

Nuffield Foundation Main Public Report

Ref KID/42599: The impact of anxiety disorders and personality dysfunction in pregnancy on mother-infant interaction at 3 months postpartum

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Executive Summary

Background

It is well established that depression in pregnancy is associated with an increased risk of subsequent adverse emotional and behavioural outcomes in children, with mother-infant interaction deficits in the first year after birth being a key mediator. However, there has been little research into associations between antenatal mental disorders other than depression, and subsequent mother-infant interactions.

Study aims

We aimed to examine the association between:

- 1) antenatal anxiety disorders and subsequent mother-infant interactions during the postnatal period;
- 2) personality dysfunction measured during pregnancy and subsequent mother-infant interactions during the postnatal period.

Methods

A cohort study of pregnant women was recruited in early pregnancy after their initial antenatal appointment and followed up until 3 months after birth. At the first interview in early pregnancy, the presence of mental disorders was measured using the Structured Clinical Interview for DSM-IV (SCID) Axis I Disorders (a gold standard researcher administered diagnostic interview). Symptoms of personality difficulties, such as difficulties in making friends, difficulties in trusting people, and impulsivity were measured using the Standardised Assessment of Personality – Abbreviated Scale (SAPAS) (an 8-item researcher administered tool). At 3 months after birth, mothers completed a self-report questionnaire about their feelings regarding their relationship with their infants (the Postpartum Bonding Questionnaire; PBQ), and as part of a home visit, mother-infant interactions were recorded by a researcher. These video recordings were later coded by an independent rater using the CARE-Index, a widely used coding system of mother and infant interactions including maternal sensitivity, the ability to perceive and respond appropriately to her infant's emotional and behavioural signals.

Main results

There were 206 mother-infant interaction dyads followed up for this study. Of these women, 64 (31%) had a SCID anxiety disorder and 62 (30%) had high levels of dysfunctional personality traits (a score of 3 or more on the SAPAS). As part of the larger cohort study, 459 women provided data on their perceptions of bonding with their baby (PBQ), of whom 98 (21%) had an anxiety disorder and 103 (22%) had high levels of dysfunctional personality traits.

Maternal anxiety disorder: associations with mother-infant interactions and bonding

Antenatal anxiety disorders were not significantly associated with independently assessed mother-infant interactions. Anxiety disorders were significantly associated with maternal perceptions of poor bonding but there was no association after controlling for depressive symptoms during pregnancy.

Maternal dysfunctional personality traits: associations with mother-infant interactions and bonding

Higher scores on the SAPAS (i.e. higher levels of personality difficulties) were significantly associated with poorer mother-infant interactions; specifically, mothers were less sensitive towards their babies during the interactions. These associations remained significant after accounting for maternal socioeconomic factors, though was attenuated after controlling for depressive symptoms during pregnancy. However, scores on the SAPAS were not associated with maternal perceptions of poor bonding.

Conclusions and implications for policy and practice

This study suggests that anxiety disorders, and associated depressive symptoms, may lead to women having distorted *perceptions* of their relationship with their baby, even though their interactions are of similar quality to those of women without anxiety disorders. However, conversely, mothers with high levels of personality difficulties are not more likely to perceive they have a problem with bonding but *independently observed interactions* are more likely to be impaired when compared to women with lower levels of personality difficulties; this appears to be partly related to symptoms of depression which are often comorbid with personality difficulties.

This study needs replication with larger populations but suggests that mothers with anxiety disorders may benefit from support in reappraising their perceptions so that they can feel less anxious and negative about their bonding with their babies. As mothers with high levels of personality difficulties may have less insight into difficulties in their relationship with their baby,

they may benefit from early antenatal identification. This would facilitate preparation and support with becoming a parent including during the antenatal period, in addition to treatment of comorbid depression and other psychological difficulties, so that interactions with the infant can be optimised.

Project information

The research team:

Professor Louise Howard, NIHR Research Professor; Professor in Women's Mental Health & Consultant Perinatal Psychiatrist, King's College London. (Principal Investigator)

Dr Selina Nath, King's College London (Postdoctoral Researcher)

Dr Rebecca Pearson, University of Bristol (provided expertise in longitudinal analysis and interpretation of maternal and child outcomes)

Professor Paul Moran, University of Bristol (provided expertise in longitudinal analysis and personality dysfunction)

Dr Susan Pawlby, King's College London (provided expertise in developmental psychology, mother-infant interaction, and maternal and child outcomes)

About the Nuffield Foundation



The Nuffield Foundation is an endowed charitable trust that aims to improve social well-being in the widest sense. It funds research and innovation in education and social policy and also works to build capacity in education, science and social science research. The Nuffield Foundation has funded this project, but the views expressed are those of the authors and not necessarily those of the Foundation. More information is available at www.nuffieldfoundation.org

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Introduction

Background and importance

Maternal mental health during pregnancy

Around 1 in 4 to 1 in 5 women experience a mental health problem during pregnancy. Antenatal depression occurs in around 10% of women [1-3] and anxiety disorders are also common with approximately 15% of pregnant women suffering from an anxiety disorder [1, 2, 4]. There is now a large evidence base linking antenatal and postnatal depression (particularly if persistent and severe) with negative child developmental outcomes, including behavioural, emotional, cognitive and growth development [5-9]. Research suggests that these adverse outcomes are at least partly due to deficits in mother-infant interaction [5].

Maternal sensitivity, a mother's ability to perceive and respond appropriately to her infant's emotional and behavioural signals [10] is a key aspect of mother-infant interaction, and has been longitudinally associated with positive child development across emotional, social and cognitive domains [11]. Maternal sensitivity can be improved through a number of psychoeducation or behavioural interventions [5-7, 11-13]. For this reason, research into prevention and treatment of maternal depression has become a priority, with the antenatal period now recognised as ideal time to implement preventative interventions [8].

There is also evidence that antenatal anxiety is associated with an increased risk of adverse child developmental outcomes including poorer emotional, behavioural and cognitive development [5, 14-18], though most studies have examined anxiety symptoms rather than clinically significant disorders. Recent preliminary evidence suggests maternal cognitions in the context of postnatal anxiety disorder may play a significant role in mother-infant interaction disturbances [19, 20] though the cross-sectional nature of these studies makes interpretation of directions of causality difficult.

There has been much less research on other aspects of mental health in pregnancy and mother-infant interactions. However, as personality determines behaviours towards others, so aspects of maternal personality that are dysfunctional could impact on early mother-infant interactions. We have recently reported in a longitudinal cohort study that personality difficulties, or "personality dysfunction" (symptoms found in personality disorder) are associated with adverse child outcomes including self-harm, depression, and anxiety, independently of maternal depression and other confounding variables [21].

In order to ameliorate the potential negative impact of mental disorders on children, it is important to establish modifiable pathways. This means finding factors that could be subject to change which may have the potential to affect child outcomes. One likely candidate, for disorders not as well researched as depression such as anxiety disorders and personality dysfunction, could similarly be difficulties in mother-infant interaction during early infancy.

Why is this research important?

The investigation of the influence of maternal mental health disorders during pregnancy on mother-infant interaction in the postpartum period is important for a number of reasons:

- 1) Theoretical understanding: Investigating maternal mental health during *pregnancy* and mother-infant interactions after birth eliminates the role of reverse causality and child evocative effects. This is a real limitation of previous research that only investigates mental health in the postnatal period where both the exposure (maternal mental health) and outcome of interest (mother-infant interactions) are collected at the same time-point. For example, as mother-infant interaction is driven by both maternal and infant responses, it may be that more 'difficult' infants (referred to as difficult child temperament in the literature) are evoking less sensitive maternal behaviours and increasing mental health problems in mothers rather than the other way around (maternal mental health influencing mother-infant interactions). However, infant characteristics cannot influence mental health in pregnancy. For this reason, we may be able to infer a causal direction in the association which add to our understanding of maternal mental health influences on mother-infant interaction.
- 2) Early intervention, treatment and prevention: If disorders such as anxiety and personality dysfunction during pregnancy are indeed associated with less sensitive mother-infant interactions, this could inform future tailored early interventions during pregnancy for at risk mothers and infants. Pregnancy provides an ideal opportunity to identify at risk mothers due to routine health service contact and screening. Interventions implemented before the child is born, could potentially prevent difficulties from starting in the first place and hence support mothers. This study will therefore enable health and social care providers to identify potential targets for early interventions to break the intergenerational transmission of risk from mothers to their offspring and reduce the risks of adverse outcomes in their children. Perinatal mental health services are being prioritised by NHS England with the aim of optimising child health (see <http://www.england.nhs.uk/2015/02/26/geraldine-strathdee-9/>) so services are potentially becoming available to address this issue.
- 3) Impact on policy: Findings from the study could help inform future recommendations to policy makers, NHS commissioners and health and social care providers about targets

for interventions to improve the outcomes of children of women with anxiety disorders or personality dysfunction. This could include consideration of early identification of problems other than depression, which is currently the main focus of health policy internationally.

Aims and objectives:

Aim:

To examine mother-infant interactions and bonding in women with 1) anxiety disorders and 2) personality dysfunction in pregnancy.

Objectives:

1. To investigate mother-infant interaction (specifically maternal sensitivity, control, and unresponsiveness) and maternal perceptions of bonding in women with anxiety disorders in early pregnancy compared to women with no anxiety disorders in early pregnancy
2. To investigate mother-infant interaction (specifically maternal sensitivity, control, and unresponsiveness) and maternal perceptions of bonding in women with high levels of personality dysfunctional traits compared to women with low levels of personality dysfunctional traits

Hypotheses:

Maternal anxiety:

1. Anxiety disorders in pregnant women are significantly associated with reduced maternal sensitivity, increased maternal unresponsiveness and more controlling mother-infant interactions compared with pregnant women without an anxiety disorder
2. Anxiety disorders in pregnant women are significantly associated with reduced postpartum bonding (in a maternal self-report measure) compared to women without an anxiety disorder

Personality dysfunction:

1. High levels of personality dysfunction in pregnant women are significantly associated with reduced maternal sensitivity, increased maternal unresponsiveness and more controlling mother-infant interactions compared with pregnant women with low personality dysfunction

2. High levels of personality dysfunction in pregnant women are significantly associated with reduced postpartum bonding (in a maternal self-report measure) compared to women with low personality dysfunction

Methods

Study design: cohort study

Study population: This cohort was originally recruited within a research programme funded by an NIHR Programme Grant for Applied Research (RP-PG-1210-12002). The “WENDY” (Wellbeing in pregnancy) study recruited a representative cohort of 545 pregnant women at the time of their antenatal booking in a South-East London maternity service [2], to assess how well the mental health screening questions asked by midwives identified antenatal depression and other mental disorders. The cohort were recruited using stratified sampling i.e. due to the primary purpose of the study, we over-sampled women who responded positively to either one of two screening (“Whooley”) questions about low mood.

Inclusion criteria: women aged >16 years who answered the Whooley questions at their antenatal booking appointment.

Exclusion criteria: women who declined answering the Whooley questions, or lacked mental capacity to provide informed consent or had undergone a comprehensive maternity booking elsewhere in the UK.

Procedure: All eligible women who responded positively to Whooley questions (approximately 10% of women booking in for antenatal care) and a random sample of women who responded negatively to the Whooley questions were invited to participate. The study team used translated instruments and interpreters where possible to enable non-English speaking women to take part. Baseline assessment included a diagnostic interview, information on socio-demographics, partner violence, obstetric and medical history and self-reported health, well-being, depressive symptoms and services use.

Two follow-up telephone interviews were then conducted, at 28 weeks gestation and at 3 months post partum.

At the 3 months postpartum follow-up, we used a self-report Parental Bonding measure (see details below). Nuffield Foundation funding, awarded mid-way through the follow up period (from July 2016), enabled us to carry out a face-to-face assessment of mother and baby playing in their home environment where they were comfortable.

Measures

Exposures: At baseline early pregnancy

The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) measures anxiety disorders and other mental disorders according to the widely used American classification, the Diagnostic and Statistical Manual of Mental Disorders DSM-IV [22]. The SCID is a semi-structured diagnostic interview which has been widely used in psychiatric research [23, 24], including national epidemiological studies [25, 26]. The interview consists of standardised diagnostic questions arranged in modules corresponding to each DSM-IV Axis I disorder [27]. For the current analysis, “anxiety disorders” included Generalised Anxiety Disorder (GAD), panic disorder, agoraphobia, social phobia, Obsessive-Compulsive Disorder (OCD) and Posttraumatic Stress Disorder (PTSD).

Personality dysfunction: The Standardised Assessment of Personality – Abbreviated Scale (SAPAS) is an eight-item researcher-administered screening tool which provides a validated measure of personality dysfunction [28]. The eight items correspond to eight descriptive statements (e.g. regarding difficulty in making friends, trusting others, being a worrier, being impulsive), and are scored either 0 = “no” or 1 = “yes” (item 3 is reverse scored); the eight items are added together to produce a total score of between 0 and 8. A score of 3 or more on the SAPAS indicates probable personality disorder [28]. The measure demonstrates good sensitivity and specificity (0.94 and 0.85, respectively) with the SCID - II [28]. For this study we defined women with a score of 3 or more as having personality dysfunction and also used the scale as a continuous measure in analysis.

Outcomes: At 3 months’ postpartum time-point

Mother-infant interactions

At 3 months after birth, interactions were captured in a 5-minute video clip taken during play at home; this was subsequently assessed by a trained independent rater using the Crittenden CARE-Index (which can be used from birth to 15 months of age) [29]. The CARE-index has been widely used in scientific research with mothers who have mental health difficulties, as early as one to five months post partum [30-32] and validated for use with families from different

social classes and cultural backgrounds [33]. Coding comprises seven aspects of adult and infant dyadic behaviour: four aspects concentrate on affect (facial expression, verbal expression, affection and body contact) and three focus on temporal contingencies (turn-taking, control and developmental appropriateness of chosen activity). Each aspect of adult and infant behaviour is evaluated individually and summed to make seven scale scores. Maternal patterns assessed were sensitivity (a score of 7 or more being normally sensitive), unresponsiveness and controlling. Interactions receive a score on each aspect of adult and infant behaviour and scores are then summed to create the seven scale scores, each on a range from 0 to 14 [29]. In this study, video-taped interactions were coded by an experienced coder who was blind to the women's mental health status and our research questions. The coder had Level II+ research coding reliability (i.e. the level required to code for research).

Postpartum Bonding Questionnaire (PBQ) – 3 months post partum

The PBQ is a 25 item self-administered measure designed to provide an early indication of disorders within mother-infant relationships through the assessment of a mother's feelings and attitudes towards her infant[34]. Items are rated on a six-point scale from 0 = "always" to 5 = "never". When the statement reflects a negative emotion or attitude, the scoring is reversed. Total scores are calculated by summing the 25 items (scores ranges between 0 - 125). Higher scores indicate more impaired bonding and a score of 26 or more has been suggested as a cut-off to indicate bonding disorder.

Other measures

Depressive symptoms during pregnancy

Depressive symptoms were measured using the Edinburgh Postnatal Depression Scale (EPDS). This is a ten-item self-administered screen for antenatal and postnatal depression, validated in >20 languages [35]. We used a cut-off of 13 or more to indicate high depressive symptoms for descriptive statistics [2, 36], but used the continuous scale for analysis. This measure was used at baseline, and 28 weeks gestation in pregnancy. We used the mean score of the EPDS at baseline and 28 weeks gestation to control for depressive symptom during pregnancy in the analysis.

Maternal socio-demographic factors

Maternal date of birth, maternal education, relationship status and other socio-demographic information was collected during the WENDY baseline interview.

Infant factors

Information on child gender and gestational age at birth was collected from women's medical records (where women gave informed consent to access medical records). Where women did

not give permission access their medical records, this information was collected during 3-month postpartum interview home visit.

See Appendix 1 for information on statistical analysis.

Results

Study population

Flowchart (figure 1) shows the flow of participants through the study and the samples used in the current analyses. Information regarding each time-point are as follows:

Baseline antenatal interview (early pregnancy)

The baseline recruitment period was between November 2014 and June 2016. 545 pregnant women were recruited into the WENDY study (for details of this study, see Howard et al, 2018) [2]. In order to increase our sample size for the current study, we also approached women participating in a related study (a nested exploratory randomised controlled trial, DAWN, which included referrals to the trial with and without involvement in the WENDY study [37]) to take part in the mother-infant interaction data collection at a home visit [37], which enabled us to approach an additional 11 women.

28 weeks gestation follow-up:

The mid-pregnancy follow-up of women was conducted between February 2015 and November 2016. 91% (n=508/556) of women were successfully followed-up.

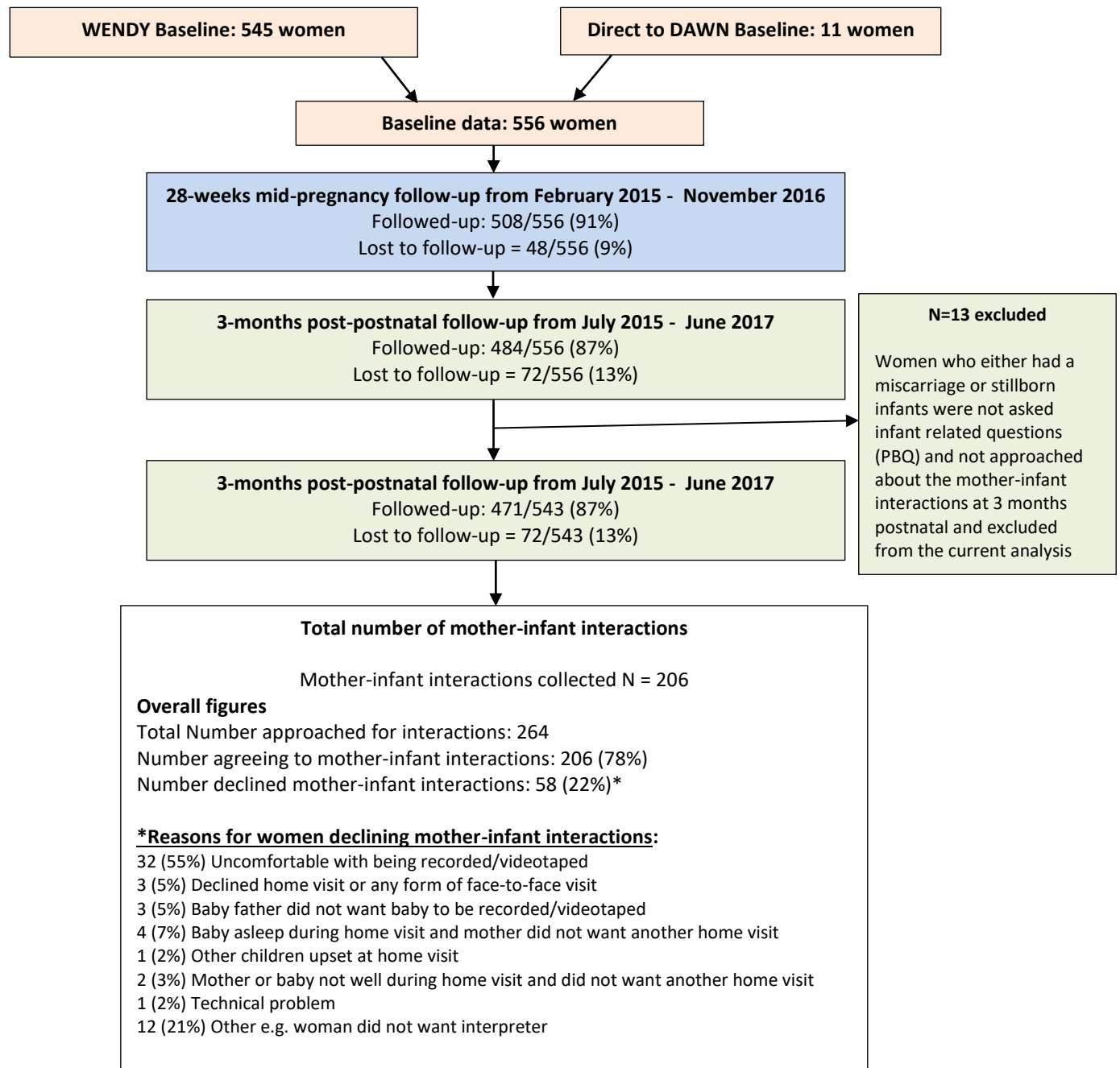
3 months postpartum follow-up

The 3 months postpartum follow-up of women was conducted between July 2015 and June 2017. Overall, 87% (n=474/556) of women were successfully followed-up.

Mother-infant interaction data collection

206 mother-infant interactions were collected. Most of this data collection started once Nuffield Foundation funding was secured (July 2016 – June 2017). Between January 2016 – June 2016), we started collecting mother-infant interactions without funding (prioritising women with high SAPAS scores and anxiety – our target populations). Additionally, if women were difficult to follow-up over the telephone and a home visit took place, then mother-infant interaction was collected. In total, 264 women were approached to take part in this mother-infant interaction video study and 78% (n=206) agreed, 9 of whom were women recruited directly from the DAWN study.

Figure 1: Flow chart for study sample



Socio-demographic characteristics of study sample

Women with mother-infant interaction data (n=206):

Women with mother-infant interaction data were mainly aged between 30-39 (67%) (mean 33 years old, SD: 5.34), white (58%), employed (68%), married or in relationship (88%) and educated to degree level or above (53%) (see table 1). There were no differences in socio-demographic characteristics of mothers that were approached for filming compared to those in the WENDY study that were not approached (i.e. seen prior to us receiving funding). Of the mothers that were approached to take part in the filming of their interactions with their babies, mothers who agreed were older compared with those who did not agree. There were no other significant differences in socio-demographic characteristics between women who agreed to filming compared to those that declined the filming.

Women with Postpartum Bonding Questionnaire (PBQ) data (n=471)

Women who were lost to follow-up were younger, had lower levels of education, more likely to be from a non-white ethnic origin, were less likely to be employed and had lower income than those who were followed up at 3 months after birth (see table 2). 2% had missing PBQ data.

Association between observational mother-infant bonding and maternal self-report

Table 3 presents the correlations between mother-infant interactions and PBQ. There were no significant correlations between observational mother-infant interaction ratings (CARE-Index) and maternal self-report of perceived bonding with her baby (PBQ). Maternal sensitivity and infant cooperation are highly correlated, and maternal control and infant compulsiveness are highly correlated.

Table 1: Socio-demographic characteristics of women who were not approached for interaction measure (n=292), those approached (n=264) and total WENDY/DAWN population (n=556)

	Sample not approached N=292 ¹	Sample approached N=264 ¹				Total WENDY/DAWN study sample N=556
		Sample declined ² N=58	Sample agreeing to interaction measure ² N=206	P value ² (women who declined vs those who agreed to interaction measure)	P value ¹ (women that were not approached (n=292) and approached (n=264))	
Age (years)				0.320	0.194	
16 – 19	31 (11%)	7 (12%)	20 (10%)			58 (10%)
20-29	54 (18%)	12 (21%)	37 (18%)			103 (19%)
30-39	176 (60%)	33 (57%)	140 (68%)			349 (63%)
40+	31 (11%)	6 (10%)	9 (4%)			46 (8%)
Ethnicity				0.320	0.768	
White	149 (51%)	25 (43%)	120 (58%)			294 (53%)
Black/ Caribbean	96 (33%)	25 (43%)	57 (28%)			178 (32%)
Asian/Asian British	16 (5%)	2 (3%)	7 (3%)			25 (5%)
Mixed/Multiple ethnicity	12 (4%)	3 (5%)	8 (4%)			23 (4%)
Other	19 (7%)	3 (5%)	14 (7%)			36 (6%)
Highest Education level				0.875	0.837	
None/school qualifications	33 (11%)	11 (19%)	23 (11%)			67 (12%)
College/Diploma/Higher/Certificate/training	105 (36%)	21 (36%)	74 (36%)			200 (36%)
Degree level/ Postgraduate qualifications	154 (53%)	26 (45%)	109 (53%)			289 (52%)
Employment status³				0.569	0.281	
Employed	183 (63%)	37 (64%)	139 (68%)			359 (65%)
Student	16 (5%)	1 (2%)	5 (2%)			22 (4%)
Unemployed	37 (13%)	6 (10%)	21 (10%)			64 (11%)
Homemaker	41 (14%)	7 (12%)	27 (13%)			75 (14%)
Not working due to illness/Other	15 (5%)	7 (12%)	12 (6%)			34 (6%)

Income ⁴				0.669	0.776	
< £15000	36 (17%)	10 (24%)	31 (19%)			77 (18%)
£15,000-£30,999	38 (18%)	11 (26%)	25 (15%)			74 (17%)
£31,000-£45,999	31 (14%)	8 (19%)	23 (14%)			62 (15%)
£46,000-£60,999	37 (17%)	4 (10%)	23 (14%)			64 (15%)
£61,000 or more	75 (34%)	9 (21%)	64 (39%)			148 (35%)
Relationship status				0.641	0.490	
Married/in a relationship	252 (86%)	52 (90%)	181 (88%)			485 (87%)
Single/separated/divorced/widowed	40 (14%)	6 (10%)	25 (12%)			71 (13%)
Translator required				0.780	0.741	
No	272 (93%)	52 (90%)	192 (93%)			516 (93%)
Yes	20 (7%)	6 (10%)	14 (7%)			40 (7%)

¹ Comparison between women that were not approached (n=292) and approached (n=264).

² Comparison between sample that declined (n=58) and accepted (n=206) interaction recording (all these women were approached).

³ 2 participants had missing data on employment status (both women completed the mother-infant interaction).

⁴ 131 participants had missing data on income. Therefore, this variable was not used further in analysis.

Table 2: Socio-demographic characteristics of women followed-up (asked PBQ questions) and lost to follow-up for WENDY study

	Women followed-up at 3 months after birth (n=484)	Women lost to follow-up at 3 after birth (n=72)	p	Overall (total) (n=556)
Age (years)			0.050	
16 – 19	45 (9%)	13 (18%)		58 (10%)
20-29	88 (18%)	15 (21%)		103 (19%)
30-39	313 (65%)	36 (50%)		349 (63%)
40+	38 (8%)	8 (11%)		46 (8%)
Ethnicity			0.011	
White	269 (56%)	25 (35%)		294 (53%)
Black/ Caribbean	147 (30%)	31 (43%)		178 (32%)
Asian/Asian British	21 (4%)	4 (6%)		25 (5%)
Mixed/Multiple ethnicity	19 (4%)	4 (6%)		23 (4%)
Other	28 (6%)	8 (11%)		36 (6%)
Highest Education level			0.003	
None/school qualifications	52 (11%)	15 (21%)		67 (12%)
College/Diploma/Higher/Certificate/training	168 (35%)	32 (44%)		200 (36%)
Degree level/ Postgraduate qualifications	246 (54%)	25 (35%)		289 (52%)
Employment status¹			0.020	
Employed	322 (67%)	37 (51%)		359 (64%)
Student	21 (4%)	1 (1%)		22 (4%)
Unemployed	52 (11%)	12 (17%)		64 (12%)
Homemaker	58 (12%)	17 (24%)		75 (14%)
Not working due to illness/Other	29 (6%)	5 (7%)		34 (6%)
Income²			0.001	
< £15000	60 (16%)	17 (38%)		77 (18%)
£15,000-£30,999	63 (17%)	11 (24%)		74 (17%)
£31,000-£45,999	57 (15%)	5 (11%)		62 (15%)
£46,000-£60,999	59 (16%)	5 (11%)		64 (15%)
£61,000 or more	141 (37%)	7 (16%)		148 (35%)
Relationship status			0.069	
Married/in a relationship	427 (88%)	58 (81%)		485 (87%)
Single/separated/divorced/widowed	57 (12%)	14 (19%)		71 (13%)
Translator required			0.062	
No	453 (94%)	63 (88%)		516 (93%)
Yes	31 (6%)	9 (13%)		40 (7%)

¹ 2 participants had missing data on employment status.

² 131 participants had missing data on income

Table 3: Correlations between mother patterns and infant patterns (correlation matrix)

Variables	PBQ total scores	Maternal sensitivity	Maternal control	Maternal Unresponsiveness
PBQ total scores	-			
Maternal sensitivity	0.02 (ns)	-		
Maternal control	-0.02 (ns)	- 0.54**	-	
Maternal unresponsiveness	0.00 (ns)	-0.19*	-0.72**	-

p<0.01=*; p<0.001=**; non-significant=ns

Main findings

Antenatal anxiety disorder: associations with mother-infant interactions and bonding

Mother-infant interactions (CARE-Index)

Two women who had agreed to the interaction being filmed had missing data on the PTSD SCID module and it is not known therefore whether they should be categorised as having an anxiety disorder or not; thus the total number of women for this analysis was 204 mother-infant dyads. 64 (31%) women with mother-infant interaction data met SCID criteria for an anxiety disorder during pregnancy; 140 (69%) women did not have an anxiety disorder. Of the women without an anxiety disorder, 47 (34%) met criteria for SCID depression.

There were no significant associations between antenatal anxiety disorder and mother-infant interactions (see table 4).

Maternal self-report of bonding (Parental Bonding Questionnaire)

Of the women who had complete data on SCID anxiety disorder, 20 had missing PBQ data and the sample for this analysis is therefore 454. 98 (22%) women with PBQ data met SCID criteria for an anxiety disorder during pregnancy. Of the 356 (78%) without an anxiety disorder, 68 women met criteria for depression.

Mothers with anxiety disorders reported higher levels of perceived bonding impairment (mean, SD: 9.30, 8.45; median, range: 7, 1-43) compared with those without anxiety disorders (n=356; 78%; mean, SD: 7.15, 7.32; median, range: 5, 0-55), even after accounting for maternal age, education, relationship status, infant gestational age at birth and infant gender [coefficient (95% CI): 2.40 (0.69 – 4.12), $p=0.006$]. However, after adjusting for maternal depressive symptoms during pregnancy, there was no association between maternal anxiety and impaired bonding [coefficient (95% CI): 0.88 (-0.98 – 2.73), $p=0.353$]; higher maternal depressive symptoms during pregnancy was associated with reported impaired bonding [coefficient (95% CI): 0.30 (0.15 – 0.44), $p<0.001$].

Table 4: Maternal antenatal anxiety disorder and mother-infant interactions

Outcomes	Total sample Mean (SD) Median (range)	No anxiety N=140 Mean (SD) Median (range)	Anxiety N=64 Mean (SD) Median(range)	Unadjusted linear regression Coefficient (95% CI)	P	Multivariable linear regression adjusting for Socioeconomic factors ^a	p	Multivariable linear regression adjusting for Socioeconomic factors and depressive symptoms during pregnancy ^b	p
Mother patterns									
Sensitivity	4.17 (2.89) 4 (0-13)	4.29 (3.00) 4 (0-13)	3.81 (2.61) 3.5 (0-13)	-0.48 (-1.33- 0.38)	0.271	-0.29 (-1.13 - 0.55)	0.499	-0.02 (-0.91 - 0.94)	0.974
Controlling (total)	3.74 (4.12) 2 (0-14)	3.77 (4.14) 2 (0-14)	3.73 (4.15) 2 (0-14)	-0.05 (-1.28 – 1.18)	0.935	-0.23 (-1.40 – 0.94)	0.703	-0.68 (-1.97 – 0.60)	0.293
Unresponsive (total)	6.09 (3.53) 6 (0-14)	5.92 (3.49) 6 (0-14)	6.45 (3.64) 6 (0-13)	0.53 (-0.52 - 1.59)	0.321	0.52 (-0.53 - 1.57)	0.334	0.67 (-0.49 – 1.82)	0.255

^a Adjusting for maternal age (continuous in years), maternal education, maternal relationship status, infant gender and infant gestational age at birth (continuous in weeks).

^b Adjusting for maternal age (continuous in years), maternal education, maternal relationship status, infant gender, infant gestational age at birth (continuous in weeks) and depressive symptoms during pregnancy (continuous).

Maternal dysfunctional personality traits: associations with mother-infant interactions and bonding

Mother-infant interactions (CARE-Index)

Of women with mother-infant interaction data, 62 (30%) had high levels of dysfunctional personality traits (i.e. score of 3 or more on the SAPAS). Of the 144 (70%) women with low levels of dysfunctional personality traits, 50 (35%) met criteria for SCID depression.

Higher levels of maternal dysfunctional personality traits were associated with reduced maternal sensitivity, even after controlling for key variables such as maternal education, maternal age, maternal relationship status, infant gender and gestational age at birth (see table 5). However, the association was attenuated after adjustment of maternal depressive symptoms during pregnancy.

Maternal self-report of bonding (Parental Bonding Questionnaire)

Of the women who had complete SAPAS data, 21 (4%) had missing data on the PBQ and the sample size for this analysis is therefore 459. 103 (22%) women with PBQ data had high levels of dysfunctional personality traits (i.e. score of 3 or more on the SAPAS). Of the 356 (78%) women with low levels of dysfunctional personality traits, 79 (22%) women met criteria for SCID depression.

Mothers with high levels of dysfunctional personality traits reported higher levels of perceived bonding problems ($n=103$; mean, SD: 8.08, 8.00; median, range: 6, 0-43) than mothers with lower levels of dysfunctional personality traits ($n=356$; mean, SD: 7.42, 7.32, median, range: 5, 0-55) but these were not statistically significant differences [coefficient (95% CI): 0.01 (-0.54 – 0.55), $p=0.981$]. High levels of maternal depressive symptoms during pregnancy were associated with reports of impaired bonding [coefficient (95% CI): 0.31 (0.17 – 0.46), $p<0.001$].

Table 5: Maternal dysfunctional personality traits and mother-infant interactions

Outcomes	Total sample N=206 Mean (SD) Median (range)	Low SAPAS scores N=144 Mean (SD) Median (range)	High SAPAS scores N=62 Mean (SD) Median (range)		Unadjusted linear regression Coefficient (95% CI)	p	Multivariable linear regression adjusting for Socioeconomic factors ^a	p	Multivariable linear regression adjusting for Socioeconomic factors and depressive symptoms during pregnancy ^b	p
Mother patterns										
Sensitivity	4.17 (2.89) 4 (0-13)	4.49 (2.93) 4 (0-13)	3.40 (2.66) 3 (0-11)		-0.39 (-0.65 - -0.14)	0.003	-0.27 (-0.54 - 0.00)	0.051	-0.20 (-0.49 - 0.09)	0.166
Controlling	3.74 (4.12) 2 (0-14)	3.28 (3.96) 1 (0-13)	4.82 (4.31) 4 (0-14)		0.47 (0.10 - 0.83)	0.012	0.22 (-0.15 - 0.60)	0.243	0.14 (-0.26 - 0.55)	0.486
Unresponsive	6.09 (3.53) 6 (0-14)	6.22 (3.52) 6 (0-14)	5.77 (3.56) 6 (0-13)		-0.08 (-0.39 - 0.24)	0.634	0.05 (-0.29 - 0.38)	0.789	0.06 (-0.30 - 0.43)	0.740

^a Adjusting for maternal age (continuous in years), maternal education, maternal relationship status, infant gender and infant gestational age at birth (continuous in weeks).

^b Adjusting for maternal age (continuous in years), maternal education, maternal relationship status, infant gender, infant gestational age at birth (continuous in weeks) and depressive symptoms during pregnancy (continuous).

Interpretation of findings and clinical implications

Maternal antenatal anxiety disorder

There were no significant differences in the quality of postnatal mother-infant interactions for women with antenatal anxiety disorders compared with women without anxiety disorders, though this may reflect lack of statistical power to detect small differences as antenatal anxiety disorders were (non-significantly) associated with slightly lower sensitivity. Mothers with antenatal anxiety disorders were more likely to report perceived bonding problems, but this association was not present after controlling for depressive symptoms. These results suggest that anxiety and associated depressive symptoms, may lead to women having distorted *perceptions* of their relationship with their baby, even though their interactions are of similar quality to those of women without anxiety disorders. These perceptions may arise from a specific type of maternal cognition (or pattern of thinking) called “preoccupation” [38]. Recurrent negative thought processes (referred to as worrying or ruminating) are a key factor of anxiety disorders and depression [39, 40], and therefore mothers with anxiety may be more concerned/worried about their bonding with their baby.

Our findings are contrary to findings from other studies which have reported an association between *postpartum* anxiety and impaired mother-infant interactions (specifically reduced sensitivity) [19, 20, 41, 42]. Our sample size of 64 mothers with anxiety disorders is relatively large compared with most previous research collecting observational mother-infant interactions [20, 41, 42]), but our findings would need to be replicated in future research using larger sample sizes and measuring anxiety and depression more frequently through pregnancy and postnatally to help establish the optimal timing and targets of interventions.

Publication: Nath S, Pearson RM, Moran P, Pawlby S, Molyneaux E, Challacombe FL, & Louise M. Howard. The association between prenatal maternal anxiety disorders and postpartum perceived and observed mother-infant relationship quality. *Journal of Anxiety Disorders Online first* <https://doi.org/10.1016/j.janxdis.2019.102148>

Maternal dysfunctional personality traits

High levels of maternal dysfunctional personality traits were associated with significantly lower sensitivity during interactions with their infants compared to mothers with low levels of dysfunctional personality traits. This association was still present after adjusting for socio-demographic factors. However, inclusion of depressive symptoms during pregnancy attenuated this relationship suggesting that depressive symptoms may at least partly explain the relationship between dysfunctional personality traits and reduced maternal sensitivity. It is

already well established that depression impairs maternal sensitivity. Personality dysfunction is often associated with depression [43], and it therefore appears that women with personality dysfunction may show lower sensitivity because these women are also depressed. This hypothesis needs to be investigated with a larger epidemiological study to investigate these mechanisms more thoroughly. Of note, though, unlike the women with anxiety disorders, women with high levels of personality dysfunction did not report impaired bonding with their infants compared to mothers with low personality dysfunction, despite being more likely to have difficulties in being sensitive to the infant. This suggests a lack of insight into relational difficulties in women with higher levels of dysfunctional traits.

Nath S, Pearson R, Moran P, Pawlby S, Molyneaux E, Howard LM, Maternal personality traits, antenatal depressive symptoms and the postpartum mother-infant relationship: a prospective observational study. *Social Psychiatry and Psychiatric Epidemiology In press*

Strengths and limitations

We used observational methods to investigate mother-infant interaction with a well-validated coding system; the lack of association between maternal reports of bonding and observed mother-infant interactions highlight the importance of studies of mother-infant interaction using observational methods. We also used well validated measures of anxiety disorders, depressive symptoms and dysfunctional personality traits. However, our study population was relatively small, follow-up participants were not entirely representative of the base population (suggesting that we might have underestimated the associations found), and longer term follow up of child outcomes was not possible in this small study. We were unable to include a pregnancy measure of reflective functioning due to delays with ethical approval so examination of reflective functioning in pregnancy as a potential mechanism was not possible.

Clinical implications and recommendations for policy and practice¹

This study provides evidence that anxious mothers perceive that they have less close relationships with their babies, though their observed behaviour in their interactions with their infants is similar to that of non-anxious mothers. Mothers with anxiety disorders may therefore

¹ Results in published tables included in journal publications differ slightly due to reviewer requests

benefit from support in reappraising their negative perceptions so that they can feel less anxious.

With regards our findings that maternal dysfunctional personality traits are associated with reduced maternal sensitivity, provided that our findings are replicated, this suggests that mothers with high personality dysfunction need parenting preparation and support. As mothers with high levels of personality difficulties may have less insight into difficulties in their relationship with their baby, they may benefit from early antenatal identification. This would facilitate preparation and support with becoming a parent including during the antenatal period, in addition to treatment of any comorbid depression and other psychological difficulties, so that interactions with the infant can be optimised. Currently, there is a lack of support for this group of women. Further work is needed to understand why this group of mothers have difficulties in their interactions in order to tailor interventions, but existing evidence based parenting interventions may be helpful. Given that symptoms of depression were important in potentially explaining the association between personality dysfunction and mother-infant interaction, identifying and treating depression is also important. Identification of personality difficulties in pregnancy is not currently policy internationally and most maternity guidelines focus on depression. More research on personality difficulties and interventions in pregnancy and postnatally, could improve outcomes for mother and child and is an area traditionally neglected but we recommend needs urgent funding.

Appendix 1: Statistical analysis for main findings

Data management and analysis was conducted using statistical software package Stata v.15 [44]. We conducted the following analysis separately for each outcome variable (maternal sensitivity, control, unresponsiveness and PBQ bonding). First by investigating the exposure of maternal antenatal anxiety disorder during pregnancy and then maternal dysfunctional personality traits.

1. Unadjusted linear regression was run to investigate the associations between exposure during pregnancy (anxiety or personality dysfunction) and outcome variable (maternal sensitivity, control, unresponsiveness or PBQ bonding) (model 1).
2. Based on previous literature [5, 12], potential confounding variables were considered to be those associated with both the exposure (maternal mental health) and the outcomes (mother-infant interaction patterns and bonding), but not part of the causal pathway. On this basis, the following were thus included in multivariable regression analysis: maternal age, education, relationship status, infant gender, infant gestational age (model 2).
3. In a final step, we investigated whether any associations were also independent of maternal depressive symptoms during pregnancy (mean EPDS scores from baseline early pregnancy and 28 weeks' mid-pregnancy follow-up). However, attenuation of any associations once including maternal depression, would not negate the associations, but rather suggest that depressive symptoms are an important driver of the impact on mother-infant interaction/PBQ.

References

1. Howard, L.M., et al., *Non-psychotic mental disorders in the perinatal period*. The Lancet, 2014. **384**(9956): p. 1775-1788.
2. Howard, L.M., et al., *Accuracy of the Whooley questions and the Edinburgh Postnatal Depression Scale in identifying depression and other mental disorders in early pregnancy*. The British Journal of Psychiatry, 2018. **212**(1): p. 50-56.
3. National Institute for Health and Care Excellence, *Antenatal and Postnatal Mental Health guidelines - Clinical guidelines CG192*. 2014, National Institute for Health and Care Excellence (NICE): London.
4. Dennis, C.-L., K. Falah-Hassani, and R. Shiri, *Prevalence of antenatal and postnatal anxiety: systematic review and meta-analysis*. Br J Psychiatry, 2017. **210**(5): p. 315-323.
5. Stein, A., et al., *Effects of perinatal mental disorders on the fetus and child*. The Lancet, 2014. **384**(9956): p. 1800-1819.
6. Goodman, S.H., et al., *Maternal depression and child psychopathology: a meta-analytic review*. Clin Child Fam Psychol Rev, 2011. **14**(1): p. 1-27.
7. Grace, S.L., A. Evindar, and D.E. Stewart, *The effect of postpartum depression on child cognitive development and behavior: a review and critical analysis of the literature*. Arch Womens Ment Health, 2003. **6**(4): p. 263-74.
8. Letourneau, N.L., et al., *The effect of perinatal depression treatment for mothers on parenting and child development: A systematic review*. Depression and anxiety, 2017.
9. Letourneau, N.L., L. Tramonte, and J.D. Willms, *Maternal Depression, Family Functioning and Children's Longitudinal Development*. J Pediatr Nurs, 2013. **28**(3): p. 223-34.
10. Ainsworth, M.S., *Infant–mother attachment*. American psychologist, 1979. **34**(10): p. 932.
11. Murray, L., S.L. Halligan, and P.J. Cooper, *Effects of postnatal depression on mother-infant interactions, and child development.*, in *Handbook of Infant Development* B.G. Wachs T, Editor. 2010, Wiley-Blackwell Malden.
12. Goodman, S.H., et al., *Extending models of sensitive parenting of infants to women at risk for perinatal depression*. Parenting, 2017. **17**(1): p. 30-50.
13. Stephenson, L.A., et al., *Mother and Baby Units matter: Improved outcomes for both*. British Journal of Psychiatry Open, 2018. **In Press**.
14. Barker, E.D., et al., *The contribution of prenatal and postnatal maternal anxiety and depression to child maladjustment*. Depress Anxiety, 2011. **28**(8): p. 696-702.
15. Blair, M.M., et al., *Prenatal maternal anxiety and early childhood temperament*. Stress, 2011. **14**(6): p. 644-51.

16. O'Connor, T.G., et al., *Maternal antenatal anxiety and children's behavioural/emotional problems at 4 years. Report from the Avon Longitudinal Study of Parents and Children*. Br J Psychiatry, 2002. **180**: p. 502-8.
17. Newman, L., F. Judd, and A. Komiti, *Developmental implications of maternal antenatal anxiety mechanisms and approaches to intervention*. Translational Developmental Psychiatry, 2017. **5**(1): p. 1309879.
18. Glover, V., *Maternal depression, anxiety and stress during pregnancy and child outcome; what needs to be done*. Best practice & research Clinical obstetrics & gynaecology, 2014. **28**(1): p. 25-35.
19. Stein, A., et al., *Maternal cognitions and mother-infant interaction in postnatal depression and generalized anxiety disorder*. J Abnorm Psychol, 2012. **121**(4): p. 795-809.
20. Nicol-Harper, R., A.G. Harvey, and A. Stein, *Interactions between mothers and infants: Impact of maternal anxiety*. Infant Behavior and Development, 2007. **30**(1): p. 161-167.
21. Pearson, R., et al., *Impact of dysfunctional maternal personality traits on risk of offspring depression, anxiety and self-harm at age 18 years: a population-based longitudinal study*. Psychological medicine, 2018. **48**(1): p. 50-60.
22. First, M.B., et al., *Structured Clinical Interview for DSM-IV® Axis I Disorders (SCID-I), Clinician Version, Administration Booklet*. 2012: American Psychiatric Pub.
23. Spitzer, R.L., et al., *The structured clinical interview for DSM-III-R (SCID): I: history, rationale, and description*. Archives of general psychiatry, 1992. **49**(8): p. 624-629.
24. Williams, J.B., et al., *The structured clinical interview for DSM-III-R (SCID): II. Multisite test-retest reliability*. Archives of general psychiatry, 1992. **49**(8): p. 630-636.
25. Weissman, M.M., et al., *Cross-national epidemiology of major depression and bipolar disorder*. Jama, 1996. **276**(4): p. 293-299.
26. Williams, J.B. and M. Gibbon, *International Reliability of a Diagnostic Intake Procedure*. Am J Psychiatry, 1992. **149**: p. 560-562.
27. American Psychiatric Association, *Diagnostic and Statistical Manual-Text Revision (DSM-IV-TRim, 2000)*. 2000: American Psychiatric Association.
28. Moran, P., et al., *Standardised Assessment of Personality - Abbreviated Scale (SAPAS): preliminary validation of a brief screen for personality disorder*. Br J Psychiatry, 2003. **183**: p. 228-232.
29. Crittenden, P.M., *CARE-Index: Infants coding manual*. Family Relations Institute, Miami, 2003.
30. Steadman, J., et al., *An exploratory study of the relationship between mother-infant interaction and maternal cognitive function in mothers with mental illness*. Journal of Reproductive and Infant Psychology, 2007. **25**(4): p. 255-269.
31. Kenny, M., et al., *Mother-infant interaction in mother and baby unit patients: Before and after treatment*. Journal of Psychiatric Research, 2013. **47**(9): p. 1192-1198.
32. Conroy, S., et al., *Maternal psychopathology and infant development at 18 months: the impact of maternal personality disorder and depression*. J Am Acad Child Adolesc Psychiatry, 2012. **51**(1): p. 51-61.
33. Leventhal, A., et al., *Caregiving attitudes and at-risk maternal behavior among mothers with major mental illness*. Psychiatric Services, 2004. **55**(1431-1433).
34. Brockington, I.F., et al., *A screening questionnaire for mother-infant bonding disorders*. Arch Womens Ment Health, 2001. **3**: p. 133-140.
35. Cox, J.L., J.M. Holden, and R. Sagovsky, *Detection of Postnatal Depression - Development of the 10-Item Edinburgh Postnatal Depression Scale*. Br J Psychiatry, 1987. **150**: p. 782-786.
36. Gibson, J., et al., *A systematic review of studies validating the Edinburgh Postnatal Depression Scale in antepartum and postpartum women*. Acta Psychiatr Scand., 2009. **119**(5): p. 350-64.

37. Trevillion, K., et al., *Depression: an exploratory parallel-group randomised controlled trial of Antenatal guided self help for Women (DAWN): study protocol for a randomised controlled trial*. *Trials*, 2016. **17**(503).
38. Stein, A., et al., *The influence of postnatal psychiatric disorder on child development. Is maternal preoccupation one of the key underlying processes?* *Psychopathology*, 2009. **42**(1): p. 11-21.
39. McEvoy, P.M., et al., *The relationship between worry, rumination, and comorbidity: Evidence for repetitive negative thinking as a transdiagnostic construct*. *Journal of Affective Disorders*. **151**(1): p. 313-320.
40. Ehring, T. and E.R. Watkins, *Repetitive negative thinking as a transdiagnostic process*. *International Journal of Cognitive Therapy*, 2008. **1**(3): p. 192-205.
41. Challacombe, F.L., Salkovskis, P. M., Woolgar, M., Wilkinson, E. L., Read, J., & Acheson, R., *Parenting and mother-infant interactions in the context of maternal postpartum obsessive-compulsive disorder: Effects of obsessional symptoms and mood*. *Infant Behavior and Development*, 2016. **44**: p. 11-20.
42. Kaitz, M., et al., *Maternal anxiety, mother–infant interactions, and infants’ response to challenge*. *Infant Behavior and Development*, 2010. **33**(2): p. 136-148.
43. Hakulinen, C., et al., *Personality and depressive symptoms: Individual participant meta-analysis of 10 cohort studies*. *Depression and anxiety*, 2015. **32**(7): p. 461-470.
44. StataCorp, *Stata Statistical Software: Release 15*. 2017: College Station, TX: StataCorp LLC.