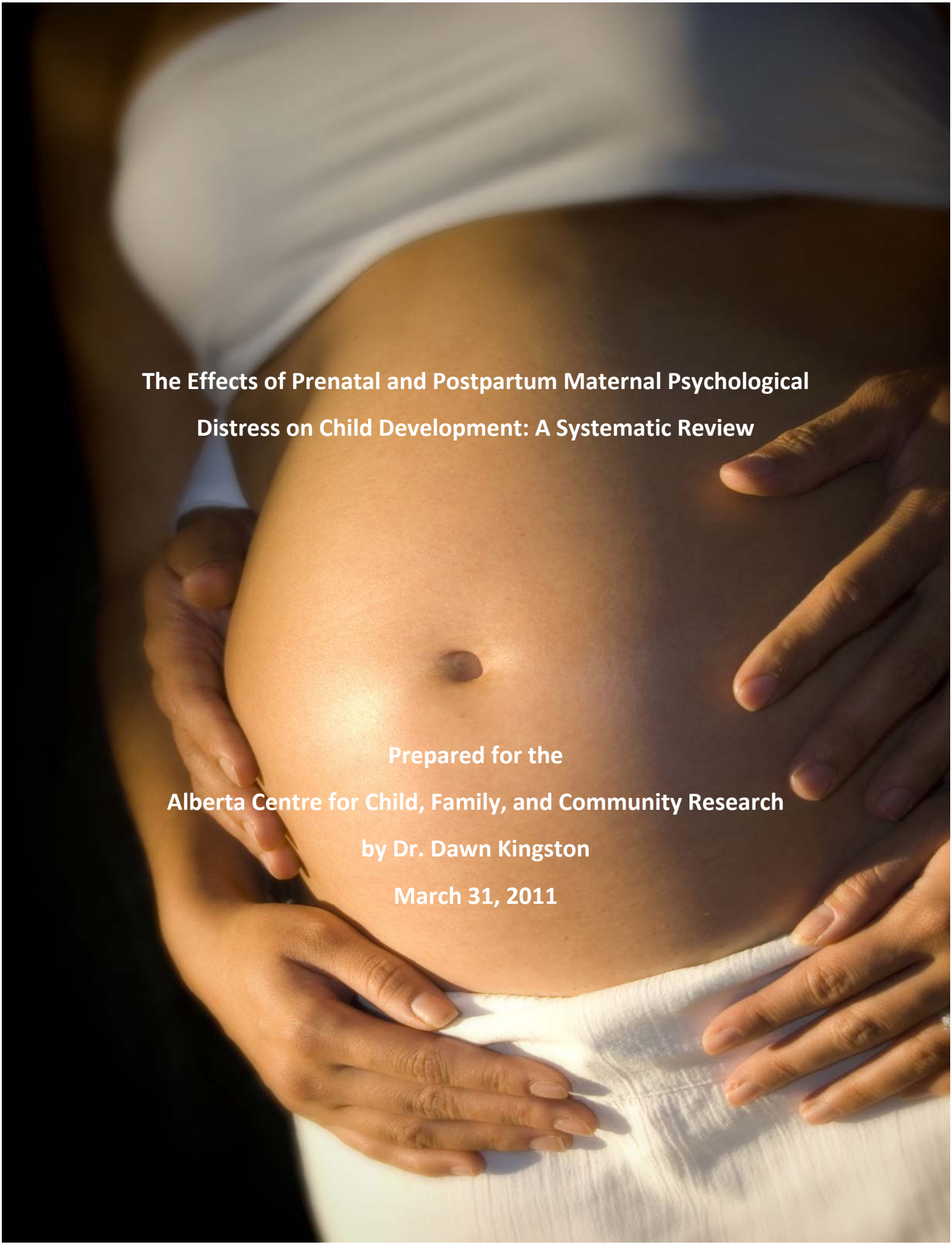

The Effects of Prenatal and Postpartum Maternal Psychological Distress on Child Development: A Systematic Review

Prepared for the

Alberta Centre for Child, Family, and Community Research

by Dr. Dawn Kingston

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Background

Healthy child development has been viewed as a necessary foundation for reducing health and social inequities across the life course. [1,2] Early years programming has been an important strategy for the prevention of developmental problems, largely resulting from our increased understanding of environmental influences on the neuroplasticity of the young brain.[2] From an economic standpoint, investment in the early years in the form of quality education, development, and parenting programs has shown greater return than that occurring post-kindergarten. [2] Yet, based on the Early Development Index (EDI), 25% to 30% of children in Canada enter school with some form of physical, socio-emotional, or cognitive-language delay, and Canadian trends reveal an increase in developmental vulnerability across several provinces over the past decade.[2,3] Advocates suggest that the decline in healthy child development at a time when there has been increased attention in this area implies that greater investment in early years services is required.[2] While this is a widely held position, this declining trend in light of current resource expenditure also compels us to consider earlier influences in a child's life that have not been sufficiently addressed to date.

Tandem to the movement to develop and enhance universal services to support healthy early years' development has been a growing interest in the long-term effects of risk factors that occur during pregnancy and the postpartum period on child development. Although maternal health may represent a key point of early, "upstream" intervention, the evidence surrounding early life factors has not been translated into prevention or intervention strategies, or policy. To some degree, this may reflect the chasm that exists between professions and services that address mothers' health, and those that target children's health; regardless, the endpoint has been far less investment in the earliest influences on a child's life compared to those in the early years. However, the recently released Marmot Review, "Fair Society, Healthy Lives", proposed a "second revolution in the early years" to increase the support of parents starting in pregnancy and continuing through primary school.[4] This report

recommended "giving priority to pre- and post-natal interventions that reduce adverse outcomes of pregnancy and infancy" (p. 16) and "priority for maternal health interventions" (p.172).[4] These recommendations formally acknowledge the importance of maternal health during the prenatal and postpartum periods in child health and development.

Maternal psychological distress in pregnancy is common, affecting up to 30% of pregnant women.[5] Furthermore, a substantial proportion of women who experience distress in pregnancy continue to suffer during the postpartum period and beyond.[6-8] As such, maternal psychological distress represents a prevalent, enduring, and modifiable influence that significantly impacts fetal and child development. Indeed, a WHO Commission of Social Determinants report stated, "Implementing a more comprehensive approach to early life includes…comprehensive support to and care of mother before, during, and after pregnancy – including interventions that help to address prenatal and postnatal maternal mental health problems" (p. 53).[9] Although a few reviews have summarized evidence related to the impact of specific forms of prenatal and postpartum distress on child outcomes, many questions remain unanswered.[10-13] A comprehensive review of the impact and magnitude of effect of prenatal and postpartum psychological distress on child development is required to inform prevention, early intervention, and policy strategies to reduce the risks for developmental delay that occur in a child's earliest environment.

Objectives

The objectives of this systematic review were to: (a) assess the relationship between prenatal and postnatal maternal psychological distress and child development; (b) estimate the magnitude of effect of the relationship between various forms of maternal psychological distress and child developmental outcomes; (c) describe the quality of the evidence for the relationship between maternal psychological distress and child development; (d) identify gaps in the existing evidence; (e) describe the implications of the review findings; and (f) formulate research, clinical, and policy related recommendations.

Methods

Inclusion and Exclusion Criteria

Studies were included in this review if the:

(a) exposure was any form of maternal psychological distress occurring during pregnancy or the postpartum period (e.g., 1 year following birth);

(b) outcome was a measure of child development that was assessed from birth up to and including age 8;

(c) study recruited women and children from developed countries;

(d) study was published in English; and,

(e) study was a primary study that was published between 1990 and 2010.

Studies were excluded from this review if:

(a) maternal distress during the prenatal or postpartum period was part of a composite variable that extended beyond 1 year postpartum;

(b) the study recruited women and children from developing countries;

(c) the sole outcomes were preterm birth or small for gestational age;

(d) the exposure was a pharmacologic treatment for maternal distress; or,

(e) the study did not have a comparison group (e.g., case study).

This particular review describes the findings related to 5 specific child developmental outcomes, including global indices of child development, behaviour, cognitive development, emotional development, and psychomotor development. The categorization of the child outcomes (e.g., as cognitive, or behavioural) was based on the investigators' own descriptions of the nature of the outcome.

Definitions

A few definitions require supplemental explanation, including:

(a) Child developmental stages:

Infant: Birth to 12 months

Toddler: >12 months - 36 months

Pre-schooler: >36 months – 48 months

School-Age: >48 months – 8 years

(b) Global index of development: An index that combined a number of developmental components (e.g., emotional, behavioural, cognitive development) into a single index (e.g., Child Behavior Checklist Total Score; Bayley Scales of Infant Development);

(c) Trimesters:

First trimester: 0 - 13 weeks

Second trimester: >13 weeks - 26 weeks

Third trimester: >26 weeks - 40 weeks

(d) Effect sizes: Based on Cohen's guidelines, effect sizes were defined as small when d=.20 or r=.10; medium when d=.50 or r=.30; and, large when d=.80 or r=.50. Calculations were used to determine the corresponding effect sizes of odds ratios when presented.

Search Strategy

The complete search strategy is found in Appendix A. The strategy was developed in consultation with a university-based librarian. Five electronic databases were searched, including Embase, CINAHL, Eric, PsycInfo, and Medline. Reference lists were reviewed and key journals were hand-searched for relevant articles that were missed in the electronic search. The search encompassed the period from January 1, 1990, to August 10, 2010.

Title and Abstract Review

The titles and/or abstracts of each article were reviewed independently by 2 individuals based on the a priori inclusion and exclusion criteria. Disagreements related to inclusion or exclusion were resolved by discussion and consensus. In cases where decisions could not be

reached based on title or abstract review, the full-text version of the article was retrieved and reviewed for inclusion.

Critical Appraisal

A modified version of the critical appraisal form for observational studies developed by the Scottish Intercollegiate Guideline Network (http://www.sign.ac.uk/methodology/checklists.html) was used to assess the quality of each article (Appendix B). The quality of the articles was assessed by 2 independent reviewers with experience in critical appraisal. Disagreements were resolved by consensus. One point of clarification should be noted regarding the criterion of blinding of the outcome assessor. Child outcomes were frequently reported by mothers. Although this is an important part of clinical assessment of child outcomes, it is a methodologic limitation in that distressed mothers may have a tendency to report their child's development as more negative. As such, studies that based their assessment of the child outcome solely on maternal report were assigned a lower quality rating compared to those that used additional sources.

Data Extraction

Data were extracted using a standardized data extraction form that was developed for this review. Data were extracted by one reviewer. The key aspects abstracted from each study are included in the results section by child outcome.

Analysis

Data were analyzed and summarized qualitatively by each developmental stage. Studies were also reviewed for the potential to conduct a meta-analysis.

Results: Overview

The search strategy comprising searches of the electronic databases, reference lists, and hand-searches yielded a total of 17,792 studies. Figure 1 represents a flow diagram of the studies captured for review (Figure 1). The final number of studies meeting criteria for the

review was 176 studies. Of those, the findings of 64 studies were summarized in this review focusing on global indices of child development, behaviour, cognitive development, emotional development, and psychomotor development. Among the 64 individual studies, 51 different cohorts were included.

We examined each child outcome for the potential to conduct a meta-analysis. The diversity in the presentation of the child outcome data (e.g., as dichotomous and continuous measures) precluded meta-analysis. We also reviewed the studies for the potential to calculate mean differences where outcomes were dichotomized, but insufficient data were available for us to extrapolate results. As such, a thorough qualitative analysis was conducted.

The details of the analysis are presented by child outcome in the Results section, and compiled in the Summary sections. A summary of the quality of each article is presented in Appendix C and detailed data extraction tables are found in Appendices D through G.

It should be noted that some studies evaluated the influence of maternal distress in both pregnancy and postpartum, and therefore the total number of studies reporting findings in each of these periods may exceed the total number of articles reported for a particular outcome. For example, 7 studies were reviewed for the outcome of infant cognitive development. Three of these studies explored the effect of maternal distress in the prenatal period, and 5 in the postpartum period (e.g., one study examined both periods).

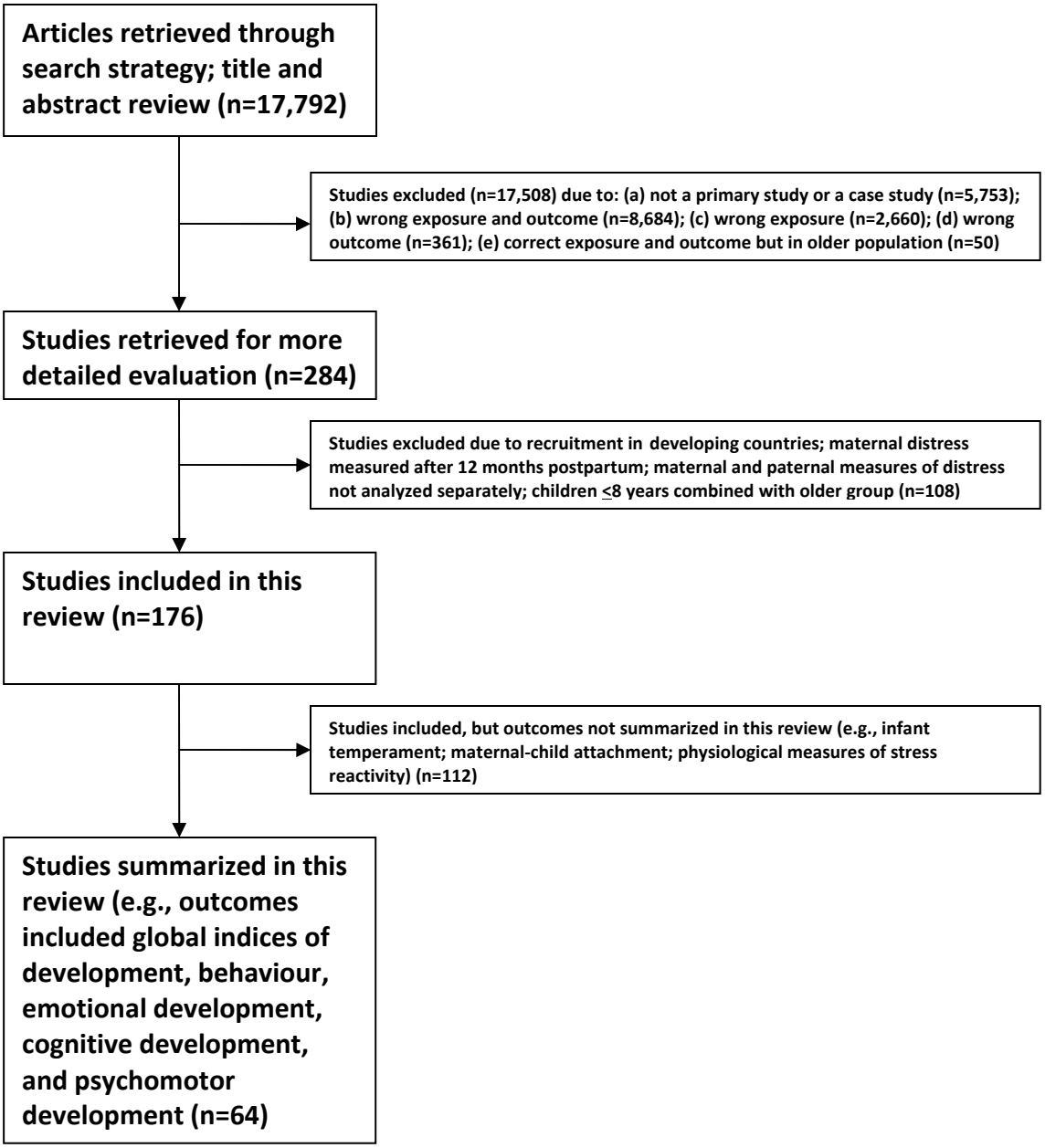

Figure 1: Flow Diagram of Included and Excluded Studies

Results: Infant Development

Global Indices of Infant Development (Table 1)

General overview of studies (n=2). Two longitudinal studies from Finland and New Zealand evaluated the influence of maternal distress on global indices of infant development at 12 months.[14,15] One study was community-based, but half of the mothers had term, small for gestational age infants (n=520), and the other recruited half of its participants from infertility clinics. The follow-up sample sizes were 520[14] and 744[15] (total N = 1264).These studies assessed the effect of prenatal trait anxiety in the second trimester (18-20 weeks),[14] prenatal/postnatal perceived stress in late gestation through to the immediate postpartum period,[15] parenting stress at 12 months (maternal report),[15] and postpartum depression at 2 and 12 months.[14]

Quality. The overall quality rating was weak for the Punamaki et al.[14] and moderate for Slykerman et al.[15] Attrition rates were similar at 25%[15] and 30.2%.[14] The main limitation in both studies was the lack of blinding of the outcome assessor due to maternal reporting of the child outcomes. In both studies, maternal distress was measured using psychometrically tested self-report instruments. Slykerman et al.[15] assessed maternal perceived stress shortly after delivery for the previous month, a period encompassing largely the prenatal, but also early postpartum, periods. Both studies controlled for a number of potential confounders, but only Punamaki et al.[14] adjusted for postpartum and current distress. While Slykerman et al.[15] used a widely validated child development screening instrument, Punamaki et al.[14] utilized investigator-developed questions. Both studies evaluated infant development by maternal report at 12 months of age.

Main findings. The proportions of developmental delay in the Slykerman study[15] were 33.8% in AGA infants and 32.4% in SGA infants (NS difference), and were not reported in the Punamaki study.[14] Neither study found a direct, significant effect of maternal distress in the whole sample. However, in a subsample of SGA infants, Slykerman et al.[15] found that those of

mothers with high parenting stress had over twice the odds of developmental delay. Punamaki et al.[14] found that prenatal anxiety played an indirect role in delayed development (see Moderators and mediators). Neither study found a significant association between the other forms of distress, including perceived stress, prenatal trait anxiety, or current postpartum depression (at 12 months) on global indices of child development.

Moderators and mediators. Using structural equation modeling techniques, Punamaki et al.[14] found that prenatal anxiety was mediated by neonatal health. In other words, prenatal anxiety during the second trimester was related to poor neonatal health, which then was associated with developmental problems. In the subsample of women with ART,[14] the relationships were somewhat different. Both prenatal depression and anxiety were associated with postpartum depression at 2 months, which was related to developmental problems at 12 months. No direct or indirect effect of postpartum depression at 12 months (e.g., concurrent depression) was found.

Other potential confounders. Although both studies assessed a large number of potential confounders, only prenatal smoking (n=1) and parenting satisfaction (n=1) were significantly related to child development. Other factors that were not related included: socioeconomic status (education, marital status, occupation), birthweight, pregnancy-related hypertension, parity, social support at one year, breastfeeding duration, marijuana use in pregnancy, maternal medical problems/birth complications, and child temperament**.**

Table 1: Key Aspects of Studies of Global Indices of Infant Development

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other	Adjusted for key potential confounders	Overall Quality Rating

						time periods		
Punamaki 2006[14]	Community (subsample of women with and without ART) (n=520)	mother	Prenatal Postpartum	S (indirect effect)	small	Yes (+ current)	Yes	W
Slykerman 2007[15]	Community (half SGA) (n=744)	mother	Prenatal	NS	-	No	Yes	M

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Infant Behaviour (Table 2)

General overview of studies (n=2). One longitudinal[16] and one cross-sectional study[17] explored the relationship between prenatal maternal distress and infant behaviour. These community-based studies involved participants from the Netherlands[16] and Spain[17] with respective sample sizes of 131 and 163 (Total N = 249). They explored the effect of a variety of forms of prenatal distress, including third-trimester state-trait anxiety,[16,17] perceived stress, and emotional stability.[17] Neither study assessed the effect of postpartum distress. Hernandez et al.[17] measured maternal distress during the first few days post-delivery for the period encompassing the previous month (the third trimester of pregnancy). Some distinction was made in the definition of state-trait anxiety. In particular, Brouwers et al.[16] defined high prenatal anxiety as *either* high state or trait anxiety, whereas Hernandez-Martinez et al.[17] distinguished these in the analysis. Infant behaviour was assessed throughout infancy, including the first few days of life[17] and 3 and 12 months of age.[16] In all cases, the developmental assessment was performed by a researcher or examiner. The early examinations were conducted using the same instrument (Neonatal Behavioural Assessment Scale).

Quality. These studies achieved overall quality ratings of strong[16] and moderate[17]. The attrition rate for the longitudinal study was less than 20%. In both studies, self-reported maternal distress and infant behaviour were assessed using psychometrically evaluated instruments, with both studies utilizing the same measure of state-trait anxiety. The retrospective measures of prenatal distress used by Hernandez-Martinez et al.[17] represented a

source of limitation in this study. Although confounders were addressed for other outcomes in the Brouwers' study,[16] the analysis of infant behaviour was unadjusted. Neither study adjusted for the potential influence of postpartum distress on the relationship between prenatal distress and infant behaviour.

Main findings. The proportion of infants with behaviour problems was not reported in either study. Both studies reported significant effects of prenatal maternal distress in the third trimester on behavioural outcomes. Specifically, infants of mothers with high state/trait[16] and trait anxiety[17] had lower scores on orientation (e.g., infant attention, alertness) in both studies at 3 weeks,[17] 3 months, and 12 months.[16] In addition, moderate levels of prenatal trait anxiety were associated with reduced social interaction scores at 2-3 days post-delivery[17] and high state/trait anxiety was related to less motor coordination at 12 months.[16] Emotional stability (e.g., the absence of mood changes) was associated with improved infant self-regulation.[17] Of all the measures of prenatal distress assessed, perceived stress and state anxiety did not have an impact on infant development. The finding that trait anxiety (and combined trait/state) and emotional stability were related to infant development may suggest that it is the more enduring forms of prenatal distress that are implicated in infant behaviour. Hernandez et al.[17] found these effects to be small, whereas Brouwers et al.[16] did not report the magnitude of effect or provide data to derive it.

Moderators and mediators. Hernandez-Martinez et al.[17] found that infant sex did not moderate the relationship between maternal prenatal distress and behavioural outcomes**.**

Other potential confounders. Although Hernandez-Martinez et al.[17] controlled for a wide variety of potential confounders, their individual significance was not reported.

Table 2: Key Aspects of Studies of Infant Behaviour

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other	Adjusted for key potential confounders	Overall Quality Rating

						time periods		
Brouwers 2001[16]	Community (n=131)	researcher	prenatal	S	Not reported	No	No (not for this outcome)	S
Hernandez 2008[17]	Community (n=163)	examiners	prenatal	S	small	No	Yes	M

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Infant Cognitive Development (Table 3)

General overview of studies (n=7). Seven longitudinal studies evaluated the effects of prenatal (n=3) and postpartum (n=5) distress on infant cognitive development at 3 to 12 months. These studies recruited women from a variety of countries, including the Netherlands (n=3), Australia (n=2), the United Kingdom (U.K.) (n=1), and the United States (U.S.) (n=1). Four represented community samples,[16,18-20] whereas three focused on unique populations including women attending a residential parentcraft program for infant difficulties;[21] those with high risk pregnancies complicated by pre-eclampsia, HELLP, or fetal growth restriction;[22] and chronic cocaine users.[23] Sample sizes ranged from 71 to 170 for all studies except Reilly et al. (n=1591)[20] (Total N = 2327).

The studies that assessed prenatal distress measured a variety of types spanning the second and third trimesters of pregnancy, including state-trait anxiety (32 weeks);[16] stressful life events, perceived stress, maternal cortisol levels (15-17, 27-28, and 37-38 weeks);[18] and depression (last trimester). Of the 5 studies evaluating postpartum distress, most assessed postpartum depression[19,21,23] with 2 assessing non-specific psychological distress.[20,22] In terms of infant outcomes, 5 of these studies assessed global cognitive infant development, and 2 focused on language development.[20,21]

Quality. Among these 7 studies, most were rated as strong[16,19,22] or moderate,[18,20,21] with only one study receiving a weak rating.[23] Attrition rates varied from less than 10% to 54%. The main limitation among these studies was the lack of assessment of potential confounders. All studies used psychometrically evaluated measures of maternal distress and child cognitive

development. Four studies used self-report measures of maternal distress,[16,18,20,22] and the remaining 3 used a combination of self-report and structured interview by a psychologist.[19,21,23] In most of the studies, assessments of cognitive development were conducted by a researcher or psychologist[16,18,19,22,23] with only 2 using maternal report.[20,21] Global cognitive development was conceptualized quite consistently in these studies, with 4 studies using the Mental Development Index (MDI) of the Bayley Scales of Infant Development to assess cognitive outcomes.[16,18,22,23]

Main findings. The prevalence of cognitive delay ranged widely from 7% in infants of non-distressed women to 25% in those of distressed women.[16] In women with high risk pregnancies, the rates of cognitive delay were 34% (distressed women) and 38% (non-distressed women).[22] Three of the 7 studies reported small, significant influences of maternal distress experienced in the prenatal (n=1) or postnatal (n=2) periods. None of the studies of cognitive outcomes at 12 months were significant, and neither study focusing on language development reported significant associations.

The overall quality ratings of the 3 significant studies varied from weak to strong. Each of these significant studies controlled for postpartum distress and a variety of additional potential confounders. By form of distress, first trimester prenatal stress and high cortisol in the third trimester were associated with small reductions in cognitive scores at 3 months.[18] Postpartum depression at 2-3 months was also associated with poor functioning on a cognitive object task test in 9-month old infants, even compared to mothers who had experienced both a history of depression and a postpartum depression.[19] Adjusting for very few confounders, a significant association was also found between clinically diagnosed postpartum dysthymia in cocaine-abusing women and low cognitive scores in 6-month old infants, as well as with a combination of prenatal and postpartum dysthymia.[23] In this study, no relationship was found between prenatal dysthymia alone and cognitive development. Finally, although Kaspers et al. found no difference in MDI scores of infants of women with high (MDI M=87; Range 59-102) and low levels of psychological symptoms (MDI M=89; Range 66-124), all infants in this study were born to mothers with severe complications (e.g., pre-eclampsia, HELLP syndrome) and the

mean MDI scores were below the population mean of 100.[22] Neither study that assessed cognitive outcomes by maternal report was significant.[20,21]

Moderators and mediators. Beckwith's study of substance-abusing mothers with high levels of dysthymia found that maternal-child interaction was not a significant mediator of the relationship between prenatal dysthymia and cognitive development.[23] In this study, chronicity of dysthymia was a significant moderator where infants of women who were severely depressed during pregnancy and postpartum had poorer cognitive outcomes than those of women who were depressed during pregnancy but experienced recovery.[23] Murray et al. found that severity of depression was also an important factor in that infants of mothers with a major postpartum depression scored more poorly on cognitive assessments than those with mothers who had a minor postpartum depression.[19] However, Cornish et al.[21] did not find that severity or chronicity of postpartum depression had an effect on language development. Finally, one study found a non-significant gender interaction ,[21] indicating that the relationship between maternal distress and cognitive outcomes did not differ between boys and girls.

Other potential confounders. Numerous potential confounders were assessed in this group of studies, including child factors (gestational age, birthweight, Apgar scores), maternal demographics (age, income, education, social class), maternal behaviour (prenatal smoking, prenatal alcohol, breastfeeding), obstetrical characteristics (parity, mode of delivery, complications, unplanned pregnancy), and social factors (social support, marital conflict, home environment). Overall, very few additional variables were significant predictors of cognitive development. In particular, global cognitive functioning was impacted by low maternal education in one study,[19] whereas language development was predicted by low SES, multiple births (e.g., twins had poorer scores) and gender (e.g., girls better cognitive scores than boys).[20] Three of the 7 studies did not report significance levels for the potential confounders.

Table 3: Key Aspects of Studies of Infant Cognitive Development

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-	Effect Size	*Adjusted for distress at	Adjusted for key potential	Overall Quality

				significant		other time periods	confounders	Rating
Buitelaar 2003[18]	Community (n=170)	researcher	Prenatal	S (general cognitive)	small	Yes	yes	M
Murray 1992[19]	Community (n=111)	researcher	postpartum	S (general cognitive)	Not reported	Yes	Yes	S
Beckwith 1999[23]	Cocaine-abusing women (n=71)	researcher	Prenatal postnatal	S (general cognitive)	small	Yes	Minimal	W
Brouwers 2001[16]	Community (n=131)	researcher	Prenatal	NS (general cognitive)	-	Postpartum/ current	Yes	S
Cornish 2005[21]	Clinical (n=112)	mother	postpartum	NS (language)	-	No	Minimal	M
Kaspers 2009[22]	High risk pregnancy (n=141)	psychologist	postpartum	NS (general cognitive)	-	No	Yes	S
Reilly 2006[20]	Community (n=1591)	mother	Postpartum	NS (language)	-	No	Yes	M

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Infant Emotional Development (Table 4)

General overview of studies (n=4). Four studies evaluated the influence of postpartum distress on infant emotional development, comprising 3 longitudinal[24-26] and one cross-sectional study.[27] No studies explored the effect of prenatal exposure on infant outcomes. Four different countries were represented by these studies (Sweden, Israel, Australia, U.K.), and sample sizes ranged from 44 to 223 (total N = 481). Two of the 4 studies involved clinical samples,[24,25] one was community-based,[26] and one blended community and clinical.[27] As such, these studies examined the effect of postpartum psychiatric illness,[24-27] generalized anxiety disorder and social phobias,[25,26] major postpartum depression,[25] and postpartum mood[27] on infant emotional development. Infant outcomes were assessed throughout the first year of life at 10 weeks,[26] 9 and 10 months[24,25] and between 13 and 52 weeks (mean 30.1 weeks).[27] All studies focused on social behaviour as the indicator of infant emotional development. Three studies assessed sociability using a variety of laboratory-based tests[24-26] and one was based on

a primary clinician's rating of the infant-clinician interaction during a routine child care visit.[27] As such, all studies used researchers or clinicians to assess infant emotional development.

Quality. Among these studies, most received weak ratings,[24,25,27] with the remaining study rated as strong.[26] The main limitations contributing to lower quality scores were having high potential for selection bias, lack of assessment of potential confounders, and lack of blinding of the outcome assessor. Attrition rates were less than 25% for the longitudinal studies. None of the studies controlled for prenatal mood in their analyses. Two studies measured maternal distress with self-report measures,[26,27] one used a structured psychiatric interview,[24] and one used both approaches.[25]

Main findings. The inclusion criteria for each of the 4 studies ensured that rates of clinical maternal distress were high in these studies. The rates of poor sociability in 2 studies reporting these data ranged from 6% to 14.8% in non-distressed women and 27.3% to 55% in those experiencing distress.[26,27] Three studies found a significant effect of postpartum distress involving generalized anxiety/ social phobia,[25] depression,[25] postpartum mood[27] and psychiatric illness[24] on infant social development. Among the significant studies, all had an overall quality rating of weak (the single study rated as strong reported a non-significant association). Overall, these studies found moderate effects of postpartum depression on reduced social engagement and increased fear in infants; however, the magnitude of this effect may be inflated by the lack of control for potential confounders.

Moderators and mediators. In addition to having an independent, direct effect, Feldman et al. found that maternal sensitivity moderated the relationship between maternal postpartum depression and infant social engagement.[25] In other words, in mothers with high levels of sensitivity to their infants, maternal depression had no effect on infant social development; however, infants of depressed mothers with low sensitivity were more likely to experience suboptimal social development. This moderating effect was not found for maternal anxiety.

Other potential confounders. Few potential confounders were assessed in this group of studies. Among these, infant sex, neonatal irritability, and the degree to which mother encouraged her infant to interact were not significant predictors of infant sociability. Only maternal sensitivity demonstrated a moderate effect on social engagement in infants.

Table 4: Key Aspects of Studies of Infant Emotional Development

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
Albertsson-Karlgren 2000[24]	Clinical (n=114)	researchers	postpartum	S	Moderate	No	Minimal	W
Feldman 2009[25]	Clinical subsample of community sample (n=100)	researchers	postpartum	S	Moderate for effect of anxiety; large for effect of depression	No	Minimal	W
Matthey 2005[27]	Clinical (n=44)	clinicians	postpartum	S	Not reported	(current)	None	W
Murray 2007[26]	Community (n=223)	researcher	postpartum	NS	-	No	Minimal	M

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Infant Psychomotor Development (Table 5)

General overview of studies (n=7). Seven longitudinal studies examined the effect of prenatal[16,18,28-31] and postpartum[22,31] distress on infant psychomotor development. These 7 studies recruited women from the Netherlands (n=4) and the U.S. (n=3). Sample sizes ranged from 131 to 200 with the exception of van Batenburg et al. (n=2724)[31] (total N = 3690). Six of these studies were community-based, with the remaining study recruiting women for a larger study of women with pre-eclampsia, HELLP, or severe fetal growth restriction.[22] Two of the community-based studies involved low-to-middle income women,[29,30] one-third of whom were African-American and single.

A wide variety of prenatal influences were assessed, including state-trait anxiety,[16] stressful life events,[18] perceived stress,[18] salivary cortisol,[18] plasma cortisol and placental corticoptropin releasing hormone,[28] anger,[29] dysthymia and major depression,[30] anxiety,[31] and depression.[31] One study evaluated prenatal distress in the first trimester,[18] 5 in the second,[18,28-31] and 2 in the third.[16,28] Postpartum distress included exposure to psychological symptoms,[22] anxiety, and depression,[31] and was assessed within the first 3 months postpartum[22,31] and at 12 months.[22] Infant outcomes were assessed throughout the first year of life, ranging from a few days post-delivery to 12 months of age.

Quality. The overall quality rating was strong for 3 studies,[16,22,28] moderate for 2,[18,31] and weak for 2.[29,30] Attrition rates ranged from less than 20% to 35% (not reported in 2 studies), and were a limitation in these studies. The other main contributor to reduced quality scores was the lack of inclusion of potential confounders. Three of 7 studies evaluating the influence of prenatal distress controlled for postpartum distress in their analysis[16,18,31] and one of the 2 studies examining postpartum effects controlled for prenatal distress.[31] All studies utilized psychometrically tested measures for maternal distress and child outcomes. Infant psychomotor development was conceptualized quite consistently across these studies and was measured by a variety of widely used instruments including the Neonatal Behavioural Assessment Scale,[16,29,30] the New Ballard Maturation Assessment Scale,[28] the Bayley Scales of Infant Development (Psychomotor Development Index),[16,18,22] and the Touwen's Neurodevelopmental Examination.[31]

Main findings. Prevalence rates of psychomotor delay were reported in one community-based study as 30% in infants of anxious women and 14% of those in non-anxious women.[16] Among women with high risk pregnancies, the rate of psychomotor delay was much higher, where 58% of infants of mothers with high levels of postpartum psychological symptoms experienced psychomotor delay compared to 50% of those whose mothers had low symptoms.[22] Overall, 5 of the 7 studies reported significant associations between maternal distress and child psychomotor outcomes. These studies demonstrated an effect of maternal distress on psychomotor outcomes that spanned across the first year of life from 48 hours of birth to 8 months. However, neither study that evaluated 12-month psychomotor development was significant.[16,22] By overall quality ratings, significant associations were found in one the 3 strong studies, both moderate studies, and both weak studies.

No association was found between any measure of postpartum distress and psychomotor development. Specific aspects of distress that were associated with poor psychomotor performance largely clustered in the second trimester of pregnancy, and included second trimester pregnancy-specific stress, anxiety, anger, dysthymia, cortisol levels, and corticotrophin releasing hormone; and third trimester cortisol. Of importance, both studies that controlled for postnatal distress found that prenatal distress (but not postnatal distress) had an independent effect on psychomotor development.[18,31] In their large, community-based sample, VandenBurg et al. also observed that infants of women with *both* prenatal and postnatal distress were not more likely to experience psychomotor delay.[31]

The effect sizes of self-reported maternal distress on psychomotor delay were small in studies that controlled for postpartum distress and additional potential confounders.[18,31] However, the two studies that found moderate effects did not control for potential confounders.[29,30] Effect sizes for the physiological measures were small to moderate for cortisol measured in both the first and third trimesters.[28]

Moderators and mediators. Ellman et al.[28] did not find that child sex was a moderator of the relationship between prenatal cortisol and CRH and neuromuscular maturation in 2-day old infants.

Other potential confounders. A large variety of potential confounders was assessed in 5 of the 7 studies, however 4 of these did not report significance of the association with infant development.[18,22,28,31] The single study that did report on the associations did not find any significant predictors, including the 1- and 5-minute Apgar scores, home environment, education, age, parity, prenatal smoking, prenatal alcohol, mode of delivery, breastfeeding, child sex, gestational age, and birthweight.[16]

Table 5: Key Aspects of Studies of Infant Psychomotor Development

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
Buitelaar 2003[18]	Community (n=170)	researcher	Prenatal	S	small	Yes	Yes	M
Ellman 2008[28]	Community (n=158)	physician	prenatal	S	small	No	Yes	S
Field 2002[29]	Community (n=166)	researcher	prenatal	S	moderate	No	No	W
Field 2008[30]	Community (n=200)	researcher	Prenatal	s	moderate	No	No	W
Van Batenburg 2009[31]	Community (n=2724)	researcher	Prenatal Postpartum	S NS	small	Yes	Yes	M
Brouwers 2001[16]	Community (n=131)	researcher	Prenatal	NS	-	Yes	Yes	S
Kaspers 2009[22]	High risk pregnancy (n=141)	psychologist	postpartum	NS	-	No	Yes	S

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Results: Toddler Development

Global Indices of Toddler Development (Table 6)

General overview of studies (n=12). Twelve longitudinal studies examined the effect of prenatal[32-37] and postpartum[21,36,38-42] maternal distress on global indices of toddler development, with 2 analyses drawing from the same study.[38,39] These studies originated from 7 different countries (e.g., U.K., Netherlands, Finland, Australia, U.S., Switzerland, and Canada) with sample sizes ranging from 25 to 9244 (Total N = 13190). Eight studies were community-based, and 4 represented unique populations of disadvantaged, minority adolescents[37-39] and women recruited from a residential parent-craft centre for infant problems.[21]

A wide variety of forms of maternal prenatal distress were studied, including prenatal depression,[32,33] anxiety,[32] perceived stress,[34] pregnancy-related stress,[34] psychological well-being,[34] cortisol,[34] stressful life events/ daily hassles,[34,36] psychiatric symptoms,[35] and personal adjustment (internalization/externalization).[37] Postpartum exposures included the number of baby blues,[36] postpartum depression,[21,38-41] and stressful life events.[36,38,39,42] Mantymaa et al. also assessed perinatal psychiatric symptoms over a period encompassing pregnancy and the first year postpartum.[35] One study assessed maternal exposure during the first trimester of pregnancy,[32] 4 in the second trimester,[32-34,36] and 5 during the third trimester.[32-34,36,37] Four studies examined postpartum distress in the first 6 months postpartum,[21,38-40] 4 late in the postpartum period[21,38,39,42] and one over the first year postpartum.[41] Child outcomes were evaluated from age 18 to 36 months.

Quality. Most of the studies had an overall quality rating of moderate (n=10), with 2 being rated as weak. The main limitations of this group of studies included attrition rates >20% (n=10), lack of blinding of the outcome assessor (n=8), not considering important potential confounders (n=3), and having high potential for selection bias (n=3). Four studies of prenatal distress controlled for postnatal distress,[32-34,36] and 2 studies of postnatal distress adjusted for prenatal distress.[36,38] Four studies basing their outcome assessment on maternal report also controlled for current maternal distress. All studies used psychometrically evaluated measures

of maternal distress and child development. Most of the studies measured maternal distress by self-report (n=10); however, one used structured interviews by a psychologist,[35] and one used both approaches.[21] An additional strength of many of these studies was the prospective measurement of maternal distress across different time points in order to assess the impact of the timing of exposure.[21,32-34,36,38,39]

Maternal exposure was defined and measured using a wide variety of approaches. On one hand, this may be construed as inconsistent from a conceptual and methodological perspective; however, this diversity also provides the opportunity to study the relationship between several distinct forms of distress and child development. Child behaviour was consistently defined and measured with widely used instruments, including the Child Behavior Check List (n=8), the Denver Developmental Screening Test (n=2), the Bailey Scales of Infant Development II (n=1) and the Parents' Evaluation of Developmental Status (n=1).

Main findings. The proportions of toddlers demonstrating delay based on global indices ranged from 9%[33] to 30%.[41] Tough et al. reported prevalence rates by level of risk, indicating that 11.0% of toddlers demonstrated high risk based on the presence of multiple significant concerns that predict development disability, 30% moderate risk (e.g., one significant concern present), and 24% moderate-low risk (e.g., non-significant concerns at present but elevated risk due to disruption of family functioning, parent-child conflict, or disciplinary problems).[41] The studies focusing on adolescent mothers reported rates similar to those found in community-based studies (e.g, Leadbeater et al. 13%[38]; Sommer et al. 14.9%[37]). Not all studies provided details regarding sample means of toddler developmental scores, therefore it was difficult to comment on the level of clinical morbidity among the participating children. However, the CBCL total sample means were below the clinical cut-off level in the 4 studies that reported these data.[32,34,37,42]

Nine of the 12 studies found significant relationships between prenatal (n=5) and postpartum (n=4) distress and global indices of toddler development. Among these studies, associations were found with prenatal depression,[33] perceived stress,[34] stressful life events,[36] and combination measures of depression and/or anxiety.[32,37] Significant postpartum influences

involved both depression and stress. By timing of prenatal exposure, one assessed distress in the first trimester,[32] 2 in the third trimester,[32,37] and 3 in the second and third trimesters.[33,34,36] Although Gutterling et al.[34] and Robinson et al.[36] found an association between the average or cumulative stress across the second and third trimesters and toddler development, Deave et al. [33] found that depression was only related when it persisted through both trimesters, but not either trimester independently. Two of the 3 studies of adolescent mothers demonstrated significant relationships between toddler development and prenatal internalization symptoms during pregnancy (e.g., depression, anxiety, withdrawal)[37] and postpartum depression at 12 months.[38]

By overall quality ratings, most of the significant studies had been assigned moderate ratings (n=8), whereas one had a rating of weak. Seven of the significant studies assessed child development by maternal report, one used both maternal and paternal report[32] and another used a psychiatrist.[40] Of the 8 studies that relied upon maternal report of toddler development, 2 controlled for current maternal distress. The single study that used a psychiatric interview and the one using both structured interviews and self-report measures had non-significant findings.

Overall, the magnitudes of effect of maternal distress on global indices of toddler development were small, except for one moderate sized effect reported by deBruijn et al.[32] The studies of adolescent mothers also reported small effects of prenatal and postpartum distress on these infant outcomes.[37,38] By timing of exposure, 4 studies of prenatal distress reported small effects[33,34,36,37] and one reported moderate effects.[32] Except for Sommer et al.,[37] each of these studies found significant associations after controlling for postpartum distress, and the moderate effects observed by deBruijn et al.[32] were observed following further adjustment by current distress. Similarly, Deave et al. found only a small attenuation of the effect of prenatal distress on toddler development when adjusted for postpartum depression, indicating that when distress at both times was considered, prenatal distress had the greater impact on toddler development.[33] Both studies of postpartum distress reported small effects.[38,41]

Moderators and mediators. DeBruijn et al. found that gender moderated the effect of the timing of depression/anxiety in pregnancy and total behaviour problems.[32] Specifically,

distress at 12 weeks gestation was associated more strongly with behaviour problems in boys (r= -.21, p<.05), whereas distress at 36 weeks largely affected girls (r= -.36, p<.01).[32] Significant interactions were not found between maternal distress and socioeconomic status,[37] the duration of postpartum depression,[21] or mother-toddler interactions,[38] suggesting that the influence of maternal distress on toddler development was not different among women with high/low SES, those with brief or chronic depression, or those with optimal/suboptimal interactions with their toddlers.

The role of current maternal distress should be addressed. Based on maternal report, de Bruijn et al. found that current depression/anxiety (i.e., at 36 months) was significantly related to poor developmental scores, but distress at 12 and 24 months was not related in a model including assessments at all time points.[32] However, these findings may reflect the effect of current mood on maternal assessment of child problems since paternal report demonstrated an effect of distress in the first and third trimesters with no effect of current maternal depression. When comparing the influence of postpartum depression at 12 months and current depression (e.g., 36 months) in inner-city adolescent mothers, Leadbeater et al. found that current depression played a much greater role than postpartum depression (i.e., 22% vs 2% contribution to the variance), although both were significantly related to toddler development.[38] It is unclear whether these findings are related to maternal reporter bias (e.g., depressed mothers at 36 months report their child's behaviour as more negative) or whether they reflect a continuation of depression over time.

Other potential confounders. Although a large number of potential confounders were considered, few demonstrated significant associations with toddler development. Factors that were associated with developmental delay were: current maternal[32] and paternal distress,[32,35] low paternal education,[32] early daycare attendance,[35] dysfunctional maternal-child interaction,[35] ethnicity,[36-38] prenatal smoking,[36] reduced social support,[38] ear infections,[41] and, among adolescents, not living with the toddler's grandmother.[38]

Predictors that were not significant in any of the studies included demographic factors (maternal socioeconomic status, maternal education, income, maternal age, paternal age,

housing, welfare status), obstetrical factors (parity, prenatal biomedical risk, delivery complications, mode of delivery, inter-pregnancy interval), maternal behaviours (breastfeeding duration, prenatal alcohol or drug use), maternal factors (maternal health; IQ, self-esteem) infant factors (gestational age, birthweight, 5-minute Apgar scores, chronic child health problems, infant temperament, child age, child sex (direct effect), cognitive functioning at 12 months, language development at 20 months), social factors (family structure/marital status; maternal abuse) or parenting factors (parenting morale; parenting style). Two studies did not report the significance of the potential confounders assessed.[33,34]

Table 6: Key Aspects of Studies of Global Indices of Toddler Development

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-	Effect Size	*Adjusted for distress at	Adjusted for key potential	Overall Quality

				significant		other time periods	confounders	Rating
Deave 2008[33]	Community (n=9244)	mother	Prenatal	S	small	Yes (+ pre-pregnancy)	Yes	M
deBruijn 2009[32]	Community (n=444)	Mother and father	Prenatal	S	Small for 12 week effect on boys; moderate for 36-week effect on girls	Yes (+ current)	Yes	M
Gutterling 2005[34]	Community (n=119)	mother	prenatal	S	small	Yes	yes	M
Robinson 2008[36]	Community (n=1979)	mother	Prenatal postpartum	S NS	Small -	Yes	Yes	M
Sommer 2000[37]	Inner city adolescents (n=121)	mother	Prenatal	S	small	No	Minimal	M
Leadbeater 1994[38]	Inner city adolescents (n=120)	mother	Postpartum	S	small	(current)	Yes	M
Righetti-Veltema 2003[40]	Community (n=25)	psychiatrist	Postpartum	S	Not reported	No	No	M
Tough 2008[41]	Community (n=791)	maternal	Postpartum	S	small	No	Yes	M
Walker 2007[42]	Community (n=122)	maternal	Postpartum	S	small	No	Minimal	W
Mantymaa 2004[35]	Community (n=50)	maternal	prenatal	NS	-	(pre-pregnancy)	Yes	W
Cornish 2005[21]	Clinical (n=112)	researcher	postpartum	NS	-	No	Minimal	M
Leadbeater 1996[39]	Inner city adolescents (n=63)	mother	Postpartum	NS	-	(current)	Minimal	M

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Toddler Behaviour (Table 7)

General overview of studies (n=9). Eight longitudinal and one cross-sectional study[43] evaluated the effect of prenatal[16,32,34-36,43,44] and postpartum distress[36,40,44,45] on toddler

behaviour. Studies recruited participants from 7 different countries, including the Netherlands, Finland, Australia, New Zealand, Russia, Switzerland, and the U.S. While 5 of the studies were quite small (N range 25 to 131), the remaining studies had sample sizes ranging from 444[32] to 1979[36] (total N =4920). Eight of the studies involved community-based samples, and the remaining study limited its inclusion to Pacific Islanders from New Zealand.[45]

A wide variety of forms of prenatal distress were studied, including state-trait anxiety,[16,44] anxiety,[32,44] depression,[32] stressful life events,[34,36,44] pregnancy-related anxiety/stress,[34,44] perceived stress,[34,44] cortisol levels,[34] psychiatric symptoms,[35] depression,[44] and combined depression/anxiety.[43] Most of these studies assessed maternal distress in the second[32,34,36,44] or third trimesters,[16,32,34,36,44] with only one study examining distress in the first trimester.[32] Two studies assessed prenatal distress during pregnancy without defining specific trimesters.[35,43] Postpartum influences included depression,[40,44,45] baby blues,[36] perceived stress,[44] and state-trait anxiety.[44] Each of these studies measured distress within the first 3 months postpartum. Child behaviour was evaluated from 18 to 30 months.

Quality. The majority of studies in this group were rated as moderate (n=7), with one rated as strong[44] and the other weak.[35] Attrition rates ranged from 15% to 55%. Weak ratings were assigned for lack of blinding of the outcome assessors (n=3) and having high potential for selection bias (n=2). Almost all studies considered a broad array of potential confounders in their analyses. Two studies exploring prenatal distress controlled for postpartum distress[36,44] and one study with a primary exposure of postpartum distress controlled for prenatal distress.[44] Four of the 6 studies that based their evaluation of child behaviour on maternal report controlled for current distress.[32,34,43,45]

All studies scored strong (n=8) or moderate (n=1) for their use of psychometrically evaluated instruments of maternal distress and child behaviour. Maternal distress was conceptualized and measured with a wide variety of approaches, particularly prenatal distress. Definitions of postpartum distress were more consistent in that 4 of 5 studies measured postpartum depression or baby blues. Eight studies measured maternal distress by self-report, and one was by psychiatric interview.[35] Four studies of prenatal distress conducted assessments

over multiple time points in pregnancy.[32,34,36,44] Child behaviour was consistently conceptualized as externalizing behaviour or attentional/emotional regulation (i.e., a predictor of hyperactivity), and was measured by either the Bayley Scales of Infant Development[16,34,40,44] or the Child Behaviour Check List (externalization subscale)[32,34-36,43,45]. Toddler behaviour was reported by a variety of sources, including mothers,[43] mothers and fathers,[32] psychologists and mothers,[34] and psychologists/psychiatrists.[40,44]

Main findings . Prevalence rates of behavioural problems were reported in 2 community-based studies as 6.8% [45] and 22%.[35] Five of the 9 studies found significant associations between maternal prenatal (n=4) and postnatal distress (n=1) and toddler behaviour. In particular, pregnancy-related anxiety,[34,44] state-trait prenatal anxiety,[32] prenatal anxiety,[44] combined prenatal anxiety/depression,[32,43] and postpartum depression at 3 months[40] were significantly associated with toddler behaviour. Among the significant prenatal studies, one measured maternal distress in the third trimester, one over the second and third trimesters, and one during pregnancy (trimester not specified).

In terms of overall quality, most of the studies with significant findings were rated as moderate[32,34,40,43] and one was strong.[44] Each study measured maternal distress by self-report. Each of the studies that based its assessment of child behaviour on maternal report controlled for current maternal mood.[32,34,43] In the studies that reported magnitudes of effect, all found small effect sizes for the relationship between toddler externalizing behaviour and prenatal distress.[32,34,44] No effect size was reported by the single significant study of postpartum depression.[40]

Moderators and mediators. DeBruijn et al. found that the effect of prenatal anxiety/depression differed between boys and girls when analyzed separately.[32] Specifically, there was no relationship between prenatal distress and externalizing behaviours in boys; however, combined measures of prenatal anxiety/depression and state-trait anxiety at 36 weeks gestation were associated with externalizing behaviours in girls. However, interactions between maternal distress and child sex were not found to be significant by Gao et al.[45] and

diPietro et al.,[44] suggesting that the influence of maternal distress on toddler behaviour was the same whether the child affected was a boy or a girl.

Using structural equation modelling, Ruchkin et al. found that the direct relationship between prenatal mood and externalizing behaviours was fully mediated by current family dysfunction and current depression.[43] The authors suggested that the development of externalizing problems in toddlers originated with maternal prenatal distress, which progressed through a chain of risk involving current depression and family dysfunction.[43]

Other potential confounders. Other significant predictors of behavioural problems included: low paternal education (n=1), lack of psychological well-being at 2 years, maternal psychiatric problems before pregnancy, paternal psychiatric problems at any time, poor mother child interaction, current family dysfunction, ethnicity, and child health problems. Factors that did not play a role in toddler behaviour comprised obstetrical factors (parity, n=2; biomedical risk during pregnancy; obstetric complications, n=2), child factors (child age; infant complications; 5-minute Apgar scores, n=2; birthweight, n=2; breastfeeding duration), social factors (social support, family structure), and parenting/family factors (day care attendance prior to one year of age, child rearing practices, family size, family structure, and marital status).

The relationship between toddler behaviour and maternal distress was equivocal for a number of factors, including: prenatal alcohol, child sex (with boys at risk in 2 studies and girls at greater risk in one), maternal age, and prenatal smoking, gestational age, gender, and prenatal alcohol. Overall, 9 studies found a non-significant association with income, education, housing status or socioeconomic status, and one found a significant relationship.

The impact of current maternal mood on toddler behaviour is unclear. For example, Gutterling et al. found a small effect of poor psychological health on attention regulation,[34] whereas Gao et al. found no effect.[45] DeBruijn et al. found that current maternal depression had a moderate effect on externalizing behaviour in both boys and girls based on maternal report, but this finding was not repeated when the outcome was based on paternal report.[32] As such, it is not clear whether current maternal distress played a role in externalizing behaviour,

or whether the association reflected depressed mothers' perceptions of their children's behaviour as more problematic.

Table 7: Key Aspects of Studies of Maternal Distress and Toddler Behaviour

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
deBruijn 2009[32]	Community (n=444)	Mother and father	prenatal	S	small	(current)	Minimal	M
Gutterling 2005[34]	Community (n=119)	Psychologist and mother	prenatal	S	Small	(current)	Yes	M
Righetti-Veltema 2003[40]	Community (n=25)	psychiatrist	postpartum	S	Not reported	No	Minimal	M
DiPietro 2006[44]	Community (n=82)	psychologist	Prenatal postpartum	S NS	small -	Yes (+ current)	Minimal	S
Ruchkin 2008[43]	Community (n=692)	mother	Prenatal	S (indirect effect)	Indirect effect not reported	(current)	Yes	M

Brouwers 2001[16]	**Community (n=131)**	**researcher**	**prenatal**	**NS**	**-**	**No**	**No (not for this analysis)**	**S**
Mantymaa 2004[35]	**Community (n=50)**	**mother**	**prenatal**	**NS**	**-**	**(pre-pregnancy)**	**Yes**	**W**
Robinson 2008[36]	**Community (n=1979)**	**mother**	**Prenatal postnatal**	**NS NS**	**- -**	**Yes**	**Yes**	**M**
Gao 2007[45]	**Community (n=1398)**	**mother**	**Postpartum**	**NS**	**-**	**(current)**	**Yes**	**M**

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Toddler Cognitive Development (Table 8)

General overview of studies (n=13). Thirteen longitudinal studies explored the association between toddler cognitive development and prenatal (n=8) and postpartum distress (n=6). These studies recruited participants from the Netherlands (n=1), U.K. (n=4), Canada (n=2), U.S. (n=4), and Australia (n=2) and represented 11 different cohorts. Sample sizes ranged from 42 to 4109, with 9 of 13 studies having less than 135 participants (total N = 7021). Eight of these samples were community-based, whereas 5 involved unique populations comprising adolescents,[37,46] women attending an amniocentesis clinic,[47,48] and women participating in a residential parentcraft program for infant difficulties.[21]

Maternal distress was conceptualized in a variety of ways. Prenatal influences included state-trait anxiety,[16,44] anxiety,[44] stressful life events/ objective stress,[44,47-50] pregnancy-related stress; [44] perceived stress;[44,49,50] personal adjustment (emotional withdrawal, depression),[37] and depression.[44,51] Four of these studies assessed these maternal exposures during pregnancy (no trimesters specified),[47-50] one assessed distress during the second and third trimesters, [44] and 3 focused on the third trimester. No studies specifically assessed the effect of first trimester distress.

Postpartum exposures included separation anxiety[46] and postpartum depression.[19,21,52] Six studies measured postpartum distress in the first 6 months postpartum[19,21,44,46,53] and 5 assessed it in the last half of the first postpartum year.[19,21,46,52,53] Cognitive development was assessed between 15 and 36 months for indicators of mental development;[16,19,21,44,46-49] play patterns;[50] language development,[19,21,37,49,51-53] intelligence,[37] and visual-motor abilities.[51]

Quality. Among the 13 studies, 5 had overall quality ratings of strong, 5 were moderate, and 3 were weak. Attrition rates ranged from <10% to 62% and were a main limitation in this group of studies. Other factors that contributed to lower quality ratings were not including potential confounders (n=4 weak), lack of blinding of the outcome assessor (n=4 weak), and having a high potential for selection bias (n=2). Seven of the 8 studies exploring prenatal distress adjusted for postpartum distress[16,44,47-51] and 2 controlled for current distress.[16,44] All studies used psychometrically evaluated measures of maternal distress and toddler cognitive development. All studies used self-report measures for maternal distress, and Murray used this in combination with a structured interview. Bergman et al. (2007; 2008) assessed the total number of stressful life events experienced in pregnancy retrospectively at the first postnatal visit.[47,48]

Overall, global cognitive development was conceptualized consistently in these studies. The majority of studies used Bayley Scales of Infant Development (mental development index),[16,19,21,44,46-49] one used a measure of functional play,[50] and one used the Stanford-Binet Form to measure intelligence.[37] In 6 of these studies, toddler cognitive development was evaluated by a researcher or psychologist.

Language development was assessed using a few different instruments, including the Peabody Picture Vocabulary test (n=2), MacArthur Communicative Development Inventory (n=2), the Reyell Developmental Language Scale (n=2), and the Receptive-Expressive Emergent Language Test (n=1). In most cases, researchers or psychologists assessed language development; however, one study based their assessment of language development on maternal report (not adjusted for current distress), and two did not provide details on the outcome assessor.

Main findings. In these studies, the rate of cognitive delay among toddlers varied widely. In the community-based samples, rates ranged from 22.0% to 54.3% in children of distressed women and 6% to 26.4% in those of non-distressed women.[16,19] In the studies of unique populations, sample rates were 19.7% in children of adolescents, and in children of

women who had attended a residential parentcraft centre at 4 months postpartum they ranged from 9% in toddlers of non-depressed mothers to 29% in those of depressed mothers.

Overall, 7 of the 13 studies reported significant direct relationships between maternal distress and toddler cognitive development[16,19,21,44,47,48,50] and 2 additional studies reported significant interactions[37,49] for a total of 9 significant studies. None of the 6 studies that focused on the language component of cognitive development found a significant direct association. Of the 9 significant studies, 5 had an overall quality rating of strong[16,19,44,47,48] and 4 were moderate.[21,37,49,50] Among the studies that demonstrated an independent association between prenatal distress and toddler cognitive outcomes, all controlled for postpartum distress and, in 2 cases, current maternal distress.[16,44] Among those that did adjust for postpartum distress, none found a significant effect of postpartum distress on cognitive development. None of the studies exploring postpartum depression controlled for prenatal distress specifically, although Murray et al. reported important findings regarding to the effects of first onset postpartum depression compared to women with a past history of depression.[19]

The findings of these studies suggest that maternal distress occurring across the continuum of pregnancy and postpartum periods has a negative impact on toddler cognitive development. Specifically, significant findings were found for exposures in the second trimester,[44] third trimester,[16,37,44] during pregnancy in general (trimesters not specified),[47-50] and in both the first[19,21] and last 6 months[19,21] of the first postpartum year. Specific forms of distress that were related to toddler cognitive development were prenatal anxiety,[16,44] prenatal stressful life events/objective stress,[47,48,50] prenatal depression,[44] personal adjustment (emotional withdrawal, depression),[37] and postpartum depression.[19,21] In addition, Bergman et al. reported that analyses conducted using perceived stress during pregnancy (also retrospectively assessed at first postnatal visit) showed similar results to those using stressful life events.[47,48]

Overall, studies that reported magnitudes of effect found moderately sized effects of prenatal distress on toddler cognitive outcomes, after controlling for postpartum distress. Cornish et al. reported a large effect size (OR=3.36), but this estimate was not adjusted by any potential confounders.[21]

Moderators and mediators. Bergman et al. (2008) did not find an interaction between maternal-child attachment and prenatal stress, suggesting that the effect of prenatal stress on toddler cognitive development was not different among dyads with optimal versus suboptimal attachment.[48] In exploring interactions between the timing of prenatal stress, cognitive scores, and gestational age, Laplante et al. found that stress in the first and second trimesters was associated with poorer cognitive development, whereas higher birthweight was an important predictor for women exposed during the third trimester.[49] Three studies did not find a significant interaction between maternal distress and child sex. However, Sommer et al. found that boys of depressed adolescent mothers had better verbal abilities than girls, suggesting that girls' language development was more affected by maternal depression than that of boys.[37] This study did not find an interaction between depression and socioeconomic status, implying that the effect of maternal depression on toddler intelligence was the same whether the adolescent mothers were advantaged or disadvantaged. In subanalyses, Laplante et al. found that cognitive scores were lower in women who experienced stress in the first or second trimesters, but not the third.[49]

Other potential confounders. Other significant predictors of delayed cognitive development in toddlers were: impaired child-parent attachment/ maternal caregiving (n=2), poor familial support (in adolescents), African-American race, and lack of separation-individuation (in adolescents). Factors that were not significant predictors of cognitive development were: child factors (Apgar score at 1 and 5 minutes; breastfeeding; gestational age); family/parenting factors (home environment; maternal attachment; living with child's grandparents; marital conflict; paternal psychiatric history); maternal factors (maternal age; verbal intelligence); obstetrical factors (parity; mode of delivery; complications; pregnancy history; unplanned pregnancy; multiple births); and maternal behaviours (prenatal smoking; prenatal alcohol).

Language development was predicted by: child age, maternal IQ, social class/SES, child sex (boys poorer scores), and impaired maternal caregiving at 10 months. However, the effect

of some factors on cognitive development is unclear for some factors, including: child sex, birthweight (1 significant; 4 non-significant), maternal IQ, maternal education (3 significant; 3 non-significant) and socioeconomic status (4 significant; 4 non-significant). This summary does not represent a comprehensive list of predictors as some studies did not report the individual significance of the potential confounders they examined (n=4).

Table 8: Key Aspects of Studies of Maternal Distress and Toddler Cognitive Development

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
Brouwers 2001[16]	Community (n=131)	researcher	prenatal	S (general cognitive)	Moderate	Yes (+ current)	Yes	S
Bergman 2007[47]	Community (n=123)	researcher	prenatal	S (general cognitive)	Moderate	Yes	Yes	S
Bergman 2008[48]	Community (n=123)	researcher	prenatal	S (general cognitive)	Moderate	Yes	Yes	S
Laplante 2007[50]	Community (n=52)	researcher	prenatal	S (general cognitive)	Not reported	Yes	yes	M
Laplante 2004[49]	Community (n=52)	researcher	prenatal	NS (interaction) (general cognitive and language)	Not reported	Yes	Yes	M
Cornish 2005[21]	Clinical (n=112)	researcher	postpartum	S (general cognitive)	large	No	Minimal	M
Murray 1992[19]	Community (n=111)	psychologist	postpartum	S (general cognitive); NS (language)	Not reported	No	Yes	S
DiPietro 2006[44]	Community (n=82)	psychologist	Prenatal postpartum	S NS (general cognitive)	Moderate -	Yes (+ current)	Minimal	S
Sommer	Inner city	researcher	prenatal	S	Not reported	No	Yes	M

2000[37]	adolescents (n=121)			(interaction) (general cognitive and language)				
Tse 2010[51]	Community (n=990)	researcher	prenatal	NS (language)	-	Yes	Yes	M
Aiello 2007[46]	Adolescents (n=71)	psychologist	postpartum	NS (general cognitive)	-	No	Minimal	W
Paulson 2009[52]	Community (n=4109)	mother	postpartum	NS (language)	-	No	Minimal	W
Stein 2008[53]	Community (n=944)	Not reported	postpartum	NS (language)	-	No	Yes	W

Toddler Emotional Development (Table 9)

General overview of studies (n=5). Four longitudinal[32,34,36,43] and one cross-sectional[35] study explored the association between toddler emotional development and maternal distress. Four studies focused on prenatal maternal distress,[32,34,36,43] one assessed postpartum baby blues,[36]and one assessed the effect of perinatal distress, which encompassed both pregnancy and postpartum periods.[35] These studies recruited participants from the Netherlands (n=2), Australia, Russia, and Finland. Sample sizes ranged from 50 to 1979 with 3 studies having over 500 participants (total N = 3284). All studies were community-based.

Prenatal influences included depression,[43] state-trait anxiety;[32] anxiety,[43] stressful life events,[34,36] pregnancy-related anxiety,[34] perceived stress,[34] psychological well-being,[34] cortisol,[34] combined anxiety/depression,[32] and psychiatric symptoms.[35] The single study that specifically assessed postnatal distress did so using the number of baby blues symptoms,[36] and Mantymaa et al.[35] studied psychiatric symptoms during the perinatal period (pregnancy and postpartum). These studies assessed toddlers between 24 and 33 months of age for internalizing behaviours.

Quality. Among the 5 studies, 4 had overall quality ratings of moderate[32,34,36,43] and one was weak.[35] Attrition rates ranged from 15% to 55% and were a source of limitation in this group of studies. Two studies scored weak on the selection bias rating[32,35] and one scored weak

for lack of inclusion of potential confounders.[35] None of the studies that explored prenatal distress adjusted for postnatal distress.

All studies used psychometrically evaluated measures of maternal distress and toddler emotional development. Maternal distress was assessed by self-report in all studies except Mantymaa et al.,[35] who used a structured diagnostic interview. Toddler emotional problems were consistently conceptualized as internalizing behaviours and the same child measure was used in all studies (i.e., Child Behavior Check List, Internalizing subscale). In each case, mothers reported on their child's emotional status. Three of these 5 studies controlled for current maternal distress.[32,34,43]

Main findings. The prevalence of emotional disorders in toddlers was reported in only one community-based study as 4.5%.[36] The sample means for internalizing behaviour were below clinical cut-offs in all studies that reported these data. Only one of the 5 studies found a significant association between maternal distress and child internalizing behaviours.[32] Specifically, a small effect of first trimester anxiety/depression was related to internalizing behaviour in boys based on maternal report, and third trimester anxiety/depression had a moderate effect on these behaviours in girls based on paternal report.[32] That these findings were observed when based on both maternal and paternal report and after controlling for current maternal distress limits the possibility that these associations were due to reporter bias.

Moderators and mediators. No studies assessed potential moderators. However, using structural equation modeling, Ruchkin et al. found that the relationship between prenatal mood disturbance and internalizing behaviours was fully mediated by current maternal depression and family dysfunction.[43] In other words, prenatal mood did not have a direct effect on toddler emotional problems. Its effect was on current maternal depression and family dysfunction, and these factors in turn increased the likelihood of developing toddler emotional problems.

Other potential confounders. Current maternal distress itself was significantly associated with emotional problems in 2 studies.[32,43] Other significant factors included low paternal education, child age, ethnicity, prenatal smoking, poor child health, and paternal psychiatric problems at any time. Predictors that were not related to emotional problems in any study were maternal age, gestational age, child sex, parity, 5-minute Apgar scores, breastfeeding duration, current family dysfunction, perinatal complications, social support, family structure, day care attendance, and mother-child interaction. Factors that demonstrated significance in some studies, but not in others include: socioeconomic status (1 significant; 3 non-significant) and prenatal alcohol use. Some potential confounders are not represented in this summary because their details were not reported.[34]

Table 9: Key Aspects of Studies of Maternal Distress and Toddler Emotional Development

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
deBruijn 2009[32]	Community (n=444)	Mother and father	Prenatal	S for both	small	(current mood)	Minimal	M
Gutterling 2005[34]	Community (n=119)	Mother	Prenatal	NS	-	(current)	Minimal	M
Robinson 2008[36]	Community (n=1979)	Mother	Prenatal Postpartum	NS	-	Yes	Yes	M
Ruchkin 2008[43]	Community (n=692)	Mother	Prenatal Postpartum	NS	-	(current)	Yes	M
Mantymaa 2004[35]	Community (n=50)	Mother	Perinatal	NS	-	No	Yes	W

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Toddler Psychomotor Development (Table 10)

General overview of studies (n=6). Six longitudinal studies evaluated the effect of prenatal[16,44,47] and postpartum distress[21,40,44,46] on toddler psychomotor development. Five different countries were represented in this group (U.K., Netherlands, Australia, Switzerland, U.S.). Sample sizes were quite small, ranging from 25 to 131 (total N= 544). Three of the 6

studies were community-based, and the remaining 3 recruited unique populations of women, including those undergoing amniocentesis,[47] women attending a residential parentcraft program for infant difficulties,[21] and adolescent mothers.[46] The specific forms of prenatal distress studied included state-trait anxiety,[16] anxiety,[44] perceived stress,[44] stressful life events,[44,47] and pregnancy-specific stress.[44] Postpartum depression was assessed in 2 studies[21,44] and postpartum separation anxiety in one.[46] Maternal prenatal distress was assessed during the whole of pregnancy,[47] the second and third trimesters,[44] and the third trimester only.[16] Postpartum distress was assessed in the first 6 months of the postpartum year by 3 studies,[21,44,46] and 2 included assessments in the latter 6 months of that year.[21,46] Infant psychomotor development was assessed in toddlers who were between the ages of 15 and 24 months.

Quality. Among the 6 studies in this group, 3 had overall quality ratings of strong,[16,44,47] 2 were moderate,[21,40] and one was weak.[46] Attrition rates ranged from less than 10% to 40%. Two studies were rated as weak for lack of inclusion of potential confounders, and one was rated weak for lack of blinding of the outcome assessor. A main strength of these studies was the multiple measures of maternal distress across pregnancy and postpartum. Three studies of prenatal distress controlled for postpartum distress[16,44,47] and 2 adjusted for current distress as well.[16,44] All studies used self-report measures of maternal distress and, in addition, Cornish et al.[21] used a structured diagnostic interview. Bergman et al. measured prenatal stress retrospectively during the first postnatal visit.[47] In all studies, toddler psychomotor development was assessed by a clinical psychologist or researcher using the Bayley Scales of Infant Development (psychomotor development index).

Main findings. The prevalence of psychomotor delay reported across 3 studies was quite consistent at roughly 17% in community-based samples, and in children of adolescent mothers and those who attended a residential parentcraft program at 6 months postpartum.[21,46] Cornish et al. found that this rate was greater in women with chronic depression (i.e., 26%).[21] The studies reported sample mean psychomotor indices that were at

or just below the clinical cut-off level. Among the 6 studies, 2 found significant effects of maternal distress on psychomotor delay. One study found moderate-sized effects of various forms of second and third trimester distress (anxiety, depression, pregnancy stress) on psychomotor scores while controlling for both postpartum and current distress. Of interest, no other predictors in this analysis were significant. One other study found a large, negative effect of chronic postpartum depression on psychomotor scores, although this study did not control for prenatal distress or any other potential confounders. In both cases, the child outcomes were assessed by researchers and psychologists.

Moderators and mediators. No studies conducted analyses to evaluate moderators or mediators of psychomotor development. Although 2 studies reported the individual significance of the potential confounders they assessed, none were significantly predictive of toddler development.

Table 10: Key Aspects of Studies of Maternal Distress and Toddler Psychomotor Development

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
Cornish 2005[21]	Clinical (n=112)	researcher	postpartum	S	large	No	No	M
DiPietro 2006[44]	Community (n=82)	psychologist	Prenatal Postpartum	S S	Moderate moderate	Yes (+ current depression)	minimal	S
Bergman 2007[47]	Amnio. Clinic (n=123)	researcher	prenatal	NS	-	Yes	Yes	S
Brouwers 2001[16]	Community (n=131)	researcher	prenatal	NS	-	Yes (+ current depression)	Yes	S
Aiello 2007[46]	Adolescents (n=71)	psychologist	postpartum	NS	-	No	Minimal	W
Righetti-Veltema 2003[40]	Community (n=25)	psychiatrist	postpartum	NS	-	No	No	M

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Results: Pre-Schooler Development

Global Indices of Pre-Schooler Development (Table 11)

General overview of studies (n=2). Two studies from the same longitudinal, community-based study (The Avon Longitudinal Study of Parents and Children, ALSPAC) assessed the effects of both prenatal and postpartum depression and anxiety on a composite index of preschooler behavioural and emotional problems.[54,55] Originating in the United Kingdom, these studies were based on a large birth cohort of 6493 participants. These studies measured prenatal distress in the second and third trimesters, and postnatal distress in the early postpartum period (i.e., 8 weeks), and assessed child outcomes at 47 months of age.

Quality. The overall quality of these studies was moderate, and the studies were rated as strong for all quality components except for lack of control of blinding due to maternal reporting of the child emotional and behavioural problems. The attrition rate was 30%, which was similar to other longitudinal studies of pre-schooler outcomes. These studies included both prenatal and postnatal distress in their analyses, thereby controlling for distress occurring at other times. A wide array of potential confounders including child factors (gestational age; birthweight; first born status; sex), maternal behaviours (prenatal smoking and alcohol), perinatal factors (e.g,. mode of delivery), and socioeconomic status (e.g., maternal education; household crowding) were considered. Although both studies were based on maternal report of the child outcome, neither controlled for current maternal distress.

Main findings. The proportion of preschoolers with emotional and behavioural problems was not reported. In their study exploring a broad spectrum of prenatal (anxiety and depression at 18 and 32 weeks) and postpartum distress (depression at 8 weeks and 8 months), O'Connor et al.(2002) found that third trimester anxiety and postpartum depression at 8 weeks

were the only forms of distress associated with emotional/behavioural problems.[54] These studies revealed a moderate effect of prenatal anxiety on this child outcome. In analyses further exploring the fetal programming hypothesis, O'Connor et al. (2003) found a large, significant effect of prenatal anxiety at 32 weeks and total emotional/behavioural problem scores in boys (AOR 2.66, CI 1.81 – 3.93) and a smaller, moderate effect in girls (AOR 1.84, CI 1.27 – 2.69) after controlling for postnatal distress (8-week anxiety was not included).[55] No significant association was found for postnatal anxiety or depression. In both cases, these effects were achieved after controlling for maternal distress in other time period and a large number of additional potential confounders.

Moderators and mediators. In O'Connor et al. (2002), prenatal depression at 18 (AOR 1.76, CI 1.22 – 2.54) and 32 weeks (AOR 1.72, CI 1.19 – 2.47) had moderate, significant effects (AOR 1.76, CI 1.22 – 1.54) on preschooler emotional and behavioural problems in a model including prenatal (18 and 32 weeks) and postnatal (8 weeks and 8 months) depression.[54] Once adjusted for prenatal anxiety, prenatal depression at either time point was no longer significant, implying that its effects were less impacting than prenatal anxiety. O'Connor et al. suggested that prenatal depression may mediate the effect of postpartum depression on these child problems, or may act as a marker of prenatal anxiety.[54] In this study, other significant predictors of preschooler emotional and behavioural problems were small for gestational age, smoking during pregnancy, lower education, maternal age $\geq$21 years, and child sex (male). The odds of a child having emotional or behavioural problems was unaffected by prenatal alcohol usage or household crowding.

Table 11: Key Aspects of Studies of Maternal Distress and Global Indices of Pre-Schooler Development

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
O`Connor 2003[55]	Community (n=6493)	mother	Prenatal postpartum	S NS	Large (boys); moderate (girls) -	Yes	Yes	M
O`Connor 2002[54]	Community (n=6493)	mother	Prenatal postpartum	S NS	Moderate moderate	Yes	Yes	M

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Pre-Schooler Behaviour (Table 12)

General overview of studies (n=2). Two longitudinal, community-based studies assessed the effects of postpartum depression on preschooler behavioural problems.[56,57] These studies recruited participants in the U.S.[57] and Sweden[56] and had sample sizes of 70[57] and 675[56] (Total N=745). Josefsson et al.'s sampling approach was to identify 221 index women with postpartum depression and 454 controls matched on child sex.[56] No studies were found that evaluated the effect of prenatal distress on preschooler behaviour. Joseffson et al. assessed postpartum depression at 2 time periods (6-8 weeks; 6 months),[56] and Philipps et al. did not provide details on this assessment.[57] These studies assessed child behaviour at 4[57] and 4-1/2[56] years of age.

Quality. The overall quality of these studies was moderate[56] and weak.[57] Factors contributing to a reduced quality rating in these studies were lack of blinding of the outcome assessor,[56,57] and lack of inclusion of potential confounders. Attrition rates were 10%[56] and 29%.[57] Both studies controlled for current depression, but neither adjusted for prenatal distress. Josefsson et al.[56] considered a few potential confounders, whereas Phipps et al.[57] did not. These studies used different psychometrically tested instruments to assess child behaviour by maternal report.

Main findings. The prevalence rate of behaviour problems was not reported in either study. In the smaller of the 2 studies, postpartum depression did not significantly predict externalizing behaviours.[57] The larger study found a moderately-sized, significant effect of postpartum depression (at any time) on disturbed preschooler behaviour (AOR 2.03, CI 1.16 – 3.56),[56] although the magnitude of this relationship may be inflated because few potential confounders were assessed. However, once controlled for current maternal distress, this relationship was no longer significant.[56]

Moderators and mediators. Neither study specifically assessed moderators or mediators of the relationship between postpartum depression and preschooler behaviour problems. However, Josefsson et al. found that the relationship between postpartum depression and child behaviour was no longer significant when current depression was included in the analysis.[56] In this subanalysis, current depression at 4.5 years (AOR 4.71, CI 1.88 – 11.78) and, to a slightly lesser degree, current depression + postpartum depression (AOR 3.71, CI 1.75 – 7.87), significantly predicted child behaviour.[56] Although these findings contribute to our understanding of the development of preschooler behaviour problems, it should be noted that mothers were the source of data for this child outcome and the potential effect of reporter bias is largely unknown. This is in contrast to the relationship between postpartum depression and child behaviour at 4-1/2 years, which reflected a prospective approach.

Table 12: Key Aspects of Studies of Maternal Distress and Preschooler Behaviour

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
Josefsson	Community	mother	postpartum	S (until	Moderate	(current	Minimal	M

2007[56]	**(subsample of cases with depression and controls without) (n=625)**			**adjusted by current depression, then NS)**		**depression)**		
Philipps 1991[57]	**Community (n=70)**	**mother**	**postpartum**	**NS**	**-**	**(current depression + depression at 1 to 4.5 years)**	**No**	**W**

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Pre-Schooler Cognitive Development (Table 13)

General overview of studies (n=3). Three longitudinal, community-based studies evaluated the effects of both prenatal and postpartum distress on preschooler cognitive development.[58-60] Two of these studies[58,59] are based on the same sample, although Sharp focused on a subsample of disadvantaged families with higher rates of maternal psychopathology.[59] These 3 studies recruited women and children from New Zealand and the U.K. and had sample sizes ranging from 92 to 550. Slykerman et al. assessed prenatal perceived stress during the late third trimester,[60] and the others assessed it during both the prenatal and postpartum periods. [58,59] Preschooler cognitive outcomes were assessed at 3.5[60] and 4[58,59] years of age.

Quality. The overall quality of these studies was strong[60] and moderate.[58,59] These studies achieved strong or moderate ratings on all components of the quality assessment. Attrition rates varied from 23% to 46%. All studies used psychometrically evaluated measures of maternal distress and child cognitive status. Maternal distress was measured by self-report in one study[60] and both self-report and diagnostic interview in the remaining studies.[58,59] Slykerman et al. assessed prenatal stress retrospectively (e.g., just after delivery for the previous month).[60] Indicators of child cognitive ability were similar in all studies (e.g.,

intellectual attainment; intelligence) and were assessed by examiners and psychologists. Two of the 3 studies controlled for current[60] or postnatal distress.[59]

Main findings. The prevalence of cognitive delay was not reported in any study. All 3 studies found significant associations between maternal distress and preschooler cognitive outcome. The findings of these studies suggest that cognitive development in preschoolers is influenced by maternal distress occurring in either the prenatal or postnatal periods. Specifically, perceived stress in the third trimester was related to a large reduction in mean standardized intelligence scores of 3.4 points (Mean difference -3.4, CI -6.0, -0.8).[60] Hay et al. and Sharp et al. both found a relationship between postpartum depression in the first year and lower cognitive scores, even after controlling for current depression.[58,59] In these analyses, current depression did not contribute to the development of child cognitive development.[58,59] In the whole sample, the lower cognitive scores were largely due to poorer performance on the perceptual-performance and motor subscales, which measure an aspect of intelligence (e.g., sensorimotor intelligence) that develops rapidly in the child's first year of life.[58] Effect sizes varied widely in these 3 studies from small to large, and in each case these were observed after controlling for a large number of potential confounders.

Moderators and mediators. In their analysis of disadvantaged families, Sharp et al. found a significant interaction between maternal postpartum depression and child sex.[59] Specifically, they found that postpartum depression had a large effect on boys' cognitive development, whereas girls were unaffected. Depression that mothers experienced after the postpartum period and prior to the current assessment did not impact boys' or girls' cognitive scores. Further analysis showed that the main factors contributing to low cognitive scores were suboptimal performance on perceptual, verbal, motor, and memory subscales.[59]

In the whole sample, however, Hay et al. did not find significant interactions between maternal depression and child sex (i.e., boys and girls were equally affected by maternal depression) or maternal depression and maternal education (i.e., the effect of maternal depression on cognition did not vary depending on whether the mother was advantaged or

disadvantaged).[58] In the disadvantaged subsample, the interactions between maternal depression and indicators of socioeconomic status (education; social class) remained negative, indicating that among these women the effect of these mothers' illness on child cognition was still the same whether a mother was advantaged or disadvantaged.[59]

Table 13: Key Aspects of Studies of Maternal Distress and Preschooler Cognitive Development

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
Slykerman 2005[60]	Community (half SGA) (n=550)	examiner	prenatal	S	Large	Yes	Yes	S
Hay 1995[58]	Community (n=92)	psychologist	Prenatal Postpartum	NS S	- Moderate	No	Yes	M
Sharp 1995[59] (same sample as Hay)	Community (n=172)	psychologist	Prenatal Postpartum	S	Small	Yes (+ depression from 1 to 4.5 years)	Yes	M

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Pre-Schooler Emotional Development

General overview of studies (n=1). Only one longitudinal, community-based study assessed the effect of postpartum depression on preschooler emotional health.[57] This small (n=70) study from the United States assessed the effect of depression at any time in the first postpartum year on internalizing symptoms in children at 4.5 years of age.

Quality. This single study had an overall quality rating of weak for limitations involving a lack of consideration of potential confounders, lack of blinding of the outcome assessor, and an

attrition rate of 29%.[57] Both maternal depression and child outcomes were measured with psychometrically evaluated instruments, and both involved maternal report.[57] This analysis controlled for the influence of current depression (e.g., at 4.5 years).

Main findings. Philipps et al. did not find a significant association between postpartum depression and internalizing symptoms (no data provided).[57] However, they did find that maternal depression that had occurred after the first postpartum year, but prior to the current assessment was related to poorer emotional health among preschoolers.

Moderators and mediators. No moderators or mediators were assessed.

Results: School-Aged Child Development

Global Indices of School-Aged Child Development (Table 14)

General overview of studies (n=4). Four longitudinal, community-based studies assessed the effect of prenatal[36,55,61] and postpartum distress[36,55,61,62] on global indices of development in school-aged children. Originating from the U.K. and Australia, these studies represented 3 different birth cohorts and one administrative data analysis. Sample sizes of these studies were large, ranging from 1979 to 6493 (Total N= 17912). The forms of prenatal distress were stressful life events,[36] depression,[62] and anxiety,[55] and postpartum distress included the number of baby blues,[36] and postpartum depression.[55,61,62] Prenatal distress was assessed during the pregnancy (specific trimester not defined),[36,61] and during the third

trimester.[55] Postpartum distress was measured in all studies during the first 6 months postpartum.[36,55,61,62] Three studies assessed child development at age 5,[36,61,62] with one performing assessments at 6.75 years (81 months).[55]

Quality. Among the 4 studies in this group, one received an overall quality rating of strong,[62] and the remaining studies were moderate. Attrition rates were similar across these studies at roughly 30%. The main limitation shared by these studies was the lack of blinding of the outcome assessor (e.g., maternal report of child outcome). Three of these studies measured maternal distress over multiple time points during pregnancy and the postpartum period.[36,55,61] All 3 studies of prenatal distress controlled for postpartum and/or current distress.[36,55,61] Two of the studies controlled for maternal distress occurring at other times by including prenatal and postnatal distress together in multivariable analyses.[36,55] All studies used self-report measures of maternal distress.

School-aged indices of development were conceptualized consistently in 3 of the 4 studies, encompassing dimensions of emotional and behavioural problems. The remaining study used a global index with skill-based components related to math, literacy, social, and independent learning skills.[62] As such, the child outcomes were reported by the mothers in 3 studies,[36,55,61] and one study utilized teacher reports.[62]

Main findings. The prevalence rates of global developmental delay reported by 2 studies were quite consistent at 13.6%[36] to 22%.[62] Three of the four studies found significant associations between maternal distress and global indices of emotional/behavioural development in school-aged children.[36,55,61] In the remaining study (which measured global delay in terms of literacy, math, social, and independent learning skills), the lower limit of the confidence interval was 1.0 (i.e., AOR 1.3, CI 1.0 – 1.7).[62] In each of the significant studies, child development was reported by the mother, whereas the non-significant study was by teacher report. However, none of the significant studies using maternal report of child development controlled for current maternal distress.

The findings of these studies suggest that distress that occurs at any point during pregnancy and through to 6 months postpartum can have a detrimental impact on the global development of school-aged children. Specifically, cumulative prenatal stress[36] and that occurring in the third trimester[55] increased the odds of developmental delay. Three of the four studies that assessed postpartum depression in the first few days postpartum[36] up to 6 months[61] found associations as well. In terms of effect sizes, both small and moderate effects were found for exposures during the prenatal period, after adjusting for postpartum distress and multiple potential confounders.[36,55] O'Connor et al. found that the magnitudes of prenatal effect were somewhat higher in boys (AOR 2.16, CI 1.41 – 3.30) than girls (AOR 1.91, CI 1.26 – 2.89), suggesting that boys were affected more by prenatal distress.[55] Similar magnitudes of effect were noted for postpartum distress. In particular, Robinson et al. found a small effect of the number of baby blues on developmental delay (AOR 1.15, CI 1.06 – 1.23)[36] and O'Connor et al. found moderate effects of postnatal anxiety on girls (AOR 1.79, CI 1.08 – 2.97) (but not boys), and postnatal depression on boys (AOR 2.03, CI 1.13 – 3.62) (but not girls).[55]

Moderators and mediators. One study focused on assessing the effect of chronicity and severity of depression across the pregnancy and postpartum periods on developmental indices.[61] The severity of depression, defined as moderate or severe by the number of symptoms, had a moderate effect on developmental delay. Chronicity of depression, based on the number of depressive episodes in pregnancy and postpartum, also had a modest effect on developmental indices. This study also found a significant interaction between severity and chronicity of depression, suggesting that children of mothers who had both chronic and severe depression were more likely to experience developmental delay.

In testing the programming hypothesis, O'Connor et al. found that the magnitude of the effect of prenatal anxiety on global development declined slightly from 47 to 81 months in boys (e.g., 47 months: AOR 2.66, CI 1.91 – 3.93; 81 months: AOR 2.16, CI 1.41 – 3.30), but remained stable for girls (e.g., 47 months: AOR 1.84, CI 1.27 – 2.69; 81 months: 1.91, CI 1.26 – 2.89).[55] O'Connor et al. suggested that the enduring effects of prenatal anxiety on development

support a fetal programming mechanism whereby the influence of maternal stress on child outcomes is mediated by dysregulation of the hypothalamic pituitary adrenal (HPA) axis.[55]

Other potential confounders. Other significant predictors of global emotional/ behavioural delay in school-aged children were: prenatal smoking (n=2), male sex (n=2), parity (protective; n=2), shorter breastfeeding duration, father not living in home, not having any form of preschool education, low maternal education (n=2), and a poor home environment. Factors that were not associated with emotional/behavioural delay were prenatal alcohol (n=2), mode of delivery, 5-minute Apgar scores, and birth order (n=2). Factors that were found to be related in some studies, but not others were: maternal age (1-S; 1-NS), and gestational age (1-S; 1-NS).

Factors that influenced global delay based on literacy, math, social, and independent learning skills were: bottle feeding at one month, low birthweight, increased parity, ethnicity, and housing disrepair.

Table 14: Key Aspects of Studies of Maternal Distress and Global Indices of Development in School-Aged Children

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
Robinson 2008[36]	Community (n=1979)	mother	Prenatal Postpartum	S S	Small small	Yes	Yes	M
Brennan 2000[61]	Community (n=4953)	mother	Perinatal	S	Small	(chronicity assessed)	Minimal	M
O'Connor 2003[55]	Community (n=6493)	mother	Prenatal Postpartum	S s	Moderate Moderate	Yes	Yes	M
Rigby 1999[62]	Community (n=4487)	teacher	Postpartum	NS	-	(previous psychological history)	Yes	S

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

School-Aged Child Behaviour (Table 15)

General overview of studies (n=8). Eight longitudinal studies from 5 different countries (e.g., Australia, Scandinavia, Sweden, U.S., U.K.) examined the effect of maternal distress on

behaviour in school-aged children. While 3 of these studies explored the effect of maternal prenatal distress,[36,55,63] twice as many studied postpartum distress.[36,55,64-68] Five of these studies were community-based, and 2 represented unique samples of women admitted to a psychiatric unit[64] or a parent-craft centre for infant problems.[67] Sample sizes in the community-based cohorts ranged from 290 to 6493, while those representing higher risk women ranged from 75 to 95 (Total N = 10387).

The studies of prenatal distress focused on stress (e.g., perceived stress, stressful life events)[36,63] and anxiety,[55] whereas studies of postpartum distress assessed a broader array of exposures, including the number of baby blues,[36] psychiatric problems,[64] depression,[65-68] maternal separation anxiety,[65] and anxiety.[55] Prenatal distress was assessed over the whole of pregnancy[36] and during the third trimester.[55] Four of the studies of postpartum distress measured it during the early postpartum period (e.g., <6 months)[36,64,67,68] and 2 assessed it in the latter half of the postpartum year.[55,67] One study defined postpartum depression by its occurrence at any point in the first postpartum year.[66] Child outcomes were assessed when children were between 5 and 8 years of age.

Quality. Among the 8 studies in this group, 5 were rated as moderate and 3 were weak.[64-66] Attrition rates were reasonable in this group despite the long follow-up, with 6 of 8 studies having rates less than 25%. The main limitations shared by these studies were the lack of blinding of the outcome assessor (e.g., maternal report of child outcome) (n=5) and lack of consideration of potential confounders (n=6). All studies utilized widely used, psychometrically tested measures of maternal distress. Half of the studies measured maternal distress over multiple time points during pregnancy and the postpartum period. Two studies that assessed both prenatal and postnatal distress controlled for both time periods in their analyses,[36,55] and Fihrer et al.[67] formally tested current depression as a mediator. None of the other postpartum studies adjusted for the potential influence of prenatal or current distress. All but 2 studies used self-report measures of maternal distress,[64,66] and Fihrer et al. used both self-report and diagnostic interview.[67]

Child behaviour problems were defined in a number of different ways, including as externalizing behaviour,[36,64-67] ADHD,[63] difficulties with concentration, inattention, and behaviour;[55,63,68] lower school work efficiency,[64] and difficulty with school adjustment (readiness, maturity). As such, a number of different instruments were used to assess this outcome, although all had been psychometrically evaluated. Rodriguez et al. based their assessment of ADHD on a general assessment of attention and behavioural difficulties (mild ADHD) and having 6 or more symptoms described in the DSM-IV (a measure of greater severity).[63] Child behaviour was reported by the mothers in 3 studies,[36,55,65] by teacher report in 2,[66,68] and by both mother and teacher report in 3.[63,64,67] None of the studies that based their outcome assessment on maternal report controlled for current distress. While Rodriguez averaged the parent/teacher scores of child behaviour in order to provide an average measure of behaviour across different (home, school) environments, Fihrer et al.[67] and Albertsson et al.[64] compared the reports provided by both sources.

Main findings. Overall, the prevalence rates of behaviour problems based on recruitment from community samples and the parent-craft residential program ranged from 7% to 18%, with a rate of 17.8% reported for ADHD.[63] Seven of 8 studies found significant associations between behaviour problems in school-aged children and exposure to both prenatal and postpartum distress, including cumulative prenatal stress,[63] prenatal anxiety in the third trimester),[55] postnatal psychiatric illness,[64] postpartum depression or depressive symptoms,[55,65-68] and postpartum anxiety.[55] In these studies, postpartum distress occurring either in the early or late postpartum periods negatively impacted school-aged behaviour. The study that reported non-significant findings had a lower confidence interval limit of 1.00 (AOR 1.05, CI 1.00 – 1.11) for the effect of the number of postpartum baby blues on externalizing behaviours.[36]

The effect sizes reported by this group of studies were small to moderate. By timing of maternal distress, little difference was apparent in the magnitudes of effect of exposures occurring in the prenatal versus the postpartum periods. Specifically, prenatal perceived stress across pregnancy and mild ADHD (B=.17);[63] third trimester prenatal anxiety and inattention/

hyperactivity (boys: AOR 1.85, CI 1.18 – 2.91; girls: AOR 2.10, CI 1.20 – 3.39);[55] and conduct problems (boys: AOR 1.62, CI 1.07 – 2.47; girls: AOR 1.62, CI 1.01 – 2.62) yielded small to moderate effect sizes.[55] The moderately sized effects achieved by O'Connor et al. were after adjustment for maternal distress in other time periods and a large number of potential confounders. ADHD diagnosis based on the number of DSM-IV symptoms yielded a large adjusted odds ratio of 9.3 (CI 1.65 – 52.38), but this study controlled for very few potential confounders and may represent an inflated effect.[63] For exposures during the postpartum period, small effects were found for postpartum distress and externalizing behaviours (.09 - .25)[65,67] and behaviour problems.[68] Moderate effects were found for the effect of postpartum depression on: externalizing behaviour comorbid with internalizing behaviour (AOR 2.15, CI 1.07 – 4.32)[66] and conduct problems in boys (AOR 1.95, CI 1.13 – 3.37);[55] and for the effect of postpartum anxiety on conduct problems in girls (AOR 1.94, CI 1.10 – 3.42). No clear pattern was apparent regarding the magnitude of effect and timing of postpartum distress (e.g., early vs late in the postpartum year).

Moderators and mediators. Two studies found significant interactions between maternal distress and child sex.[63,68] In both cases, the association between prenatal stress and ADHD[63] and postpartum depression and behavioural scores[68] was largely accounted for by the effect of distress on boys. In further exploring the effect of timing of prenatal stress across all trimesters and ADHD, Rodriguez et al. found that stress at the beginning of pregnancy (e.g., by 10 weeks) had the greatest effect on the development of ADHD, whereas stress at later times had little effect. [63] Given that the comorbidity of internalizing and externalizing symptoms in children has received little attention, Essex et al. examined the effect of postpartum depression on both "pure" externalizing symptoms and those comorbid with internalizing behaviours.[66] Their findings demonstrated that postpartum depression had a greater effect on the development of comorbid symptoms (AOR 5.00, CI 2.05 – 12.30) than externalizing symptoms alone (AOR 2.23, CI 0.94 – 5.37) [66]. In evaluating the role of current depression, Fihrer et al. found that the relationship between postpartum depression and child behaviour at age 6-8 was fully mediated by current depression.[67] In other words, postpartum depression was related to

the development of current depression, and current depression was associated with increased behavioural difficulties. Recurrent depression (e.g., the number of depression episodes since the postpartum depression) did not lessen the effect that postpartum depression had on behaviour at 6 to 8 years of age. However, they did find that severity of depression at 4 months postpartum was associated with externalizing behaviour.

Other potential confounders. Other predictors that were significantly related to externalizing behaviour in school-aged children included: low gestational age and social support. Factors that were not significant in any of these studies were: maternal age (n=2), prenatal alcohol, parity, 5-minute Apgar scores, breastfeeding duration, father not living in home, maternal health, father's or mother's employment status, child care plans, locus of control, and being non-English speaking. However, factors which were equivocal in their relationship to child behaviour were: maternal education, income; ethnicity, prenatal smoking, and child sex.

Table 15: Key Aspects of Studies of Maternal Distress and Behaviour in School-Aged Children

Citation	Type of Sample	Outcome assessor(s)	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
Rodriguez 2005[63]	Community (n=290)	Mother and teacher	prenatal	S	Small based on symptoms; large based on DSM-IV diagnoses	No	Minimal	M
Albertsson-Karlgren 2000[64]	Clinical (n=86)	Mother and teacher	Postpartum	S	Not reported	No	Minimal	W
Essex 2001[66]	Community (n=421)	Teacher	Postpartum	S	Moderate	No	Minimal	W
Fihrer 2009[67]	Clinical (n=75)	Mother, father, teacher	Postpartum	S	Small	No	Minimal	M
O'Connor 2003[55]	Community (n=6493)	mother	Prenatal Postpartum	S S	M M	Yes	Yes	M
Sinclair 1998[68]	Community (n=95)	teacher	Postpartum	S	-	No	Minimal	M
Anhalt 2007[65]	Community (n=948)	mother	Postpartum	S	Small	No	Yes	W
Robinson 2008[36]	Community (n=1979)	mother	Prenatal Postpartum	NS NS	- -	Yes	Yes	M

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

School-Aged Child Cognitive Development (Table 16)

General overview of studies (n=7). Seven longitudinal studies examined the effect of maternal prenatal[69-72] and postpartum[61,73,74].distress on cognitive outcomes in school-aged children. Six different countries were represented in this group of community-based studies (Netherlands, Canada, United States, United Kingdom, New Zealand, Australia) with sample sizes ranging widely from 89 to 4953 (Total N =7182). Several forms of maternal prenatal distress were assessed in these studies, including stressful life events,[69,70] pregnancy-related anxiety,[69] cortisol,[69,71] psychological distress,[72] and depression.[61] These studies measured prenatal distress during the second[69] and third trimesters,[69,71,72] as well as at any point during pregnancy.[61,70] The types of postpartum distress were less varied and included perceived stress[74] and depression[61,73] with assessments occurring throughout the first postpartum year. Child cognitive outcomes were assessed at ages 5 to 8.

Quality. Among the 7 studies in this group, all received overall quality ratings of moderate, except for 2 weak ratings.[70,71] Attrition rates ranged from 5% to 51%, and were a main limitation in 3 of these studies. All studies were rated strong or moderate for their use of psychometrically evaluated measures of maternal distress and child cognitive development. Three of the 7 studies measured maternal distress over multiple time points during pregnancy and the postpartum period. Two of the 4 studies that explored prenatal distress controlled for postpartum mood,[69,70] and one controlled for past distress at 3 years.[72] In most cases, maternal distress was assessed by maternal self-report,[69,70,72,74] with one study using a diagnostic interview,[61] one using both an interview and self-report,[73] and one using physiological measures.[71] As such, a wide variety of instruments was used to measure maternal distress. LeWinn et al. acknowledged the limitation of not knowing the specific time of day when the cortisol measure was collected, which is problematic since cortisol levels are generally highest in the morning.[71] Child cognitive development was also assessed by multiple measures, including indices of memory and learning ,[69] intelligence,[70,71,74] language development,[61,70] reading and math achievement,[72] and a composite of cognitive abilities (e.g verbal, perceptual, quantitative, memory, motor).[73] In all cases, child cognitive development was assessed by examiners or researchers.

Main findings. The prevalence of cognitive delay among school-aged children was reported in one study as 22% to 25% using an index of reading and math achievement.[72] Of interest, this study recruited participants from 8 different sites across the United States. Four of the 7 studies found a significant association between maternal distress and child cognition.[61,69-71] Three of these studies involved exposures during the prenatal period using measures of stressful life events throughout pregnancy[69,70] and cortisol collected during the third trimester,[71] and one assessed perinatal depression from pregnancy through postpartum.[61] The child cognitive outcomes that were negatively affected by prenatal distress included memory and learning, [69] IQ,[70,71] and language development.[70,71] Three of the four significant studies controlled for maternal distress at other time periods, and 3 studied a wide array of potential confounders. The effect sizes indicated that prenatal and postnatal distress had small effects on learning and memory, IQ, and verbal scores. LeWinn et al. found that high levels of cortisol were associated with a 3-point decline in IQ and a 4-point decline in standardized verbal scores.[71]

Moderators and mediators (gender, pre/post distress, SES, severity, chronicity). In examining the influences of severity, timing, and chronicity of perinatal depression on language development, Brennan et al. found that severity and chronicity had a significant, but very small effect on language scores.[61] An interaction between severity and chronicity was also tested, but its non-significant influence suggested that children whose mothers had both chronic and severe perinatal depression were not more at risk for language delay than children whose mothers had chronic (but not severe), severe (but not chronic), or no depression. Neither Brennan et al.[61] nor Laplante et al.[70] found an effect of the timing of exposure on IQ or language scores. However, Laplante et al. did find that 4 of the 5 cognitive outcomes that they assessed were better in mothers with moderate levels of prenatal stress compared to those with the lowest levels of stress.[70]

Other potential confounders. Despite the large number of potential confounders that were assessed in this group of studies, very few significantly predicted cognitive development, including: low maternal IQ, low socioeconomic status (but contribution very small compared to prenatal stress),[70] a risky home environment, poor maternal-infant interaction at 2 months, low 18-month cognitive scores, low paternal education, birth order, and developmental delay at one year of age. The multiple predictors that were not significant in any of the studies included: infant factors (gestational age, n=2; birthweight, n=2; multiple births), maternal demographic factors (age, education), maternal behaviours (prenatal smoking, n=2; prenatal alcohol), obstetric factors (obstetric complications, hypertension), family/social factors (marital conflict, quality of social relationships, paternal psychiatric history maternal sensitivity at 2 months, current maternal-child communication, social support, marital status), and socioeconomic status (maternal employment, income, paternal occupation). Factors that were inconsistently related to cognitive delay were: maternal education and child sex.

Maternal distress during pregnancy, the postpartum, or at the time of the school-aged assessment did not play a role in academic achievement. In fact, performance on math scores was largely shaped by maternal IQ and verbal scores at age 3 and 5, as well as low gestational age. Poor reading scores were attributed to these factors, as well as low maternal education.[72] Three studies did not report the significance of potential confounders.

Table 16: Key Aspects of Studies of Maternal Distress and Cognitive Development in School-Aged Children

Citation	Type of sample	Outcome assessor	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
Gutterling 2006[69]	Community (n=112)	Researcher	Prenatal	S (general cognitive)	Small	Yes	Yes	M
Laplante 2008[70]	Community (n=89)	researcher	Prenatal	S (general cognitive and language)	Small	Yes	Yes	W
LeWinn 2009[71]	Community (n=832)	examiner	Prenatal	S (general cognitive)	Small	No	Yes	W
Brennan 2000[61]	Community (n=4953)	researcher	Perinatal	S (language)	Small	Yes (assessed chronicity)	Minimal	M
Roberts 2007[72]	Community (n=494)	examiner	Prenatal	NS (general cognitive)	-	(age 3)	Yes	M
Murray 1996[73]	Community (n=111)	researcher	Postpartum	NS (general cognitive)	-	Yes	Yes	M
Theodore 2009[74]	Community (n=591)	psychologist	Postpartum	NS (general cognitive)	-	(age 3.5; age 7)	Yes	M

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

School-Aged Child Emotional Development (Table 17)

General overview of studies (n=10). Ten longitudinal studies from 4 countries (Australia, Sweden, U.S., U.K.) evaluated the relationship between maternal distress and emotional development in school-aged children. Among these 10 studies, 8 different cohorts are represented, with 3 studies using data from the ALSPAC study.[55,75,76] Eight of these studies were community-based with 2 recruiting from a psychiatric unit within 6 months of delivery[64] and residential parent-craft centre for infant difficulties at 4 months.[67] The sample sizes among the community samples were large, ranging from 421 to 6493, with those recruiting women from unique locations or a clinically-diagnosed subsample of a larger cohort ranged from 75 to 95.[64,67,68] While 2 studies examined prenatal distress,[36,55] the majority studied the effect of

postpartum distress on emotional development in school-aged children.[36,55,64,65,67,68,75-77] In particular, the 2 types of prenatal distress were the cumulative number of stressful life events throughout pregnancy[36] and third trimester anxiety,[55] while postpartum distress comprised a wider array of distress, including psychiatric illness,[55,64] depression,[65-68,75-77] anxiety,[55,77] maternal separation anxiety,[65] and parenting stress.[65] Child outcomes were assessed when children were between ages 5 and 8.

Quality. Five studies had overall quality ratings of moderate[36,55,67,68,77] and five were weak.[64-66,75,76] The main contributing factors to lower quality scores were the lack of blinding of the outcome assessor (e.g., maternal reports of child outcome) (n=8) and lack of inclusion of potential confounders (n=7). Given the length of follow-up involved in these studies, attrition rates were with 2 studies having participant losses less than 20%, and 4 studies losing 20% to 30% of their initial cohorts. All studies were assigned a strong or moderate rating based on their use of psychometrically evaluated measures of maternal distress and child emotional development.

Six of the 10 studies measured maternal distress over multiple time points during pregnancy and the postpartum period. One study of prenatal distress adjusted for postpartum distress,[55] one studying postnatal distress controlled for prenatal distress,[75] and one study adjusted for current distress.[67] Of interest, Evans et al. controlled for pre-pregnancy depression in their analysis.[76] In most cases, maternal distress was assessed by maternal self-report, with two studies using diagnostic interviews,[64,66] and two using both an interview and self-report.[67,68] Child emotional development was conceptualized largely as internalizing behaviours,[36,64-67,77] but also as social competence/ social behaviour[64,68] and emotional symptoms (e.g., headaches, fears, clingy).[55,75,76] Child emotional development was assessed by maternal report in 6 studies,[36,55,65,75-77] by teachers in 2 studies,[66,68] and by both teachers and mothers in 2.[64,67] As such, the issue of maternal reporter bias was somewhat addressed in these studies by using other sources for the evaluation of child outcomes (e.g., teachers), although no studies that assessed child outcomes by maternal report controlled for current maternal mood. Alternatively, Fihrer et al. tested current mood as a mediator of the relationship between

postpartum depression and maternally-reported child internalizing problems (see Moderators and mediators).[67]

Main findings. The prevalence of internalizing problems in these studies was quite consistent, ranging from 12.8% to 14.5% in the community-based samples.[36,66,75,76] The proportion was over twice as high (35%) in children of women who had attended a residential parentcraft centre at 4 months postpartum and were characterized by high rates of major postpartum depression.[67] In comparing the occurrence of internalizing problems at ages 2 and 5 in the Raine cohort, Robinson et al. concluded that internalizing problems were more common at age 5 than at age 2.[36]

Overall, 8 of the 10 studies found significant associations between maternal distress and internalizing behaviours in school-aged children.[36,55,65-67,75-77] The pattern of significance in studies assessing prenatal and postnatal distress suggests that exposure to maternal distress in both time periods impact emotional development in school-aged children. For example, both studies of prenatal distress found significant associations, as well as 8 of the 10 studies that focused on postpartum distress. By specific forms of distress, cumulative prenatal stressful life events[36] and third trimester anxiety,[55] and postpartum baby blues,[36] depression,[65-67,75,76] parenting stress,[65] and anxiety[55,77] were related to child emotional problems. The effect of postpartum distress spanned all across the postpartum period. Of interest, in the 2 studies that simultaneously assessed the effects of postpartum anxiety and depression, both found significant associations between anxiety and child internalizing problems, but not with depression.[55,77] Neither study that evaluated the specific component of emotional development, social competence, found significant associations with maternal distress.[64,68]

The effect sizes of these studies ranged from small to large. However, small effects were generally found in studies that controlled for a wide array of potential confounders. The exception to this summary is O'Connor et al., who found moderately-sized effects of prenatal anxiety on emotional problems in boys and girls, and postpartum anxiety on boys.[55] Of interest, Araya et al. found that the effect of postpartum depression on emotional symptoms at age 7

persisted after controlling for both prenatal depression in the second and third trimester, and depression occurring at 21 and 33 months postpartum.[75]

None of the outcomes based on teacher- or paternal-report were significantly related to maternal distress. In examining the effect of different raters (teacher, mother) on the assessment of child emotional problems, Fihrer et al. found a significant association between maternal-report and paternal-report child internalizing problems and postpartum depression , whereas no relationship was found for teacher-reports of this behaviour.[67] This study found no correlation between maternal and teacher reports, whereas maternal and paternal reports were significantly correlated. Given the nature of the outcome, these findings may reflect a greater awareness or sensitivity of parents toward child emotional symptoms. This is in contrast to behavioural problems, where the higher level of agreement between parents and teachers may be due to the more overt nature of behavioural difficulties and the relative ease of their detection.

Moderators and mediators. An evaluation of current maternal depression as a mediator demonstrated that the effect of postpartum depression on child internalizing behaviour was unaffected by current depression.[67] Two of the ALSPAC studies found non-significant interactions between maternal distress and child sex, indicating that the effect of maternal distress on internalizing problems is the same for boys and girls.[75,76] Both Araya et al. and Evans et al. assessed gene-environment interactions as well, but found no direct or moderating effect on child emotional symptoms.[75,76] These studies concluded that genetics does not play a role in the development of internalizing problems in children of depressed mothers. Considering the impact of severity and chronicity of postpartum depression, Fihrer et al. found an association between greater severity and chronicity on internalizing problems of children.[67]

Other potential confounders. Few additional significant predictors of emotional problems children were found, including: low gestational age, low parity, and father not living with family. Factors that were not associated with emotional development in any study of this group included: maternal demographic factors (having a non-English speaking background;

maternal age; education, n=3; income/ social class, n=3; maternal employment status, paternal employment status), maternal behaviours (prenatal smoking, prenatal alcohol), infant factors (5-minute Apgar scores, breastfeeding duration), and maternal health (maternal health, social support, and parental locus of control). Those factors that had an inconsistent relationship with emotional problems include: child sex, ethnicity, and marital conflict. Given that 2 studies did not report the significance of potential confounders, this summary is incomplete.

Table 17: Key Aspects of Studies of Maternal Distress and Emotional Development in School-Aged Children

Citation	Type of Sample	Outcome assessor	Timing of Exposure	Significant/ Non-significant	Effect Size	*Adjusted for distress at other time periods	Adjusted for key potential confounders	Overall Quality Rating
Robinson 2008[36]	Community (n=1979)	mother	Prenatal Postpartum	S S	Small small	Yes	Yes	M
Anhalt 2007[65]	Community (n=948)	mother	postpartum	s	small	No	Yes	W
Essex	Community	teacher	postpartum	S	large	No	Minimal	W

2001[66]	(n=421)							
Fihrer 2009[67]	Clinical (n=75)	Mother, father, teacher	postpartum	S (mother) NS (teacher; father)	moderate	No	Minimal	M
Najman 2005[77]	Community (n=5063)	mother	postpartum	S	Not reported	No	Minimal	M
Araya 2009[75] (ALSPAC)	Community (n=4334)	mother	postpartum	S	small	Yes	Minimal	W
Evans 2009[76] (ALSPAC)	Community (n=5742)	mother	postpartum	S	Moderately-large	(pre-pregnancy)	No	W
O'Connor 2003[55] (ALSPAC)	Community (n=6493)	mother	Prenatal postpartum	S S	Moderate moderate	Yes	Yes	M
Sinclair 1998[68]	Community (subsample of high risk) (n=95)	Teacher	postpartum	NS	-	No	Minimal	M
Albertsson-Karlgren 2000[64]	Clinical (n=86)	Mother and teacher	postpartum	NS	-	No	Minimal	W

***If exposure was postpartum distress, the effect of prenatal distress was evaluated. If exposure was prenatal distress, the effect of postpartum distress was assessed.**

Summary of Findings

Summary of the Impact of Maternal Psychological Distress on Infant Development

Overview. Eighteen studies evaluated the effect of maternal psychological distress on infant outcomes, representing a variety of different countries (e.g., New Zealand, Finland, Netherlands, U.S., Australia, Sweden, Israel). The majority of these studies were published in the past decade (n=16) with over 60% of these being published in the past 5 years (2005 – 2010). All but 2 studies were longitudinal and the majority (n=12) represented community-

based or a combination of clinical/community-based samples. Among these 18 studies, most evaluated the effect of maternal distress on cognitive (n=7) or psychomotor (n=7) development, with fewer assessing the effects on global indices of infant development (n=2), behaviour (n=2), and emotional development (n=4). There was a fairly even distribution of the number of studies that assessed prenatal (n=7) and postpartum maternal distress (n=8), with 3 studies addressing the effects of both.

Global indices of infant developmental delay. One study reported a rate of 33% developmental delay among infants based on a global index. Of the 2 studies assessing the effect of maternal distress on global indices of infant development at 2 and 12 months, only one showed a small, indirect effect of prenatal anxiety. Based on this single study with an overall quality rating of weak, there is insufficient evidence to support an association between maternal distress and global indices of infant development. Prenatal smoking and lower parenting satisfaction were related to infant developmental delay, with neonatal health being a potential mediator.

Infant behaviour. No studies reported the prevalence of infant behaviour problems. Both studies evaluating the effect of prenatal distress on infant behaviour in infants 48 hours to 12 months of age reported significant findings. Based on these 2 community-based studies of moderate and strong quality, there is some evidence that third trimester anxiety is related to behaviour problems in infants. Given that the more acute forms of prenatal distress were not related to infant behaviour, it may be that more enduring forms of prenatal anxiety have a greater impact. However, caution is warranted as this interpretation is based on only 2 studies. No studies assessed postpartum distress. Infant sex was not a significant moderator.

***Infant cognitive development*.** The prevalence of infant cognitive delay ranged from 7% in non-distressed women to 25% in distressed women in a community sample, and 34% to 38% in women with high risk pregnancies. Given that both studies of moderate quality (including one community-based study with 1591 participants) did not find an association between

postpartum distress and language outcomes, there is no evidence at present to support this relationship. No studies evaluated the influence of prenatal distress.

Three of 5 studies found small, significant findings for the relationship between general cognitive delay and prenatal stress and postpartum depression at 2 to 3 months. Based on these studies of weak, moderate, and strong quality, some evidence exists for a small effect of prenatal and postpartum distress on infant cognitive development. Buitelaar et al. reported that the odds of an infant having cognitive delay were increased by 10% if a woman experienced high stress in pregnancy.[18] The 2 studies demonstrating non-significant findings were also small, although both were assigned strong quality ratings.

The small effects found for maternal distress were observed after controlling for distress in other periods, and for other potential confounders. These findings should also be considered within the context of other factors that were evaluated, of which only one (low maternal education) was related to cognitive development. Significant predictors of delayed language development included low socioeconomic status and multiple births. The studies that evaluated moderators of the relationship between maternal distress and cognitive development found that infants had poorer cognitive development if their mothers experienced chronic depression across pregnancy and postpartum (versus brief), or severe postpartum depression.

Emotional development. In the infant studies, emotional development was defined in terms of infant social competence with prevalence rates reported as 6 to 14.8% in infants of non-distressed women, and 27.3 to 55% in those of distressed women. There is limited evidence for an effect of postpartum distress on social development from 2 to 10 months based on the findings of 3 small, weak studies. Although the effects reported were moderate to large, this is likely a reflection of the lack of control of potential confounders in these studies. The study with non-significant findings was a larger, community-based sample of moderate quality. No studies assessed the effect of prenatal distress. Among the few additional predictors that were assessed, only low maternal sensitivity was related to low sociability. Maternal sensitivity was also a moderator, where there was no effect of maternal depression on infant sociability in mothers with high levels of maternal sensitivity.

***Psychomotor development*.** The prevalence rates of delayed psychomotor development were 14% in infants of non-anxious women and 30% in those of anxious women. There is some evidence for a small effect of prenatal distress on psychomotor development in infants from 48 hours to 8 months of age based on 5 studies of strong (n=1), moderate (n=2), and weak (n=2) quality. Indeed, one large study reported an increase in the odds of psychomotor delay of almost 50% in infants of mothers with high prenatal anxiety. The association between prenatal distress and psychomotor delay was consistently found for distress occurring during the second trimester across diverse forms of distress, including stress, anxiety, anger, dysthymia, and physiological measures of cortisol and corticotrophin releasing hormone. Although a few studies reported moderately sized effects (n=2), potential confounders were not addressed. Given that both studies that assessed the effect of postpartum distress were non-significant, there is no evidence to suggest that it has an effect on this outcome. Neither study of psychomotor development at 12 months of age was significant. No other significant predictors were found.

Summary of the Impact of Maternal Psychological Distress on Toddler Development

A total of 25 studies assessed the effect of maternal psychological distress on toddler outcomes. The number of studies evaluating prenatal (n=11) and postnatal (n=11) influences was distributed quite evenly with 3 assessing both. A wide range of countries was represented in these studies, including: U.K., Netherlands, Finland, Australia, U.S., Switzerland, Canada, Russia, and New Zealand. The years of publication spanned from 1992 to 2009, with 88% (22/25) being published in the past decade (2000-2010) and 64% (16/25) in the past 5 years. All of the studies of toddler outcomes were longitudinal studies with the exception of one cross-sectional study. Most of the studies assessed cognitive development (n=13), global indices of development (n=12), or toddler behaviour (n=9), with fewer assessing psychomotor development (n=6) and emotional development (n=5).

Global indices of toddler development. The prevalence of developmental delay as assessed by global indices ranged from 9% to 30%. The majority of studies in this group demonstrated small, significant associations between maternal distress and developmental

delay among 18 to 36 month old children. As such, there is evidence for an effect of maternal distress on developmental delay that is based on 8 studies of moderate quality and one weak study that originated from 6 different countries (U.K., Netherlands, Australia, U.S., Switzerland, Canada). The effects on developmental delay were evident for maternal distress that occurred across the continuum of the prenatal and postpartum periods in a variety of forms including prenatal depression, stress, and anxiety and postpartum depression. The magnitudes of effect were similar for prenatal and postpartum distress, indicating that the odds of developmental delay in toddlers were increased by 17% to 60% if the child's mother experienced distress in either of these periods.

Although several other factors were evaluated, few had an impact on developmental delay, including current maternal distress, paternal distress at any time, low paternal education, daycare attendance within the first year, reduced social support, ear infection, and, in adolescents, not living with the grandmother of the toddler. Based on the findings of single studies, mother-toddler interactions and socioeconomic status were not significant moderators. Child sex was a moderator of the relationship between timing of prenatal distress and psychomotor development, where boys were found to be at greater risk with maternal distress at 12 weeks gestation, and girls at greater risk at 36 weeks gestation.

Toddler behaviour. The rate of toddler behaviour problems ranged from 6.8% to 22%. While over half of the studies of prenatal distress in this group were significant (5/8), only one of four reported an association with postpartum distress. Given that most of the studies of postpartum distress were quite small, it is unclear whether the general lack of association between postpartum distress and toddler behaviour is related to methodological issues, or whether prenatal distress has a greater impact on this outcome. Therefore, based on the findings of these moderate and strong studies from 4 different countries (Netherlands, Switzerland, U.S., Russia), evidence exists for a small association between prenatal distress across all trimester of pregnancy and toddler behaviour at 18 to 30 months. In particular, one study reported an increase in the odds of behaviour problems of 46% in toddlers of distressed mothers. The types of prenatal distress were varied, including pregnancy-related anxiety, state-

trait anxiety, anxiety, and an anxiety-depression combination. It was not possible to conclude whether prenatal depression had an independent effect. There is limited evidence for the effect of postpartum depression at 3 months based on a very small, single study of moderate quality.

Other significant factors related to toddler behaviour problems were low paternal education, poor mother-child interaction, family dysfunction, ethnicity, and poor child health. Factors that were inconsistently related were prenatal alcohol, child sex, prenatal smoking, maternal age, gestational age, and current maternal distress. Although 2 of 3 studies did not find that child sex was a moderator, one study found that prenatal distress at 36 weeks was related to externalizing behaviour in boys, but not girls.

Toddler cognitive development. The rate of cognitive delay in toddlers was reported as 6% to 26.4% in toddlers of non-distressed women, and 22% to 54.3% in those of distressed women. Most of the studies in this group found a significant relationship between maternal distress and general cognitive development at 15 to 36 months. In particular, nine studies of strong and moderate quality provided evidence from 5 different countries (Netherlands, U.K., Canada, Australia, U.S.) of a moderate effect of distress occurring across the continuum of pregnancy and through to 6 months postpartum on general cognitive development. Different forms of distress were implicated, including prenatal anxiety, depression, and stress, as well as postpartum depression. Given that only one study found evidence for an association between prenatal distress and delayed language development in girls of inner-city, adolescent mothers, there is limited evidence for an association between prenatal distress and language development.

Other factors that were related to general cognitive development were: impaired child-parent attachment/maternal caregiving, poor familial support (in adolescents), African-American race, and lack of separation-individuation (in adolescents). The effects on cognitive development were unclear for child sex, birthweight, maternal IQ, and SES. Child sex and maternal-child interactions were not significant moderators. However, one study found that the effect on cognitive development depended upon the timing of prenatal distress. In

particular, stress in the first and second trimesters of pregnancy was associated with poorer cognitive development than that occurring in the third trimester. Finally, predictors of language development in these studies were: maternal IQ, social class/SES, child sex (boys poorer), and impaired maternal caregiving at 10 months.

Toddler emotional development. One community-based study reported a rate of 4.5% of emotional problems among toddlers. Of the 5 studies in this group, only one found a small to moderate effect of prenatal anxiety/depression on toddler emotional development at 30 months of age. However, based on this single study of moderate quality that utilized 2 sources to assess child outcome (e.g., maternal and paternal report), with adjustment for current maternal distress (e.g., minimized potential for maternal reporter bias), there is limited support for an effect of prenatal anxiety/depression on internalizing behaviours. Differences were found in the timing of anxiety/depression in that first trimester distress had a small effect on boys, and third trimester distress had a moderate effect on girls. No studies assessed the effect of postpartum distress on this outcome. Other factors that negatively impacted emotional development were: current maternal distress, low paternal education, ethnicity, prenatal smoking, poor child health, and paternal psychological problems at any time. However, the role of SES and prenatal alcohol remains unclear.

Toddler psychomotor development. The prevalence rate of psychomotor delay in toddlers was consistent across studies at 17%. One-third of the studies in this group demonstrated a significant association between maternal distress and psychomotor delay at 15 to 24 months of age. Based on these 2 small studies of moderate and strong quality, limited evidence exists for an effect of both prenatal and postpartum distress on psychomotor development. Although the strong study reported an effect of moderate size, a large effect of chronic postpartum depression was found by the second study that did not adjust for many confounders in their analysis. As such, the magnitude of this effect should be interpreted with caution. The weight of the evidence provided by these 2 significant studies must be balanced

against the 4 non-significant studies that examined the effect of prenatal (n=2) and postpartum (n=2) distress, where 3 of the 4 received strong or moderate quality ratings.

Summary of the Impact of Maternal Psychological Distress on Pre-Schooler Development

Overview. A total of seven longitudinal studies assessed the effect of maternal distress on outcomes in pre-schoolers. The number of studies that explored prenatal and postpartum influences was quite evenly distributed (prenatal = 1; postpartum = 3; both = 3). Four different countries were represented in this group, including the U.K., U.S., Sweden, and New Zealand. The years of publication ranged from 1991 to 2007, with 4 of 7 published in the past decade, and 2 published in the past 5 years. Half of these studies examined the effect of maternal distress on cognitive development (n=3), with fewer focusing on behaviour (n=2), global indices of development (n=2), and emotional development (n=1).

Global indices of pre-school development. The prevalence of developmental delay in pre-schoolers as assessed by global indices was not reported. Two longitudinal studies involving the same, large cohort from the U.K. provided evidence for a relationship between prenatal and postpartum distress and a global index of emotional/behavioural problems in 47 month old children. Based on the findings within this single cohort, there is some support for a moderate effect of third trimester anxiety and early (8 week) postpartum depression. On its own, prenatal depression did not have an effect on this outcome. These studies suggest that the role of prenatal depression may be as a mediator of the relationship between prenatal anxiety and emotional/behaviour problems, or as a marker of prenatal anxiety. The magnitudes of effect of prenatal and postpartum distress were quite similar, with odds ratios ranging from 1.56 to 1.72. Other factors that had an effect were small for gestational age, prenatal smoking, low maternal education, maternal age $\geq$21 years, and male sex.

***Pre-schooler behaviour*.** The prevalence rate of behaviour problems in pre-schoolers was not reported. The effect of maternal distress on pre-schooler behaviour is inconclusive. There is some evidence based on one large, longitudinal study of moderate quality regarding the impact of postpartum depression on behaviour problems in 4 to 4-1/2 year old children. However, this effect disappeared when further analyses included current maternal distress. The other study with non-significant findings did not find an association in their main analysis involving both postpartum and current maternal distress. Based on these limited results, it may be that current maternal distress plays a greater role in the development of pre-schooler behaviour problems that postpartum distress. No studies evaluated the influence of prenatal distress.

***Pre-schooler cognitive development*.** The prevalence of cognitive delay among pre-schoolers was not reported. All 3 studies in this group found a significant impact of maternal distress on cognitive delay in 3-1/2 to 4 year old children. These 3 studies of strong (n=1) and moderate (n=2) quality represent 2 cohorts from the U.K. and New Zealand. The findings in these 2 cohorts suggest that there is some evidence for a large effect of third trimester perceived stress and a small to moderate effect of postpartum depression in the first year on cognitive development. Current depression had no effect on this outcome. A sub-analysis of one of the cohorts found that, among disadvantaged families, boys of depressed mothers were more likely to experience cognitive delay compared to the girls

Pre-schooler emotional development. The prevalence of emotional problems was not reported in the single study that assessed this outcome among 4-1/2 year old children. Given that this small, study of weak quality did not find an association between postpartum depression at any time in the first year and emotional development, there is no evidence to support this link. No studies assessed the effect of prenatal distress on this outcome.

Summary of the Impact of Maternal Psychological Distress on School-Aged Child Development

Overview. In total, 19 longitudinal studies assessed the effect of maternal distress on developmental outcomes in school-aged children. Most of these studies focused on postpartum distress (n=11), with fewer exploring prenatal distress (n=5) or both (n=3). Eight countries were represented among these studies, including Australia, U.K., Scandinavia, Sweden, U.S., Netherlands, Canada, and New Zealand. The years of publication ranged from 1996 to 2009, with 84% (n=16) published in the last decade (2000 – 2010) and 63% (n=12) in the past 5 years (2005 – 2010). Among school-aged children, the main outcomes studied were emotional development (n=10), behaviour (n=8), and cognitive development (n=7), and to a lesser extent, global indices of development (n=4).

Global indices of school-aged child development. The prevalence rate of developmental delay based on global indices of development was 13.6% to 22%. Three of 4 of the studies in this group found a small to moderate effect of maternal distress on development in school-aged children of ages 5 to 6.8 years. Together, the results of these 3 large community-based studies of moderate quality from the U.K. and Australia suggest that maternal distress that occurs at any time during pregnancy and through to 6 months postpartum can have a detrimental effect on development in school-aged children. The particular forms of maternal distress included: cumulative stress occurring during pregnancy, stress in the third trimester, and postpartum depression and anxiety. The magnitudes of effect were similar for prenatal and postnatal distress, with the odds ratios ranging from 1.15 to 2.16. Other factors that influenced developmental delay among school-aged children were: prenatal smoking, being male, shorter breastfeeding duration, higher parity (protective), father not living at home, no form of preschool education, low maternal education, and a non-stimulating/non-supportive home environment. Inconsistent relationships were found for maternal age and gestational age.

***Behaviour of school-aged children*.** The prevalence rate of behaviour problems among school-aged children was 7% to 18.0%, with a rate of ADHD of 17.8%. Among the 8 studies in this group, most (n=7) demonstrated a significant relationship between maternal distress and behaviour problems in school-aged children at 5 to 8 years of age. Based on the findings of these 7 community-based studies originating from 5 different countries (Australia, Scandinavia, Sweden, U.S., U.K.) and on their quality ratings of moderate (n=4) and weak (n=3), there is evidence to support a small to moderate effect of maternal distress on this outcome. A wide variety of forms of prenatal and postpartum maternal distress were related to behavioural problems, including prenatal cumulative stress and third trimester anxiety and postpartum depression, anxiety, and psychiatric illness. These effects were found for distress occurring across pregnancy and throughout the first year postpartum, and were similar in magnitude for all periods assessed. The odds ratios for prenatal and postnatal distress ranged from 1.62 to 2.15, although it was much greater for ADHD (AOR 9.30 – see text).

Child sex was a significant moderator in 2 studies, suggesting that the effects of distress on behavioural problems and ADHD in boys are generally greater. Also, severity of postpartum depression at 4 months was a moderator such that children whose mothers had more severe postpartum depression were at greater risk for behavioural problems compared to those with less severe distress. Other factors that influenced behavioural problems were: low gestational age and low maternal social support. Factors that were inconsistently related were: maternal education, income, ethnicity, prenatal smoking, and child sex (i.e., direct relationship with behaviour)

***Cognitive development in school-aged children*.** The prevalence of cognitive delay among school-aged children was reported as 22% to 25%. Among the nine studies in this group, 4 demonstrated a significant relationship between maternal distress and general cognitive and language delay among 5 to 8 year old children. At first glance, the evidence appears equivocal. However, some patterns related to the timing of maternal distress on general cognitive development are evident. Most of the studies that examined prenatal distress showed a small, significant effect (e.g., 3 of 4), whereas neither study of postpartum distress found an

independent association. Although not conclusive because postpartum distress was explored in only 2 studies (moderate quality), it may be that general cognitive development is more influenced by prenatal distress than postpartum. The evidence supporting a link between prenatal distress and cognitive development is based on studies of moderate (n=1) and weak (n=2) quality, originating from 3 different countries (Netherlands, Canada, U.S.), and involving cumulative stress across pregnancy and third trimester cortisol. The specific trimester in which the prenatal distress occurred did not have an effect on cognitive delay.

In contrast to earlier developmental stages, language development was affected by both prenatal stress and perinatal depression. Although the timing of depression was not an important factor, the chronicity and severity of depression were important factors in the development of language delay. Although a large number of other factors were assessed, few were found to be important in the development of cognitive delay: low maternal IQ; low SES (but very small contribution compared to prenatal stress); a non-supportive, non-stimulating home environment; poor maternal-infant interaction at 2 months; low 18-month cognitive scores; low paternal education; birth order; and developmental delay at one year. The role of maternal education and child sex was unclear.

Emotional development in school-aged children. The prevalence rate of emotional problems in school-aged children was reported as 12.8% to 14.5%. The majority of studies in this group (80%) found a significant association between maternal distress and emotional problems in 5 to 8 year old children. The evidence supporting small to moderate effects of prenatal and postnatal distress is based on primarily large, community-based studies from 3 countries (Australia, U.S., U.K.) with quality ratings of moderate (n=4) and weak (n=4). These studies demonstrated that distress occurring throughout pregnancy and the first year postpartum could negatively impact emotional development in this age group. The specific forms of maternal distress were quite varied, and included cumulative prenatal stress and third trimester anxiety, as well as postpartum baby blues, depression, anxiety, and parenting stress. There is some indication that, comparatively, postpartum anxiety has a greater impact on emotional development than postpartum depression. In terms of magnitude of effect, the odds

ratios of prenatal distress ranged from 1.77 to 1.90, and those for postpartum distress ranged from 1.09 to 1.30. Other factors that were related to poor emotional development included low gestational age, low parity, and father not living with the family. Factors that were less consistently related were child sex, ethnicity, and marital conflict. Child sex was not a significant moderator, nor was the gene-environment interaction.

Conclusion and Discussion

This systematic review provides a comprehensive summary of research examining the effect of maternal psychological distress on the development of children from birth to age 8. The main objectives of the review were to: summarize the evidence for the relationship between maternal psychological distress and child development; comment on the impact of timing (prenatal vs postnatal) of maternal distress on the outcomes of interest; and, describe the forms of maternal distress that were related. **We found that various forms of maternal**

distress occurring throughout the continuum of pregnancy and the postpartum period were associated with a broad range of developmental problems spanning all child developmental stages from birth to age 8.

In total, 64 individual studies based on 51 different cohorts were included in this review. Studies of toddler outcomes comprised the largest group (n=25), with similar numbers of studies focusing on infant (n=18) and school-aged children (n=19). Relatively few studies assessed the effect of maternal distress on pre-schooler development (n=7). Of interest, the majority of studies in this review were published in the past 5 years, indicating a growth in interest in the influence of maternal psychological health on child development.

Relationship between maternal distress and child development. This systematic review found consistent associations of small to moderate magnitude between maternal distress and several indicators of child development. In addition to the evidence obtained through the review of individual studies, a few key observations provide further support for this relationship and extend our understanding further. Firstly, the importance of this finding is underscored by the large number of factors that were assessed, but not found to be associated with different aspects of child development. As such, maternal distress represented the single factor that was most consistently related to child development. Secondly, the associations between maternal distress and child development were observed across several developed countries, including the U.K., U.S., Canada, Israel, Sweden, Switzerland, Finland, Netherlands, Australia, and Spain. Thirdly, most of these studies were conducted using community-based samples, with few focusing on clinical populations. Therefore, the findings of this review largely reflect the risks for developmental delay that occur within the context of the average, married, middle-income, childbearing woman.

Further discussion on the impact of other influences on child development is warranted. This systematic review did not aim to comprehensively analyze other factors related to child development. Rather, we abstracted data on other significant and non-significant predictors of child development in order to understand the impact of maternal distress *within the context* of other influences. We did not find consistent associations with other factors that have

engendered a great deal of attention with respect to child development, namely socioeconomic status and family-level factors such as characteristics of the home environment (e.g., level of stimulation, organization/chaos), parental support and nurturance, parenting style, and the parent-child relationship/ attachment.[78,79] One possible explanation is that these factors were "overshadowed" by the influence of maternal distress, which may have more of a direct impact than these factors. For example, it is plausible that some of these risk factors are mediators of the relationship between maternal distress and child development, where maternal distress represents a key point of intervention for interrupting the chain of risk. Alternatively, the effects of these factors may not have been apparent in the community-based samples of the review, which largely comprised married, middle-class women. However, although limited in number, the studies of disadvantaged women in this review did not show evidence of socioeconomic impact on child development,[58] and several studies did not find evidence for a differential impact of maternal distress on development among women of low socioeconomic status. With respect to some of the parenting factors that were assessed, it may be that the specific aspects of parenting that influence child development were not captured in these studies. Finally, the lack of consistent effect of socioeconomic status may be related to a delayed effect of disadvantage on child development. For example, it may be that the effect of disadvantage is more apparent in later developmental stages. We did not observe a pattern in the effect of socioeconomic status on specific types of child development to suggest that disadvantage has a greater impact on one form over another.

Stages of child development. The studies in this review consistently demonstrated that maternal psychological distress had a negative impact on all stages of child development from infancy through to school-age. Some differences were noted in the effect of distress on particular aspects of child development (Table 18). For example, maternal distress had a consistent impact on general cognitive development from infancy through to school-aged children. Its effect on behaviour was also apparent across all developmental stages, with the exception of the pre-school period where the evidence of 2 studies was inconclusive. However, the influence of maternal distress on emotional development did not become evident until the

school-aged period. The effects on psychomotor development clustered in infancy, whereas global indices of development showed evidence of impact from toddlerhood through to school-age.

Timing of maternal distress. In most cases, child development was influenced by both prenatal and postnatal distress (Table 18). The mechanisms that underlie this finding were explored in only a few studies that sought to understand whether the effect was due to chronic distress beginning in pregnancy and continuing through the postpartum period, or whether distress in each period played a unique role in developmental delay. Although it is important to describe the findings of these few studies, there is insufficient information to draw conclusions. For example, one study found an association between chronic depression across pregnancy and the postpartum period and cognitive development,[23] while others found a relationship with a longer duration of depression (e.g., beyond the first year postpartum) and developmental delay.[21,67] However, O'Connor et al. (2002) did not find that children were more affected when their mothers had both prenatal anxiety *and* postpartum depression (e.g., chronic distress).[54] In fact, they found that both had an independent impact on emotional/ behavioural problems, and also found that the effect of postpartum depression was, in part, due to prenatal anxiety. Based on these findings, O'Connor et al. concluded that prenatal anxiety influences both the development and effect of postpartum depression on the child outcome, but that these prenatal and postpartum influences also operate independently by different mechanisms.[54]

Some studies that measured prenatal distress at multiple times reported differences in developmental outcomes by the trimester of pregnancy. For most outcomes, a distinct pattern was not observable, which may in part be due to the relatively few assessments that were done in the first trimester. The effects of prenatal distress on infant psychomotor development seemed to cluster in second trimester exposures. However, Laplante et al. (2004) found that exposure to maternal distress in the first trimester had the most detrimental impact on cognitive functioning in toddlers, and suggested that this may represent a sensitive period of fetal development.[49]

Alternatively, there was evidence of a specific prenatal effect of maternal distress without a postpartum effect for some outcomes. Based on an overview of the total number of studies with prenatal and postpartum effects (Table 17), psychomotor development in infants and general cognitive development in school-aged children were consistently affected by prenatal distress, with no evidence of an effect of postpartum distress. In addition, individual studies that examined the comparative effect of prenatal and postnatal distress within the same study also found that the effect was limited to the prenatal period for emotional/behavioural development in pre-schoolers,[54,55] global developmental indices in toddlers,[36] and behaviour and general cognitive development in toddlers.[44] These findings provide support for the fetal programming hypothesis, which suggests that factors that adversely affect the fetal environment can alter the structure and function of biological systems, particularly when they occur during sensitive periods of development.[80] Further support for the fetal programming hypothesis stems from the effect of prenatal distress well into the school-age years.[55] In contrast, only one study found a postpartum effect in the absence of a prenatal effect.[58]

Specific forms of maternal distress. No clear pattern emerged regarding the specificity of certain forms of maternal distress and their effects on developmental outcomes. Indeed, several forms of maternal distress were related to child developmental delay, including stress (perceived; stressful life events), anxiety (anxiety; state-trait; trait), depression (dysthymia; depression; major depressive disorder), and psychiatric diagnoses. Some developmental outcomes were more strongly related to specific forms of distress, but a particular pattern did not emerge. In exploring the comparative effects of depression and anxiety in the prenatal period, O'Connor et al. (2002) found that prenatal anxiety had a far greater effect on behavioural/emotional problems in toddlers than prenatal depression.[54] In another study, these investigators found that both postnatal anxiety and postpartum depression played important roles in the development of behavioural/emotional problems.[55]

Table 18: Summary of Evidence

Developmental Stage	Aspect of Development	Prenatal Distress	Postpartum Distress
Infant (n=18)	Global indices of development	x	x
	Behaviour	√	NA
	Cognitive		
	General	√	√
	Language	NA	x
	Emotional	NA	limited
	Psychomotor	√	x
Toddler (n=25)	Global indices of development	√	√
	Behaviour	√	limited
	Cognitive		
	General	√	√
	Language	limited	NA
	Emotional	limited	NA

	Psychomotor	**limited**	**limited**
Pre-schooler (n=7)	**Global indices of development**	**√**	**√**
	Behaviour	**NA**	**inconclusive**
	Cognitive		
	General	**√**	**√**
	Language	**NA**	**NA**
	Emotional	**NA**	**x**
School-age (n=19)	**Global indices of development**	**√**	**√**
	Behaviour	**√**	**√**
	Cognitive		
	General	**√**	**x**
	Language	**√**	**√**
	Emotional	**√**	**√**

X=no effect; √=clear effect; NA = not assessed

Implications

The finding that maternal distress was consistently related to a large number of child outcomes across the spectrum of developmental stages provides compelling evidence for an upstream, preventative approach to child developmental problems. Historically, much of the attention related to the issue of maternal mental health has been directed toward postpartum depression. This focus has supported an approach to prevention and intervention that begins during the postpartum period (although not routinely done). However, the observation that child development is primarily influenced by *both* prenatal and postpartum distress, or prenatal distress *alone*, implies that our current approach to the postpartum management of maternal mental health begins far too late.

That these results were found largely in community-based samples suggests that psychosocial care and assessment are important components of routine perinatal care. However, despite recommendations, [81,82] universal psychosocial assessment has not been

widely implemented as a part of routine prenatal care. As a result, mental health issues frequently go undetected in the course of routine prenatal care. [83] This is particularly problematic because during the perinatal period many women do not discuss their mental health problems with others or seek professional assistance,[84] and mental health problems during pregnancy frequently continue into the postpartum period.[6] The implementation of routine psychosocial assessment and referral processes requires addressing system-wide barriers, including the lack of established referral processes,[85] lack of community resources to provide mental health care for women in distress,[85] provider time constraints,[86] and lack of suitable instruments for clinical assessment.[87,88] However, studies have demonstrated the effectiveness of psychosocial risk assessment in promoting the early identification of women's psychosocial risk, facilitating individualized care planning, defining needs for referral, and guiding referral pathways involving hospital and community-based services with links to nursing, social work, or psychiatry.[87]

Preventing the occurrence of child developmental problems by addressing maternal psychological distress represents a key strategy. In 2002, McLennan and Offord evaluated whether postpartum depression was an appropriate target for large-scale prevention efforts that aimed to prevent the occurrence of child developmental problems.[89] Using 7 criteria to analyze the characteristics of the risk factor (postpartum depression) and interventions to reduce postpartum depression (PPD), they assessed whether: (a) PPD was a causal factor for the negative outcome; (b) PPD had a high attributable risk for the negative outcome; (c) PPD was alterable; (d) PPD was easily and accurately identified through screening; (e) interventions to reduce PPD could be easily disseminated; (f) PPD interventions would have a low risk for impact; and (g) PPD interventions would be acceptable to stakeholders. At that time, they concluded that targeting postpartum depression with the aim of reducing child developmental problems had mixed potential as a prevention strategy. They felt that the criteria were largely met except that the risks of PPD interventions were unknown, and the "strength of the link between PPD and poor child outcomes is undetermined" (p.28).[89] We propose that the remaining 2 criteria have been met for a preventative strategy involving both the prenatal and the postpartum period. For example, recent studies have found that women find screening and

treatment of PPD acceptable.[90-92] The final criteria, evaluating the strength of the relationship between maternal distress and child developmental delay, has been addressed through this systematic review.

In addition to the criteria established by McLennan and Offord,[89] there are other considerations that substantiate addressing women's mental health in order to prevent child developmental problems. First, there is some evidence to suggest that treatment of maternal distress results in an improvement in child outcomes, although to date most research in this area has focused solely on postpartum depression. For example, a recent review of 8 studies summarizing the effectiveness of treatment for postpartum depression on child outcomes found an improvement in the quality of maternal-infant interactions and infant cognitive development.[93] While promising, the effect of postpartum treatment on a broader array of child developmental outcomes and across different stages is largely unknown. Given that prenatal distress plays such a prominent role in the risk of child developmental outcomes, there is a need to evaluate the effect of prenatal interventions on child outcomes.

Second, this preventative approach is further supported by the challenges that exist in detecting and treating child developmental problems. Service utilization rates of children with developmental[41] and mental health issues are typically low (<50%), particularly among children under 7 years of age.[94] Depending on the nature of the developmental problem, preventative and treatment services are frequently not available or easily accessible.[95] As Waddell et al. (2007) note with respect to child mental health, one aspect that we addressed in this review: "It is increasingly evident that treatment services alone cannot reduce the burden of illness. As well, the understanding that many mental disorders arise during childhood has encouraged a shift toward considering prevention" (p. 174).[95]

Finally, maternal psychological distress may represent one of the most modifiable and feasible strategies for reducing risk factors for child developmental delay. Hertzman and Boyce (2010) conceptualized developmental risk factors as those that are most proximal to the child (e.g., family-based factors), those in the meso-environment (e.g., neighbourhood; school), and those belonging to the macro-environment (social/economic/political).[78] It is plausible that addressing maternal psychological distress may, in turn, affect a mother's relationship with her

child and the overall family functioning with benefits that extend to the "meso-environment". This is not to underestimate the impact of risk factors external to the family; rather, these discussion points are intended to highlight the importance of addressing maternal psychological distress as one of the most upstream factors in a child's life.

Strengths and Limitations

The findings of this review are the result of a rigorous, systematic process of review of a large number of articles. The search was conducted in consultation with a university-based librarian, and involved multiple databases, reference list review, and hand-searching of key journals. The inclusion-exclusion criteria were well-defined a priori. Two researchers independently reviewed each title and/or abstract for inclusion in the review and disagreements were resolved through consensus. For articles where decisions could not be made based on title and abstract review, full-text versions of the article were retrieved and reviewed for inclusion. Two individuals independently appraised the quality of each included article, and lack of agreement on the quality rating was resolved through consensus. We used standardized quality assessment and data extraction instruments.

Despite the strengths of this review, some limitations exist. We did not include articles that were published in languages other than English, or prior to 1990. We limited our review to developed countries, because we considered that the influences on child development may be quite different in developing countries. As such, the findings of this review cannot be generalized to developing countries. Similarly, only a few studies were conducted amongst disadvantaged families. Although sociodemographic factors were inconsistently related to child development in these studies, other aspects within the context of disadvantage have been

shown to influence child development that were not captured in the review of these particular studies.[96] Because many articles did not report details regarding maternal distress, it was not possible to comment on the relationship between severity of maternal distress and child development. In addition, several of the studies did not report rates of child development outcomes, and therefore the prevalence rates that we present reflect those reported in a few studies. Finally, because the child outcomes were presented in a variety of ways (e.g., continuous; dichotomous based on clinical cut-off points), it was not possible to conduct a meta-analysis.

Recommendations

Several recommendations relating to research, clinical practice, and policy development stem from this systematic review.

Research. Relatively few studies were conducted among pre-schoolers (n=7). This represents a significant gap in our knowledge. The high continuity of developmental issues that begin and are detectable during the pre-school years implies that assessment and prevention strategies should be a priority during this period.[97] Yet, this is the age-group that we know the least about with respect to the effects of maternal distress. There were also some specific developmental outcomes that were not assessed, including the effects of postpartum distress on infant behaviour, toddler language and emotional development, and pre-schooler language development, and the effects of prenatal distress on infant language or emotional development, or pre-schooler behaviour, language, or emotional development. These areas, in addition to those with limited evidence (Table 18) represent existing gaps in our knowledge and targets for future research.

One of the challenges related to conducting this review was the lack of detail regarding the severity of maternal distress. While some instruments provide clinical cut-off levels that indicate presence or absence of distress, many others describe ranges of severity according to specific cut-off points. Providing additional detail on the severity of maternal distress would help to further our understanding of its role in child development. Similarly, several studies conducted multiple assessments of maternal distress, but did not specifically address the impact of chronic distress. As such, it was difficult to draw conclusions regarding the impact of

chronic distress on aspects of child development. Understanding the role severity and chronicity of psychological distress has clinical importance in the identification and management of risk.

Overall, few studies explored the mechanisms of maternal distress on child development. A few studies in this review used structural equation modeling to test direct and indirect pathways between maternal distress and child development; however, they did not generally adjust for important potential confounders, and their quality rating was low as a result. Nevertheless, structural equation modeling provides one powerful analytic strategy for testing mechanisms of effect that may facilitate our understanding of the relationships among various predictors of child development. A priority of future research should be to describe the pathways between maternal distress and child developmental problems in order to inform intervention approaches and the timing. It should also consider whether pathways to child development are similar across various forms of developmental problems (e.g., internalizing versus externalizing).

The most common factor contributing to low quality scores of the studies in the review was the lack of control for potential confounders. The brief summary of other predictors of child development found in this review may guide specific factors that should be considered in future research. Consistent with this recommendation, maternal reports of child outcomes should be accompanied by an assessment of current maternal distress to reduce the potential for reporter bias. It would also be beneficial to include women's use of antidepressants or mental health services to further understand the impact of treated versus non-treated distress on child outcomes. From a surveillance perspective, it is also important for future studies to consistently report the prevalence of the child developmental outcomes.

Clinical. The findings of this review have particular utility for primary care clinicians involved in the care of women and children. The results support an early approach to prevention and intervention of child developmental problems where maternal psychological health represents an early, modifiable influence. As such, maternal psychological health should be routinely assessed beginning in pregnancy and throughout the postpartum period. Routine

prenatal care should encompass psychosocial assessment and referral or intervention as required. This process should continue throughout the postpartum period, either in the care of a perinatal clinician or a paediatrician. The Canadian Paediatric Society has recommended the implementation of screening questions for postpartum depression in routine visits and facilitation of referrals to the mother's primary care physician or a psychiatrist (http://www.cps.ca/english/statements/pp/pp04-03.htm). Numerous studies have documented the feasibility of assessing women for mental health issues as part of routine well-baby visits.[98] Given the time constraints that exist in primary care, alternative approaches to assessment and intervention may also be considered. For example, a recent study demonstrated the effectiveness of universal home visits by para-professionals in the prevention of postpartum depression.[99] Others have found internet-based screening to be a feasible, acceptable, and resource-sparing approach for the assessment of postpartum depression.[100]

Developmental assessments form a routine part of well-baby visits to 18 months. However, Tough et al. demonstrated that a substantial proportion of children are not identified as being at risk by primary care providers, or referred for appropriate follow-up services.[41] There is a need for further education regarding development delay among primary care practitioners.[101] However, given that the 18-month assessment is the last formal developmental assessment prior to school entry, an important role of the primary care clinician remains the education of parents regarding healthy/unhealthy development and provision of community resources.[101] Some have advocated for greater parental involvement in the developmental assessment process, given that parents' familiarity with the child may provide insight into problems that are not readily apparent in a single physician visit. Instruments such as the Child Behaviour Check List[102] or the Parents' Evaluation of Developmental Status[41] are just 2 examples of assessment instruments that rely upon parental contribution.

Policy. Many of the recommendations proposed as a result of this review are dependent upon the application of the findings to policy at various levels. Given the focus of this review on early, maternal influences on short- and long-term child developmental outcomes, discussions regarding policy implications must address maternal mental health. Despite recommendations,

[81] routine psychosocial care and assessment have not been implemented, and many barriers exist. The routine assessment of maternal psychological distress and referral mechanisms require community-level integration of a number of processes that minimally include: (a) the availability and use of effective, easy-to-use, and rapid assessment instruments that quantify the level of risk; (b) the education of practitioners to address psychological issues that may be resolved at a primary care level; (c) referral processes that involve mental health professionals when the level of risk exceeds that which can be addressed in primary care; (d) the availability of accessible, effective mental health services, and (e) a funding model that enables primary care clinicians to incorporate these services in their routine care. This system-level approach will necessarily involve inter-disciplinary collaboration and advocacy of perinatal psychosocial care providers for changes at the local and provincial levels. The importance of the involvement of national-level bodies (e.g., Public Health Agency of Canada) in this process must be acknowledged. For example, the routine psychosocial assessment and care processes that were implemented in Australia over a decade ago were the result of a national initiative that mandated the assessment of postpartum depression and its care.[103,104]

The current approach to delivery of early child education and care in Canada has been criticized on the basis that it is underfunded, inaccessible, and fragmented with little integration and coordination among health, education, social, and justice sectors.[2,105] A number of political steps related to the coordination of federal and provincial bodies have been recommended, along with the development of a "pan-Canadian framework to provide policies and programs to support children and their families" (p.661).[105] The findings of this review imply that this framework needs to extend the breadth of its policies and programs to support pregnant and postpartum women as a strategy to reduce risk in the earliest environments of a child's life. As such, expansion of resources and services should not only be limited to programming involving child education and care, but should also extend to pregnant and postpartum women.

In addition, reducing the risk of child developmental delay by addressing maternal mental health requires that women in childbearing years are aware of the risks. The results of the recently conducted Canadian Maternity Experiences Survey demonstrated that most

Canadian women "had enough information" on postpartum depression (http://www.phac-aspc.gc.ca/rhs-ssg/survey-eng.php). However, it is unclear how knowledgeable women are regarding the potential effects of postpartum depression on their children. We do know that many women do not seek needed care for postpartum depression,[84] and therefore may be incurring greater risk than necessary. In addition, far less attention has been directed toward prenatal psychological distress and its long-term effects on child development. There is a need for a comprehensive public awareness strategy that increases pregnant and postpartum women's knowledge of their risks, or the presence of psychological distress, the effects on their children, and where to obtain support.

Although children receive developmental assessments to 18 months of age during well-baby visits, there is a large gap between the 18-month visit and formal assessments that may be conducted in kindergarten. As such, child care providers, educators, and family members are likely to have more interaction with young families than health care providers. There is the need for education among those who care for children during the toddler, preschool, and school-age years regarding the effects of maternal psychological distress on child development, as well as how to identify maternal distress, facilitate healthy development, identify unhealthy developmental patterns, and locate local services for the child and family.[101]

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