Maternal mental health in pregnancy and child behavior

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ABSTRACT

Maternal mental health research is a public health priority due to its impact on both maternal and child health. Despite the growing number of empirical studies in this area, particularly from developing countries, there is a paucity of synthetic review articles. Therefore, attempting to synthesize the existing literature in this area seems relevant to appraise the readers of the field’s progress and to infer directions for future research. The present review aims to provide an overview of the literature on maternal mental health and its association with birth outcomes and child behavior. Specifically, the literature on mental health during pregnancy and in the postpartum period and its influence on birth outcomes and child behavior have been reviewed. Further, a conceptual and methodological evaluation of the existing literature has been provided to identify gaps in the literature and to suggest directions for future research.

Key words: Antenatal depression, birth outcomes, child emotional-behavior problems, mental health, postnatal depression

INTRODUCTION

With declining rates of maternal mortality worldwide, researchers are recognizing the importance of addressing morbidity as well. The contribution of maternal mental health to maternal morbidity however has not been well ascertained.[1] In recent decades, psychological morbidity in child-bearing women in particular has received increasing research attention because of its ramifications on the mother as well as her child.

Once considered a time of emotional wellbeing, and “protecting” women against psychiatric disorders, it is now well established that several psychiatric disorders are common during pregnancy, with depression being the most common.[2] Violence during pregnancy or intimate partner violence has also received research attention due to its lasting consequences on the mental health and wellbeing of the mother and her child. Further, motherhood is often glorified, which makes the pregnant woman or mother feel guilty about experiencing negative emotions.

For the purpose of the present review, we limit our focus to reviewing published reports on common mental disorders, such as depression and anxiety disorders, and general psychological distress during pregnancy and in the postpartum period. Research has indicated that risk factors for poor mental health during pregnancy include past personal or family history of psychiatric illness or substance abuse, past personal history of sexual, physical or emotional abuse, current exposure to intimate partner violence or coercion, current social adversity and coincidental adverse life events. Psychological disturbances during pregnancy are associated with inadequate antenatal care, low-birth weight and preterm delivery, while in the postpartum, it is associated with diminished emotional involvement, neglect and hostility towards the newborn. While the bulk of literature in this area is from the developed world, particularly, the United States, Canada, Europe and Australia, the last decade has seen some interesting publications from developing countries as well where gender disadvantage, poverty and limited access to resources further complicate the issue.

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An attempt has been made to synthesize literature on maternal mental health and child behavior in the last 5 years. Although mental health of mothers in the postpartum period is relatively well researched compared with mental health during pregnancy, empirical studies on the impact of either on infant/child behavior and development is still in its infancy. Cultural preferences and culture-specific issues in the manifestation of psychological distress during pregnancy have been elucidated as well.

ANTENATAL MENTAL HEALTH

The perinatal period, which includes both antenatal and postnatal phases, is very significant both for the mother as well as for her child. Although the impact of maternal mental health on child development starts from conception, research in the area of antenatal mental health has gained momentum only in recent years. The existing literature has largely focused on common mental disorders, such as depression and anxiety. Growing evidence also suggests that antenatal mental health problems can be a precursor for subsequent mental health problems in a woman’s life.

Prevalence of antenatal psychological distress

The prevalence rates of antenatal psychological problems are estimated to be high world over [Table 1]. Studies have indicated that the prevalence of antenatal depression (AD) and/or anxiety ranges from 8% to 30%. The prevalence rates are likely to vary across studies and cultures due to choice of measures and sociocultural determinants. Studies have used either screening measures such as the Edinburgh Post Natal Depression Scale (EPDS) or structured interview schedules that yield a clinical diagnosis.

Prevalence estimates from developed countries

A systematic review showed that of the 18% of women reporting depressed mood during pregnancy, 13% met the DSM-IV diagnostic criteria for a major depressive episode. In a Japanese study, women (n=290) were assessed both antenatally and postnatally for the presence of DSM-III-R psychiatric disorders. About 12% of the women at pregnancy and postpartum, respectively, met the criteria for one of the following psychiatric disorders: major depressive disorder, manic episode, generalized anxiety disorder, social phobia, specific phobia and obsessive compulsive disorder.

A United States population study (n=1662) investigated AD using EPDS during mid pregnancy and found that the prevalence of depressive symptoms during the antenatal period was 9%. Minority groups in the US, such as Black and Hispanic mothers, had a higher prevalence of depressive symptoms compared with non-Hispanic white mothers. Swedish studies indicated that the point prevalence of depression in pregnant women ranged from 13.7% to 29.2%. A recent study (n=1522) reported that antenatal stress (78% low–moderate, 6% high) not amounting to a disorder was highly prevalent. About 43% (n=658) of the sample completed screening at both time points during pregnancy (mean GA=22.1±6.0 weeks and 36.3±1.8 weeks), with stress scores being significantly higher at the first screening (14.8±3.9 vs. 14.2±3.8).

Mental health problems during the antenatal period are also known to vary across trimesters. While one study found the prevalence of antenatal anxiety and AD as assessed on the Hospital and Anxiety Depression Scale (HADS) to be similar across the three trimesters, others have noted a much higher prevalence of antenatal depressive disorder at 12–16 weeks (6.1%) as opposed to the third trimester (4.4%) of pregnancy.

Prevalence estimates from developing countries

In the recent decade, there has been an increasing number of studies on antenatal mental health from developing countries. A Brazilian cross-sectional study (n=432) reported the prevalence of state and trait antenatal anxiety (AA)

| Author              | Year | Country        | Measurement               | Prevalence                          |
|---------------------|------|----------------|----------------------------|-------------------------------------|
| Gavin et al.       | 2005 | Developed countries | Structured clinical interview | 18% depressed mood, 13% DSM-IV major depressive episode |
| Rubertsson et al.  | 2005 | Sweden         | EPDS                      | 13.7% depressive symptoms            |
| Anderson et al.    | 2006 | Sweden         | EPDS                      | 29.2% depressive symptoms            |
| Bowen et al.       | 2006 | Canada         | EPDS                      | 27% depressive symptoms              |
| Kitamura et al.    | 2006 | Japan          | Ad-hoc structured diagnostic interview | 12% one or more DSM-III-R psychiatric disorders |
| Rich-Edwards et al.| 2006 | United States | EPDS                      | 9% depressive symptoms               |
| Van Bussel et al.  | 2006 | Belgium        | GHQ-12                    | 21% and 25%, prevalence of CMDs before and during pregnancy |
| Lee et al.         | 2007 | Hong Kong      | HADS                      | 54% anxiety, 37% depressive symptoms |
| Woods et al.       | 2010 | United States  | PPPSS                     | 84% antenatal stress                 |
| Faisal-Cury et al. | 2007 | Brazil         | STAI and BDI              | STAI-state anxiety=60%, trait anxiety=45%, depressive symptoms=20% |
| Bunevicius et al.  | 2009 | Lithuania      | CIDI-SF                   | 6% depressive disorder (12–16 weeks), 4% in the 3rd trimester |
| Gausia et al.      | 2009 | Bangladesh     | EPDS                      | 33% depressive symptoms              |
| Karmaliani et al.  | 2009 | Pakistan       | AKUADS                    | 18% anxiety/depressive symptoms (20–26 weeks) |
| Imran et al.       | 2009 | Pakistan       | EPDS                      | 42.7% depressive symptoms            |

*Developed countries are listed first and in chronological order.
to be 59.5% and 45.3%, respectively. The prevalence of AD assessed on the Beck Depression Inventory was 19.6%.[13]

A study from Pakistan ($n=1368$) reported prevalence rates of anxiety and/or depression at 20–26 weeks gestation to be 18%.[14] Others have noted a much higher prevalence for AD among women from developing countries. In a study from Pakistan, 42.7% of the women ($n=213$) had AD, assessed on EPDS.[15] Among Bangladeshi women ($n=361$), the prevalence of AD assessed on EPDS was 33%.[16] Thus, studies from developing countries indicate that the prevalence of antenatal distress is higher compared with those from developed countries.[17] This may be attributed to limited access to health care and a broad range of sociocultural correlates that are reviewed below.

**Correlates of antenatal psychological distress**

A host of salient risk factors for antenatal psychological distress have been identified in the literature. Rich-Edwards et al. (2006) in a US population study ($n=1662$) found that the strongest predictor for antenatal depressive symptoms was a past history of depression.[7] These findings were corroborated by studies from Canada[18] and Brazil.[19] Another cross-sectional analysis on a US sample ($n=1522$) found that domestic violence, drug use and medical problems was associated with a 3–4-fold increase in the odds of reporting stress during pregnancy.[10] A study from Japan[20] found that 15 of the 279 respondents (5.4%) who reported domestic violence during pregnancy experienced significant sleep disturbances, anxiety and depression.

There is also a reported dose–effect relationship between the numbers of stressful life events experienced in the year prior to pregnancy and depressive symptoms during pregnancy. Women who reported two or more stressful life events were 3.7-times more likely to report depressive symptoms during pregnancy.[8] A qualitative study in England ($n=24$) found that adjustment to motherhood, sense of loss when social activities were curtailed, past history of fetal loss, history of distress in pregnancy and current concerns about pregnancy were primary risk factors for distress during pregnancy.[21] Another qualitative study from UK reported lack of partner support to be the most significant contributor of distress during pregnancy.[22] A study in Nigeria found that being single, polygamous, having previous history of still birth and perceived lack of social support were associated with depression.[23] Further, quality of marital relationship is also known to influence antenatal psychological distress,[11,24,25] again a consistent finding across cultures.

While few studies have examined protective factors associated with antenatal distress, an Australian study ($n=421$) showed that social support and self-confidence protected women from experiencing distress.[26] Interestingly, these findings were replicated in a developing country - Jamaica ($n=452$), using a similar methodology.[27]

The above findings suggest that a host of psychosocial risk factors are associated with distress during pregnancy. Past history of depression, domestic violence, stressful life events, marital disharmony and lack of social support emerged as the most salient risk factors.

**POSTNATAL MENTAL HEALTH**

Women’s mental health in the postnatal period has received greater emphasis in research compared with that in the antenatal period. Existing estimates indicate that approximately 12–16% of women experience postpartum depression (PPD). Depression and anxiety of postpartum onset can be either acute or chronic.[28] Like antenatal distress, postnatal distress is also known to be associated with various psychosocial risk factors.

**Prevalence of postnatal psychological distress**

While most women following delivery experience postpartum blues, postnatal psychological distress is also highly prevalent across cultures [Table 2].

**Prevalence estimates from developed countries**

A Swedish sample ($n=1580$) reported the point prevalence of depression on EPDS to be 12.5% at 8 weeks and 8.3% at 12 weeks postpartum. The period prevalence for 8–12 weeks postpartum was 4.5%.[29] In a study from Australia, 7.5% of the women ($n=12,361$) reported a high likelihood of depression between 6 and 8 weeks postpartum.[30] PPD varies across time; an Italian study ($n=167$) found a higher percentage (13.8%) of women meeting the criteria for depression on EPDS at 3 months postpartum compared to 4.8% of women both at 9 and 18 months. The stability of depressive symptoms throughout the three periods was also studied using EPDS. About 23% reported depressive symptoms on at least one of the assessments; specifically, 16.2% reported depression once, 6% twice and 1.2% showed persistent or recurrent symptomatology across all the three assessments.[31]

**Prevalence estimates from developing countries**

Klainin and Arthur (2009) reviewed 64 studies from 17 Asian countries and found that PPD ranged from 3.5% to 63.3%, with Malaysia reporting the lowest rates and Pakistan the highest.[32] A review of the literature in the African continent showed the prevalence of postnatal depression and anxiety to be 18.3% and 14.0%, respectively.[33] A cohort study of Thai women ($n=610$) reported the prevalence of postpartum depressive mood on EPDS to be 16.8%,[34] while a study from Nepal reported a 4.9% prevalence on EPDS.[35] In a Moroccan study ($n=100$), 17% of the mothers reported depression on MINI International Neuropsychiatric Interview (MINI) and...
Table 2: Prevalence estimates of postnatal distress*

| Author                  | Year | Country | Measurement       | Prevalence                                      |
|-------------------------|------|---------|-------------------|------------------------------------------------|
| Massoudi et al.         | 2007 | Sweden  | EPDS              | 12.5% and 8.3% depressive symptoms at 8 and 12 weeks, respectively, period prevalence – 4.5% |
| Buist et al.            | 2008 | Australia | EPDS            | 7.5% depressive symptoms (6–8 weeks)           |
| Monti et al.            | 2008 | Italy   | EPDS              | 13.8% (1–3 months), 4.8% (9 and 18 months respectively), 23% at least once period prevalence       |
| Patel et al.            | 2002 | India   | EPDS              | 23% postnatal depression (6–8 weeks)           |
| Chandran et al.         | 2002 | India   | CIS-R             | 19.8% had depression (incidence=11%)            |
| Limlomwongse et al.     | 2005 | Thailand | EPDS        | 16.8% depressive symptoms                       |
| Agoub et al.            | 2005 | Morocco | EPDS/Mini        | 18.7% had depression diagnosis at 2 weeks, 6.9% at 6 weeks, 11.8% at 6 months, 5.6% at 9 months |
| Ho-Yen et al.           | 2006 | Nepal   | EPDS              | 4.9% depressive symptoms                       |
| Alami et al.            | 2006 | Morocco | EPDS/Mini        | 17% depression                                  |
| Edwards et al.          | 2006 | Indonesia | EPDS        | 22% depressive symptoms                         |
| Tannous et al.          | 2008 | Brazil  | EPDS              | 20.7% depressive symptoms (6–8 weeks)          |
| Klinin and Arthur (review) | 2009 | Asia    | –                 | 3.5–63.3% depressive symptoms                  |
| Sawyer et al. (review)  | 2010 | Africa  | –                 | Depression – 18%, anxiety – 14%                |
| Savarimuthu et al.      | 2010 | India   | EPDS              | 26.3% had postpartum depression                 |

*Developed countries are listed first and in chronological order

EPDS. A study from Brazil (n=271) reported the prevalence of depression to be 20.7% between the 6th and 8th week postpartum.37

Edwards et al. (2006) examined the severity of PPD in Indonesia, and found that of the 22% women with depression, the majority had mild levels of depression (82.5%).38 A Moroccan study (n=144) reported that the prevalence of depression varied across the postpartum period; 18.7% women met the diagnostic criteria for depression at 2 weeks after delivery and 6.9% at 6 weeks after delivery. At the 6th month, the prevalence increased to 11.8% and, subsequently, decreased to 5.6% in the 9th month.39 The estimated prevalence of PPD in studies from India ranged from 11% to 26.3%.37,40,41

Correlates of postnatal psychological distress

Correlates of PPD consistently found in research are past history of depression, AD, stressful life events and inadequate partner support.33,42 In a study from Sweden, significantly increased risk was found for single women for postnatal depression.29 Others have corroborated these findings.37,43,44

A population-based study in Pakistan (n=149) found that at 12 weeks, the PPD score was associated with lower social support, increased stressful life events in the preceding year and higher levels of psychological distress in the antenatal period.45 In another study from Pakistan, Rahman et al. (2007) found that poverty, having five or more children, lower education level of spouse and lack of a confidant was associated with persistence of depression in the postnatal period.46 Other investigators from developing countries have also reported an association between disadvantaged socioeconomic status and postnatal depression.37,38,44 A recent population-based study from South India found that birth of a girl child when a boy was preferred was a major risk factor for postnatal depression,48 a finding replicated in other studies from India.17,41 Several researchers have examined the temporal stability of antenatal distress. Studies have found that the strongest risk factor for developing postnatal depression was a history of depression in the antenatal period.7 These findings were consistent across cultures: Japan,6 Sweden,9 Australia,42 Canada,47 Iran48 and India.17,44

A Chinese population study found that women with persistent AA or depression in the antenatal period had a higher likelihood of developing PPD.11 Austin et al. (2007) found that women with high AA were 2.6-times more likely to have probable postnatal depression compared with women with low scores.49 A study from China showed that women with depressive symptoms (EPDS>14) in the second trimester were 11.78-times and 7.15-times more likely to report depressive symptoms at the 3rd trimester and 6 weeks postpartum, respectively.50

Researchers have identified factors that protect the mother from developing depression in the postnatal period. Ramchandani et al. (2009) in a study of mothers in South Africa found that literate mothers are less likely to develop postnatal depression.51 Zelkowitz et al. (2008) found that women (n=106) with relatively few somatic complaints, low levels of perinatal stress and satisfactory marital relations were less likely to exhibit mental health problems during pregnancy and in the postpartum period.47 Among other factors that protect mothers from PPD is breastfeeding.52,53 Additionally, breastfeeding contributes to mother–infant attachment, mother’s sense of wellbeing and enhances self-esteem.54,55 The mediating role of breastfeeding in the link between maternal distress and child mental health is briefly discussed later in this paper.

A recent review of studies in Asia classified major risk factors for PPD as biological, psychological, obstetric, economic and cultural factors. Biological risk included a history of medical
conditions, severe premenstrual symptoms and poor physical health. Psychological risk factors were depressive symptoms, anxiety, past psychiatric history, stressful life events, child care stress, low self-esteem, poor self-image and an insecure attachment style. Obstetric correlates were problems during pregnancy, previous abortion, previous loss of baby, unplanned pregnancy and the absence of breastfeeding. Economic and cultural variables were being an immigrant, being hungry in the past month, being a homemaker, having an unemployed and uneducated husband, spouse’s history of psychiatric disorder, polygamy, domestic violence, dissatisfaction with living conditions and lack of emotional support from husband and in-laws.[32]

Findings indicate that a wide range of psychosocial risk factors and past history of depression are associated with PPD. In addition, association between culture-specific risk factors (such as birth of a female child when a male child was preferred) and PPD merits further study.

**ANTENATAL DISTRESS AND BIRTH OUTCOMES**

Antenatal psychological distress or maternal psychopathology during the antenatal period is known to impact obstetric/neonatal outcomes. A study from Pakistan compared 147 physically healthy mothers with 147 mothers diagnosed with ICD-10 depression of similar gestational age and found that infants of depressed mothers had lower birth weight (LBW; mean 2910 g) than infants of nondepressed mothers (mean 3022 g). The relative risk for LBW (<2500 g) in infants of depressed mothers was significant (RR = 1.9), even after adjusting for confounders in multivariate analyses.[56] Another study[57] compared three groups of pregnant women: those with actual psychiatric disorder, psychological distress and healthy controls. They found that infants of women with psychiatric disorders had LBW, and 30% of the infants had birth weight below the 10th centile for gestational age compared with 5% of infants of healthy mothers.

In a prospective cohort study of 681 women in France, the authors found that the rate of spontaneous preterm birth was significantly higher among women with high-depression scores (9.7%) even after adjusting for potential confounding factors. Anxiety, unlike depression, was not significantly associated with preterm birth.[58] Further, a study from Pakistan also showed that the negative effects of maternal AD on infant growth continued for at least 1 year after birth.[59]

Studies from India have described an association between psychological morbidity during pregnancy and LBW (<2.5 kg).[59] A cohort of mothers (n=270) recruited from a district hospital was interviewed with a screening questionnaire for psychological morbidity and their infants were assessed at birth. Excluding five premature babies, they found that maternal psychological morbidity was independently associated with LBW. Studies from low-income countries in South Asia have also indicated that maternal depression in the postnatal period interferes with infant growth and failure to thrive.[60,61] A recent review identified elevated fetal activity, delayed prenatal growth, prematurity and LBW as common consequences of prenatal maternal depression.[62] While enhanced levels of depression and anxiety symptoms during pregnancy contributed independently of other biomedical risk factors to adverse obstetric, fetal and neonatal outcomes, however, this cannot be generalized to women meeting diagnostic criteria for mood or anxiety disorders during pregnancy.[63]

Researchers have also questioned whether it is depression *per se* or exposure to antidepressant medication during pregnancy that affects neonatal birth weight. A recent study[64] showed no association between maternal depression and birth weight. The authors, however, showed that exposure to antidepressant medication during pregnancy was associated with an eightfold increase in infants of LBW and prematurity. In addition, infants exposed to antidepressants during pregnancy were smaller in length and had a smaller head circumference at birth. Using linked population health data, a study[65] found that prenatal SSRI exposure was associated with an increased risk of LBW and respiratory distress, even when maternal illness severity was accounted for.

Stewart, in a recent review,[66] highlighted the findings that the effect of depression as an independent risk factor for poor infant growth typically occurred in mothers/infants living in conditions of socioeconomic deprivation and among relatively deprived social groups in the economically developed world. One of the most replicated findings is the poorer birth outcomes for African-American women compared with non-Hispanic white women.[67]

Studies examining obstetric and neonatal complications in depressed mothers should be interpreted with caution because it is difficult to tease out the consequences of untreated depression from the consequences of exposure to antidepressant medication. In addition, most of the effects of antenatal psychological distress on birth outcomes have occurred in a setting of socioeconomic deprivation. Studies so far have shown that anxiety and depression influence obstetric/neonatal outcomes. However, the comorbid nature of the two conditions makes it difficult to examine their differential effects on birth outcomes. Furthermore, we expect a dose–response relationship; clinical diagnosis of anxiety or depression is likely to have a greater impact than the presence of symptoms alone, but there is little empirical research on this to date. However, findings from various studies indicate that screening and treatment for psychological distress, particularly depression, should
begin in the antenatal period itself. Engel[68] highlighted that maternal mental health problems should ideally be an integral component of primary health care systems the world over.

MATERNAL MENTAL HEALTH AND CHILD EMOTIONAL-BEHAVIORAL OUTCOMES

Maternal–fetal attachment
Maternal mental health significantly influences Maternal–fetal attachment (MFA), and infant–caregiver bonding begins fairly early in pregnancy.[69] In a recent metaanalysis,[70] 183 studies published between 1981 and 2006 were reviewed to examine predictors of MFA. Perceived social support predicted MFA to a greater extent when compared with other predictors such as anxiety, self-esteem and depression. Gestational age, however, had the highest effect size. Di Pietro[71] opined that while there is a fairly substantial literature on the development and moderation of psychological features of the maternal–fetal relationship, including the role of ultrasound imaging, relatively little is known about the manner in which maternal psychological functioning influences the fetus. Higher AA symptoms were related to less-optimal maternal–fetal quality of attachment, more negative attitudes toward self as mother and motherhood on the whole.[72] Similar trends were found for depressive symptoms as well.[69] A review of 22 studies on MFA found that the factors associated with higher levels of MFA included family support, greater psychological wellbeing and having an ultrasound performed. Factors such as depression, substance abuse and higher anxiety levels were associated with lower levels of MFA.[73]

Infant temperament
Parental psychological stress and psychopathology during pregnancy not only increased across their transition into parenthood but was also associated with difficult child temperament at 12 months postpartum.[74] In a large cohort study (Avon Longitudinal Study of Parents and Children; n=14,663), maternal depression at time 1 (6–8 months after child’s birth) was found to predict difficult child temperament (child mood and temperament) at time 2 (21–24 months after child’s birth). Paternal depression at time 1 also seemed to influence child temperament (child mood and intensity) at time 2, but the effects were more significant for male children than for female children.[73] Trait anxiety in mothers predicted difficult infant temperament, such as clinging behavior, frequent crying and irritability, independent of comorbid depression, sociodemographic and obstetric risk factors.[76] Treating maternal antenatal distress increased the likelihood of the child having an easy temperament,[77] a finding endorsed by a recent review that demonstrated that treating parental psychopathology resulted in significantly improved outcomes in child symptomatology and functioning.[78]

Child cognitive–emotional–behavior problems
While some studies have indicated an association between maternal depression and subsequent cognitive and language difficulties in the child,[79,80] other studies have found no evidence to suggest such a relationship.[81] A recent study[82] showed that poverty and maternal depression independently and collectively decreased cognitive and emotional wellbeing in children. A recent review of papers published in the last year[83] suggested that psychological distress and mental illness, including depression and anxiety, influence a child’s emotional, cognitive, and behavior development in addition to impacting birth outcomes and physical growth.

In the Raine study, a prospective cohort study of pregnant women (n=2979) recruited at 18 weeks gestation behavioral problems as assessed on the Child Behavior Check List, were predicted by maternal experience of multiple stressful events during pregnancy.[84] Kaplan et al.[85] reported that maternal sensitivity rather than antenatal psychiatric diagnosis or postnatal psychiatric status modulated infant responsiveness. Werner et al.[86] found that physiological markers of individual differences in infant temperament are identifiable in the fetal period, and possibly shaped by the prenatal environment. Antenatal psychiatric diagnosis was also associated with a fourfold increase in cry reactivity in infants.

In a study from Sub-Saharan Africa on 431 children aged 3–24 months, Hadley et al.[87] found that maternal mental health problems were associated with both global and specific developmental problems. Studies from New Zealand[88,89] reported that the prevalence rates of internalizing problems were significantly higher in children of mothers who had self-reported symptoms of psychological disorder. The adjusted odds ratio of a child having internalizing problems was 1.38 (95% CI: 0.79–2.43) in mothers reporting early symptoms of postnatal depression, 1.45 (95% CI: 0.85–2.49) in late symptoms of psychological disorder and 2.93 (95% CI: 1.54–5.57) in persistent or recurrent symptoms relative to the nonsymptomatic group. There was no association between maternal psychological disorder and externalizing symptoms.

Studies have also indicated an association between maternal AA and ADHD[90–92] A review[93] based on independent prospective studies showed that if a mother is stressed while pregnant, her child is substantially more likely to have emotional or cognitive problems, including an increased risk of attentional deficit/hyperactivity, anxiety and language delay and, interestingly, the associations were independent of maternal postnatal depression and anxiety. The magnitude of these effects is clinically significant as the attributable load of emotional/behavioral problems due to antenatal stress and/or anxiety is approximately 15%. A large birth cohort (n=3982) of children born in Brisbane...
found that maternal anxiety during or after pregnancy was associated with child attentional problems at ages 5 and 14. Children of mothers with chronic anxiety problems were more likely to have persistent attention difficulties.\textsuperscript{[94]}

**Paternal psychopathology**

Antenatal and postnatal depression in fathers has only recently received research attention. Ramchandani and colleagues\textsuperscript{[51,85-87]} found that depression in fathers during the postnatal period was associated with adverse emotional and behavioral outcomes in children, such as oppositional defiant disorder/conduct problems in boys and psychiatric disorder in their children 7 years later. They also found that most psychiatric disorders that affect fathers are associated with an increased risk of behavioral and emotional difficulties in their children, similar in magnitude to that due to maternal psychiatric disorders. Some findings indicate that boys are at a greater risk than girls, and that paternal disorders compared with maternal disorders might be associated with an increased risk of behavioral rather than emotional problems.

The above review suggests that both antenatal and postnatal psychological distress and/or disorder is likely to impact multiple facets of child growth and development. Therefore, appropriate screening and referral services during the antenatal and postnatal periods should be integrated with routine obstetrics and gynecology services.

**MEDIATORS OF MATERNAL MENTAL HEALTH AND CHILD DEVELOPMENT**

Psychological distress and psychopathology in the perinatal period are known to impact child development and behavior. The pioneering theory and research-based framework linking maternal depression and adverse child outcomes was proposed by Goodman and Gotlib.\textsuperscript{[98]} According to this model, factors that mediate the relationship between maternal depression and child outcomes are heritability of depression, innate dysfunctional neuroregulatory mechanisms, exposure to negative maternal cognitions, behaviors and affect and exposure to a stressful environment. Hence, a depressed mother who experienced one or more of the above mediating factors is more likely to have a child with psychological problems. All of these factors create a predisposition/vulnerability (physiological, such as Hypothalamic-pituitary-adrenal (HPA) axis and/or psychological, such as cognition, behavior, affect and interpersonal) in the child that may then lead to impaired psychological functioning in the child.

**Physiological mediators**

Among the physiological mechanisms underpinning the association between maternal anxiety and depression and, later, development of behavioral problems in children, the research has focused on the mediating role of cortisol.\textsuperscript{[99-101]} Animal studies have shown that prenatal stress can reprogram the function of the HPA axis in the offspring. However, the effects on the HPA axis are very variable depending on the nature of the stress, its timing in gestation, the genetic strain of the animal and the sex and age of the offspring. Recent studies in humans suggest long-term effects of prenatal stress on basal cortisol levels, or cortisol responses to stress. Evidence suggests that an altered function of the HPA axis in the child mediates behavioral or cognitive alterations observed to be associated with prenatal stress.\textsuperscript{[99]} Further, a recent review found support for the “fetal origins hypothesis” that prenatal environmental exposures, including maternal psychological state-based alterations in \textit{in utero} physiology, can have sustained effects across the lifespan.\textsuperscript{[102]}

In a recent study that followed-up 125 mothers from pregnancy to 17 months postnatal, prenatal cortisol exposure, indexed by amniotic fluid levels, negatively predicted cognitive ability in the infant, independent of prenatal, obstetric and socioeconomic factors. This association was moderated by child–mother attachment: children with an insecure attachment had higher levels of cortisol and lower cognitive ability compared with those with a secure attachment style.\textsuperscript{[103]}

Elevated maternal cortisol at 30–32 weeks of gestation, but not earlier in pregnancy, was significantly associated with greater maternal report of infant negative reactivity. Prenatal maternal anxiety and depression additionally predicted infant temperament. The associations between maternal cortisol and maternal depression remained after controlling for postnatal maternal psychological state.\textsuperscript{[104]} Perceived maternal stress during pregnancy and neonatal cortisol reactivity each remained stable across the first 10 months of postnatal life. Maternal stress during pregnancy predicted infant cortisol reactivity at 2 days and 10 months after birth as well as behavioral reactivity at 10 months. Neonatal cortisol reactivity predicted 10-month behavioral reactivity.\textsuperscript{[105]} In another study, infant’s salivary cortisol level and cry reactivity in response to inoculation at 8 weeks was found to be greatest in mothers who had assisted delivery and least in mothers who had cesarean delivery.\textsuperscript{[106]} Because studies have recommended assessing the cortisol-DHEA ratio as a measure of functional hypercortisolemia,\textsuperscript{[107]} rather than cortisol alone, future studies examining stress response in mothers and infants may benefit from using the same.

Skin-to-skin contact for 25–120 minutes after birth, early suckling or both positively influenced mother–infant interaction 1 year later when compared with routines involving separation of mother and infant.\textsuperscript{[108]} A recent Cochrane review of 30 studies showed a relationship between early skin-to-skin contact and shorter cry duration and better attachment behavior.\textsuperscript{[109]} Another study\textsuperscript{[110]}
reported a relationship between breastfeeding and attachment security in the child. Further, prenatal breast feeding intent and attachment security was mediated by maternal sensitivity. Several studies have indicated that maternal depression is correlated positively with cessation of breastfeeding.[111,112] Studies have also highlighted the protective role of breastfeeding in improving maternal distress and child outcomes.[113,114] A recent review highlighted the concurrent effects of PPD and breast feeding: PPD can lead to not initiating or early cessation of breast feeding, and breast feeding can alter or influence the course of PPD. Studies reviewed here were not methodologically sound and hence it is difficult to make definitive conclusions.[115]

Psychological mediators
Prenatal stress predicted both mental development and observed fearfulness in the child; the effect persisted even after controlling for maternal education and psychological state, exposures to medications and substances during pregnancy and birth outcomes. Prenatal stress accounted for 17% of the variance in cognitive ability and 10% of the variance in observed fearfulness. Relationship strain with the partner accounted for 73.5% and 75.0% of the prenatal stress-related variance on infant cognitive and fearfulness scores, respectively.[116] Another study[117] demonstrated the moderating role of child–parent attachment in the relationship between antenatal stress and infant fearfulness. This finding that attachment experiences during the postnatal period can attenuate the adverse effects of antenatal stress has important clinical implications. Perceived stress during pregnancy was a predictor of lower levels of restless/disruptive temperament, more total behavioral problems and more externalizing behavioral problems in 2-year-olds. Fear of bearing a handicapped child in the mother was a predictor of higher levels of restless/disruptive temperament and more attention regulation problems in toddlers.[118,119] Another study[120] found that maternal life events measured during the first part of pregnancy were negatively associated with the child’s attention/concentration index, while controlling for overall IQ, gender and postnatal stress. No associations were found between prenatal maternal cortisol and the offspring’s learning and memory.

Thus, a number of both physiological and psychosocial factors have been identified as possible mediators or moderators of the link between maternal mental health and child behavior.

EVALUATION

Literature on maternal mental health and child behavior over the last 5 years indicates that the prevalence of both antenatal and postnatal psychological distress is considerably high the world over, with higher prevalence rates reported in developing countries. A host of demographic, psychosocial and culture-specific risk factors (male child preference) have been identified for antenatal and postnatal distress. Socioeconomic deprivation and maternal psychological distress tend to co-occur; examining the differential effect of risk factors is therefore a challenge.

Antenatal distress is known to persist through the postnatal period as well. Studies have also suggested a positive association between antenatal distress and birth outcomes and antenatal/postnatal distress on MFA, temperament and cognitive–emotional and behavioral problems in the child. The impact of maternal mental health is also known to have lasting implications on child/adolescent behavior.

While research on prevalence and correlates of antenatal/postnatal depression have used cross-sectional designs, studies on mother–child interactions have been typically inferred from studies using longitudinal designs and prospective birth cohorts that provide a valuable opportunity to study mother–child dyads across time. While some papers are based on large population-based samples, others have conducted formative research on modest and convenience samples. As in most behavioral sciences research, the issue of measurement haunts this area as well. A number of measures have been used to assess psychological distress and disorders, which makes comparison difficult. They range from screening instruments such as the GHQ and EPDS to structured diagnostic interview schedules such as the MINI, SCID and the like. STAI is commonly used to assess maternal anxiety, while CBCL is commonly used to ascertain child emotional–behavioral problems.

Although studies correlating maternal distress and child behavior are disproportionately higher than paternal distress and child behavior, it is interesting to note that there is a meta analytic study in JAMA on the latter[121] but none in the former. Further, longitudinal studies examining the effects of psychosocial interventions in improving maternal and child mental health outcomes are few.

DIRECTIONS FOR FUTURE RESEARCH

Literature review in this area clearly indicates that studies from India on the impact of antenatal distress on birth outcomes and antenatal/postnatal distress on infant temperament and child behavior (cognitive, emotional and behavioral) problems are few. Sociocultural factors, such as preference for a male child, domestic violence and a lack of social support further accentuates a woman’s risk for psychopathology in our culture and merits further study. Future research is expected to highlight the biological underpinnings of the association between antenatal and postnatal psychological distress on birth outcomes and later behavioral difficulties in children and provide
neurobiological explanation for interventions aimed at improving child and maternal mental health.

While there are intervention studies and reviews on the effects of cognitive-behavior therapy (CBT) in reducing postnatal depression,[122] not many studies have examined its effects on the child. Recently, Lancet papers have demonstrated the effectiveness of community-based women’s participatory groups in improving maternal and neonatal outcomes using clustered randomized trials in poor rural communities in India,[122] Bangladesh,[124,125] and Nepal.[126] Similar intervention studies may further explore the question – Does reduction in maternal distress result in improved birth outcomes and child behavior?

It is apparent that certain societal/technological transitions have also impacted pregnancy in ways that are both positive and negative. Although technological advancements in the industrialized world have rendered pregnancy and child birth safer, introduction of various assisted reproductive procedures for the treatment of infertility have resulted in hope as well as psychological turmoil prior to and during pregnancy. Assisted conception is now being shown to result in adverse psychological problems – maternal anxiety and depression and difficulties in mother-child bonding. Adolescent or teen pregnancy is also associated with adverse health outcomes for mothers and their children. There may be merit in exploring this area further.

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