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Associations between prenatal maternal mental health indices and mother-infant relationship quality six to 18 months postpartum: A systematic review

Running head: **Prenatal personality and mother-infant relations**

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ABSTRACT

Maternal mental disorders can significantly impact on children's psychosocial and psychological development incurring substantial ongoing economic and personal costs. A key mediating mechanism is mother-infant relationship quality (MIRQ). Research studies and perinatal mental health screening initiatives predominantly focus on depressive symptoms and perinatal depression as predictors of MIRQ. While maternal depression is associated with suboptimal MIRQ, the findings are not consistent. Personality characteristics are associated with parenting and proneness to depression, presenting a potential addition to prenatal mental health assessment. We conducted a systematic review of studies that examined the link between prenatal depressive symptoms and/or personality characteristics with postnatal MIRQ. Our findings suggest that both maternal personality traits and depressive symptoms measured in early pregnancy are associated with postnatal MIRQ. A measure of personality characteristics may enhance prenatal mental health assessment affording opportunities for targeted intervention commencing in pregnancy, to improve MIRQ, parenting, maternal mental health outcomes, and infant psychosocial and psychological development, thereby contributing to reduction of human and economic cost burdens.

Keywords: prenatal; personality; mother-infant-relationship; child mental health

Introduction

Mental disorders over the perinatal period, from the time of conception until one year postpartum, may have an adverse impact on a mother's general health, family relationships and the physical, cognitive, social, behavioural and emotional development of children (Howard, Piot, & Stein, 2014; Lefkovics, Baji, & Rigo, 2014; Prince et al., 2007). Perinatal mental health problems are prevalent (estimates of 20%) and are associated with significant ongoing cost burdens for child health, education and social services (Bauer, Parsonage, Knapp, Lemmi, & Adelaja, 2014; Bauer et al., 2015). There is an imperative for perinatal mental health screening because apart from the abovementioned ongoing cost burdens, when left undetected and untreated, perinatal mental disorders can have catastrophic adverse outcomes such as maternal suicide, child abuse, neglect and infanticide (Brockington, Butterworth, & Glangeaud-Freudenthal, 2017; Kendig et al., 2017).

Mother-infant relationship quality (MIRQ), is suggested to be a fundamental link between perinatal mental health problems and adverse child outcomes (Alink et al., 2009; Howard & Challacombe, 2018; Moss et al., 2011; Provenzi, Scotto di Minico, Giusti, Guida, & Müller, 2018; Raby, Roisman, Fraley, & Simpson, 2015; Stein et al., 2014) with maternal sensitivity identified as a key feature. Maternal sensitivity comprises a range of parenting capacities, including her psychological availability, attunement and communication with her baby (Beebe & Steele, 2013; Bretherton, 2013; Murray, Halligan, & Cooper, 2010; Raby et al., 2015). The influence of maternal sensitivity shapes how infants strategically organise relationships with their primary attachment (parental) figures, and subsequently, their own offspring (Bakermans-Kranenburg, van Ijzendoorn, & Juffer, 2003; Cabral, 1995; Crittenden, 1999; Crittenden, 2016).

Depressive symptoms are common across the perinatal period and the early parenting years (Ashman, Dawson, & Panagiotides, 2008; McCue Horwitz, Briggs-Gowan, Storfer-Isser, & Carter, 2007; Woolhouse, Gartland, Mensah, & Brown, 2015). Routine perinatal mental health screening

commonly focuses on self-report measures of depressive symptoms (Long, Cramer, Jenkins, Bennington, & Paulson, 2018; Matthey & Agostini, 2017; O'Hara & McCabe, 2013; Paulden, Palmer, Hewitt, & Gilbody, 2009; Thombs et al., 2015). When persistent and severe, perinatal depressive symptoms are more likely to raise the risk of adverse child outcomes such as early childhood behaviour problems, lower secondary education certificate school leaving grades and late adolescent depression (Netsi et al., 2018). Early identification of both mothers and infants who are at an increased risk of adverse outcomes as a result of perinatal mental disorders may enhance opportunities for early treatment and prevention (Stein et al., 2012) thereby averting emerging problems and reducing both demand and cost for subsequent mental health service provision.

Suboptimal outcomes have been observed in the offspring of women with perinatal depression (Campbell et al., 2004; Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001; Howard & Challacombe, 2018; Kingston et al., 2018; Luoma et al., 2001; Martins & Gaffan, 2000; Murray & Cooper, 1996; Murray et al., 2010). An assumption is that the link between maternal depression and child outcomes is mediated through disturbances in MIRQ. Identification of perinatal depressive symptoms by means of screening has been advocated with a view to treating maternal depression and other mental disorders which is hoped to optimise infant outcomes. However, despite implementation of perinatal depression screening initiatives, the rate of identification of perinatal depression is reportedly low (Bauer et al., 2014; Cox, Sowa, Meltzer-Brody, & Gaynes, 2016; Loudon, Nentin, & Silverman, 2016; NICE, 2014; Paulden et al., 2009) and the impact for infants is unknown. Moreover, improved MIRQ and reduction in risk for psychological and developmental disturbances in children is not a direct consequence of effective treatment of maternal depression (Forman et al., 2007; Poobalan et al., 2007). Initiatives underway aim to identify and treat perinatal mental disorders and aspire to improve both maternal and infant mental health. Nevertheless, services typically focus on addressing maternal mental

disorders rather than parenting and MIRQ which are key mediators of adverse child outcomes including cognitive, behavioural and emotional problems and insecure attachment (Catalao, Howard, Jones, & McDonald, 2014; Howard & Challacombe, 2018; NICE, 2014). Other factors, especially maternal personality characteristics, may be a more potent contributor to disturbances of MIRQ.

Maternal attachment strategy and personality characteristics, mental health and contextual factors (such as home environment) are recognised as influential for child attachment and developmental outcomes (Crittenden, 2016; DeWolff & van Ijzendoorn, 1997; Rutter, 1985; Rutter & Quinton, 1984; Rutter, Quinton, & Liddle, 1983). There are clear associations between personality characteristics and parenting style (Belsky & Barends, 2012; McCabe, 2014; Prinzie, Stams, Dekovic, Reijntjes, & Belsky, 2009). A review of adult personality and attachment disorders describes similar interpersonal developmental origins and pathways from infancy; and defines features of insecure adult attachment as resembling the signs and symptoms of personality disorder (Lorenzini & Fonagy, 2013).

Maternal personality disturbance is related to risk for perinatal depression, suboptimal MIRQ and impaired parenting style (Apter, Devouche, Gratier, Valente, & Le Nestour, 2012; Laulik, Chou, Browne, & Allam, 2013; Smith-Nielsen et al., 2015; Smith-Nielsen et al., 2016). Maternal depression and personality disorder have been shown to be independently associated with maternal sensitivity, whereas maternal depression alone was shown to impact on the home environment yet not maternal sensitivity (Conroy, Marks, Schacht, Davies, & Moran, 2010). Both postpartum depression and personality disorder have been shown to be associated with dysregulated infant behaviour at 18 months, yet the detrimental effects on infant development were found only when the mother had both conditions (Conroy et al., 2012). Maternal personality characteristics, attachment strategy, transient or chronic depression or other maternal mental

illness will influence individual differences in the neurobiology of mother-infant interaction quality, thus parenting style (Kim, Strathearn, & Swain, 2016; Prinzie et al., 2009; Swain et al., 2014; Swain, Lorberbaum, Kose, & Strathearn, 2007).

Personality is associated with parenting style and is a more stable construct than depressive symptoms. We therefore hypothesise that maternal personality characteristics measured in early pregnancy may serve as a reliable indicator of subsequent MIRQ and complement measures of depression in screening for risk.

This systematic review aims to examine association between prenatal maternal personality characteristics with postnatal MIRQ; and prenatal depressive symptoms with postnatal MIRQ.

Research questions

The review addresses two questions and thus a twofold search strategy:

Research question 1: Are maternal personality characteristics measured in early pregnancy associated with the quality of the subsequent mother-infant relationship?

Research question 2: Are high levels of depressive symptoms measured in early pregnancy associated with the quality of the subsequent mother-infant relationship?

Methods

Inclusion and exclusion criteria and definitions

Studies were included in this review if: (a) exposure was any form of maternal depression, depressive symptoms or personality characteristics occurring during the first two trimesters of pregnancy (< 27 weeks gestation); (b) outcome was a measure of mother-infant relationship quality (MIRQ) that was assessed between six to eighteen months postnatally (infant age 6 to 18

months); (c) study published in English; (d) study was peer reviewed; and (e) publication was a primary study that was published between January 1996 and February 2018.

Studies were excluded from this review if: (a) maternal depression or personality was part of a composite variable that extended beyond 27 weeks gestation; (b) publication was from a government agency, a book chapter, dissertation, working paper or other grey literature; and (c) randomised controlled trials (RCT), on the basis that potential useful data may be biased due to control group participants not being randomised to receive the intervention. The outcome MIRQ was defined as standardised observational assessment of mother-infant interaction, maternal sensitivity or infant attachment.

Search strategy, title and abstract review, critical appraisal, data extraction and analysis

The review was conducted systematically using two distinct search strategies in accordance with the PRISMA statement (Moher, Liberati, Tetzlaff, Altman, & Grp, 2009). The protocol is registered with the International Prospective Register of Systematic Reviews (PROSPERO) database (registration number **CRD42016047925**).

We executed our search strategies for both personality and depression as two separate processes within six electronic databases (MEDLINE, EMBASE, PsychINFO, Cochrane Library, Maternity and Infant Care via OvidSP and Web of Science). Key words and Medical Subject Headings (MeSH) for the primary concepts, *pregnancy*, *mother-infant interaction*, *depression* and *personality traits*, were developed in consultation with an experienced university-based librarian. Reference lists were reviewed. The search encompassed the period 1 January 1996 to 28 February 2018. The detailed search strategy is available from the authors.

The titles and/or abstracts of each article were reviewed independently (by authors KHR and SN) based on inclusion and exclusion criteria. Disagreements related to inclusion or exclusion were resolved by discussion and consensus. Full text copies of the eligible studies were obtained and independently screened by two authors (KHR and SN); and reference lists were hand searched. To establish eligibility, where required, further study details were requested from corresponding authors. The PRISMA flow diagram of the screening and selection process is outlined (Figure 1). Data were extracted using a standardised data extraction form that was developed for this review. Studies were also reviewed for the potential to conduct a meta-analysis.

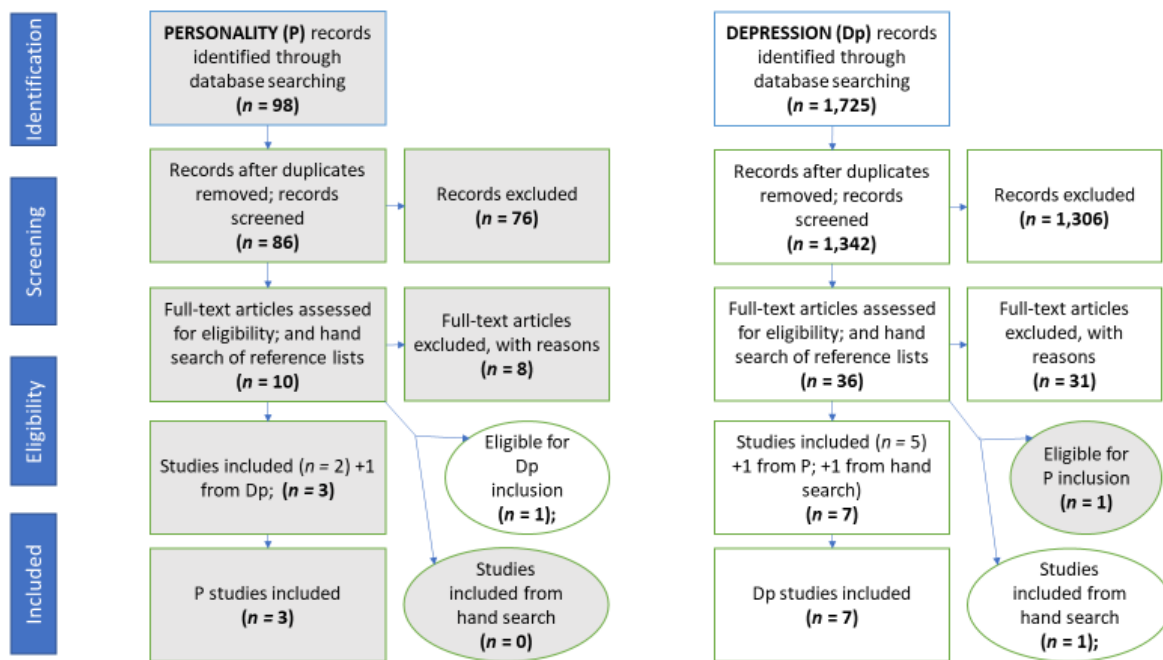
The quality of each article was evaluated with the Newcastle Ottawa Scale (NOS). The NOS was developed for assessing the quality of non-randomised studies (Wells GA et al., 2009). A star system ranging between 0 and 9 stars is used rate across three domains: selection (0 – 4 stars), comparability (0 – 2 stars) and outcome (0 – 3 stars). Each article was independently rated using the 9-point NOS. To aid comparability between results of different studies, one star was awarded for studies that adjusted for maternal age, parity, maternal education, and marital status; studies received an extra star if they adjusted for additional variables such as related to infant development, breastfeeding or other relevant maternal variables for example antidepressant medication. Based on independent agreement between two authors (KHR, SN) using the 9-point NOS, overall quality of each study was rated as low (0 – 3), medium (4 – 6) or high (7 – 9).

Results

The search strategy for both personality and depression as separate processes, identified a total of 1,823 studies. After duplicates were removed, titles and abstracts of 1,428 studies were screened based on predetermined eligibility criteria. A more rigorous independent assessment of 46 full-text articles was undertaken by two authors (KHR, SN) to determine inclusion suitability. One additional paper was found through reviewing the reference lists of the 46 full texts.

Accounting for studies that reached inclusion criteria for both the personality and depression searches, a total of eight unique studies were eligible for inclusion, and of these there were studies that measured prenatal exposure to: personality only $n=1$; depression only $n=4$; and, personality and depression $n=3$. The article selection process is presented in Figure 1 which shows a modified version of a PRISMA flow diagram to reflect a systematic review comprising two separate searches and a hand search.

Figure 1. Modified PRISMA systematic review flow diagram for screening and selection of identified studies



Study characteristics

The eight unique publications recruited participants from a variety of developed countries (Canada, Netherlands, Norway, United Kingdom and United States) and included 2,659 mother-infant dyads. Seven of the eight unique studies were published in the last decade. The eight included studies measured maternal depression (depressive symptoms) and/or personality

characteristics < 27 weeks gestation and assessed mother-infant relationship quality (MIRQ) between six to eighteen months postnatally (infant age 6 to 18 months). One of the studies from the depression search also measured a personality characteristic in early pregnancy. Three of the eight included studies measured both prenatal maternal depression (depressive symptoms or dysthymia) and personality characteristics. The included studies were all non-randomised and varied regarding rationale for measuring exposure and outcome variables of interest to this review. Presentation of results varied including reports of correlations, regressions and ratios. Mean effect size of association between exposure and outcome variables of interest to this review was not consistently reported; and given the low number of studies meeting inclusion criteria it was not feasible to proceed with quality synthesis or meta-analysis. Study characteristics including exposure and outcome measures, quality rating and publication name are shown in Table 1.

Table 1. Study characteristics: participants, exposure and outcome measures

Citation, Country	N =	Maternal age (years)	Gestational age (weeks)	PRENATAL EXPOSURE measures: Maternal Personality/Depression	POSTNATAL OUTCOME measures: Mother-infant relationship quality
Espinosa et al., 2001 United states	35	27.69 (mean)	32 – 36 (weeks)	Millon Clinical Multiaxial Inventory I (MCMI-I); dysthymia and paranoia subscales.	Maternal sensitivity (adapted from Ainsworth standardised rating scales) at 6 months. Feeding interaction (videotaped) Infant attachment at 18 months.
Goodman et al., 2017 United states	76	30.3 (mean)	Not reported	Beck Depression Inventory-II (BDI-II); State Trait Anxiety Inventory (STAI; personality characteristic).	Maternal sensitivity at 12 months. Feeding and play (videotaped) Global sensitivity summary scores were computed separately for feeding and play.
Haabrekke et al., 2015 Norway	70	20-44 (years)	Not reported	Millon Clinical Multiaxial Inventory III (MCMI-III); analyses focusing on antisocial and borderline subscales.	Parent-Child Early Relational Assessment (PCERA) at 12 months. Semi-structured play situation administered (videotaped) Coded for “maternal intrusiveness and lack of sensitivity” subscales.
Hayes et al., 2013 United states	79	30.3 (mean)	Not reported.	Beck Depression Inventory-II (BDI-II).	Infant attachment (Ainsworth SSP) 12 months.
Pearson et al., 2012 United Kingdom	964	29.0 (mean)	40 (mean)	Edinburgh Postnatal Depression Scale (EPDS).	‘Maternal responses’ derived from the Thorpe Interaction Measure (TIM) 12 months. Sensitivity of mother’s non-verbal behaviour during standardised activity (videotaped).
Raine et al., 2016 United Kingdom	706	29.3 (mean)	39.5 (mean)	EPDS and Interpersonal Sensitivity Measure (IPSM).	Thorpe Interaction Measure (TIM) 12 months. Mother-infant interaction during standardised activity. Global responsivity score (videotaped).
Tharner et al., 2012 Netherlands	586	32.0 (mean)	40.0 (mean)	Brief Symptom Inventory (BSI); depression subscale.	Infant attachment (Ainsworth SSP) 14 months.
Thomas et al., 2017 Canada	254	32.5 (mean)	39.5 (mean)	EPDS.	Maternal sensitivity 6 months. Parent Child Interaction Teaching Scale (PCITS); standardised observation measure. Maternal sensitivity derived from the total of 4 subscales assessing maternal behaviours.

Assessment of bias

Based on independent agreement between two authors (KHR, SN) using the 9-point Newcastle Ottawa Scale (NOS), overall quality of each study was rated as low (0 – 3), medium (4 – 6) or high (7 – 9) and is outlined in Table 2. Independent assessment of the quality of each study produced a high degree of inter-rater reliability (intra-class correlation coefficient =0.84).

Table 2. Quality assessment of the included studies for selection, comparability and outcome by rater, total score and quality rating.

Author	Rater	Selection (0 – 4)	Comparability (0 – 2)	Outcome (0 – 3)	Total (0 – 9)	Quality Rating
Espinosa et al., 2001	KHR	2	1	3	6	MEDIUM
	SN	2	1	3	6	(4 – 6)
Goodman et al., 2017	KHR	4	1	3	8	HIGH
	SN	4	2	3	9	(7 – 9)
Haabrekke et al., 2015	KHR	3	1	3	7	HIGH
	SN	3	1	3	7	(7 – 9)
Hayes et al., 2013	KHR	4	2	3	9	HIGH
	SN	3	2	3	8	(7 – 9)
Pearson et al., 2012	KHR	4	2	3	9	HIGH
	SN	4	2	3	9	(7 – 9)
Raine et al., 2016	KHR	4	2	3	9	HIGH
	SN	4	1	3	8	(7 – 9)
Tharner et al., 2012	KHR	4	2	3	9	HIGH
	SN	4	2	3	9	(7 – 9)
Thomas et al., 2017	KHR	4	2	3	9	HIGH
	SN	4	2	3	9	(7 – 9)

Depressive symptom measures

Seven studies measured depressive symptoms based on self-report instruments. Another study measured depression through clinical interview during early pregnancy, however, did not report the prenatal depression data in association with postnatal MIRQ. Depressive symptoms were variously measured using the Edinburgh Postnatal Depression Scale (EPDS; $n=3$, 37.5%), the Beck Depression Inventory (BDI; $n=2$, 37.5%), the dysthymia subscale from the Millon Clinical Multiaxial Inventory (MCMI; $n=1$, 12.5%) and the depression subscale from the Brief Symptom Inventory (BSI; $n=1$, 12.5%).

Measures of personality characteristics

Four studies measured personality characteristics with self-report instruments including: the paranoia, antisocial and borderline personality subscales from the Millon Clinical Multiaxial Inventory (MCMI; $n=2$); the Interpersonal Sensitivity Measure (IPSM; $n=1$); and trait anxiety as a personality characteristic with the State Trait Anxiety Inventory (STAI; $n=1$).

Measures of mother-infant relationship quality (MIRQ)

All included studies measured MIRQ based on standardised observational assessment. Measures included mother-infant interaction, maternal sensitivity or infant attachment using the Strange Situation Procedure (SSP). Maternal sensitivity (responsiveness) was measured in six of the eight studies (75%) using an adapted Ainsworth rating scale ($n=2$), the Parent-Child Early Relational Assessment (PCERA; $n=1$), the Parent Child Interaction Teaching Scale (PCITS; $n=1$), and the Thorpe Interaction Measure (TIM; $n=2$). Three studies measured infant attachment using the Ainsworth SSP; one study measured both maternal sensitivity and infant attachment.

Prenatal maternal personality characteristics and postpartum mother-infant relationship quality

Research question 1: Are maternal personality characteristics measured in early pregnancy associated with the quality of the subsequent mother-infant relationship?

Four studies measured prenatal maternal personality characteristics and postpartum MIRQ. One study that explored interaction between prenatal antisocial and borderline personality traits and postnatal MIRQ for predicting subsequent child outcomes yet did not report associations relevant to the present review (Haabrekke et al., 2015). Three studies comprising 817 mother-infant dyads report an association between prenatal personality characteristics and postpartum MIRQ. Different measures of association and reported effect were used across each of the three studies; thus in lieu of analysis, an interpretive comment regarding magnitude of effect is noted for each study. The three studies are described following. Results and comment on estimated magnitude of effect are summarised in **Table 3**.

Table 3. Results and estimated effect summary: **prenatal Personality** and postnatal MIRQ.

Citation	Association prenatal PERSONALITY and postnatal MIRQ	Results	Estimated magnitude of effect
Espinosa et al., 2001	Personality characteristics (four groups: no dysthymia/no paranoia; dysthymia; paranoia; dysthymia and paranoia) with MIRQ scores 6 months (dicotomised <5 insensitive and ≥ 5 sensitive), and toddler attachment 18 months; four by two-way repeated analysis of variance.	Paranoid only and dysthymic-and-paranoid groups displayed less sensitive MIRQ $F(3,52) = 8.67, p < .0001$ (Cohen's d estimated from means and SDs: paraoid only 2.55; dysthymia only 0.39; dysthymia and paraoia 2.08). Paranoid only and dysthymic-and-paranoid groups associated with disorganised toddler attachment however effect was small and marginally significant.	Large for MIRQ Small for toddler attachment
Raine et al., 2016	Interpersonal sensitivity (IPSM) and MIRQ; two step hierarchical regression analyses. Controlled for demographics.	Independent association of IPSM and observed MIRQ. IPSM $\beta = -.164, CI -.083, -.244$; and IPSM explained 2.7% of total variance in MIRQ scores, $R^2_{change} = .022, F_{change}(1,700) = 16.03, p < .001$.	Small
Goodman et al., 2017	Trait anxiety and maternal sensitivity using four domains: affective matching during play and feeding; sensitivity rated during play and feeding. Correlation analyses.	Higher prenatal trait anxiety consistently associated with less sensitive MIRQ; correlations were moderate on all four domains: -.40 -.24; -.25; -.30.	Medium

Collectively the summary of results outlined in Table 3 indicate that early prenatal measures of personality characteristics are associated with observed MIRQ six to 18 months postnatal.

Prenatal depressive symptoms and postpartum mother-infant relationship quality

Research question 2: Are high levels of depressive symptoms (or illness/episode) measured in early pregnancy associated with the quality of the subsequent mother-infant relationship?

Each of the eight studies measured depressive symptoms in early pregnancy. However, none reported on clinical diagnosis of depression cases. Two studies found no evidence of an association between prenatal depressive symptoms and postnatal MIRQ (Tharner et al., 2012; Thomas, Letourneau, Campbell, Tomfohr-Madsen, & Giesbrecht, 2017). Another two studies measured depressive symptoms in early pregnancy, however one found that prenatal dysthymia was associated with postnatal MIRQ only when paranoid personality traits were also present (Espinosa, Beckwith, Howard, Tyler, & Swanson, 2001); and the other did not report depressive

symptom data in relation to MIRQ (Haabrekke et al., 2015). Four studies comprising 1,825 mother-infant dyads report on association between prenatal maternal depressive symptoms and postpartum MIRQ. Dissimilar measures of association and reported effect were used in each of the four studies; hence an interpretive comment on magnitude of effect strength of finding is noted in lieu of analyses. The four studies are described following. The results from each study and comment on estimated magnitude of effect are summarised in **Table 4**.

Table 4. Results and estimated effect summary: **prenatal Depression** and postnatal MIRQ

Citation	Association prenatal DEPRESSION and postnatal MIRQ	Results	Estimated magnitude of effect
Goodman et al., 2017	Depressive symptoms and maternal sensitivity/MIRQ using four domains: affective matching during play and feeding; sensitivity rated during play and feeding. Correlation analyses.	Clinically significant prenatal depressive symptoms consistently associated with less sensitive MIRQ; correlations on three of four domains: -.39; -.33; -.26.	Medium
Hayes et al., 2013	Prenatal depressive symptoms and infant attachment disorganisation; correlation, logistic regression analyses.	Prenatal depressive symptoms correlated with infant attachment disorganisation (.31).	Medium
Pearson et al., 2012	Depressive symptoms and single domain of the TIM (MIRQ) measure; correlation, log-binomial regression analyses.	High prenatal depressive symptoms associated with reduced MIRQ scores. Effect after demographic controls included risk ratio = 1.26, CI 0.97-1.62). Low effect in adjusted analysis; risk ratio 1.31.	Small
Raine et al., 2016	Depressive symptoms (EPDS) and TIM; two step hierarchical regression analyses controlling for demographics	Higher prenatal EPDS predicted postnatal TIM ($\beta = -.129$, CI $-.231, -.027$).	Small

Together the four studies summarised in Table 4 find a consistent association between prenatal depressive symptoms and postnatal MIRQ. While unadjusted associations demonstrate small-medium effect, once adjustments are made for demographics and postpartum depression, effects are small, though significant.

Combined evaluation of prenatal personality characteristics and depressive symptoms associated with postnatal MIRQ

Three of the eight unique studies comprising 817 mother-infant dyads measured and reported on association of both prenatal personality characteristics and depressive symptoms with postnatal MIRQ within the same study (Espinosa et al., 2001; Goodman, Bakeman, McCallum, Rouse, & Thompson, 2017; Raine, Cockshaw, Boyce, & Thorpe, 2016). A summary of the three studies with comments regarding associations is outlined in **Table 5**.

Table 5. Results summary and comment on associations: **prenatal Personality and Depression** with postnatal MIRQ.

Citation	Association prenatal PERSONALITY and DEPRESSION with postnatal MIRQ	Results	Comment
Espinosa et al., 2001	Maternal characteristics (four groups: no dysthymia/no paranoia; dysthymia; paranoia; dysthymia and paranoia), maternal sensitivity/MIRQ and toddler attachment 18 months.	Paranoid only and dysthymic-and-paranoid groups displayed less sensitive MIRQ (cohen's d estimated from means and SDs: paraoid only 2.55; dysthymia only 0.39; dysthymia and paraoia 2.08); and associated with disorganised toddler attachment.	Prenatal dysthymia associated with postnatal MIRQ and toddler attachment only when paranoid personality traits were also present.
Goodman et al., 2017	Depressive symptoms, trait anxiety and maternal sensitivity using four domains: affective matching during play and feeding; sensitivity rated during play and feeding. Correlation analyses.	Medium effect for both prenatal depressive symptoms (on three of four domains MIRQ: -.39; -.33; -.26) and trait anxiety (on all four domains MIRQ: -.40; -.24; -.25; -.30).	Both depressive symptoms and trait anxiety characteristics associated with MIRQ.
Raine et al., 2016	Depressive symptoms (EPDS) and Interpersonal sensitivity (IPSM) and TIM/MIRQ; two step hierarchical regression analyses controlling for demographics	Both prenatal EPDS and IPSM predicted postnatal MIRQ with IPSM being the stronger: EPDS ($\beta = -.129$, 95 % CI [-.231, -.027]); IPSM: $\beta=.164$, 95 % CI [.083, .244].	At the bivariate level IPSM predicted TIM but the relationship between EPDS and TIM did not reach significance.

The finding that prenatal dysthymia was associated with postnatal MIRQ only when paranoid personality traits were also present (Espinosa et al., 2001), suggests the importance of depressive symptoms in combination with personality characteristics but not in isolation; because in this study the prenatal dysthymia group and the control group did not differ in terms of postnatal MIRQ. Each of the three studies including examination of association between personality characteristics ;and depressive symptoms with postnatal MIRQ, report that both prenatal depressive symptoms and personality characteristics are markers of postpartum MIRQ thus parenting style. Two of these

studies focus on general populations (Goodman et al., 2017; Raine et al., 2016) and of these, one study (Raine et al., 2016) tested the relative predictive capacity of depressive symptoms and personality characteristics; and although the study reports personality as the stronger predictor, it remains an isolated example and warrants further investigation. The key finding is that in the same sample both prenatal depressive symptoms and the personality characteristic, interpersonal sensitivity, present as markers for postnatal MIRQ. However, prenatal interpersonal sensitivity predicted more of the variance in postnatal MIRQ scores.

Discussion

This systematic review shows that both prenatal maternal personality characteristics and depressive symptoms are associated with postnatal MIRQ. We found relatively few studies across which there was heterogenous measurement and design. Tentatively, the data suggest that both prenatal depressive symptoms and personality characteristics are markers for later MIRQ, thus at-risk parenting style and child outcomes. The magnitude of adjusted effect was overall small though consistent, signifying an association between the prenatal maternal mental health indices of interest to this review, depressive symptoms and personality characteristics, and postnatal MIRQ. Additional data is required to explain other potentially intervening factors, nevertheless, taken together these data show that prenatal personality characteristics as well as depressive symptoms, associate with postnatal MIRQ.

Perinatal depressive symptoms and depression have been a central focus of research related to perinatal mental health screening (Long et al., 2018; O'Connor, Rossom, Henninger, Groom, & Burda, 2016). However, personality traits which are relatively stable over time and consistent across situations (Fajkowska, 2018) are associated with a range of mental disorders (Jeronimus, Kotov, Riese, & Ormel, 2016), including risk for psychosis (Masillo et al., 2012), parenting (McCabe, 2014; Prinzie et al., 2009), maternal depression (Boyce, Parker, Barnett, Cooney, &

Smith, 1991; Evans et al., 2005) and are related with poor parenting (Wilhelm, Boyce, & Brownhill, 2004). Recent publications have suggested the importance of the perinatal period for identifying at-risk parenting style associated with developmental outcomes of young children (Green et al., 2018; Judd, Newman, & Komiti, 2018). Our finding, that both prenatal maternal personality characteristics and depressive symptoms are associated with postnatal MIRQ, emphasises that assessment of prenatal maternal personality characteristics may enhance opportunities for early identification of vulnerable MIRQ and thus suboptimal parenting style. Assessment of personality characteristics may also identify pregnant women who may have a propensity to develop depression or other mental disorders later in pregnancy or while infant parenting.

Our findings yield from five studies that examined three study cohorts using heterogenous methods. Two studies examined a large community sample from the Avon Longitudinal Study of Parents and Children (ALSPAC). These studies found a small yet significant effect for associations between: prenatal depressive symptoms and postnatal MIRQ in $n=964$ mother-infant dyads (Pearson et al., 2012); and both prenatal depressive symptoms and the personality characteristic, interpersonal sensitivity, with postnatal MIRQ in $n=706$ dyads (Raine et al., 2016). Two studies draw on the same sample of women who had a lifetime history of depression prior to pregnancy and report associations with medium effect for: prenatal depressive symptoms and infant attachment disorganisation in $n=79$ dyads (Hayes, Goodman, & Carlson, 2013); and, prenatal depressive symptoms and the personality characteristic, state trait anxiety, with postnatal MIRQ in $n=76$ dyads (Goodman et al., 2017). All four abovementioned studies found that depressive symptoms in early pregnancy but not postpartum were significantly associated with MIRQ at 12 months postnatal (Goodman et al., 2017; Hayes et al., 2013; Pearson et al., 2012; Raine et al., 2016); underscoring the importance of maternal mental health factors in early pregnancy related to subsequent MIRQ. One study of a cohort of cocaine using women ($n=35$) in high risk contexts (Espinosa et al., 2001) found a significant association between prenatal

personality and postnatal MIRQ. Effect sizes for the reported associations were proportional to the study cohorts. That is, we noted strongest effect in the high-risk cohort of women, medium for the at-risk sample and small for the community cohort.

Consistent associations were found between prenatal depressive symptoms and postnatal MIRQ. While unadjusted associations demonstrate small-medium effect, once adjustments were made for demographics and postpartum depression, the effects were found to be small, though significant. Of the studies that measured both prenatal personality characteristics and depressive symptoms, one clinical population study showed that prenatal dysthymia was associated with postnatal MIRQ only when paranoid personality traits were also present, that is, women with prenatal dysthymia did not differ from women in the control group in terms of postnatal MIRQ (Espinosa et al., 2001). One large normative population study tested the relative predictive capacity of depressive symptoms and personality characteristics for postnatal MIRQ and reports personality as the stronger predictor (Raine et al., 2016), however this is an isolated example signaling necessity for further research.

This systematic review has several strengths and weaknesses. To the best of our knowledge, it is the first review to systematically explore associations between early prenatal maternal mental health indices with MIRQ six to 18 months postnatal. Our findings, that both prenatal depressive symptoms and personality characteristics are associated with postnatal MIRQ, imply potential for antenatal identification of both mothers and infants who are at an increased risk of adverse outcomes as a result of perinatal mental disorders; therefore, enabling early dyadic interventions. Although we did not assess antenatal maternal reflective functioning in the current review, we acknowledge other studies have shown these factors to impact on subsequent maternal sensitivity (Ensink, Normandin, Plamondon, Berthelot, & Fonagy, 2016; Smaling et al., 2016; Smaling et al., 2017; Stacks et al., 2014). Similarly, we did not assess antenatal maternal

attachment strategy in the present review and recognise other studies which have shown that maternal sensitivity (MIRQ) mediates transmission of insecure attachment from mother to infant (Atkinson et al., 2005) and that secure maternal attachment can moderate the effect of postpartum depression on infant attachment security (McMahon, Trapolini, & Barnett, 2008). We suggest that antenatal maternal reflective function and attachment strategy should be considered in future research. Limitations of this systematic review that restrict generalisability of the findings, are that we report on an insufficient number of studies within which measurement and design were heterogenous. We acknowledge the need for more studies with consistency in design and analysis, from which meta-analyses can be undertaken.

Several publications emphasise that identifying and treating maternal depressive symptoms alone will not necessarily improve the parent-infant relationship or infant attachment security (Cicchetti, Toth, & Rogosch, 1999; McMahon, Barnett, Kowalenko, & Tennant, 2006; Murray, Cooper, Wilson, & Romaniuk, 2003). Moreover, services focused on treating perinatal mental disorders in the absence of intervention targeting parenting and MIRQ are unlikely to mediate the effect of maternal mental disorders on adverse child outcomes (Catalao et al., 2014; Howard & Challacombe, 2018; NICE, 2014; Stein et al., 2014). Maternal attachment and parenting style are central in determining a mother's responses to her infant and attendant developmental outcomes. Attachment, personality and parenting style are interpersonal constructs whereas depressive symptoms, although potentially emerging from and impacting on interpersonal contexts, are characteristically intrapersonal.

Implications for practice

Inclusion of personality measures in prenatal mental health screening and assessment emerges as a potential advancement because personality presents a more stable trait measure which is associated with propensity to maternal depression and a range of mental disorders (Boyce et al.,

1992; Evans et al., 2005; Jeronimus et al., 2016; Masillo et al., 2012). However, choosing whether to include a measure of personality in routine perinatal mental health screening presents complex issues. There is a lack of evidence showing that perinatal mental health (depression) screening provides benefit for women in excess of costs and potential harms (Thombs et al., 2014). The effect of perinatal depression screening on overall outcomes, that is specific benefits or suffering for infants and mothers is not known. Comparison of all the benefits and harms for women and their children that may result from current perinatal mental health screening is required before consideration of a different course of action, such as inclusion of a measure of antenatal maternal personality characteristics.

We highlight that identification of personality characteristics in pregnant women may enhance opportunities for early dyadic interventions targeting vulnerable MIRQ and parenting style. Personality characteristics have been noted as a potential improvement to antenatal screening for postpartum depression (Austin & Lumley, 2003; Monk, Leight, & Fang, 2008). Psychiatric assessment of pregnant women who screened positive for depressive symptoms identified a substantial number of women with borderline personality disorder and borderline personality traits to a greater extent than depressive or anxiety disorders (Judd, Lorimer, Thomson, & Hay, 2018). Furthermore, pregnant women with disordered personality traits are particularly vulnerable to multiple psychosocial problems (Crowley et al., 2019). However, we stress that personality measures should not be construed as an alternative to perinatal depression screening because depressive symptoms may be a marker of relapsing past psychopathology (Patton et al., 2015) or psychosocial risk factors (Woolhouse, Gartland, Hegarty, Donath, & Brown, 2012) and are potentially deleterious for both mother and child (Lefkovic et al., 2014; Netsi et al., 2018).

Improvements to current perinatal depression screening initiatives are required to demonstrate better outcomes for vulnerable families, more appropriately targeted early interventions for

pregnant women, and greater efficiency and cost savings for the health system. It has been recommended that perinatal mental health screening should only be implemented where diagnostic assessment and treatment pathways are in place (Boyce & Judd, 2019; Kendig et al., 2017). Prior to treatment for identified perinatal mental health problems, a vital component of the clinical investigation is to assess the mother's relationship with her fetus or infant (Brockington et al., 2017). Nevertheless, there continues to be robust implementation of perinatal depression screening initiatives, for example in Australia (Williams, 2017) yet comprehensive biopsychosocial psychiatric assessment is not necessarily available for women who are identified with high depressive symptom scores (Boyce & Judd, 2019). The value of detecting relationships at risk is paramount for preventing long-term health, social and emotional costs. Preventive screening and targeted interventions focused on the mother-infant relationship are more likely to reduce incidence of abuse and neglect and improve child outcomes than reactive protection services. Improved accuracy of detection for mother-infant relationship problems presents the opportunity for greater efficiency in targeting resources.

Taken together, our findings show that both maternal personality and depressive symptoms measured in early pregnancy associate with postnatal mother-infant relationship quality. A measure of personality may enhance prenatal mental health screening and assessment affording greater opportunities for targeted dyadic intervention commencing in pregnancy. Early intervention aiming to improve mother-infant relationship quality, parenting, and mental health outcomes of both mother and child, may thereby contribute to reduction of human and economic burden.

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