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Postnatal Depression, Mother–Infant Interactions, and Child Development

Prospects for Screening and Treatment

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Overview

Depression is common among women of childbearing age, with over 8% being affected at any one time (Weissman, Warner, Wickramaratne, & Prusoff, 1988). Depression occurring specifically in the postnatal period affects around 14% of women in developed world samples (O'Hara & Swain, 1996) and is substantially more common in some developing world populations (Cooper et al., 1999; Parsons, Young, Rochat, Kringelbach, & Stein, 2012; Wachs, Black, & Engle, 2009). Although postnatal depression (PND) may affect women across the social spectrum, rates are increased among those experiencing stressful life events, poor social support, and a history of depression (Beck, 2001; O'Hara & Swain, 1996; Robertson, Grace, Wallington, & Stewart, 2004). Typically, symptoms of PND resolve by around 6 months postpartum, but some women are affected throughout the first year and beyond. Overall, depression-related impairments can be wide-ranging and persistent and may have a profound effect on interpersonal functioning.

Concern about the possible adverse consequences of exposure to PND for the developing child has arisen principally as a result of evidence from nondepressed populations of both the sensitivity of young infants to their interpersonal environment and the importance of social interactions in fostering optimal child psychological development (see Murray, 2014). The fact that the infant's primary environment in the early weeks and months is, in many cases, largely constituted by their mother has added to concern about the possible effects of PND on the child. Accumulating evidence from both animal and human studies of the role of caretaking in the development of neurobiological systems has provided further research impetus.

In this chapter, a careful review of the effects of PND on the mother–infant relationship is conducted in order to inform the need for intervention and screening. We review research on the effects of PND on maternal interactions with the infant and young child and on biological outcomes. We then consider what is known about the development of children of postnatally depressed mothers in the domains of cognitive, emotional–behavioral, and

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psychiatric functioning. We note throughout the role of other factors commonly occurring with PND and those that are also associated with adverse child outcome (i.e., socioeconomic adversity, marital conflict, and subsequent maternal depression). We also address the question of more proximal mechanisms mediating associations between PND and adverse child outcome, giving particular attention to the role of parent–child interactions. Finally, we review intervention studies and prospects for screening for mother–infant difficulties.

Effects of Postnatal Depression on Mother–Child Relationships

Early infancy

The seminal work in the 1980s by Field, Cohn, and Tronick and colleagues (Cohn, Matias, Tronick, Connell, & Lyons-Ruth, 1986; Field, 1984; Field et al. 1985, 1988) was largely conducted with high adversity populations. It showed marked differences between depressed and well women during face-to-face play with their infants. The depressed mothers deviated from the normal pattern of interaction, where parents respond to infant cues by imitating and elaborating infant expressions and gestures and adjusting the timing and form of response to help regulate the infant's attention and affect (Brazelton, Koslowski, & Main, 1974; Papousek & Papousek, 1987; Stern, Beebe. Jaffe, & Bennett, 1977; Trevarthen, 1979). Instead, depressed mothers were generally insensitive, with the form of insensitivity varying from intrusive and hostile communication at one extreme to flat, withdrawn, and disengaged behavior at the other. In turn, the infants of depressed mothers showed high rates of distress and avoided social interaction with their mothers.

While subsequent research with lower-risk samples has shown less marked disturbance in the interactions between depressed mothers and their infants, more subtle effects of depression *have* been found (Campbell, Cohn, & Meyers, 1995; Murray, Fiori-Cowley, Hooper, & Cooper, 1996; Weinberg, Olson, Beeghly, & Tronick, 2006). These mainly involve reductions in depressed mothers' behavioral responsiveness and sensitivity to infant signals (Murray, Stanley, Hooper, King, & Fiori-Cowley, 1996; Stanley, Murray, & Stein, 2004), less physical touching of the infant, and fewer signs of overt affection (Ferber, Feldman & Makhoul, 2008; Herrera, Reissland, & Shepherd, 2004). These interactive disturbances are most evident when the depression persists (Campbell et al., 1995) or when the interaction takes place under challenging circumstances (Weinberg et al., 2006). Depressed mothers' speech to their infants has also been found to differ from that of nondepressed mothers. Slower and less responsive speech has been reported (Bettes, 1988; Breznitz & Sherman, 1987; Murray, Kempton, Woolgar, & Hooper, 1993; Zlochower & Cohn, 1996), as have a reduction in the use of both prosodically "exaggerated" intonation contours (Fernald, 1989) and modulations in fundamental frequency (Kaplan, Bachorowski, Smoski, & Hudenko, 2002; Kaplan, Bachorowski, Smoski, & Zinser, 2001) and an increased frequency of falling intonations (Murray, Marwick, & Arteche, 2010). In these relatively low-risk samples, infants of depressed mothers do not show the gross disturbances apparent in high-risk groups, although disruptions in attention and behavioral regulation have been observed in response to maternal insensitivity (Murray, Fiori-Cowley et al., 1996), particularly among boys (Weinberg et al., 2006).

Late infancy and beyond

Two meta-analyses have shown an overall reduced likelihood of attachment security in infants and young children of depressed mothers (Atkinson et al., 2000; Martins & Gaffan, 2000), although effects were not substantial. Subsequent studies (Campbell et al., 2004; McMahon, Barnett, Kowalenko, & Tennant, 2006) indicated that depressed mothers' functioning may be highly variable, with the degree of disturbance being linked to background risk. This variability appears significant in determining the impact on the child's developing attachment. The Campbell study showed that the chronicity of maternal depression, rather than early depression per se, was important in predicting child attachment insecurity and that when depressed mothers were able to be sensitive with their infant, the child generally escaped the risk for insecure attachment. Similarly, McMahon found that children of depressed mothers who were themselves securely attached were buffered from the otherwise adverse effect of maternal depression on child attachment.

Other studies examining mother–child interactions in late infancy and early childhood have found residual impairments in child responsiveness to maternal communication. Thus, Stein et al. (1991), conducting home-based observations in a UK sample, found that, compared to controls, 19-month-old infants of postnatally depressed women showed less sharing of emotion with their mothers and more anger. While this pattern of behavior was particularly evident if the mother was still depressed, the effect was also present where the mother's depression had remitted, particularly where there was marital conflict. A similar profile of less responsive engagement with the mother was found in children of postnatally depressed mothers in a follow-up at 5 years of the Cambridge (UK) longitudinal sample (Murray, Sinclair et al., 1999). In this study, postnatal depression (PND) was associated with reduced engagement, even when controlling for current and chronic maternal depression, marital conflict, and the quality of the mother's current behavior toward the child, and this association was wholly mediated by the development of an insecure pattern of attachment in infancy.

Overall, research on the effects of maternal PND on the mother–infant relationship indicates that there may be long-term effects of early difficulties, especially in contexts of marked adversity, where depression is more likely to be chronic and where maternal responsiveness and sensitivity to the child is particularly impaired. Insecure infant attachment may be a particular risk and may mediate longer-term effects of PND on difficulties in mother–child relationships. This research suggests that intervening early may play an important role in helping to prevent longer-term difficulties.

Effects of PND on Biological Outcomes

Neural development

Emerging research suggests that the marked difficulties in social interactions of PND mothers with their infant may have direct effects on developing infant and child neurophysiological systems. EEG recordings taken from children of PND mothers have shown reduced left frontal activation from 1 to 3 months (Jones, Field, Fox, Lundy, & Davalos, 1997) through to six (Field, Fox, Pickens, & Nawrocki, 1995) and 15 months (Dawson, Frey, Panagiotides, Osterling, & Hessl, 1997; Dawson et al., 1999), with evidence of some stability through to early childhood (Jones, Field, Davalos, & Pickens, 1997).

Meta-analysis shows this association to be quite robust (Thibodeau, Jorgensen, & Kim, 2006). This pattern of activation, observed in infants of depressed mothers from both low- and high-risk samples, shows systematic associations with the severity of the maternal disorder, and it is not accounted for by prenatal depression (Dawson, Frey, Panagiotides, Osterling et al., 1997). There is evidence that the association between reduced left frontal activation and maternal depression is mediated by the infant's experience of interaction with the mother, particularly by her noncontingent (Dawson, Frey, Panagiotides, Self et al., 1997; Dawson et al., 1999) and withdrawn behavior (Diego, Field, & Hernandez-Reif, 2001). Longitudinal cross-panel data in childhood suggest that earlier maternal depression predicts changes in EEG asymmetry later on, consistent with a potential causal influence (Forbes et al., 2008). Notably, by 13–15 months, differences between index and control infants in frontal activity are not confined to periods when the infant interacts with the mother, but extend to both baseline conditions and positive interactions with a stranger (Dawson et al., 1999). Importantly, evidence indicates that EEG asymmetry may partially mediate the association between withdrawn parenting in depressed mothers and adverse child outcomes (Dawson et al., 2003).

HPA axis functioning

A second area of investigation concerns infant and child stress responses, with the functioning of the HPA axis system being a particular focus. The suggestion that maternal depression may influence the development of the HPA axis arises from animal studies indicating its early programming by maternal behavior. In rodents, reduced levels of maternal tactile stimulation can result in a more reactive HPA axis, at least in part due to reduced levels of central glucocorticoid receptors which provide negative feedback to the system (see review of Kaffman & Meaney, 2007). These changes in glucocorticoid receptor density appeared to be controlled by epigenetic mechanisms that are regulated by parental caregiving (Weaver et al., 2004). While nonhuman primate research is at an earlier stage, findings are consistent with the rodent model (Coplan et al., 1996, 2001, 2006; Rosenblum et al., 1994). Studies have also examined human cortisol secretion in relation to maternal PND, again with broadly consistent findings. Field et al. (1988) observed elevated cortisol levels in both PND mothers and their infants during face-to-face interactions; and they attributed these findings to the fact that interactions were nonsynchronous and therefore stressful. Studies have also demonstrated longitudinal associations between PND and offspring cortisol secretion, with elevations being observed in basal measures in children at 18 months (Bugental, Martorell, & Barraza, 2003), 3 years (Hessl et al., 1998), and 4.5 years of age (Essex, Klein, Cho, & Kalin, 2002). Finally, evidence for long-term effects of depressed mothers' early interactions was found in a follow-up of the Cambridge sample: here, elevated morning cortisol secretion observed in the postnatally depressed mothers' children at 13 years (Halligan, Herbert, Goodyer, & Murray, 2004) was predicted by maternal withdrawal during early interactions, rather than by later interaction difficulties (Murray, Marwick et al., 2010). Few studies have addressed HPA reactivity in response to *challenge* among children exposed to PND, although Waters et al. (2013) found *reduced* cortisol responsiveness to mild challenges in infants whose mothers had experienced depression (antenatally or postnatally) relative to controls.

While consistency in findings regarding biological outcomes of children of PND mothers is notable given the methodological variability, some caution is required in their

interpretation. Thus, in relation to cortisol, although there have been attempts to examine the relevance of early versus later exposure to maternal depression (Essex et al., 2002; Halligan et al., 2004) and associated disturbances in maternal interactions (Murray, Marwick et al., 2010), there is evidence to suggest that *any* parental history of depression may have an impact on HPA reactivity in the child (Mannie, Harmer, & Cowen, 2007; Young, Vazquez, Jiang, & Pfeffer, 2006). The same possibility, in principle, exists for EEG effects. Antenatal exposures may also be influential (Field et al., 2004; O'Connor et al., 2005), and genetic effects are likely (Bartels, Van den Berg, Sluyter, Boomsma, & de Geus, 2003). Further clarity requires studies that differentially link exposure to maternal depression during particular periods of development to biological changes in the offspring, as well as further research into the mechanisms by which effects are brought about.

Effects of PND on Cognitive Development

Outcome studies

A number of prospective longitudinal studies of community samples have examined the effects of PND on preschool and school-aged children, and several have identified associations with poor child cognitive functioning. Sutter-Dallay et al. (2011) examined cognitive outcome in 2-year-olds in a French sample of almost 600 mothers whose depression was carefully monitored throughout. Depression at 6 weeks postpartum was associated with significantly poorer child cognitive outcome, even when controlling for other risk factors and intervening depression. Cogill, Caplan, Alexandra, Robson, and Kumar (1986) assessed child IQ at four years in a London community sample. Boys and girls whose mothers had been depressed in the first postnatal year had poorer scores than both children of well mothers and children of mothers who had been depressed later on. However, the adverse effects of PND were confined to children whose mothers had a low level of education (Hay & Kumar, 1995). A second study of a largely disadvantaged London sample (Sharp et al., 1995) found that, while girls' IQ was unaffected by PND, boys whose mothers had been depressed in the first year had significantly lower scores compared to both those never exposed to maternal depression and those exposed to maternal depression subsequent to the postnatal period. A follow-up of this sample at 11 found persistent effects on boys' IQ, taking account of subsequent maternal depressive episodes, although the number of children exposed only in the early months was small (Hay et al., 2001). Similar findings were obtained in a follow-up by Milgrom, Westley, and Gemmill (2004) of an Australian inpatient sample who were depressed at 6 months, with index group boys having lower IQ at 42 months than both index group girls and control children. Murray and colleagues examined this issue in their Cambridge longitudinal sample. As in the studies of Sharp and Milgrom, boys of PND mothers had lower scores than both exposed girls and control group infants on the Bayley Mental Development Index at 18 months (Murray, 1992; Murray, Fiori-Cowley et al., 1996). Further, at 16 years, these boys had significantly poorer school results (on UK GCSE public examinations); and these showed substantial continuity with their poorer cognitive performance in infancy (Murray, Arteche et al., 2010).

Other studies have failed to identify adverse long-term effects of maternal PND on child cognitive development or have shown smaller effects. In a large Bavarian sample, Kurstjens and Wolke (2001) assessed cognitive development at 20 months and 4 and 6 years and found no adverse effects of PND per se. However, boys with additional risk factors (low SES,

neonatal risk), as well as those whose mothers experienced subsequent depression in addition to the postnatal episode, did have poorer scores at the final assessment (Kurstjens & Wolke, 2001). Cornish et al. (2005) assessed cognitive functioning in 15-month-old infants of Australian mothers and found no effect on infant outcome of maternal depression occurring only at 4 months postpartum. However, infants of mothers whose depression persisted did have reduced scores on the Bayley Scales.

The importance of the chronicity and severity of maternal depression for infant and child cognitive functioning is also shown by two large-scale studies. The US National Maternal and Child Health survey found only modest associations between maternal depression after the birth and child cognitive functioning at 3 years, whereas severe and chronic maternal depression was associated with substantially poorer child cognitive outcome, independent of family income (Petterson & Burke-Albers, 2001). In an Australian sample of almost 5000 mothers, assessments of maternal mood were made in pregnancy, shortly after the birth, and at 6 months and 5 years (Brennan et al., 2000). At 5 years, both severity and chronicity of depression were associated with poorer child vocabulary, although these effects were not substantial. Further, the US NICHD sample of more than 1000 families showed that, compared to nonexposed children, children whose mothers were chronically depressed over the first 3 years were adversely affected on a range of cognitive measures, while those exposed intermittently were less affected (NICHD, 1999).

The findings from these diverse studies suggest that maternal depression in the postnatal period poses a risk for long-term poor cognitive functioning in the child where the depression is chronic. They also suggest that this effect principally obtains in the context of wider socioeconomic difficulties and for male offspring. In low-risk samples, long-term effects of PND on child cognitive development are not so evident and are principally confined to subgroups experiencing additional risks. Recent studies are beginning to examine whether antenatal depression may also have effects on child cognitive outcomes (e.g., Evans et al., 2012).

Mechanisms mediating cognitive effects of PND

General responsiveness

Substantial evidence with normal populations has shown the overall level of child-centered parental responsiveness, or *contingency*, during social interactions to be important for child cognitive development (Eshel, Daelmans, Cabral De Mello, & Martines, 2006). This kind of responsiveness concerns the parent's ability to notice and respond to their infant's cues—such as their direction of attention or their efforts to engage with the environment. As noted earlier, depressed mothers' awareness of their infant's experience can be quite reduced, in all likelihood due to symptoms such as rumination. Accordingly, such impairments in maternal responsivity may contribute to poor cognitive functioning for their children. This possibility has been investigated in four studies. Stanley et al. (2004) found reduced maternal contingent responsiveness during interactions in the first 2–3 postnatal months predicted infant performance in an operant learning task. In the Cambridge longitudinal study, Murray and colleagues (1993, 1996) showed that reduced maternal responsiveness to the infant at 2 months mediated the adverse effects of PND on boys' performance on the Bayley Scales at 18 months. Furthermore, those children whose mothers had shown a particularly marked reduction in responsiveness postnatally were continued on a trajectory of poor cognitive functioning to 5 years (Murray, Hipwell, Hooper, Stein, & Cooper, 1996) and later childhood and adolescence (Murray, Arteche et al., 2010).

In the NICHD study, variability in the interactions of depressed mothers was also highlighted, with those experiencing adversity having markedly lower levels of responsiveness. Where the interactions of depressed mothers were particularly poor, risk for poor child cognitive outcome was substantial. In contrast, children whose mothers maintained good interactions despite their depression were buffered from the potentially negative effects of the maternal disorder. Finally, in their clinic-based Australian sample, Milgrom et al. (2004) found that low maternal responsiveness at 6 months mediated the adverse effect of maternal depression on boy's IQ at 42 months.

Attention regulation

Difficulties in depressed mothers' interactions that concern infant attention regulation may also contribute to poorer infant cognitive performance, since the infant's ability to sustain attention is a robust predictor of later childhood IQ (Slater, 1995). The mother's ability to support the infant's attention is one element of contingent responsiveness that typically involves vocal modulations that help both attract and maintain infant attention (Stern, Spieker, & MacKain, 1982). Kaplan, Bachorowski, and Zarlengo-Strouse (1999), for example, found that segments of child-directed speech recorded from postnatally depressed mothers, in contrast to that of nondepressed mothers, failed to promote associative learning in their infants in a conditioned attention paradigm. Notably, the fundamental frequency of the final portion of the speech segments of mothers with more depressive symptoms was less modulated than that of other mothers, and this reduced modulation may have failed to increase infant arousal sufficiently to enable efficient processing of, and attention to, the information required.

Dysregulation of emotion

Emotion regulation processes during parent–infant interactions may also be important. Dysregulated affect is likely both to impair attention and disrupt infant information retrieval (Fagen, Ohr, Fleckenstein, & Ribner, 1985). The increase in infant and child cortisol levels associated with depressed mothers' withdrawal and lack of support for infant emotion regulation (Field et al., 1988; Murray, Halligan, Goodyer, & Herbert, 2010) may also be relevant. This mechanism requires further investigation.

Conclusions

Studies on the cognitive development of postnatally depressed mothers' children suggest that particularly poor mother–child interactions are likely to occur when the maternal disorder is accompanied by wider adversity and they may also be more impaired with male infants, whose regulation of their state and behavior may be more dependent on maternal support than that of girls. Where this is the case, child cognitive functioning may be affected in the longer term. While general deficits in maternal responsiveness have been widely linked to poor child outcome, research also indicates more specific features of parent–child interactions that may have differential effects on particular psychological processes underpinning optimal cognitive development. Further research is needed to investigate these specific processes in the context of maternal depression and to explore the role of biological changes. These findings suggest that intervention may need to be targeted not only on the early mother–child interaction but also at later points to prevent long-term effects. *Maternal responsiveness* (or contingency) appears to be an important target for child cognitive development, and other characteristics such as supporting the infant's attention and regulation of affect may also be important.

Effects of PND on Behavioral, Socioemotional, and Psychiatric Problems

Outcome studies

Maternal reports in infancy and the preschool and early school years

Using maternal report measures, Murray (1992) found that mothers who had been depressed in the first few postnatal months reported increased behavior problems in their infants at 18 months on an age-adjusted version of the Behavior Screening Questionnaire (BSQ; Richman & Graham, 1971), despite most mothers having recovered by the time of assessment. Reported problems mainly concerned behavioral regulation difficulties (e.g., sleep disturbance, separation difficulties, temper tantrums). Similarly, Cicchetti, Rogosch, and Toth (1998) found raised child behavior problem scores at 20 months on the Child Behavior Checklist (CBCL; Achenbach, 1991) to be associated with maternal depression occurring at some point following childbirth. In this sample, the relationship between maternal depression and child behavior disturbance was accounted for by general contextual risk. Avan, Richter, Ramchandani, Norris, and Stein (2010), in a large socioeconomically deprived longitudinal cohort in Soweto, Johannesburg, South Africa, also found associations between postnatal depressive symptoms and child behavioral problems at age 2.

With regard to older, preschool-aged children, Ghodsian, Zajicek, and Wolkind (1984) found that depression at both 4 and 14 months predicted maternal reports of child behavior problems (BSQ) at 42 months in a London sample, although only the effects of 14-month depression were significant when current maternal mental state was taken into account. Caplan et al. (1989) also investigated maternal reports of child behavior at four years in another London sample. In addition to effects of current depression, postnatal episodes showed some association with child disturbance. However, as in the study of Cicchetti et al. (1998), this was principally accounted for by chronic difficulties co-occurring with PND (marital conflict and paternal psychiatric history).

The importance of chronic and later maternal depression for child behavior problems, rather than depression confined to the postnatal period, is suggested by four further studies of community samples. In the Australian study, maternal reports of child disturbance on the CBCL at 5 years were associated with both chronicity and severity of maternal depression, and these effects were additive (Brennan et al., 2000). There was little evidence for the impact of disorder in the immediate postpartum period, whereas later depressions were significantly associated with child behavior problems. Philipps and O'Hara (1991), following up a community sample in the United States, also found no effect of PND on child behavior problems (assessed on the CBCL) at 4½ years, but did find that subsequent maternal depression was associated with child disturbance. Finally, in a disadvantaged London sample, compared to children of never-depressed women, maternal reports of "violent" behavior in 11-year-olds were associated with postnatal episodes but only if the mother experienced subsequent depression (Hay, Pawlby, Angold, Harold, & Sharp, 2003). A more recent nationally representative study from Norway (Bekkhus, Rutter, Barker, & Borge, 2011) examined the effects of antenatal and postnatal depressive symptoms on age 3 crying and aggressive behavior. Robust associations were found for postnatal, but not prenatal, depressive symptoms (see also Bagner, Pettit, Lewinsohn, Seeley, & Jaccard, 2013). Notably, there was substantial continuity in postnatal depressive symptoms, and it seemed that this quite stable trajectory was the most significant predictor of later child problems.

In contrast, at least five studies have found positive associations with PND and maternally reported child behavior problems. In the high-risk US sample studied by Alpern and Lyons-Ruth (1993), both chronic (18 months and at 5 years) and recent maternal depression were associated with increased problems at age 5. Three further studies of low-risk samples of preschool children have reported similar findings. In a study of a Scottish community sample, Wrate, Rooney, Thomas, and Cox (1985) found PND episodes of relatively short duration (1 month) were associated with maternal reports of child behavior problems at 3 years, even when controlling for current and recent depression. Similarly, in the Cambridge longitudinal study (Murray, Sinclair et al., 1999), maternal reports of child behavior problems on the Rutter Scale at age 5 showed a significant association with PND, even when account was taken of the recent and chronic episodes, the presence of marital conflict, and the current quality of the mother's interaction with the child. In similar vein, Dawson et al. (2003) found that exposure to maternal depression during the child's first 2 years was the strongest predictor of maternal reports of behavior problems at 3½ years. Once early depression was taken into account, the degree of subsequent exposure was unrelated to child outcome. Finally, Bagner et al. (2013) also found that postnatal major depression predicted later child internalizing problems after controlling for later depressive episodes, while later depression did not.

These maternal report studies indicate that chronic depressive disorder, particularly in the context of general adversity, generally emerges as a strong predictor of poor child outcome. Nevertheless, there is evidence of behavior difficulties in children of mothers who were depressed in the first 1–2 postnatal years, independent of subsequent depression.

Independent assessments in the preschool and early school years

The findings from some maternal reports of persistent effects of early exposure to depression are in line with a number of studies that have used independent evidence concerning child behavior. These include teacher reports, direct observations, and child reports.

Using teacher reports, Alpern and Lyons-Ruth (1993) found that recent and chronic maternal depression was linked to raised rates of child behavior problems in school. Children who had been exposed to depression by 18 months, but not those exposed at 5 years, were reported to be more withdrawn and anxious than children whose mothers had been well. Similar findings have emerged from a prospective study of a low-risk US community sample, where teacher reports at 6 years showed significant effects of the timing of the child's exposure to depression (Essex, Klein, Miech, & Smider, 2001). Children who had initially been exposed during their first year had high rates of both internalizing and externalizing symptoms. In contrast, first exposure to maternal depression beyond infancy increased the risk only of externalizing problems (a finding confined to girls). These associations were not altered when the overall chronicity of maternal depression was taken into account. Boys who were exposed only to early maternal depression had raised rates of internalizing problems (assessed by combined teacher and mother reports) but developed externalizing difficulties if early maternal depression was followed by marital conflict (Essex, Klein, Cho, & Kraemer, 2003). Teacher reports of child adjustment in the Cambridge longitudinal study (Sinclair & Murray, 1998) revealed an association between PND and boys' behavior problems (antisocial and hyperactive symptoms), particularly in the context of low SES. Finally, in a small sample study of clinic-referred women, Wright, George, Burke, Gelfand, and Teti (2000) found that 5- to 8-year-old children of mothers who experienced depression between 3 and 30 months had more adverse outcomes on teacher reports of adjustment than children of

well mothers, especially on measures of aggression and poor peer relationships, even when controlling for current symptoms.

Direct assessments of children of PND mothers were made in several contexts in the longitudinal study of Murray and colleagues. In school-based observations, both boys and girls of postnatally depressed mothers showed low levels of creative play, and they were relatively unresponsive to the positive approaches of other children (Murray, Sinclair et al., 1999), effects that were still obtained when both recent depression and marital conflict were taken into account. More extreme social difficulties in the form of marked aggression were also shown by the children of postnatally depressed mothers in this sample during peer play, although in this case the presence of marital conflict accounted for the association (Hipwell, Murray, Ducournau, & Stein, 2005).

Research has also identified child sociocognitive disturbances relevant to the development of depression. Thus, when children in the Cambridge longitudinal study were exposed to a mild stressor, those who had been exposed to early maternal depression were more likely than nonexposed children to show evidence of depressive thinking, even when controlling for the effects of recent maternal depression (Murray, Woolgar, Cooper, & Hipwell, 2001). A similar finding emerged from the study of Maughan, Cicchetti, Toth, and Rogosch (2007), where early maternal depression (before 21 months) was significantly associated with child reports of low self-competence at 5 years.

The findings derived from independent assessments, while often consistent with maternal reports in showing effects of current difficulties, are notable in that all show persistent effects of early maternal depression, even when controlling for later episodes, with the majority showing an impact on child internalizing problems in the preschool or early school years.

Psychiatric disturbance in adolescence

Children whose parents experience depression are at substantially raised risk themselves for depression and anxiety (Weissman et al., 2006). However, since first episodes of depression typically occur only from adolescence onward, long-term follow-up is required to examine associations between maternal PND and offspring disorder. To date, three studies have been reported involving children below the age of greatest risk for occurrence of depression. Hammen and Brennan (2003) examined the psychiatric status of 15-year-old children of mothers in a large Australian community sample, overselected for maternal depression. Both severity and chronicity of maternal depression were important, with adolescent disorder (and particularly depression) being more likely in the context of severe maternal episodes, even of short duration. Milder maternal depression posed risk only if it was prolonged. Timing of maternal depression was also considered. They found the occurrence of maternal depression at any time in the first 10 years to be associated with adolescent risk for depressive disorder, but there was no specific risk from exposure in infancy.

Offspring psychiatric disorder was also assessed in the Cambridge longitudinal sample. At 13 years, those who had been exposed to PND were at increased risk of both depression and anxiety disorder, although the number of episodes of depression by this age was small. In a later follow-up when offspring were aged 16, the risk for depression in the index group was confirmed, with almost half having experienced an episode of depression, more than four times the rate among controls (Murray et al., 2011). Adolescent depression was predicted by low levels of resilience in childhood, itself predicted by insecure infant attachment. Other factors of importance were further prolonged maternal depression and the occurrence of marital conflict. Although both of these factors were associated with the

original PND, neither of them fully accounted for the impact of the postnatal episode on adolescent offspring mental state.

Finally, assessments were made of psychiatric disorder in the disadvantaged London sample of Sharp and colleagues. At 11 years, PND was associated with a raised risk of child disorder (SAD, social anxiety, depression, and behavior disorders combined). However, since subsequent maternal depression was not considered, conclusions regarding specific links to the postpartum episode cannot be drawn (Pawlby, Hay, Sharp, Waters, & O'Keane, 2009). A subsequent report of offspring depression at 16 years in this sample focused on the effects of timing of *new onsets*, rather than on exposure to maternal depression per se during particular time periods (Pawlby et al., 2009). As in the Cambridge sample, this study found chronicity of child exposure to maternal depression to be important.

Mechanisms mediating socioemotional outcomes

Some individual differences in infant emotional expressiveness and reactivity through the first year, such as crying levels, appear relatively independent of parenting (James-Roberts & Plewis, 1996). However, capacities concerned with the self-regulation of behavioral and emotional states, which are key to subsequent good adjustment (DeGangi, Breinbauer, Roosevelt, Porges, & Greenspan, 2000; Kochanska, Murray, & Harlan, 2000; Kochanska, Tjebkes, & Forman, 1998), develop only gradually (Posner & Rothbart, 2000) and appear more responsive to parental intervention (Sameroff & Emde, 1989). Whereas good cognitive outcome is primarily promoted by contingent responsiveness to infant attention and engagement with the environment, good behavioral and emotional regulation appears to be particularly affected by parental sensitivity to the infant's emotions. This includes the ability to be appropriately and affectively attuned to the child's behavior and to provide "emotional scaffolding" where the child's difficult emotions are supportively contained. This association holds in both depressed and normal samples. In the NICHD study, for example, behavior problems (poor cooperation) were predicted by maternal depression that was accompanied by insensitivity (NICHD, 1999). Three specific ways in which parental interaction difficulties associated with PND may reflect poor emotional scaffolding and impede the development of emotional and behavioral are proposed.

Contagion of distress

Field (1995) suggested a contagion effect, whereby infants show increased sad affect and distress, either through modeling their mothers' depressed behavior or else being directly affected by the mother's manifest sadness. This suggestion is consistent with the high levels of matching of negative emotional expressions in depressed mother–infant interactions (Field, Healy, Goldstein, & Guthertz, 1990). To date, direct evidence for the effects of distress contagion on longer-term regulatory problems is lacking, although findings from studies with older children and adolescents of depressed parents are consistent with this mechanism (Joormann, Talbot, & Gotlib, 2007; Monk et al., 2008).

Failures of interactive repair

In normal populations, mother and infant repeatedly shift during social interactions from miscoordinated to coordinated states, as the mother supports the infant's immature capacities to regulate their behavior and affect (Jaffe, Beebe, Feldstein, Crown, & Jasnow, 2001; Tronick, 1989; Tronick & Gianino, 1986). Postnatally depressed mothers may fail to provide

such experience (Tronick & Weinberg, 1999; Weinberg et al., 2006), as do depressed mothers of older children (Jameson, Gelfand, Kulcsar, & Teti, 1997). While there is evidence from normal populations for the longer-term beneficial effects of parental strategies to promote infant self-regulation, as assessed by secure attachment (Isabella & Belsky, 1991; Jaffe et al., 2001) and good sleep outcomes (Murray & Ramchandani, 2007), further research is required to investigate the role of parenting in infant self-regulation outcomes in the context of PND.

Maternal hostility and coercion

The hostile and intrusive, or coercive, behavior that characterizes some depressed mothers may directly provoke infant distress and behavioral dysregulation. A microanalysis of face-to-face interactions between depressed and well mothers and their infants in the Cambridge study showed that episodes of infant behavioral dysregulation were immediately preceded by the mother's negating the infant's experience, often through intrusive or hostile interventions (Murray, Fiori-Cowley et al., 1996). Long-term associations were also found, with early maternal hostility predicting negative child self-cognitions at 5 years (Murray et al., 2001). Such an association was similarly identified in the study of Maughan et al. (2007). In the Cambridge study, a path analysis of mother–infant/child interactions and child behavior assessed over 8 years showed that infant emotional and behavioral dysregulation at 2 months, assessed independently of the mother, was unrelated to depressed mothers' hostile and coercive interactions at this time; but by 4 months, an association was present. This difficult infant behavior began to show continuity over time and in turn appeared to provoke further maternal negativity and intrusiveness, with the ensuing vicious cycle culminating in raised rates of conduct problems and ADHD symptoms by age 5–8 years (Morrell & Murray, 2003). Such findings are consistent with more general research with older children, showing the occurrence of disruptive behavior disorders to be associated with parental hostility and coercive control (see review by Hill, 2002).

Conclusions

Research on the effects of maternal PND on child behavioral and socioemotional development indicates the importance of the general parenting characteristic of emotional scaffolding sensitivity. This may be an important target for intervention and includes the ability to be affectively attuned to the child's behavior and contain the child's difficult emotions. In addition, a number of specific dimensions of interactions between depressed mothers and their infants in the postnatal months are implicated. Further longitudinal work is needed that directly examines the role of early mother–infant interactions in longer-term child outcomes.

Mediators of poor psychiatric outcomes

While preliminary research indicates that PND is associated with increased rates of offspring psychiatric disorder, longer-term follow-up studies are required for more definitive estimation of risks. Furthermore, the limited nature of the evidence to date necessarily constrains conclusions regarding the mechanisms underlying any increased risk. What does seem apparent, however, at least for offspring depression, is that the chronicity and severity of maternal depression are important. This may, in part, reflect genetic liability, since both

these dimensions are associated with genetic risk (Kendler, 1996). Nevertheless, recent adoption study data suggest that any genetic vulnerability is likely to be environmentally mediated (Silberg, Maes, & Eaves, 2010), a conclusion consistent with the well-established role of environmental adversity in the etiology of depression (Brown & Harris, 1978). In addition to these broad influences, a number of specific processes initiated in the postnatal period itself are also suggested.

Biological processes

As noted earlier, the unresponsive or withdrawn interactions with the infant seen in some postnatally depressed mothers predict particular infant EEG profiles (i.e., reduction in left vs. right prefrontal EEG activity) (Dawson, Frey, Panagiotides, Osterling et al., 1997; Dawson et al., 1999; Diego et al., 2001). In adults, this EEG profile is induced by observing negative emotion stimuli (Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Tomarken, Davidson, & Henriques, 1990) and is also associated with adult depressive disorder itself (Henriques & Davidson, 1990; Schaffer, Davidson, & Saron, 1983). While the parallels between EEG responses in infants of depressed mothers and those of adults experiencing depression are notable, it is important that follow-up studies of infant populations be conducted to establish whether there are indeed direct links between early EEG functioning and subsequent disorder.

Research on HPA axis functioning has also begun to show associations with disturbances in parenting in the context of PND (Murray, Halligan et al., 2010). The previously noted pattern of increased basal cortisol secretion among children exposed to PND has also been associated with both risk for depression (Goodyer, Tamplin, Herbert, & Altham, 2000; Harris et al., 2000; Mannie et al., 2007) and the occurrence of adolescent and adult depressive disorder (Southwick, Vythilingam, & Charney, 2005). For example, the age 13 cortisol elevations in offspring of PND mothers in the Cambridge longitudinal study were found to prospectively predict depressive symptoms at 16 years (Murray, Halligan et al., 2010).

Social cognitions

Aside from physiological processes, certain patterns of social cognition regarding close relationships and emotions have been found to raise the risk for depression (Gjerde, 1995; Gore, Aseltine, & Colten, 1993). The question arises whether early relationships between PND mothers and their infants may set in train such biases in social cognition. In the Cambridge study, in interviews about friendship difficulties, girls of PND mothers showed substantially heightened sensitivity to negative social experience, which in turn was associated with their experience of depressive symptoms (Murray, Halligan, Adams, Patterson, & Goodyer, 2006). These social cognitions also showed continuity with both insecure attachment to the mother in infancy and with representations of family relationships at age 5 (Murray, Woolgar, Briers, & Hipwell, 1999).

Conclusion

Findings from both biophysiological and social–cognitive research suggest that the particularly difficult patterns of interaction in the early postpartum months that can occur in the context of PND may set in train developmental processes that confer increased risk for depressive disorder in adolescent offspring. Whether these are translated into actual disorder, however, is likely to depend upon subsequent adverse experience, most notably on further exposure to maternal depression. Further research is needed.

Treatment

Treatment studies

Given the evidence concerning the adverse impact of PND on mother–infant relationships and child development, the provision of effective interventions for the depression, and for the disturbances in mother–child relationships, is a priority. In the following, we review the evidence concerning psychological interventions.

Intervention effects on depression

Both a review of randomized control trials (Dennis & Hodnett, 2007) and a meta-analysis (Cuijpers, Brännmark, & van Straten, 2008) concluded that psychological interventions (cognitive behavior therapy (CBT) and interpersonal therapy (IPT)) and psychosocial interventions (primarily nondirective counseling) are moderately effective and similarly beneficial at alleviating maternal mood disorder. However, both reviews highlighted the short-term nature of most trials and their follow-ups, with a consequent lack of information about longer-term outcomes. In general, high-quality health economic data regarding these interventions is also lacking (e.g., see Stevenson et al., 2010).

Intervention effects on mother–infant relationships

A critical question regarding the treatment of PND concerns the extent to which treatment effects are reflected in improvements in mother–infant relationships and infant development. A few studies have addressed this issue, with mixed results. A large-scale randomized control trial comparing three forms of psychological intervention with a control group found that, while all active treatments were moderately effective in treating depression and brought about short-term benefits in the quality of the mother–infant relationship, there was no consistent improvement in infant outcomes and effects were generally not sustained at 18-month and 5-year follow-ups (Cooper, Murray, Wilson, & Romaniuk, 2003; Murray, Cooper, Wilson, & Romaniuk, 2003). Clark, Tluczek, and Wenzel (2003) conducted a pilot study comparing mother–infant therapy or IPT to a waiting list control condition. Although treatments were beneficial in improving depression, consistent effects on subsequent mother–child interactions or child outcome were not observed Finally, a study of IPT found that mother–infant dyads who received effective treatment for PND were no better than nontreated dyads in terms of observed mother–infant interactions, infant negative emotionality, and attachment security (Forman et al., 2007)—the same pattern of results held at a 4-year follow-up. This suggests that a major focus on treating maternal mood is insufficient and that programs addressing the mother–infant interaction may be necessary in order to yield benefits.

A related approach has been to directly focus on improving parenting and more specifically targeting the mother–infant interaction. Cicchetti, Rogosch, and Toth (2000) examined the impact in a depressed group of prolonged psychotherapy (average of 57 weeks) compared to nontreated depressed and nondepressed control groups. The intervention, which focused on promoting positive maternal attachment representations and mother–infant interactions, resulted in infant cognitive abilities that were comparable to control group levels at the end of treatment, whereas the untreated depressed group showed a relative decline over the same period. Several further studies focusing on improving mother–infant interactions have also indicated improvements, with interactive coaching (Horowitz et al., 2001), relationship facilitation based on maternal administrations of the

NBAS (Hart, Field, & Nearing, 1998), and infant massage (Glover, Onozawa, & Hodgkinson, 2002; Onozawa, Glover, Adams, Modi, & Kumar, 2001) all showing short-term benefits. Notably, a recent meta-analysis of 10 studies aiming to improve parenting sensitivity among depressed mothers (Kersten-Alvarez, Hosman, Riksen-Walraven, Van Doesum, & Hoefnagels, 2011) indicated that, overall, significant, albeit modest, improvements were achieved. However, there was also evidence of publication bias, and given the limited number of studies, the results should be treated with caution. Furthermore, few studies have assessed longer-term benefits or examined implications for infant development. One notable exception is that of van Doesum and colleagues (2008). This intervention for PND mothers combined home visiting with video feedback to promote mothers' sensitivity and responsiveness to infant cues, help broaden their repertoire of interactive behaviors, and challenge and modify negative thinking patterns. At posttest, the intervention showed robust effects on maternal sensitivity, relative to a control group, as well as improvements in infant attachment security and social competence. Nevertheless, in a follow-up at 5.5 years, Kersten-Alvarez et al. (2011) found little evidence of persistent benefits of the intervention for maternal behavior, child self-esteem, school adjustment, and behavior problems. Thus, it appears that while short-term effects may be demonstrated in improving parenting sensitivity, longer-term effects have yet to be further researched. It is possible that some of the outcome measures used in follow-up studies have not addressed the particular aspects of the parent–child interaction that has been protected or that over time other influences are powerful moderators of continuity. Further research of targeted tailored interventions with long-term outcomes is needed.

Provision of alternative care

Given the lack of evidence to date regarding the potential for preventing long-term adverse child outcome in the context of PND by altering difficulties in mother–infant relationships, it is also worth considering the possible role of alternative caregivers. Studies have shown that infants of PND mothers respond positively during interactions with their nondepressed fathers (Hossain et al., 1994), childminders, or day-care nurses (Pelaez-Nogueras, Field, Cigales, Gonzalez, & Clasky, 1994). Mother–infant relationships themselves were found in one study to be affected, with better engagement occurring in cases where the mother was not based at home full time (Cohn, Campbell, Matias, & Hopkins, 1990). Results from the early child care NICHD sample (SECC) showed that internalizing behavior problems were reduced at 24 and 36 months where the child received alternative care (Lee, Halpern, Hertz-Picciotto, Martin, & Suchindran, 2006). Provision of alternative caregivers may be important to institute in the first 6–9 months, before infants start to generalize the difficult behavior shown with their mother to interactions with other people. This would potentially provide the infant with additional attachment figures in the long term. Nevertheless, such strategies require considerable clinical sensitivity, since it is important not to increase depressed women's poor self-esteem, and therefore, ways of introducing additional caregivers need careful consideration.

Prospects for screening for mother–infant interactions difficulties

Despite the fact that evidence is not yet available showing that intervening early to promote the quality of mother–infant interactions in the context of PND has beneficial longer-term effects, given the powerful impact of PND on cognitive and behavioral outcomes, it may nevertheless be prudent to start interventions early when possible. Our view is that a standardized assessment of parent–child interactions should be a part of routine clinical

practice. There are several potential benefits. First, disturbances in parent–infant interactions often go unrecognized by practitioners, and so opportunities for appropriate intervention are commonly missed. Second, even where problems are identified, they may be assessed in highly inconsistent ways which is likely to lead to undermine the coherence of care for affected families. Third, successful interventions focused on parent–infant interactions depend critically on practitioners having a good level of understanding of the specific behavioral targets that require improvement. Thus, routine care will benefit from practitioners being trained in both observational measures of parent–child interactions and the fundamental concepts underpinning thinking within the field of infant mental health. Finally, clinical services need to be able to demonstrate that they are able to bring about positive changes in the quality of interactions; this necessitates access to measurement instruments that are well validated and robust, as well as the skills and experience to use them properly.

There are several measures that practitioners might use in clinical practice for the assessment of the mother–infant relationship. These vary in focus, length, and the degree of training (and cost) required to achieve adequate levels of reliability (Aspland & Gardner, 2003; Mesman & Emmen, 2013; Wolff & Van Ijzendoorn, 1997). The choice of observational measure is constrained by several practical and methodological issues. High interrater reliability is, of course, critical, as is predictive validity. Further, a single measurement in time, based on a limited sample of behavior (and in a particular context), inevitably does not capture all of what might be important in a parent–infant relationship. A recent study, for example, showed that repeated assessments of sensitivity (i.e., taken on more than one occasion) dramatically increased the predictive validity of the ratings (Lindhiem, Bernard, & Dozier, 2011). There are also good arguments for generally favoring home observations, as they probably provide a better gauge of a dyad's typical interactions.

Although it is important to consider measures that can capture some of the focal areas of parent–infant interaction discussed in this chapter (e.g., negative affect, withdrawn behavior, intrusiveness, and cognitive scaffolding), assessing overall sensitivity is clearly a key initial priority. In that regard, Mesman and colleagues (2013) identified 8 measures of sensitivity that had been validated in at least 10 studies (including our own Global Ratings of Mother–Infant Interaction (Murray, Fiori-Cowley et al., 1996)). Which measure one chooses will depend on the specific clinical focus and context. However, it must be noted that only five of them are free to use, and not all have been validated against attachment security and/or cognitive development (Mesman & Emmen, 2013).

The choice of measure and its implementation depend critically on a recognition of the specificity of effects highlighted earlier; that is, different kinds of parenting difficulty predict different kinds of child developmental difficulties, and this is best revealed in contexts that are directly relevant to the area of child development being considered. Thus, if the clinician is primarily concerned to identify the nature of *cognitive* support that the parent is able to provide, then it would make sense to assess the level of sensitivity (as well as specific behaviors that support cognitive development like facilitation of attention or scaffolding exploration of the environment) in a cognitive-relevant context—for example, during picture book sharing or helping the infant explore a new toy. Similarly, if the primary clinical focus is behavior problems such as aggression or poor emotion regulation, the interaction should be assessed in a context relevant to these behaviors, such as the frustration of the child's having an attractive toy removed from them. Finally, if the clinical focus is a parent's ability to provide support for the infant's attachment needs, such assessment should be made when attachment needs are challenged—as in when the infant is separated briefly

from the parent or has to meet a stranger. A detailed description of observations of parenting in these different contexts is provided in *The Psychology of Babies: How Relationships Support Development from Birth to Two* (Murray, 2014).

Conclusions

A number of treatments have been shown to be effective in helping mothers recover from PND. Notably, however, more limited success has been achieved in improving mother–infant interactions and in preventing poor child outcome in the longer term. Interventions that are promising in this regard are ones that focus specifically on difficulties in mother–infant interactions. These may, however, need to be delivered beyond the early postpartum period. This is because many adverse child outcomes associated with PND are particularly likely to occur in the context of chronic, or recurrent, depression, and it is unsurprising that shortening the infant's initial exposure to depression is insufficient to prevent longer-term problems in child development. In high-risk contexts where depression is more likely to be prolonged or recurrent, it may be helpful to set up long-term monitoring of vulnerable families, so that support can be provided quickly if depression recurs. In addition, it would seem profitable for professionals working with parents to be trained in systematic identification of interaction difficulties in developmentally sensitive contexts. Finally, in addition to efforts to support mother–infant relationships, it may also be beneficial to give infants experience of positive interactions with additional caregivers.

Summary

PND is a common and disabling disorder associated with a range of adverse infant and child outcomes. These occur principally where the maternal depression is chronic or recurrent and in the presence of other background risks. Adverse patterns of parenting associated with PND are likely to play a major role in bringing about poor child outcome. Biological processes are also likely to be important in mediating effects of depression on the child but require further investigation. Attempts to change parental interactions in the postpartum period and thereby improve the longer-term outcome for children of PND mothers have met with only limited success. This is likely, in large measure, to be because chronic maternal depression and background difficulties are strongly linked to particularly poor child outcome. For these reasons, interventions that are restricted to the early postpartum period may be of limited use, and longer-term monitoring and support for families may be necessary; an additional therapeutic strategy could include enhancing the role of other caregivers. There is a need for further research on the impact of depression in the developing world and on deliverable screening for parenting difficulties, in particular general parental sensitivity, as well as interventions.

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