression; Antenatal mood; Postnatal mood; STAI

1. Introduction

There is a clear need for a better understanding of patterns of maternal anxiety across the transition from pregnancy to parenthood. Several recent studies suggest that psychological distress during the perinatal period

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doi:10.1016/j.jad.2007.10.002

may have a negative impact on both maternal postnatal mental health and offspring development. Anxiety during pregnancy has been linked to negative expectations about motherhood (Hart and McMahon, 2006), difficulties adjusting to the demands of the maternal role (Barnett et al., 1991), and the development of other forms of distress, particularly postnatal depression (Austin et al., 2007; Heron et al., 2004; Matthey, 2004; Matthey et al., 2003; Sutter-Dallay et al., 2004). An emerging literature also indicates that maternal antenatal psychological state is associated with fetal neurobehavioural functioning (DiPietro et al., 2003; DiPietro et al., 2002; Monk et al., 2000), and with the development of difficult infant temperament (Austin et al., 2005b; Huizink et al., 2002; Werner et al., 2007), developmental delays (Brouwers et al., 2001; Buitelaar et al., 2003; Huizink et al., 2003; Laplante et al., 2004), and other emotional and behavioural disturbances in childhood (O'Connor et al., 2003; Van den Bergh and Marcoen, 2004). Following birth, high levels of maternal anxiety may contribute to suboptimal child development, possibly mediated by dysfunctional parenting behaviours such as reduced sensitivity (Nicol-Harper et al., 2007; Warren et al., 2003) and over-control (Whaley et al., 1999). Thus, antenatal anxiety may be an important early marker that could be used to identify women at risk for compromised mental health and offspring outcomes. Few studies, however, have systematically investigated the course of maternal anxiety across the transition to parenthood and results from existing studies are equivocal.

Several conceptual and methodological limitations in the research to date have constrained the generalisability of findings and made the comparison of results across studies difficult. One important limitation is the inconsistency with which perinatal anxiety is defined and operationalised. Approaches to the measurement of perinatal anxiety include dispositional indicators such as trait anxiety (e.g., Austin et al., 2005b; Field et al., 2003) and worry (Austin et al., in press), indicators of general state anxiety (e.g., Davis et al., 2004; Van den Bergh and Marcoen, 2004; Van den Bergh et al., 2005), and anxiety specifically related to pregnancy (e.g., Gutteling et al., 2005a; Gutteling et al., 2005b; Huizink et al., 2004). Although some groups have started to explore similarities and differences among measures of perinatal anxiety (Austin et al., 2007; Huizink et al., 2004), further work testing their conceptual equivalence and their differential utility in predicting maternal mental health and offspring outcomes is needed.

A related issue requiring further attention is the validation of anxiety inventories for use in perinatal research. Very few studies use diagnostic interviews for the assessment of antenatal and/or postnatal anxiety, with most relying on self-report measures such as the Crown-Crisp Experiential Index (CCEI: Crisp et al., 1978) and the State–Trait Anxiety Inventory (STAI: Spielberger et al., 1987). Although widely used in the general population, most self-report anxiety instruments are yet to be validated for use with pregnant and postnatal women. Given the substantial psychological, social, and physiological changes that often accompany pregnancy and childbirth, the establishment of appropriate clinical cut-offs and norms for use during the perinatal period is essential for interpreting the clinical significance of research findings and facilitating meaningful cross-study comparisons.

Finally, self-report measures are subject to mood-related reporting biases and these may be particularly salient when assessments are conducted during pregnancy or during the first few weeks following birth. In studies where the measures are administered retrospectively (e.g., Brockington et al., 2006), there is the additional risk of memory bias or forgetfulness about crucial events. While prospective studies may overcome some of the shortcomings associated with retrospective reporting, the data is currently limited.

The present study adds to the existing literature by using a prospective design and both diagnostic interviews and self-report measures to assess patterns of maternal anxiety from pregnancy through 7 months following birth. Given the widespread use of self-rating scales and the dearth of validation data, the study also explores the relative utility of diagnostic clinical interviews and symptom checklists as predictors of postnatal anxiety and mood disorders.

2. Methods

2.1. Participants

Participants were women taking part in a prospective longitudinal project investigating the influence of antenatal psychosocial factors on fetal neurobehaviour, child development, and maternal adjustment to parenthood. The study was approved by the relevant institutional ethics review committees and all participants provided written consent. Recruitment took place during routine antenatal psychosocial assessment at clinics at the Royal Hospital for Women, Sydney and nearby private clinics. English-speaking women with singleton, uncomplicated pregnancies, and with no known substance/alcohol abuse problems or chronic psychiatric disorders (e.g., bipolar disorder, schizophrenia) were approached consecutively and invited to participate. A questionnaire completed

during the assessment (ANRQ: Austin, 2003) guided the selection of a sample in which women at "high" and "low–moderate" risks for developing anxiety and/or depression during the postnatal period were equally represented. Recruitment continued over a two-year period until approximately150 women were enrolled into the study. The target sample size was determined statistically prior to commencement of the prospective study.

Of the 273 women invited to participate in the study, 54.5% agreed, yielding an initial sample of 149 pregnant women. Seventeen were subsequently excluded for medical reasons, including hypertension ($n=6$), gestational diabetes ($n=2$), delivery prior to 36 weeks ($n=7$), or delivery before the assessments in late pregnancy had taken place ($n=2$). Twenty-three women withdrew from the study prior to the 7-month follow-up. The most common reasons for withdrawing were scheduling difficulties ($n=10$) and re-location ($n=9$). A further nine women did not complete their antenatal and/or follow-up diagnostic interviews. Only those women who completed all antenatal and postnatal questionnaires and interviews have been included in the current report ($n=100$).

2.2. Procedure

Screening took place during the first antenatal clinic visit ($M=15.46$ weeks gestation, SD=4.45 weeks, range 7–32 weeks). Diagnostic clinical interviews and questionnaires assessing anxiety and depression were administered during the third trimester of pregnancy ($M=36.93$ weeks, SD=.78 weeks, range=35–39 weeks) and again at 32 weeks after birth ($M=31.66$ weeks, SD=2.60 weeks, range=25–38 weeks). Socio-demographic data were collected during the third trimester of pregnancy and updated at the 7-month postnatal follow-up.

2.3. Measures

2.3.1. Antenatal risk assessment

The ANRQ is a brief screening questionnaire completed by all women booking in to antenatal clinics at the Royal Hospital for Women, Sydney. It was used in the present study to guide the selection of a sample in which women at high and low risk for postnatal mood disturbances were equally represented. The questionnaire asks about psychosocial risk factors known to be associated with the onset of perinatal distress, including current major stressors and losses, anxiety, and history of depression. The ANRQ is a short form of the Pregnancy Risk Questionnaire (PRQ: Austin et al., 2005a) an antenatal screening tool validated against the Composite International Diagnostic Interview (CIDI: World Health Organisation, 1997) for the identification of women at risk for postnatal mood disorders. In the present study, an ANRQ cut-off score of 23 was used to identify a sample of "high" ($n=51$) and "low" ($n=49$) risk women. Further information about the ANRQ can be obtained by contacting the authors.

2.3.2. DSM-IV anxiety and depression

The Mini-Plus International Neuropsychiatric Interview version 5.0.0 (MINI: Sheehan et al., 1998) was administered to assess anxiety and depression meeting DSM-IV diagnostic criteria. The MINI is a short, structured, diagnostic interview containing questions addressing the intensity, frequency, and duration of specific symptoms, and the degree of distress or impairment associated with them. Participants in the current study were assessed using the panic disorder, agoraphobia, social phobia, post-traumatic stress disorder, generalised anxiety disorder, mixed anxiety–depressive disorder, and major depression components of the MINI. Both current and past episodes of each disorder were explored. At the postnatal interview, "past episode" was redefined to include occurrences of each disorder "since the end of pregnancy". The MINI is both reliable and valid (Lecrubier et al., 1997; Sheehan et al., 1997) and demonstrates good concordance with both the Structured Clinical Interview for DSM diagnoses (SCID: Spitzer et al., 1990) and the Composite International Diagnostic Interview for ICD-10 (CIDI: World Health Organisation, 1990).

2.3.3. Maternal state and trait anxiety

Maternal state and trait anxiety were measured using the Spielberger State–Trait Anxiety Inventory (STAI: Spielberger et al., 1987). The STAI is a reliable and valid measure that has been used with both clinical and non-clinical populations (Spielberger et al., 1987). The measure comprises separate self-report scales for assessing state and trait anxiety. The state anxiety scale consists of 20 items that evaluate *current* feelings of tension, anxiety, and nervousness, while the 20-item trait scale assesses anxiety levels in general. Women scoring above 40 on the STAI trait scale have been considered as highly anxious in prior Australian studies with childbearing women (Barnett and Parker, 1986; Hart and McMahon, 2006; McMahon et al., 2001). The STAI demonstrated good internal consistency in the present study with Cronbach's alpha reported at .95 for the antenatal assessment and .94 for the postnatal follow-up.

2.3.4. Depression symptoms

Symptoms of maternal depression were assessed using the 10-item Edinburgh Postnatal Depression Scale (EPDS: Cox et al., 1987). Originally designed as a screening

instrument for postnatal depression, the EPDS has since been validated for use during pregnancy (Murray and Cox, 1990). Cases of at least probable minor depression in the antenatal and postnatal periods have been identified using EPDS cut-off scores of ≥13, and ≥10 respectively (Matthey et al., in press). The scale demonstrates good reliability with Cronbach's alpha calculated at .87 for the antenatal assessment and .86 for the postnatal follow-up.

2.4. Data analysis

For the purposes of data analysis, the MINI modules of major and minor depression were collapsed into a single variable, "depression". Although minor depression is not yet recognised as a formal diagnostic category (DSM-IV, Appendix B), it was included for the present purposes as it is associated with significant distress and impairment. Similarly, panic disorder, agoraphobia, social phobia, generalised anxiety disorder, and post-traumatic stress disorder were collapsed into the variable "anxiety". Values of 0 and 1 were assigned to each variable, indicating the absence or presence of a mood disorder, respectively. Receiver operating characteristic (ROC) curve analyses were based on continuous scores from the STAI state and trait anxiety scales. However, subsequent analyses using the STAI scales were based on dichotomised data using the clinical cut-offs indicated by the ROC analyses. Probabilities reported are two-tailed and significance is established at $p < .05$.

3. Results

3.1. Socio-demographic characteristics of participants

The sample consisted of predominantly Caucasian (93%) and highly educated women, with most (81%) having attained tertiary level education (55% university and 26% technical colleges). Mean age was 31.97 years (SD=4.43 years, range=20–43 years). Ninety percent ($n=90$) of women had a partner at the time of recruitment and 70% ($n=70$) were expecting their first baby. While five women reported smoking (defined as ≥5 cigarettes/day) during pregnancy, none reported an alcohol intake of >2 standard drinks per day. Fifty-one women (51%) were identified as being at "high risk" for developing postnatal mood disorders and 49 (49%) at "low risk" as assessed by the ANRQ.

3.2. Analysis of recruitment and attrition biases

Given the broad range of gestational ages at which women completed their antenatal screening (7–32 weeks), a Pearson correlation was conducted to test for associations between gestational age and ANRQ score. The result was small and not significant ($r=-.003$, $p=.98$). Independent samples t-tests revealed that there were no significant differences in ANRQ scores between study participants and those women who declined participation (p-values>.10). Similarly, there was no evidence for attrition biases. Women excluded for medical reasons, and women who either withdrew or returned incomplete data, did not differ from women retained in the study on ANRQ scores, age, or parity (p-values >.05).

3.3. DSM-IV anxiety and depression

During pregnancy, 21 women (21%) met diagnostic criteria for at least one current anxiety disorder, while seven (7%) met criteria for current depression. All seven cases of antenatal depression were co-morbid with anxiety. Twenty women (20%) were diagnosed with at least one anxiety disorder during the first 7 postnatal months. Twenty-four participants (24%) met criteria for depression since birth and of these cases, 15 (63%) were co-morbid with diagnoses of anxiety.

3.4. Self-reported anxiety and depression

Self-report measures of anxiety and depression administered during pregnancy yielded mean scores of 35.99 (SD=11.60) on the STAI state anxiety scale, 37.46 (SD=12.67) on the STAI trait anxiety scale, and 5.78 (SD=4.69) on the EPDS. At the postnatal follow-up, mean STAI state and trait anxiety scores were 35.72 (SD=10.65) and 35.94 (SD=10.58) respectively, and the mean postnatal depression score as assessed by the EPDS was 5.53 (SD=4.52). Thirty-three women (33%) exceeded previously defined cut-off points (Barnett and Parker, 1986; Hart and McMahon, 2006; McMahon et al., 2001) on measures of state and trait anxiety during pregnancy, while nine (9%) exceeded the established clinical cut-off for antenatal depression as measured by the EPDS (Matthey et al., 2006). Postnatal measures indicated high state anxiety in 33 cases (33%), high trait anxiety in 26 cases (26%), and probable postnatal depression in 16 cases (16%). Table 1 shows mean scores and standard deviations for self-report measures of anxiety and depression according to antenatal and postnatal diagnostic category.

3.5. Patterns of anxiety and depression across pregnancy and the postnatal period

Preliminary analyses indicated considerable stability in anxiety and depression from pregnancy through seven

Table 1
Mean (SD) scores on self-report measures of state anxiety, trait anxiety, and depression, by MINI diagnostic category ($n=100$)

Self-report measures	Antenatal					Postpartum									
	Anxiety disorder					Anxiety disorder					Depressive disorder				
	Diagnosis[a] $n=21$		No diagnosis $n=79$			Diagnosis[b] $n=20$		No diagnosis $n=80$			Diagnosis[c] $n=24$		No diagnosis $n=76$		
Antenatal															
State anxiety	48.38	(11.33)	32.70	(9.25)	**	43.00	(13.20)	34.24	(10.54)	**	43.04	(13.52)	33.76	(10.03)	*
Trait anxiety	52.10	(10.63)	33.57	(10.09)	**	47.10	(14.89)	35.05	(10.88)	**	48.21	(13.82)	34.07	(10.23)	**
Depression	11.05	(5.25)	4.38	(3.36)	**	8.95	(5.03)	4.99	(4.27)	**	9.00	(4.85)	4.76	(4.16)	**
Postpartum															
State anxiety	41.72	(12.50)	34.28	(9.70)	*	45.72	(12.26)	33.32	(8.73)	**	44.18	(12.76)	33.10	(8.40)	**
Trait anxiety	43.83	(13.64)	34.04	(8.81)	*	47.17	(10.76)	33.24	(8.64)	**	46.82	(11.51)	32.56	(7.66)	**
Depression	7.89	(6.29)	4.96	(3.82)		9.11	(5.69)	4.67	(3.75)	**	9.00	(5.95)	4.45	(3.35)	**

Significance of comparisons between women who meet and did not meet diagnostic criteria: $^{**}p<.001$, $^{*}p<.01$.
[a]GAD only $n=9$, GAD and agoraphobia $n=1$, GAD and social phobia $n=2$, GAD and panic disorder $n=2$, GAD and PTSD $n=1$, agoraphobia only $n=1$, PTSD only $n=1$, panic disorder only $n=2$, social phobia only $n=1$, agoraphobia, social phobia, GAD, PTSD $n=1$; [b]GAD only $n=5$, GAD and social phobia $n=1$, GAD and panic disorder $n=3$, panic disorder only $n=8$, panic disorder and social phobia $n=2$, agoraphobia, GAD, panic disorder $n=1$; [c]major depression $n=19$, minor depression $n=5$.

months following birth, as assessed by both diagnostic interview and maternal self-report. Of the 21 women who met criteria for an anxiety disorder during pregnancy, 10 (47.6%) continued to meet criteria during the postnatal period. An additional 10 women received diagnoses as new cases of anxiety. Depression was comparably stable with 5 (71%) antenatal cases continuing to meet diagnostic criteria postnatally. Nineteen new cases of depression were diagnosed during the first seven months following birth. Although mean scores on self-report measures of state anxiety, trait anxiety, and depression decreased from pregnancy through the postnatal period, the changes were small and insignificant (all p-values $>.10$). Correlations between antenatal and postnatal measures of state anxiety ($r=.64$), trait anxiety ($r=.76$), and depression ($r=.52$) were moderate to high and statistically significant (all p-values $<.001$).

3.6. Diagnoses of anxiety and depression and demographic variables

Chi-square analyses indicated that non-Caucasian, χ^2 (1)=5.93, $p=.02$, and single women, χ^2 (1)=5.63, $p=.02$, were more likely to be diagnosed as anxious during pregnancy. Non-Caucasian and single women were also more likely to report elevated scores on antenatal measures of state and trait anxiety (p-values $<.05$). Parity and diagnosis of an anxiety disorder were marginally related during pregnancy, χ^2 (1)=3.93, $p=.05$. Following birth, however, women with more than one child were significantly more likely to meet criteria for diagnoses of anxiety, χ^2 (1)=4.76, $p=.03$, and/or depression, χ^2 (1)=6.02, $p=.01$, than were first time mothers. Highest level of education attained was unrelated to diagnoses of anxiety and depression during either pregnancy or the postnatal period (all p-values $>.2$). Finally, no associations were found between smoking and diagnoses of anxiety in either the antenatal or postnatal periods ($p>.05$). Partnership status, ethnicity, and parity were controlled in all relevant analyses.

3.7. Assessing the validity of the STAI for use during pregnancy

Initial analyses indicated significant and positive point-biserial correlations between the state ($r_{pb}=.55$, $p<.001$) and trait anxiety ($r_{pb}=.60$, $p<.001$) scales of the STAI assessed antenatally, and anxiety meeting DSM-IV diagnostic criteria. Internal validity of the STAI scales was also established, with Cronbach's alphas of .95 and .96 reported for the state and trait scales respectively. Validity was further explored using ROC curve analyses. Area under the curve (AUC) was .87 (95% CI=.78–.93) for state anxiety, and .89 (95% CI=.81–.95) for trait anxiety, indicating that the scales correctly predicted diagnosis/non-diagnosis of antenatal anxiety with probabilities of 86.5% and 89.2%, respectively. The sensitivity, specificity, and positive predictive values for a range of scores on the STAI state and trait anxiety scales are shown in Table 2. The data indicate that a cut-off score of >40

Table 2
Sensitivity, specificity, and positive and negative predictive values for a range of cut-off scores on the STAI state and trait anxiety scales

Measure	Cut-off	Sensitivity (%)	Specificity (%)	Predictive value (%)	
				Positive	Negative
STAI — state anxiety	>30	90.48	44.30	30.20	94.60
	>34	90.48	59.49	37.30	95.90
	>38	80.95	75.95	47.20	93.80
	>40	80.95	79.75	51.50	94.00
	>42	71.43	88.61	62.50	92.10
	>44	61.90	91.14	65.00	90.00
STAI — trait anxiety	>30	100.00	49.37	34.40	100.00
	>34	95.24	63.29	40.80	98.00
	>38	85.71	70.89	43.90	94.90
	>40	80.95	79.75	51.50	94.00
	>42	71.43	83.54	53.60	91.70
	>44	71.43	87.34	60.00	92.00

yielded a sensitivity of 80.95%, a specificity of 79.75%, and a positive predictive value of 51.5% on both the state and trait anxiety scales. At a threshold of >40, 33 women were classified as high in trait anxiety, and of these, 17 (51.5%) met criteria for anxiety disorder during pregnancy. Of the 67 women who scored low in trait anxiety, 63 (94.0%) were actual non-cases. Associations between self-reported trait anxiety and clinical diagnoses of anxiety were significant, $\chi 2$ (1)=27.65, $p<.001$. At the cut-off of >40, the association between self-reported state anxiety and anxiety meeting diagnostic criteria also reached significance, $\chi 2$ (1)=27.65, $p<.001$. Of the 33 women who scored high in state anxiety, 17 (51.5%) met criteria for antenatal anxiety disorder, while 63 of the 67 (94.0%) women who scored low were non-cases.

3.8. Antenatal anxiety disorder as a predictor of postnatal anxiety and mood disorders

Binary logistic regression analyses were used to determine the relationship between antenatal anxiety disorder and the odds of postnatal mood disorder, adjusting for differences in demographic characteristics (ethnicity, parity, partnership status) and antenatal depressive disorder. Postnatal anxiety and depressive disorders were examined in separate analyses. The first set of results indicated that a diagnosis of anxiety during the third trimester of pregnancy was associated with significantly higher odds of an anxiety diagnosis during the first 7 postnatal months (OR=4.97, 95% CI=1.31–18.88) after adjusting for the variables noted above. A second model showed that antenatal anxiety disorder was also associated with a significantly increased likelihood of a diagnosis of depressive disorder during the postnatal period (OR=4.99, 95% CI=1.37–18.15) after adjusting for demographic factors and antenatal mood. Antenatal depressive disorder was unrelated to postnatal outcomes (p-values>.10). The results of the analyses are presented in Table 3.

3.9. Self-report measures of state and trait anxiety as predictors of postnatal mood

A further set of logic regression analyses tested associations between the self-report measures of antenatal state and trait anxiety and diagnoses of postnatal anxiety and depression. Postnatal anxiety and mood disorder were again examined in separate analyses. Antenatal state and trait anxiety were entered into the analyses as categorical independent variables using a cut-off score of 40. Ethnicity, parity, partnership status, and antenatal depression symptoms were also included in each model. The results are shown in Table 4. Antenatal trait anxiety emerged as a significant independent predictor of both postnatal anxiety and depressive disorders. Trait anxiety measured during the third trimester of pregnancy was associated with a greater than six-fold increase in postnatal anxiety (OR=6.44, 95% CI=1.28–32.28) and postnatal depression (OR=6.12, 95% CI=1.37–27.41) meeting diagnostic criteria. Antenatal state anxiety predicted neither postnatal anxiety nor depression (p-values>.10).

Table 3
Logistic regression model testing the association between antenatal anxiety disorder and postpartum anxiety and mood disorders (n=100)

	β	S.E.	Wald χ^2 (df=1)	p	OR	CI (95%)
Postpartum anxiety disorder						
Ethnicity	−0.38	1.13	0.11	0.74	0.69	0.08–6.29
Partnership status	0.76	0.97	0.62	0.43	2.15	0.32–14.36
Parity	0.85	0.56	2.26	0.13	2.33	0.77–7.04
Antenatal depressive disorder	0.89	1.08	0.68	0.41	2.43	0.29–20.14
Antenatal anxiety disorder	1.60	0.68	5.55	0.02	4.97	1.31–18.88
Postpartum depressive disorder						
Ethnicity	0.08	1.04	0.01	0.94	1.09	0.14–8.38
Partnership status	0.43	0.89	0.23	0.63	1.53	0.27–8.83
Parity	0.98	0.54	3.28	0.07	2.66	0.92–7.65
Antenatal depressive disorder	1.04	1.10	0.91	0.34	2.83	0.33–24.24
Antenatal anxiety disorder	1.61	0.66	5.96	0.02	4.99	1.37–18.15

Table 4
Logistic regression model testing the association between antenatal self-reports of state and trait anxiety, and postpartum anxiety and mood disorders ($n=100$)

	β	S.E.	Wald χ^2 (df=1)	p	OR	CI (95%)
Postpartum anxiety disorder						
Ethnicity	−0.59	1.07	0.30	0.58	0.56	0.07–4.48
Partnership status	0.52	0.98	0.28	0.59	1.69	0.25–11.56
Parity	0.87	0.58	2.31	0.13	2.40	0.78–7.39
Antenatal depression symptoms	1.56	0.94	2.75	0.11	4.74	0.75–29.76
Antenatal state anxiety	−0.83	0.86	0.94	0.33	0.44	0.08–2.34
Antenatal trait anxiety	1.86	0.82	5.12	0.02	6.44	1.28–32.28
Postpartum depressive disorder						
Ethnicity	0.01	0.94	0.00	0.99	1.01	0.16–6.31
Partnership status	0.25	0.87	0.09	0.77	1.29	0.24–7.03
Parity	0.89	0.54	2.71	0.10	2.44	0.84–7.06
Antenatal depression symptoms	0.65	0.87	0.56	0.46	1.91	0.35–10.40
Antenatal state anxiety	−0.24	0.78	0.10	0.76	0.79	0.17–3.59
Antenatal trait anxiety	1.81	0.77	5.60	0.02	6.12	1.37–27.41

3.10. Testing the relative utility of antenatal diagnostic interviews and anxiety inventories as predictors of postnatal anxiety and mood disorders

The formula given by Steiger (1980) was used to test the statistical difference in predictive utility between antenatal anxiety as assessed by diagnostic interview and antenatal anxiety as assessed using the STAI trait anxiety scale. The formula tests the hypothesis that two predictors correlate equally with a criterion variable. The results revealed that antenatal anxiety diagnosis and self-reported trait anxiety did not differ significantly in predictive utility as they correlated comparably with both postnatal anxiety disorder, $t(97)=-0.18$, $p>.10$, and postnatal depressive disorder, $t(97)=0.02$, $p>.10$.

4. Discussion

The present study demonstrates that anxiety and depression were stable from pregnancy through 7 months following birth and that antenatal anxiety meeting diagnostic criteria and self-reported trait anxiety were comparable and reliable predictors of postnatal anxiety and depression meeting DSM-IV diagnostic criteria. These findings confirm and extend previous studies in which the measurement of antenatal and/or postnatal anxiety and mood has relied on maternal self-report (Heron et al., 2004; Sutter-Dallay et al., 2004). In the present study, almost half of the women diagnosed with an antenatal anxiety disorder and 71% of those diagnosed with an antenatal mood disorder continued to meet criteria during the postnatal period. Thus, for many women, antenatal anxiety was a persistent clinical condition rather than a transient state during pregnancy.

Persistent psychological disturbances during the perinatal period are of particular concern given recent findings to suggest that they are associated with the least optimal offspring outcomes. Diego's group found that mothers reporting symptoms of both antenatal and postnatal depression have neonates who exhibit less optimal physiological profiles (Diego et al., 2004) and neurobehavioural assessment scores (Diego et al., 2005) than either non-depressed mothers, or mothers reporting depression symptoms during prenatal or postnatal assessment only. Although prospective studies examining the impact of severe or prolonged perinatal anxiety on offspring outcomes are presently limited, the available data suggests that anxiety during pregnancy is strongly related to both parent and observer ratings of difficult infant temperament (Austin et al., 2005b; Huizink et al., 2002; Werner et al., 2007), lower scores on measures of infant mental and motor development (Brouwers et al., 2001; Huizink et al., 2003), and problems regulating behaviour and emotions in novel or challenging situations (Davis et al., 2004; Huizink et al., 2002). It has been hypothesised that maternal distress during pregnancy may be transmitted to the infant *in utero* (Barker, 1998; Wadhwa, 2005), however, the mechanisms underlying these effects are presently unclear.

There is evidence that maternal anxiety following birth may contribute to suboptimal child outcomes, with several studies pointing to dysfunctional parenting as a possible mediating mechanism. Warren et al. (2003) observed that compared to controls, mothers with panic disorder displayed less sensitivity towards their infants during interaction, reported less effective parenting behaviours in disciplinary situations, and reported parenting behaviours that could be associated with disturbed infant sleep (e.g., more maternal feedings at night, sleeping with the children). Mothers with panic disorder were also found to have infants with higher salivary cortisol levels and more disturbed sleep than the infants of control mothers. Using a sample of older children, Whaley and colleagues observed that mothers with anxiety disorders were less warm and positive in their interactions with their children, less granting of autonomy, and more critical and catastrophising in comparison with control mothers, and

that these characteristics were salient predictors of child anxiety status (Whaley et al., 1999). Thus, it is possible that with continuing research to identify the dysfunctional behaviours that anxious mothers bring to their interactions with their offspring, it will be possible to formulate interventions at the interactional level to minimise the negative impact of maternal anxiety on offspring outcomes.

The current results indicate that parity may be an important consideration in setting the parameters of both research and intervention programs. Although first time mothers are often the focus of research and clinical attention, the present study found that women with more than one child were more likely to meet criteria for a postnatal anxiety or mood disorder than were first time mothers. This may reflect the additional social, emotional, and psychological demands of caring for both an infant and a toddler or pre-schooler, however, further research is needed to delineate these factors.

4.1. Validity of the STAI for antenatal use

Self-report measures of state and trait anxiety are regularly used in studies with childbearing women although few have been validated for use during pregnancy.

The present study reports data showing the STAI to be a valid instrument for distinguishing between cases and non-cases of antenatal anxiety in a sample of Australian women. The STAI scales demonstrated excellent internal validity, and when tested against DSM-IV diagnostic criteria (derived using the MINI-Plus), performed satisfactorily in terms of sensitivity, specificity, and positive predictive value. A cut-off score of >40 on both the state and trait scales was found to correspond with the highest accuracy, or the point at which false positive and negative results were minimal. These criterion values both replicate and validate the less formally derived cut-offs used in previous Australian studies with childbearing women (Barnett and Parker, 1986; Hart and McMahon, 2006; McMahon et al., 2001). Further validation is still required, however, as the sample used in this study was relatively small and not representative of pregnant women.

4.2. Antenatal anxiety as a predictor of postnatal anxiety and depressive disorders

This study demonstrates that antenatal anxiety as assessed by either diagnostic interview or maternal self-report is associated with significantly greater odds of developing an anxiety or mood disorder during the first seven postnatal months. The data add to the findings of previous studies that have relied on the use of self-report measures for the assessment of antenatal and/or postnatal anxiety and mood disturbances (Austin et al., 2005; Heron et al., 2004; Sutter-Dallay et al., 2004). The current results indicate that antenatal anxiety meeting diagnostic criteria predicted a five times greater likelihood of an anxiety or mood disorder during the first seven months following birth, even after controlling for antenatal depression, ethnicity, partnership status, and parity. Comparable results emerged when antenatal anxiety was assessed using the STAI scales. Antenatal trait anxiety was associated with a greater than six-fold increase in postnatal anxiety (OR = 6.44) and depression (OR = 6.12) meeting diagnostic criteria after adjusting for antenatal depression and demographic variables. Interestingly, antenatal *state* anxiety predicted neither postnatal anxiety nor depression in the present study suggesting that higher-order personality traits (e.g., neuroticism) may be the relevant risk factors underlying persistent perinatal anxiety and depression. Indeed, this finding concurs with the results of other studies in which personality style (including neuroticism) has been identified as a risk factor for onset of postnatal depression in childbearing women (Boyce et al., 2001; Boyce et al., 1991), and major depression and anxiety disorders in the general population (Wilhelm et al., 2004).

The transition of risk from anxiety antenatally to depression postnatally has been noted elsewhere in the perinatal literature (Austin et al., 2005; Matthey et al., 2003; Sutter-Dallay et al., 2004) and is consistent with a sizeable literature documenting anxiety as a risk factor for depression in the general population (e.g., Breslau et al., 1995; Parker et al., 1999). Factors specific to the perinatal period, however, may accentuate the risk of transition from anxiety to depression in perinatal women. Apart from the biological and psychosocial changes that accompany pregnancy and childbirth, the recent study of Austin et al., (2005) identified worry during pregnancy as a cognitive factor predictive of postnatal depression as assessed by the EPDS. The association between anxiety and depression is complex, however, and the mechanisms underlying the differential development of anxiety or depression in postnatal women is likely to involve a complex interplay among genetic, biological, cognitive, interpersonal, and contextual factors.

Interestingly, antenatal depression was unrelated to postnatal outcomes in the current analyses, but this is not surprising given that there were fewer cases of antenatal depression compared with anxiety. Consistent with the studies of Muzik et al. (2000) and Matthey et al. (2003), the low occurrence of antenatal depression indicates that not all anxious women are also depressed. The current emphasis on screening for perinatal depression may thus leave cases of antenatal anxiety undetected and untreated

with consequent increased risk for suboptimal fetal development and maternal mental health outcomes. This confirms the need to consider anxiety as well as depression when examining adjustment to pregnancy and the transition to parenthood (Hart and McMahon, 2006; Matthey, 2004; Matthey et al., 2003).

4.3. Comparative utility of diagnostic interviews and self-report measures as predictors of postnatal anxiety and mood disorders

The present study compared the utility of anxiety as assessed by the MINI-Plus diagnostic interview to anxiety as assessed using the STAI trait anxiety scale. The results show that antenatal anxiety as assessed by the MINI and the STAI were comparable as predictors of postnatal anxiety and mood disorders. Although diagnostic interviews are generally considered the gold standard for determining clinically significant levels of anxiety and depression, with further testing and replication in a sample representative of pregnant women, the STAI may prove to be a more practical and cost-effective alternative for use in research with perinatal women. In studies where infant outcomes are the variables of interest, however, the relative predictive utility of diagnostic interviews and self-report measures will need to be reassessed.

5. Limitations

Several limitations of the study need to be considered. First, we acknowledge that there is some potential for selection bias in our sample as demographic data for those who declined participation were not available for analysis. We were, however, able to compare participants and non-participants on their antenatal screening assessments, and found no differences between study participants and those who declined. Secondly, the current study used a sample in which women at high risk for postnatal anxiety and/or mood disturbances were over-represented. While this limits the generalisability of our results, over sampling high-risk women enabled us to explore the course of maternal antenatal anxiety in a clinical group, despite the relatively small sample size. Third, anxiety and depression were considered as single diagnostic categories. Diagnoses of anxiety and depression, including acute and chronic disorders, were aggregated because of the relatively low prevalence of each specific disorder. This limits the conclusions that can be drawn about the course of specific disorders and classes of disorders, and their role in maternal mental health and infant outcomes. More in-depth studies are required to explore this issue. Finally, maternal anxiety and depression were assessed only once during pregnancy. It would be important to consider the timing of onset and chronicity of anxiety and depression over the course of pregnancy as additional predictors of maternal postnatal psychological state and offspring outcomes. These limitations are offset by strengths, including the use of prospective methodology and both diagnostic interviews and self-report measures to assess antenatal and postnatal anxiety and depression.

6. Conclusions

Notwithstanding the above limitations, the present data adds to the literature by using prospective methodology and both diagnostic interview and self-report to examine the course of maternal anxiety across the transition to parenthood. The results suggest that women with an antenatal anxiety disorder or women reporting elevated levels of self-reported trait anxiety were significantly more likely to meet diagnostic criteria for an anxiety or mood disorder during the seven months following birth. The findings highlight the importance of considering anxiety when examining psychological adjustment to pregnancy and the transition to parenthood, and suggest that it may be possible to identify and treat a substantial proportion of women who are at risk for developing anxiety and mood disturbances during the postnatal period. Any such intervention may also minimise risk to the developing fetus and child. Although it is yet to be demonstrated empirically, it is likely that screening and subsequent treatment uptake will be met with some success, as perinatal women may not perceive anxiety as a stigmatising illness connected with their perception of being a good mother (Shakespeare et al., 2003). Finally, a novel contribution of the present study was the validation of the STAI for use during pregnancy in a sample of Australian women.

Role of the funding source

Funding for this study came from a NH&MRC Program Grant (157209) and a NSW Centre for Mental Health Infrastructure Grant. The funding sources had no further role in study design; the collection, analysis and interpretation of the data; in the writing of the report; and in the decision to submit the paper for publication.

Conflict of interest

There are no conflicts of interest, actual or potential, related to the submitted manuscript.

Acknowledgements

Our thanks go to the women who participated in this study, to Nicole Reilly for co-ordinating data collection,

and to Dr Alan Taylor (Macquarie University) for statistical advice.

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