Abstract

The aims of the current study were to examine the effect of fathers' and mothers' pre and postnatal mental health on mother-infant and father-infant interactions. Mental health was broadly defined to include anxiety, depression and PTSD. A community sample of 44 mothers and 40 fathers from 45 families completed questionnaire measures of mental health in late pregnancy and three months postpartum. Mother-infant and father-infant interactions were observed and videoed three months postpartum and analysed using the CARE-index. Results showed that prenatal mental health, in particular anxiety, was associated with parent-infant interactions to a greater extent than postnatal mental health. Fathers' prenatal symptoms were associated with higher paternal unresponsiveness and infant passivity whilst fathers' postnatal symptoms were associated with higher levels of infant difficulty in the father-baby interaction. The results also indicated that mothers and fathers interaction with their babies were similar, both on average and within the couples, with 34% being inept or at risk. These findings highlight the need for early detection and prevention of both mental health and parent-infant relationship problems in fathers as well as mothers. However, further prospective and longitudinal studies are needed to understand the influences of parental mental health on the parent-infant interactions further. Also it should be noted that the mental health scores were low in this well-educated, middle-class relatively low risk community sample of two-parent families, and that future studies therefore would benefit from focusing on more vulnerable groups of parents.

Keywords: child birth, mental health, mother, father, infant, interaction

1. Introduction

The quality of the early dyadic interaction between the primary caregiver and baby is important for the child's socio-emotional, cognitive, language and brain development (Hay & Pawlby, 2003; Murray, FioriCowley, Hooper & Cooper, 1996; Trevarthen & Aitken, 2001), for the formation of secure attachment (Steadman et al., 2007; Crittenden, 1995; Tomlinson, Cooper & Murray, 2005) and the child's future mental health (Skovgaard et al., 2008). A failure to establish a satisfactory early parent-baby relationship may also put the baby at risk of child abuse and neglect (Scannapieco & Connell-Carrick, 2005). It is therefore important to understand early risk factors for an unsatisfactory parent-infant relationship. One such risk factor is poor parental mental health. The current study aims to extend previous research by using direct observations to explore both mothers and fathers interactions with their baby in relation to their mental health. Mental health was broadly defined to include anxiety, depression and PTSD measures

1.1. Parent-infant interactions

Although the family systems perspective acknowledges the importance of fathers' impact on their baby and the family as a whole (e.g., Bell et al., 2007; Cowan & Cowen, 2002; Erel & Burman, 1995; Fivaz- Depeursinge, Favez, Lavanchy, De Noni & Frascarolo, 2005), there is still far less research on fathers than mothers, with inconclusive findings. There are indications that fathers may experience more difficulties with their emotional relationship and interactions with their baby than mothers (Edhborg, Matthiesen, Lundh and Widstrom, 2005). Whilst some studies show an interdependence of negative intrusive interactive patterns across the mother-infant and father–infant dyads (Barnett, Deng, Mills-Koonce, Willoughby & Cox , 2008) as well as maternal and paternal positive, supportive parenting patterns resembling each other (Martin, Ryan & Brooks-Gunn, 2007), other

researchers have not found any significant associations between observed mother-infant and father-infant interactions (Goodman, 2008).

1.2. Parental mental health and parent-infant interactions

One of the major parental risk factors for a negative parent-baby relationship, with increased risks for child maltreatment, is parental mental illness (Brockington, 2004; Hindley, Ramchandani & Jones, 2006; Pawlby, Hay, Sharp, Waters & Pariante, 2011; Scannapieco & Connell-Carrick, 2005). Specifically maternal depression has been linked to poor quality of mother-baby interaction (for a review, see Field, 2010). For example, Beck (1995) found a moderate to large effect of postpartum depression on maternal-infant interaction. Similarly Kemppinen, Kumpulainen, Moilanen and Ebeling (2006) found that 75% of mothers who were identified as being "at risk" in lack of sensitivity towards their infant 6 to 8 weeks postpartum, also reported depressive symptoms. Evidence shows that depressed mothers are less sensitive towards their babies (Murray et al., 1996; Steadman et al., 2007), being more intrusive or withdrawn (Black et al., 2007; Field, Hernandez-Reif & Diego, 2006; Herrera, Reissland & Shephard, 2004;) and less accurate in interpreting their baby's emotions (Broth, Goodman, Hall & Raynor, 2004). Similarly paternal depression has been associated with a less optimal father –infant relationship (Field, Hossain & Malphurs, 1999; Field, 2010; for a review, see Wilson & Durbin, 2010) with examples of less involvement with their child (Roggman, Boyce, Cook & Cook, 2002). Also, maternal depression has been shown to indirectly influence the father-infant interaction negatively (Bradley & Slade, 2011; Goodman, 2008). Comparable effects of maternal and paternal depression on parenting behaviours have been found (e.g., Cummings, Keller & Davies, 2005; Leinonen, Solantaus & Punamaki, 2003). However, few observational studies have looked at father-infant interactions in relation to paternal and maternal pre and postnatal mental health, as previous

studies have mainly relied on maternal postpartum self-report or interview measures and concern older children.

Interestingly, different types of parental psychopathology and/or adversity may give rise to different dyadic interactional patterns. For example, Cassidy, Zoccolillo and Hughes (1996) found that severity of depression amongst adolescent mothers correlated with maternal control and infant difficulty, whilst mothers with severe antisocial histories showed unresponsiveness and their infants had higher levels of passivity. There is also evidence of negative effects of anxiety on the parent-baby relationship and child outcomes (Feldman et al., 2009; Glasheen, Richardson & Fabio, 2010, for a review). Finally, studies also suggest that PTSD following childbirth may be linked to problems in the parent-baby relationship (Ballard, Stanley & Brockington, 1995; Nicholls & Ayers, 2007; Parfitt & Ayers, 2009). However, we are aware of only three observational studies of mother-baby interaction that include PTSD measures, two in the context of premature birth and very low birth weight infants (Feeley et al., 2011; Forcada-Guex, Borghini, Pierrehumbert, Ansermet & Muller-Nix, 2011) and the third focusing on mothers with a history of childhood maltreatment (Muzik et al., 2012, in press).

The timing of the onset and duration of parental mental health problems may also have differential effects on the parent-baby interaction. Flykt, Kanninen, Sinkkonen and Punamaki (2010) found, for example, that prenatal depressive symptoms had a stronger impact on unresponsiveness in the mother-baby interaction than postnatal symptoms. The infant also plays an active part in the dyadic interaction with the parent. Crittenden (1985, 1992) drew attention to the fact that although a parent may initiate poor interactive patterns or maltreatment, the baby behaves and uses coping strategies in ways that maintains those negative patterns. Therefore, it is crucial that the parent-infant interaction is as much about the behaviour of the infant as that of the parent.

1.3. The present study

Research to date has focused on the effects of maternal postnatal depression on mother-baby interactions. The present study addresses several gaps in the existing literature by also including prenatal measures of mental health, postnatal PTSD measures and fathers' mental health measures in the context of both mother-infant and father-infant interactions . A preliminary aim of the current study was to explore mean-level differences between mother-infant and father-infant interactions, as well as to assess the degree of similarity of mother and fathers within families. The main aim was to examine contributions of both mothers' and fathers' pre and postnatal mental health to mother-infant and father-infant interaction. It was predicted that high levels of pre-and/or postnatal mental health problems would be associated with less optimal parent-infant interactive patterns.

2. Method

2.1. Participants

The participants were 44 mothers and 40 fathers from 45 families and were a sub-sample from The Sussex Journey to Parenthood Study (UK), a longitudinal study of the transition to parenthood from pregnancy to the postpartum. Couples were included in the Journey to Parenthood study if they were expecting their first baby, were cohabiting, fluent in English, and over 18 years old. The majority of the participants in the sub-sample (85%) were Caucasian and 97 % had undergone higher education (diploma, undergraduate degree and beyond). At the time of recruitment, the length of the couple's relationship ranged from 12 to 308 months ($M = 74.02$ months, $SD = 49.87$) and 64 % were married. Mothers ($n = 44$) were aged between 26 and 43 years ($M = 33.12$ years, $SD = 4.79$) and fathers ($n = 40$) were aged between 26 and 44 years ($M = 34.64$, $SD = 5.22$). At the time of the observation, the infants (28 girls and 17 boys) were around three months old.

2.2. Procedure

Ethical approval was obtained from the NHS Research Ethics Committee. Parents were recruited to the Sussex Journey to Parenthood Study in late pregnancy, mainly through hospital and community antenatal clinics and antenatal classes. Expectant parents who were interested in taking part (N = 141) were given information sheets, consent forms and the first set of questionnaires (Time 1), including demographics and measures for anxiety and depression. Questionnaires were completed in pregnancy, at the time or later at home, and sent back in a prepaid envelope. Approximately three months after birth (Time 2), parents were sent a second set of self-report questionnaires (including anxiety, depression and PTSD measures) and also invited to take part in this observational study of a subsample of parents and their infants. Forty-one couples and another five mothers and one father agreed to take part, and a date for a home visit was arranged.

The videotaped interactions were recorded by researchers in participants' homes and were conducted separately with the mother and father. Written informed consent confidentiality, and the right to withdraw at any time was assured. Before beginning the videotaping, a suitable, light place was chosen, external sounds were reduced and a few age appropriate toys and a baby blanket were supplied, in preparation for the play interaction. Each parent was asked to "play with your baby as you usually would. You can use toys, or not, as you choose. Sit so you are comfortable and don't worry about the camera". The video recording commenced once the parent sat down to play and 3 – 5 minutes of the parent-infant play was recorded, with a handheld camcorder. After the interaction, participants were debriefed and were later sent a copy of the video recording. Three of the video recording were faulty and could therefore not be coded or included in the analysis. The remaining taped interactions were coded by two trained, reliable coders, as recommended by Crittenden (2004), with the coder scoring each adult and infant separately, for each of seven aspects of

the interactional behavior (see below). Each recording was viewed repeatedly, checking for

subsets of items, until the coder was satisfied that the scoring reflected the pattern of the

interaction. The main coder was blind to all other information regarding the parents and their

infants. To check reliability, 12% of video interactions were scored by the first author

(YP)The intra class correlation coefficient (ICC) showed an good to excellent agreement,

with the ICC (two-way random, absolute agreement, single measure) for parental sensitivity

= .82, parental control = .84, parental unresponsiveness = .70, child cooperation = . 86, child

difficulty = .90, child compulsivity =. 92 and child passivity =. 85.

2.3. Measures

   2.3.1. Parent-infant interactions. The quality of the mother-infant and father-infant

interactions was measured using the infant version of the CARE index procedure (Crittenden,

2004) when the babies were three months old. This procedure is based on short 3 to 5 minute

videotaped free adult-infant play interactions. It has been validated for use with families from

different social classes and cultural backgrounds (Leventhal, Jacobsen, Miller & Quintana,

2004) and shown to discriminate interactional patterns between abusive and non-abusive

mothers and their infants (Cassidy et al., 1996). For each parent-infant dyad, seven aspects

(facial expression, verbal expression, position, affection, turn-taking, control and choice of

activity) were evaluated and contributed to scores on three adult scales (sensitive, controlling

or unresponsive) and four infant scales (cooperative, difficult, compulsive and passive). The

operational definitions for these scales are specified in Crittenden's coding manual for CARE

index (2004). For each of the seven aspects two points were allocated, either both on one

scale or split between two scales, with a total of 14 points, separately for the parent and the

infant, thus making the possible range for each scale 0 - 14. Note that the higher the parental

sensitivity and infant co-operative scores, the more optimal the interaction. Also, categorical

variables were derived, with the parent-infant dyads being classified into highly sensitive

(scores 11 – 14); adequately sensitive (scores 7 – 10); ineptly sensitive (scores 5 – 6) and high-risk (scores 0 – 4). Note that the latter two categories are also classified as needing intervention, whilst the first two are classified as "good enough" (Crittenden, 2004).

 2.3.2. Mental Health. Mental health symptoms were assessed using two self-report scales.

 The Hospital Anxiety and Depression Scale, HADS (Zigmond & Snaith, 1983) was completed by parents both in late pregnancy and at three months postpartum. This scale measures mental health symptoms and consists of a total of 14 items, seven for depression and seven for anxiety, through statements of presence or absence of symptoms rated on a continuous 4-point scale, with a total range of 0 – 42 and 0 – 21 for anxiety only and the same for depression only . High scores indicate more pathological responses. This scale has been used widely in non-obstetric populations and has a well-established internal consistency, test-retest reliability and validity (Ayers, 2001). In this study, Cronbachs α for the total scale was .77 in pregnancy and .87 postpartum.

 The Posttraumatic Stress Diagnostic Scale, PDS (Foa, Cashman, Jaycox & Perry, 1997) was used to calculate a symptom severity score at three months after birth. It consists of 17 items (5 intrusion, 7 avoidance and 5 arousal items) and has previously been used in relation to childbirth (e.g., Parfitt & Ayers, 2009; Sawyer & Ayers, 2009). Items are scored on a continuous 4- point scale with a total range of 0 – 51, with higher scores indicating a greater symptom severity. It has been shown to have a high reliability of .92 (Foa et al. 1997). The full PDS scale corresponds to all DSM-IV criteria for the diagnosis of PTSD, and has shown to have an 82% agreement with structured clinical interviews. In the present study, continuous scale scores were used. The internal consistency of α for these was .87.

2.4. Statistical Analysis

All of the 84 participants who took part in the parent-infant interaction had responded to at least one of the two previous questionnaires (Time 1 in pregnancy or Time 2, three months postpartum). Overall, 64 of those (76%) responded at both stages, with 72 participants completing the Time 1 questionnaire (86%) and 70 (83%) the Time 2 questionnaire. When participants with complete and non-complete data were compared (using χ^2 and Mann-Whitney), no significant differences were found regarding ethnicity, marital status, gender, education or mental health. Missing data was replaced using the EM method for the following reasons. First, it is consistent with the way previous studies have dealt with missing data of multiple assessment points (e.g. Flykt et al, 2010; Conners, Grant, Crone & Whiteside-Mansell, 2006). Additionally, Little's MCAR test was not significant ($\chi^2 = 44.15$, p = ns), which indicates that the data was missing completely at random and therefore suitable for imputation. Imputation of parental mental health data was therefore performed in order to retain maximal information. The data screening for normality variables revealed that a few of the mental health variables were significantly skewed according to Kolmogorov-Smirnov (K-S) test. Therefore associations were examined using Spearman's (*rho*) rank order correlation test. Paired-samples *T*-tests were then carried out to compare mean differences between the mother-infant and father-infant interactional scores. Hierarchical multiple regression analyses were finally used to examine the impact of pre and postnatal parental mental health variables on the mother-infant and father-infant interaction. The residuals met the necessary assumptions for multiple regressions regarding homoscedasticity and multicollinearity and the errors were independent and normally distributed.

3. Results

3.1. Mother- infant and father-infant interactions

Table 1 shows the means and standard deviations of mother-infant and father-infant interaction scores. Table 2, shows that out of the 44 mothers, 9 (20.5%) were categorised as being "sensitive" to their baby, 20 (45.5%) as "adequate", 11 (25%) as "inept" and 4 (9.1%) "at risk". Amongst the 40 fathers, 7 (17.5%) fell within the "sensitive" category, whilst 25 (62.5%) were within the "adequate", 6 (15.0%) the "inept" and 2 (5.0%) the "at risk" categories. There was no significant average difference between men and women in relation to these categories. In accordance with the aims of the study, mothers and fathers interactive patterns with their infants were compared as shown in Table 1, using paired-samples *T*-tests. No significant overall differences between mothers' and fathers' interactive patterns with their infants were found. Table 1 also reports the mean scores for the other (predictor) variables included in the study. This shows that mothers reported higher levels of depression in pregnancy and postnatal PTSD than did fathers. In order to assess the similarity of mothers and fathers within families, correlations' were computed (Table 1). Maternal interaction scores were positively correlated with the equivalent paternal interaction scores, showing large effect sizes for parental control and infant compulsivity, medium effect sizes for parental sensitivity and infant cooperation, and small non-significant effect sizes for parental unresponsiveness, infant difficulty and infant passivity. Additionally, Table 1 shows that mothers and fathers are not similar in terms of any of the mental health measures.

3.2. Univariate mental health predictors of parent-infant interactions

The main aim of the study was to explore effects of parental mental health variables on parent-infant interaction. Correlation analyses were conducted to estimate these associations (see Table 2). For mothers, prenatal anxiety was the only mental health variable that was significantly correlated with any of the mother–infant interaction codes. Prenatal anxiety showed a significant medium sized correlation with high maternal control and a medium sized significant correlation with low maternal unresponsiveness and infant

passivity. Table 2 further shows that for fathers, the significant correlations were in the opposite direction to the mothers, with high prenatal anxiety being moderately associated with low paternal control and high paternal unresponsiveness. Also, prenatal depression in fathers was moderately associated with significantly lower control whilst high levels of paternal PTSD and postnatal depression showed a significant positive correlation with high levels of infant difficulty and negative correlations with infant passivity.

3.3. Multivariate mental health predictors of parent-infant interactions

To further examine the prediction of the impact of mental health on mother-infant and father-infant interaction, hierarchical multiple regression analyses were conducted. To reduce the number of mental health predictors, due to the small sample size, the total score of the Hospital Anxiety and Depression Scale was used to represent prenatal and postnatal "affective symptoms", rather than separate anxiety and depressive measures.

Maternal and paternal prenatal mental health symptoms were entered at Step 1, followed by maternal and paternal postnatal mental health symptoms at Step 2. None of the regression models explained a significant amount of the variance for any of the mother-baby interaction outcome variables.

In contrast, models explained a significant amount of variance for four of the father-infant interaction outcome variables (Table 3). The model for *paternal controlling interaction* was significant, with the predictors accounting for 37% of the variance of the paternal controlling interaction score $F (6, 33) = 3.29$, $p=.01$, with a unique individual contribution of paternal prenatal affective symptoms ($\beta = -.66$, $t = -3.89$, $p =.001$) and maternal postnatal affective symptoms ($\beta = -.45$, $t = -2.20$, $p = .04$). Also, the overall model for *paternal unresponsive interaction* was significant $F (6, 33) = 2.70$, $p = .03$, with 33 % of the variance being accounted for by the predictors. The β-weights for prenatal affective symptoms in the fathers ($\beta = .54$, $t = 3.06$, $p = .004$) and postnatal affective symptoms in the mothers ($\beta = .52$,

$t = 2.47$, $p = .019$) were significant, with high levels of affective symptoms predicting high levels of unresponsiveness in the father-infant interaction. Additionally, 36% of the variance was accounted for by the model for *infant difficulty* when playing with the father, $F (6, 33) = 3.15$, $p = .01$. Individual significant predictors were paternal prenatal affective symptoms ($\beta = -.38$, $t = -2.24$, $p = .03$) and paternal postnatal affective symptoms ($\beta = .61$, $t = 2.43$, $p =. 02$). High levels of prenatal affective symptoms predicted low infant difficulty and high levels postnatal affective symptoms in the father predicted high infant difficulty. However, *infant passivity* showed the opposite pattern, with high levels of paternal prenatal affective symptoms contributing to high infant passivity ($\beta = .49$ $t = 2.70$, $p =. 01$) whilst high levels of paternal postnatal affective symptoms were associated with low infant passivity scores   ($\beta = -.42$, $t = -1.61$, $p =.$ ns). The overall model explained 30% of the variance of infant passivity when playing with the father.

4. Discussion

Results of the present study showed no mean-level differences regarding the patterns of dyadic interactions between the mother-infant and father-infant dyads. Additionally similarity between the interactive patterns of mothers and fathers in the same family was found, with especially high associations between maternal and paternal controlling patterns and their infants'compulsiveness. The latter finding is in line with Barnett et al.'s (2008) study, which found an interdependence of interactive patterns, especially negative ones, between mothers and fathers. The finding that a relatively high proportion of both mother-infant (34%) and father-infant (20%) interactions were classified as being "inept" or "at risk" and therefore in need of intervention (Crittenden, 2004) with 10 % of families presenting with impairment in both parents' interactions with their baby is of concern, especially as the current study was based on a relatively "low risk" community sample. Similarly, Flykt et al. (2010) also found high rates (42.3%) in a Finnish community sample of mother-infant dyads

being within these intervention categories and even higher rates were found (67%) within a

high psychosocial risk sample (Sidor, Kunz, Schweyer, Eickhorst & Cierpka, 2011).

4.1. Parental mental health and parent-infant interactions

The main aim of the present observational study was to examine the impact of

parental mental health on the parent-infant interaction. Contrary to previous research (e.g.,

Beck, 1995; Cassidy et al., 1996; Murray et al., 1996), no associations were found between

symptoms of pre or postnatal depression and any of the maternal sensitivity or child

interaction variables. However, a few recent studies (e.g. Flykt et al., 2010;; Sidor et

al.,2011) have similarly failed to find such associations. These studies suggested that factors

such as chronicity and severity of depression and the additive effect of other risk factors (e.g.

maternal attachment patterns and antisocial history) may moderate such associations. These

results may therefore be partly explained by the current study consisting of a low risk sample

with few parents presenting with high levels of depression and other risk factors, whereas

other studies have used disadvantaged, high scoring samples (e.g., see Lovjoy et al., 2000).

Also, Sidor et al. (2011) reasoned that their lack of significant associations between maternal

postnatal depression and mother-infant interaction may have been attributed to the difference

in measuring methods (self-report and observation). This may thus also be relevant to the

current study.

However, the findings that high levels of maternal prenatal anxiety were associated

with less optimal mother-infant interaction are in line with previous studies regarding

postnatal anxiety (e.g., Feldman et al., 2009). It has been suggested that poor maternal

prenatal mental health may have twofold effect on the mother-infant interaction; through

biological, hormonal negative effects on the baby's regulatory systems and development (e.g.

Evans et al., 2011; Correia & Linhares, 2007; Glover, 2011; Kinsella & Monk, 2009) and/or

through less psychological preparation for motherhood, e.g. lack of prenatal bonding and/or

unwanted pregnancy (Brockington, Aucamp & Fraser, 2006; Siddiqui & Hagglof, 2000). This highlights the importance of also including prenatal measures of anxiety when looking for risk factors to the parent-infant relationship.

Interestingly, the results indicated that paternal prenatal affective symptoms were associated with higher maternal sensitivity and infant-mother cooperation   Speculations about the reasons for this surprising finding may include potential compensation by mothers, where they develop a heightened sensitivity to their baby when their partners are suffering from prenatal mental health problems. A similar compensation was observed by Edhborg, Lundh, Seimyr & Widstrom (2003), where fathers of partners reporting high levels of early depressive symptoms displayed a more optimal relationship with their babies when observed later postpartum. Alternatively, paternal prenatal depression may be a consequence of the expectant father feeling neglected by the expectant mother's possible pre-occupation and prenatal bonding with the unborn baby. Future studies may thus also benefit from including prenatal bonding measures in both parents.

Additionally, the results of the current study point to the importance of paternal affective symptoms for the father-infant interaction. Again, prenatal mental health seemed to play a significant role in the quality of the interaction. Prenatal affective symptoms (depression and anxiety) in the father predicted, for example, lower paternal control and infant difficulty but higher paternal unresponsiveness and baby passivity. This interactive pattern suggests that the father–infant interaction is more likely to be based on under-stimulation than over-stimulation by fathers with prenatal mental health problems, with lower intrusiveness but higher disengagement, a similar finding to that reported by Wilson & Durbin (2010). Disengaged and remote father-infant interactions have also been linked to early behavioural problems in children (Ramchandani et al., 2012). Flykt et al. (2010) also

observed a comparable interactive pattern amongst expectant mothers, with high levels of prenatal depressive symptoms predicting lower levels of maternal control.

An opposing pattern emerged for paternal postnatal measures of PTSD and depression. These were both correlated with higher levels of infant difficulty, and lower levels of infant passivity. In the regression analysis, paternal postnatal affective symptoms in the father also significantly contributed to the variance of infant difficulty. This corresponds to other findings in mothers where postnatal depression and anxiety have been linked to high levels of infant difficulty (Cassidy et al., 1996; Field, Healy, Goldstein & Gutherz, 1990) or difficult infant temperament (e.g., Britton, 2011). Alternatively, high level of infant difficulty may perturb the postpartum mental health itself. However, the direction of causality is not possible to establish here, i.e. whether the father's mental health affects the infant's behaviour negatively or vice versa. Additionally/Finally, maternal postnatal affective symptoms predicted higher levels of unresponsiveness in the father's interaction with their baby. A comparable deleterious effect rather than buffering effect was also found by Goodman (2008). Overall, the present findings suggest that father-infant interactions suffer and are more sensitive to negative mood in the mother, whilst mothers compensate to improve their interaction with their babies in the context of paternal mental health problems.

4.2. Methodological issues and future directions

This study benefitted from including both paternal and maternal measures of observed interactions and mental health. Specific advantages with the CARE-Index measure were that it includes both over-responsiveness (control) and under-responsiveness in the assessment of parental sensitivity and also considers the infants' interactive patterns, not just the parents'. The infant's interactive pattern may also be less influenced by demand characteristics of the assessment. Another novel aspect of this study was the inclusion of PTSD and anxiety in the mental health measures, not just depression. The sample was also relatively large for a video-

based study of parent-infant interaction (e.g. Beck, 1995). However, the sample size is limited statistically, resulting in a lack of power and consequently more likelihood of Type II errors. The sample also mainly consisted of white European, well-educated, two-parent families, with low depression and anxiety scores, which limits the generalizability of the results. Future studies should examine whether the results are applicable to other socio demographic groups.

Finally, a pertinent methodological issue is when the optimal time to measure parent-infant interactions is. Although this study found some significant associations between parental mental health and parent-infant interactions, more associations may show up later, as three months postpartum is still early and many parents experience transient mental health or interactional problems as part of a normal transition to parenthood. However, Kemppinen et al. (2006) found a continuity of maternal sensitivity from early to late postpartum and early maternal postpartum depression has been linked to negative maternal interactional behaviours more than a year later (Edhborg, Lundh, Seimyr, Widstrom, 2001). This indicates that early measures of mental health are potentially important for later interactive behaviours, although it is possible that further links may become apparent over time. Future prospective longitudinal observational studies are needed to further clarify links between parental mental health and interactions between the parents and their infants over time.

4.3. Conclusions and implications

The finding that a high proportion of the parent-infant dyads presented with high rates of inept or at risk interactions may imply that people are not necessarily natural parents. A clinical implication from this is that observations of the parent-infant interaction should be part of routine screening for early detection of parent-infant relationship problems in all families, not just in high risk samples. Furthermore, preventive interventions designed for parents to learn to interact well with their infants should be provided, to prevent long term

negative child outcomes. The significant and differential impact of paternal pre and postnatal mental health on the father-infant and mother-infant interaction highlights the distinct role of fathers in the family and the importance of including both parents in screening and interventions regarding mental health and relationship problems, and also that mental health risk factors should be identified in pregnancy.

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Table 1. *Means (SD), T- test comparisons and correlations of parent-infant interaction and mental health variables*

	Mothers Mean (SD)	Mothers Range of Scores	Fathers Mean (SD)	Fathers Range of Scores	*t*-values (Mothers vs. Fathers)	Effect size for *t*-differences r	Correlations between Mothers and Fathers [a]
Parental Sensitivity	8.23 (2.79)	2 – 14	8.23 (2.26)	2 – 12	0.00	.00	.38**
Parental Control	3.26 (3.64)	0 - 12	2.77 (2.86)	0 – 12	1.04	.17	.62**
Parental Unresponsiveness	2.51 (2.97)	0 – 9	3.00 (2.32)	0 – 7	-0.91	.15	.20
Infant Cooperation	7.87 (2.72)	2 – 13	7.92(2.71)	2 – 12	-0.11	.02	.38**
Infant Difficulty	2.79 (2.60)	0 – 10	2.92 (2.64)	0 – 9	- 0.26	.04	.25
Infant Compulsiveness	1.18 (2.77)	0 – 12	0.90 (2.92)	0 – 12	1.09	.16	.68**
Infant Passivity	1.92 (2.64)	0 – 9	2.26 (2.41)	0 – 8	-0.62	.10	**.**17
Anxiety pregnancy	6.36 (4.72)	1 – 11	6.41 (3.41)	0 - 15	-0.08	.12	-.01
Depression pregnancy	5.01 (2.85)	0 - 11	3.48 (2.15)	0 - 11	2.82**	.39	-.03
Anxiety postpartum	5.42 (3.55)	0 – 14	4.47 (3.29)	0 – 13	1.24	.18	-.11
Depression postpartum	4.17 (2.38)	0 - 9	3.40 (3.63)	0 - 13	1.24	.18	.21
PTSD postpartum	4.81 (4.73)	0 - 21	2.71 (2.69)	0 - 10	2.67**	.37	.18

Note: r = .10 (small effect), *r* = .3 (medium effect), *r* = .5 (large effect). [a] **p* <.05, ***p*<.01, Spearman's (*rho)* one tailed test.

Table 2. *Correlations between parental mental health and parent-infant interaction variables*

	Mother-Infant Interaction							Father-Infant Interaction						
	Mother			Infant				Father			Infant			
Maternal Mental Health	Sensitivity	Control	Unresponsive	Cooperation	Difficulty	Compulsive	Passivity	Sensitive	Control	Unresponsive	Cooperation	Difficulty	Compulsive	Passivity
Prenatal anxiety	.06	.35*	-.49**	-.02	.22	.14	-41**	-.14	.25	-.06	-.09	.14	.14	-.28*
Prenatal depression	.07	.06	-.08	.05	-.02	.05	.07	.13	.10	-.23	.13	.19	-.11	-.18
Postnatal anxiety	.01	.12	-.14	-.02	.19	-.14	.06	.11	-.11	.03	.19	-.02	-.06	-.25
Postnatal depression	-.07	-.06	.07	-.07	.07	-.07	.07	-.12	-.09	.16	-.02	-.09	.10	-.09
Postnatal PTSD	-.08	.17	-.16	-.08	.19	-.01	-.08	.01	.15	-.23	.03	.14	-.13	-.12
Prenatal affective symptoms	.07	.21	-.29*	.01	.11	.10	-.15	.03	.12	-.17	.05	.19	-.01	-.28*
Postnatal affective symptoms	-.01	.04	-.06	-.02	.19	-.17	.06	.04	-.10	.09	.14	.04	-.02	-.19
Paternal Mental Health														
Prenatal anxiety	.22	-.19	.02	.21	-.20	-.18	.14	-.03	-.36*	.44*	.05	.15	-.36**	.21
Prenatal depression	.30*	-.14	-.06	.26*	.05	-.11	-.10	.24	-48**	.23	.23	-.11	-.13	.14
Postnatal anxiety	.14	-.12	-.08	.16	-.20	-.18	.13	-.07	-.01	.12	-.04	.14	-.13	-.12
Postnatal depression	-.02	.16	-.18	-.04	.02	.05	.02	-.06	-.10	-.06	-.05	.40**	-.06	-.26*
Postnatal PTSD	-.10	.05	.01	-.09	-.01	.01	.07	.02	.01	-.09	-.06	.35*	-.02	-.24
Prenatal affective symptoms	.33*	-.22	-.02	.31*	-.14	-.19	.05	.04	-.46**	.48**	.09	-.03	-.30*	.27*
Postnatal affective symptoms	.15	-.05	-.12	.15	-.14	-.12	.09	-.05	.03	.05	-.02	.33*	-.13	-.22

Note: *p <.05, **p<.01, Spearman's (rho), one-tailed

Table 3. *Hierarchical regression models (significant) of parental mental health symptoms on father-infant interaction variables*

	Father- Infant Interaction															
	Paternal control				Paternal unresponsiveness				Infant difficulty				Infant passivity			
Predictor	B	$SE\ B$	β	$R^2\Delta$	B	$SE\ B$	β	$R^2\Delta$	B	$SE\ B$	β	$R^2\Delta$	B	$SE\ B$	β	$R^2\Delta$
Step 1				.16*				.13				.02				.10
Prenatal affective symptoms (mother)	0.15	0.11	.25		-0.13	0.09	-.28		-0.01	0.10	-.01		-0.08	0.10	-.16	
Prenatal affective symptoms (father)	-0.38	0.10	-.66***		0.25	0.08	.54**		-0.20	0.09	-.38*		0.24	0.09	.49**	
Step 2				.22*				.20				.35				.20
Postnatal affective symptoms (mother)	-0.23	0.10	-.45*		0.22	0.09	.52*		-0.10	0.10	-.20		0.01	0.09	.01	
Postnatal affective symptoms (father)	0.17	0.11	.40		-0.09	0.09	-.25		0.24	0.10	.61**		-0.15	0.10	-.42	
Postnatal PTSD (mother)	0.09	0.11	.16		-0.14	0.09	-.31		0.19	0.10	.36		-0.05	0.10	-.11	
Postnatal PTSD (father)	0.04	0.24	.04		-0.06	0.20	-.07		0.10	0.22	.11		-0.14	0.21	-.15	
Total R^2				.38**				.33*				.37**				.30*
F				3.29				2.70				3.15				2.33

Note. *$p < .05$. **$p < .01$. ***$p < .001$. β- values are from the final 2nd step of the regression models. Further tables for non-significant regression models are available from the authors on request.