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Prenatal depression effects on the foetus and neonate in different ethnic and socio-economic status groups

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Abstract *The questions addressed in this study were whether prenatal depression effects on the foetus and neonate varied by ethnicity and socio-economic status. Eighty-six depressed pregnant women were compared by ethnic group, Hispanic and African-American, and by socio-economic status (upper/lower) on prenatal and neonatal outcome variables. The Hispanic mothers were older, had a higher SES and had higher prenatal norepinephrine levels. Their foetuses were also more active. At the neonatal period they had higher anger scores, but also higher serotonin levels, and their infants had higher dopamine and lower cortisol levels and they spent less time in deep and indeterminate sleep. The comparison by middle/lower socio-economic status revealed that the middle SES group was older, had more social support and showed less depressed affect but had higher norepinephrine levels prenatally. At the postnatal period the middle SES mothers had lower depression, anxiety and anger scores and lower norepinephrine levels. Their infants also had lower norepinephrine levels, fewer postnatal complications and were less excitable on the Neonatal Behaviour Assessment Scale.*

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The negative effects of maternal depression are being increasingly documented including growth and immune problems in the form of failure-to-thrive (Raynor & Rudolf, 1996), malnutrition (Guedeney, 1997), and significantly greater illness (Francois *et al.*, 1996) in the infants of depressed mothers during the first year of life, non-optimal cognitive outcomes at toddlerhood (Field, 1998; Murray & Cooper, 1997), and behaviour problems (Mohan *et al.*, 1998), hyperactivity and aggression (Stormont & Zentall, 1995), repeat injuries (Russell, 1998) and an increased incidence of child maltreatment (Runyan *et al.*, 1997) by the preschool stage. For almost two decades, the non-optimal outcomes for children of depressed mothers have been attributed to the depressed mothers being emotionally unavailable and unresponsive during their early interactions with their infants (see Field, 1998, for a review).

Little is known about maternal depression in different cultural groups and different levels of socio-economic status. In a cross-cultural study by our group, mother–infant dyads of Cuban and African-American backgrounds visited our lab when their infants were 3 to 4 months of age (M = 14 weeks) (Field & Widmayer, 1981). The Cuban mothers talked to their infants almost continuously, whereas the African-American mothers talked very little. The infants themselves differed during their interactions, with the Cuban infants being the most active and the most expressive, but also engaging in the least eye contact and the most fussing. That was, perhaps, not surprising given that the high levels of stimulation provided by their mothers might be strongly arousing and evoke greater positive as well as negative reactions in their infants.

On the other hand, the infants may have differed in these ways at birth, and it is not clear whether the stimulating mother or the labile infant came first. A number of cross-cultural studies have reported significant differences between neonates of various cultures (Brazelton, 1977; Freedman & Freedman, 1969) on orienting and early behaviours. Neonates of depressed mothers are notably different than infants of non-depressed mothers at birth including differences in neurotransmitters (Field *et al.*, in review; Lundy *et al.*, 1999), EEG patterns (Field *et al.*, in review; Jones *et al.*, 1997), sleep (Field *et al.*, in review; Jones *et al.*, 1997) and behaviour (Abrams *et al.*, 1995; Lundy *et al.*, 1999). The non-optimal neonatal outcomes have been related to elevated stress hormones in their mothers prenatally (Field *et al.*, in review; Lundy *et al.*, 1999) and elevated foetal activity (Dieter *et al.*, in press). If depressed mothers differ prenatally by cultural group, it is conceivable that foetuses and newborns of depressed mothers would also differ by culture.

The purpose of the present study was to determine whether prenatal depression effects on the foetus and neonate varied by ethnicity in two Miami cultures, Hispanic and African-American and by socio-economic status, lower and middle. At equivalent levels of prenatal depression, for example, the effects on the foetus and neonate might be less in one or the other culture and in a middle versus a lower socio-economic status group.

Method

Participants

Following the ethics committee approval of the study and informed consent by the women, 112 depressed pregnant women were recruited during the second trimester (M = 20.1 weeks; *R* = 16–24 weeks) from obstetrician–gynaecologists' offices. To identify 112 women with prenatal depression, 320 women had been screened. The

women were assigned to a depressed group based on their scores on the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). Those who had elevated scores (> 16) (considered the clinical cut-off for depression score by Radloff (1977) were recruited for the depressed symptom group (M CES-D = 24.0). The women's medical charts were also reviewed to identify and exclude any women who showed recreational drug use during pregnancy based on routine drug screens and any alcohol use or smoking. The final sample included 86 pregnant women with elevated depressed symptom scores of lower (52%) to upper middle (48%) socio-economic status (M = 3.1 on the Hollingshead, 1975). The women averaged 25.8 years of age, 37% were single, and their ethnicity was distributed 54% Hispanic and 46% African-American which was representative of the samples in the prenatal clinics of the university hospital and that catchment area. Eighty-four percent of the infants were full-term (M = 37 weeks GA) and healthy. The infants were tested within 2 days after birth (M = 1.9 days). Fifty-eight percent of the depressed group were female infants.

Procedure

At their prescribed ultrasound session at the prenatal clinic (M gestational age = 20.1 weeks) the mothers were given the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977), and the Profile of Mood States (POMS) (McNair *et al.*, 1971). Their ultrasound sessions were coded for foetal activity. First-morning urine samples were obtained from the mothers during the prenatal visit and from them and their newborns within 24 hours after delivery. The CES-D was given again shortly after delivery, and the medical records were used to score the Obstetric Complications Scale (OCS) and the Postnatal Complications Scale (PNS) (Littman & Parmelee, 1978). The Brazelton Neonatal Behaviour Assessment Scale (Brazelton, 1984) was also given within the first few days after birth. In addition, at that time, the newborns' sleep states were coded while they remained in their bassinets.

Measures

The Center for Epidemiological Studies Depression Scale. The CES-D (Radloff, 1977) is a 20-item self-report scale designed to measure depressive symptoms including depressed mood, feelings of guilt, worthlessness, helplessness and hopelessness, loss of energy and sleep and appetite disturbances (Radloff & Teri, 1986). The 20 symptoms are rated for frequency (over the past week) from 'rarely or none of the time' to 'most or all of the time'. A summary score ranges from 0 to 60 by summing all items. Reliability and validity have been acceptable across a variety of demographic characteristics including age, education, geographic area, and racial, ethnic and language groups (Radloff & Teri, 1986). The CES-D was given to the mother at the time of prenatal recruitment and again within 24 hours following delivery.

Profile of Mood States (POMS). The POMS (McNair *et al.*, 1971) consists of 15 adjectives rating depressed mood, nine items on anxiety and 12 items on anger. They are rated on 5-point scales ranging from (0) 'not at all' to (4) 'extremely' using words such as 'blue' and 'sad'. The scale has adequate concurrent validity, good internal consistency (r = 0.95; McNair & Lorr, 1964) and it is an adequate measure of intervention effectiveness (Pugatch *et al.*, 1969).

Foetal activity. Foetal activity assessment was made at 16–24 weeks (M = 20.1 weeks). For this assessment the technician positioned the scanner to obtain a lateral view of the foetus. The observer, who was blind to the mother's group assignment, entered the darkened room after the pregnant woman was draped and then watched the foetus for 5 consecutive minutes. Every 3 seconds (a total of 100 samples), a tape-recorded cue (heard through an earphone) prompted the observer to record the foetal activity categories including: (1) single limb movement, (2) multiple limb movement, and (3) gross body movement. For the data analyses, the percent time the foetus engaged in total movement, as well as each movement category, was calculated. No effort was made to discern foetal behaviour states because they cannot be reliably identified prior to 36 weeks gestation and most particularly during a 5-minute clinical foetal ultrasound exam without confirmation through foetal heart rate monitoring.

First-morning urine samples. First-morning urine samples were collected from the depressed and non-depressed women at their ultrasound visit and within 24 hours following delivery. Newborn first-morning urine samples were collected in the nursery also within 24 hours following delivery. The samples were frozen and sent to Duke University to be analysed by lab technicians who were 'blind' to group assignment. The urines were assayed for norepinephrine, epinephrine, dopamine, serotonin and cortisol levels after correcting for creatinine levels. Norepinephrine, epinephrine and cortisol levels were assessed because of their previously reported positive association with depression (Field, 1995), dopamine because of a recent animal model implicating a negative association between dopamine levels and depression (Weiss *et al.*, 1996), and serotonin because of its negative association with depression.

Complications. Obstetric complications were assessed on the Obstetric Complications Scale (OCS) (Littman & Parmelee, 1978), which is comprised of 41 items taken from the medical charts and rated as optimal or non-optimal. *Postnatal complications* were quantified using the Postnatal Complications Scale (PNS) (Littman & Parmelee, 1978), which consists of 10 items rated as optimal or non-optimal.

Sleep/wake behaviour. Sleep/wake behaviour was continuously videotaped in compressed time (3 hours sleep coded in 1 hour using time lapse video) for an inter-feeding interval (2–3 hours) before the Brazelton was performed on the first afternoon after birth. Thoman's studies of term infants' sleep patterns suggest that an inter-feeding interval time frame can provide a representative sample (Thoman, 1975), and Sostek and Anders (1975) have used 'nap' recordings of this duration. The videotapes were coded for all movements that occurred during that period onto a laptop computer according to the procedures we have used in our other sleep studies (Scafidi *et al.*, 1986). Prior to sleep state coding the examiner was trained to 0.90 reliability. An adaptation of Thoman's Sleep State Criteria was used to define sleep/wake behaviour categories (Thoman, 1975). Sleep was assessed because less quiet and more indeterminate (uncodable) sleep was observed in infants of depressed mothers in our previous study (Jones *et al.*, 1998).

The Brazelton Neonatal Behaviour Assessment Scale. The Brazelton Neonatal Behaviour Assessment Scale (Brazelton, 1984) was given on the first afternoon after birth. The

Table 1. *Means for significant demographic and prenatal and postnatal variables for different ethnic groups (SDs in parentheses)*

	Groups			
	Hispanic (N = 48)	African-American (N = 38)	F	p
Mother prenatal				
Age	25.58 (5.96)	22.73 (5.20)	5.09	0.03
SES[a]	3.34 (1.19)	4.05 (0.93)	8.59	0.004
Fatigue (POMS)[a]	16.61 (6.10)	12.73 (5.43)	3.65	0.05
Norepinephrine[a]	64.33 (26.48)	43.45 (21.69)	11.31	0.001
Foetal activity (% time)[a]	52.01 (33.33)	31.56 (16.01)	5.20	0.03
Mother postnatal				
Anger (POMS)[a]	14.94 (9.81)	10.44 (8.64)	3.95	0.05
Serotonin	4442.60 (2007.97)	2944.80 (950.28)	3.87	0.04
Infant				
Dopamine	505.40 (256.29)	348.94 (168.29)	4.49	0.04
Cortisol[a]	464.57 (179.50)	614.30 (162.15)	6.28	0.02
Deep sleep (% time)[a]	22.00 (26.00)	42.00 (25.00)	5.62	005
Indeter. sleep (% time)[a]	50.91 (22.95)	67.14 (13.35)	4.84	0.05
Quiet alert (% time)[a]	11.00 (16.00)	1.00 (1.00)	5.01	0.05

[a] Lower score is optimal.

Brazelton assessments were performed by researchers who were trained to 0.90 reliability and were blind to the group classification of the mothers and infants. This neurobehavioural examination consists of 28 items, each scored on a 9-point scale, and 20 elicited reflexes, each scored on a 3-point scale. The infant's performance was summarized according to the traditional Lester *et al.* (1982) clusters, and Lester and Tronick's (1992) depression, excitability and withdrawal factors.

Results

On demographic variables, the sample was distributed as follows. The women were lower (52%) or middle (48%) socio-economic status (M = 3.1 on the Hollingshead, 1975), they averaged 25.8 years of age, 37% were single, and their ethnicity was distributed 54% Hispanic and 46% African-American. They were interviewed and given ultrasounds at their prenatal clinic. Of the 86 mother–neonate dyads who could be located at the university delivery hospital, 84% of the neonates were full-term (M = 37 weeks GA) and 58% of the sample were female infants. The newborns were tested within 2 days after birth (M = 1.9 days) on the newborn unit.

MANOVAS on the groups of prenatal and postnatal variables were conducted followed by ANOVAS on the individual variables. Only means for the statistically significant variables are presented in the tables. As can be seen in Table 1, the Hispanic prenatally depressed mothers as compared to the African-American prenatally depressed mothers: (1) were older; (2) were higher socio-economic status; (3) reported greater fatigue on the POMS; (4) had higher nonepinephrine levels; and (5) had foetuses who showed greater foetal activity. Interrater reliability for foetal activity,

Table 2. *Means for significant demographic, prenatal and postnatal variables for middle and lower SES groups (SDs in parentheses)*

	Groups			
	Middle (N = 40)	Lower (N = 46)	F	p
Mother prenatal				
Age	27.03 (5.71)	22.99 (5.88)	19.03	0.001
Social support	3.14 (0.61)	2.85 (0.79)	4.89	0.03
Depressed mood[a]	3.44 (3.24)	6.00 (4.24)	6.19	0.02
Norepinephrine[a]	56.77 (25.98)	47.50 (24.18)	4.28	0.04
Mother postnatal				
Depression (CESD)[a]	9.16 (7.97)	13.78 (8.81)	4.78	0.006
Anxiety (POMS)[a]	8.41 (5.87)	12.31 (6.03)	7.74	0.007
Anger (POMS)[a]	6.64 (7.05)	10.81 (10.60)	4.06	0.05
Mother norepinephrine[a]	32.10 (19.77)	43.31 (23.47)	5.30	0.02
Infant				
Epinephrine[a]	4.63 (3.18)	6.49 (2.86)	6.50	0.01
Postnatal complications[a]	145.06 (27.21)	128.07 (33.38)	5.93	0.02
Excitability (Brazelton)[a]	2.39 (1.65)	1.32 (1.39)	8.97	0.004

[a] Lower score is optimal.

calculated on one-third of the sample for two observers, yielded the following Kappa values: single limb movement = 0.82; multiple limb movement = 0.86; gross body movement = 1.00.

At the postnatal period (see Table 1), the Hispanic as compared to the African-American group: (1) reported greater anger on the POMS Scale; and (2) had higher serotonin levels. Their newborns: (1) had higher dopamine and lower cortisol levels; and (2) spent less time in deep and indeterminate sleep and more time in a quiet alert state.

MANOVAS were then conducted on the groups of prenatal and postnatal variables followed by ANOVAS on the individual variables using SES as a grouping variable and ethnicity as a covariate. As can be seen in Table 2 on the prenatal variables, the middle SES versus the lower SES mothers: (1) were older; (2) had more social support; and (3) showed less depressed affect; but (4) had higher norepinephrine levels.

On the postnatal variables (Table 2), the middle SES versus the lower SES mothers had: (1) lower depression, anxiety and anger scores; and (2) lower norepinephrine levels. Their newborns had: (1) lower norepinephrine levels; (2) fewer postnatal complications; and (3) higher excitability scores on the Brazelton Neonatal Behaviour Assessment Scale.

Discussion

Although the Hispanic depressed mothers seemed to be advantaged by their age and their socio-economic status, they reported more fatigue on the POMS and they had higher norepinephrine levels (a stress neurotransmitter) during pregnancy. Their

foetuses also showed greater foetal activity, which has been considered a risk factor in foetuses of depressed mothers (Dieter *et al.*, in press). At the neonatal stage, however, despite their higher anger scores, the Hispanic mothers seemed to be advantaged by having higher serotonin levels. Their newborns also looked more optimal by having higher dopamine and lower cortisol levels which are generally associated with lower prenatal depression and prenatal stress in both human (Field *et al.*, in review; Wadhwa *et al.*, 1998) and animal models (Weiss *et al.*, 1998). The Hispanic newborns also spent less time in indeterminate (disorganized) sleep and more time in a quiet alert state, again factors that would be associated with lower depression (Jones *et al.*, 1997). The two different ethnic groups also differed by socio-economic status, although when SES was controlled, these ethnic group differences remained.

With ethnic group as a covariate, data analyses were conducted comparing lower and middle socio-economic status groups. Depressed mother effects have often been attributed to low socio-economic status (Tronick & Field, 1986). In the present comparison the middle SES mothers were advantaged prenatally by being older, having more social support and having less depressed mood, although they had higher norepinephrine levels (usually considered a stress neurotransmitter) (Field *et al.*, in review; Lundy *et al.*, 1999).

At the neonatal stage, the newborns of middle SES mother experienced fewer postnatal complications, had lower epinephrine (stress neurotransmitter) levels but were more excitable. Their mothers at this time also had lower norepinephrine levels and scored lower on depression, anxiety and anger measures, suggesting more optimal outcomes for the middle SES mothers, as might be expected.

Many depressed mother–infant studies in the literature have the problems that (1) the studies were started too late in development such that prenatal and neonatal differences were not considered even though many of the women are chronically depressed and presumably would be depressed during pregnancy; (2) they combined cultural groups in one sample, although it is apparent from this and other databases (e.g. Field & Widmayer, 1981) that cultural differences may affect even physiological and biochemical measures; and (3) they combined different socio-economic status groups that needed to be analysed separately, as lower SES seems to confer an additional risk factor on prenatal depression.

Future studies are needed to tap variables that might contribute to the stress hormone (norepinephrine) differences usually associated with pregnancy stress (Glover *et al.*, 1999). Another perplexing finding was that both the Hispanic and middle SES groups showed higher norepinephrine levels during pregnancy and yet had lower norepinephrine levels (in the case of the middle SES group) or more optimal neurotransmitters (serotonin in the case of the Hispanic group) postnatally and more optimal neonatal outcomes (in the case of both the Hispanic and middle SES group). More research is needed on these neurotransmitter changes and other potential cultural and socio-economic status differences in underlying mechanisms.

The addition of non-depressed groups of different ethnic and SES backgrounds would also enable comparisons against the norms for the different cultural and SES groups. Finally, it should be noted that including a diagnostic interview would have strengthened this study. Although depression diagnosis and depressive symptom self-reports are highly correlated (Wilcox *et al.*, 1998), the CES-D recruitment criterion may have resulted in false positives in the sample. Nonetheless, the present results highlight the need to view these ethnic and SES groups as potentially at greater risk for prenatal depression effects and as possibly needing early intervention.

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