Effects of Maternal Depressive Symptoms and Infant Gender on the Interactions Between Mothers and Their Medically At-Risk Infants

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Abstract

Objective—To examine the effects of maternal depressive symptoms and infant gender on interactions between mothers and medically at-risk infants.

Design—Longitudinal descriptive secondary analysis.

Participants—One hundred eight (108) preterm infants and their mothers, 67 medically fragile infants and their mothers, and 83 infants seropositive for HIV and their primary caregivers were studied in their homes between 6 and 24 months.

Main Outcome Measures—Observation and the HOME Inventory were used to assess the interactions of mothers and their medically at-risk infants. Maternal depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale.

Results—The level of depressive symptoms did not differ between the mothers of boys and mothers of girls in the three groups. Mothers of medically fragile infants had higher levels of depressive symptoms than mothers of preterm infants at 6 months corrected age and similar levels of depressive symptoms as HIV-positive mothers at 12 months. HIV-positive mothers with elevated depressive symptoms were less attentive to their infants. The effects of gender on mother-infant interactions were not moderated by maternal depressive symptoms.

Conclusion—Maternal depressive symptoms had a somewhat negative effect on the interactions of mothers and medically at-risk infants.

Keywords

Establishing positive interactions between medically at-risk infants and their mothers is important because the quality of interactions is related to later cognitive, language, and socioemotional development in the infants (Butcher et al., 2004; Girolametto et al., 2002). The quality of mother-infant interactions may differ depending on the nature of infant medical problems, such as prematurity and medical fragility, and the presence of maternal

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medical problems, such as HIV-infection. The quality of interactions also may be affected by maternal depressive symptoms (Logsdon, Wisner, & Pinto-Foltz, 2006). Unlike infant medical problems, maternal depressive symptoms are amenable to change (Horowitz et al., 2001; Thome & Alder, 1999). Nurses can help the mothers manage these symptoms in order to enhance interaction with their infants. In the present study, maternal depressive symptoms were expected to moderate the effect of infant gender on the interactions of mothers and their medically at-risk infants. Medically at-risk infants were defined as infants who were born prematurely (gestational age less than 35 weeks), were dependent on technology to maintain their vital functions, were chronically critically ill during the first year of life, or were seropositive for HIV (perinatally exposed but not necessarily infected).

> 1. Maternal depressive symptoms and male gender have been found to contribute to less positive mother-infant interactions, which predict child development.

Mothers of premature infants have been found to demonstrate less positive parenting than mothers of fullterm infants (Poehlmann & Fiese, 2001; Singer et al., 2003). These mothers had difficulties in interpreting the meaning of their premature infants' immature behaviors (Singer et al., 2003). Although mothers of fullterm infants were able to discriminate infant pain cries from hunger or anger cries, mothers of premature infants had difficulty doing this because premature infants' cries were often unusual in pitch, pattern, and volume (Worchel & Allen, 1997). As a result, mothers of premature infants tended to lose confidence in their parenting skills and perceived their infants as difficult (Leavitt, 1998). Premature infants also provided fewer cues for interactions such as eye contact and smiles, leading their mothers to engage in less positive interactions (Singer et al., 2003).

Similarly, the interactions between mothers and their medically fragile infants, infants who are technologically dependent or chronically critically ill may be problematic due to the infants' severe chronic illnesses, prolonged hospitalizations, and developmental delays (Holditch-Davis, Tesh, Miles, & Burchinal, 1999) in combination with maternal characteristics such as having poor mental health, living in poverty, or lacking of family support (Thyen, Kuhlthau, & Perrin, 1999). Home care for infants requiring technology is a tremendous burden for mothers (Miles, Holditch-Davis, Burchinal, & Nelson, 1999; Williams et al., 1999). These mothers had difficulty in interpreting their infants' ambiguous signals and in providing stimulation. They feared that excessive handling might exacerbate medical problems (Rivera & Oliden, 2001). Mothers of medically fragile infants often tried to compensate for infant social deficits through having more frequent interactions with them (Holditch-Davis, Cox, Miles, & Belyea, 2003). Some mothers achieved more personal growth through caring for a medically fragile infant (Miles et al., 1999).

HIV-positive mothers had more positive interactive behaviors than HIV-negative mothers with similar socioeconomic backgrounds because they felt guilty about exposing their infants to their illness (Andrews, Williams, & Neil, 1993) and the infant's presence encouraged them to live their lives more positively (Shambley-Ebron & Boyle, 2006; Swartz, Markowitz, & Sewell, 1998). On the other hand, the mothers' medical problems inhibited the development of maternal sensitivity and responsiveness, thus limiting the mother's ability to engage in positive interactions with her infant (Hudson, Kirksey, & Holzemer, 2004; Murphy, Marelich, Stritto, Swendeman, & Witkin, 2002).

The quality of mother-infant interactions is influenced by other infant and maternal characteristics in addition to maternal or infant health problems. One factor probably associated with interaction quality is maternal depressive symptoms. Depressive symptoms have been found in 10 to 15% of women postnatally (Gaynes et al., 2005; Gavin et al., 2005; Josefsson, Berg, Nordin, & Sydsjö, 2001), and these symptoms negatively affected mother-infant interactions in healthy fullterm infants (Herrera, Reissland, & Shepherd, 2004;

Righetti-Veltema, Bousquet, & Manzano, 2003). Depressive symptoms are often referred to as sub-threshold depression (Weinberg et al., 2001), minor depression (Wagner et al., 2000), or major depression with only 2–4 depressive symptoms (Wagner et al., 2000). Weinberg et al. (2001) defined sub-threshold depression as a score of 16 or higher on the CES-D in the absence of a diagnosis of major depression. On the one hand, Kessler, Zhao, Blazer, and Swartz (1997) reported smaller differences in functional impairment between depressive symptoms and major depression with 5–6 symptoms than between depressive symptoms and major depression with 7–9 symptoms.

Maternal depressive symptoms were even higher when infants were at medical risk (Callahan & Hynan, 2002; Davis, Edwards, Mohay, & Wollin, 2003; Eisengart, Singer, Fulton, & Baley, 2003) because of maternal traumatic birth experience and concerns about infant illness and survival (Holditch-Davis, Bartlett, Blickman, & Miles, 2003; Josefsson et al., 2001). These problems can also lead to posttraumatic stress disorder (PTSD) symptoms and mothers with more PTSD symptoms were more likely to have higher depressive symptoms (Callahan & Hynan, 2002; DeMier et al., 2000; Holditch-Davis, Bartlett, et al., 2003). Almost 50% of mothers with premature or medically fragile infants reported elevated depressive symptoms during the early postpartum period (Davis et al., 2003; Mew, Holditch-Davis, Belyea, Miles, & Fishel, 2003; Miles, Holditch-Davis, Schwartz, & Scher, 2007). Although the severity of maternal depressive symptoms were lower by 6 months after hospital discharge (Mew et al., 2003; Miles et al., 2007), mothers of premature or medically fragile infants continued to have higher rates of psychological distress than mothers of healthy fullterm infants (Davis et al., 2003). Some of these mothers had clinical levels of depression for 2 years after the infants' birth (Feldman, Weller, Leckman, Kuint, & Eidelman, 1999; Miles, Gillespie, & Holditch-Davis, 2001).

The interactions of medically fragile infants and mothers with depressive symptoms have rarely been studied, but premature infants of mothers with elevated depressive symptoms (the score of the Edinburgh Postpartum Depression Scale ≥12) have been found to respond less frequently to their mothers during feeding interactions (Davis, Edwards, & Mohay, 2003). Feldman et al. (1999) found that premature infants of mothers with elevated levels of depressive symptoms showed less attachment behaviors during dyadic interactions than those with mothers with normal levels of depressive symptoms. Poehlmann and Fiese (2001) also reported that premature infants of mothers with more depressive symptoms were insecurely attached 3.5 times as often as fullterm infants. Maternal depressive symptoms could well affect adversely the interactions of mothers and medically fragile infants in similar way to the interactions of mothers and their premature infants.

Many HIV-positive mothers exhibited elevated depressive symptoms as a response to their diagnosis with a life-threatening illness; their symptoms such as fatigue, pain, and gynecologic problems (Hudson, Kirksey, & Holzemer, 2004; Miles, Burchinal, Holditch-Davis, Wasilewski, & Christian, 1997); and their social problems such as poverty, social isolation, and stigma (Catz, Gore-Felton, & McClure, 2002; Schrimshaw, 2003). HIV-positive mothers reported higher depressive symptoms than HIV-negative mothers (Morrison et al., 2002; Richardson et al., 2001), and HIV-positive mothers have been shown to be less affectionate and less verbally responsive to their children than HIV-negative mothers (Johnson & Lobe, 2001; Kotchick, Forehand, Brody, Armistead, & Morse, 1997; Murphy et al., 2002; Reyland, McMahon, Higgins-Delessandro, & Luthar, 2002). HIV-positive mothers reported that poverty and being single parents had a more negative influence on their parenting than did their HIV status (Swartz, Markowitz, & Sewell, 1998). Elevated maternal depressive symptoms had particularly adverse effects on mother-infant interactions in mothers living in poverty regardless of HIV infection (Coyl, Roggman, & Newland, 2002). Thus, single HIV-positive mothers who live in poverty would have a

higher risk for developing depressive symptoms that may jeopardize positive mother-infant than other HIV-positive mothers.

The impact of maternal depressive symptoms may be stronger for boys than girls (Beeghly et al., 2002; Grace, Evindar, & Stewart, 2003; Hart, Field, Valle, & Pelaez-Nogueras, 1998; Weinberg et al., 2001). In studies of healthy fullterm infants, infant boys of mothers with higher depressive symptoms were found to be more vulnerable to insecure attachment and delayed cognitive development (Murray, Fiori-Cowley, Hooper, & Cooper, 1996; Righetti-Veltema, Bousquet, & Manzano, 2003). Mothers with elevated depressive symptoms had significantly more negative attitudes when the infant was boy (Grace et al., 2003; Hart et al., 1998); whereas no differences in response to infants of different genders was observed in mothers without depressive symptoms (Murray, Kempton, Woolgar, & Hooper, 1993). Mothers with high depressive symptoms and who had boys reported poorer maternal self-esteem and adaptation to motherhood than mothers of girls (Weinberg et al., 2001), and mothers of boys had a higher risk for developing major depression than mothers of girls (Beeghly et al., 2002). Boys were more resistant towards their mothers, were less alert, and scored lower on the Bayley Motor and Mental Scales than girls when their mothers had more depressive symptoms (Righetti-Veltema et al., 2003; Weinberg, Tronick, Cohn, & Olson, 1999). Mothers, who scored higher than 12 on the Beck Depression Inventory also were more intrusive (Hart et al., 1998) and experienced greater difficulties during interactions with boys than with girls because the boys tended to be more demanding, cry and fuss more, and exhibit more anger (Weinberg & Tronick, 1998).

The effects of infant gender and maternal depressive symptoms on the interactions of mothers and their medically at-risk infants have seldom been studied together. Mothers were found to show more positive interactive behaviors, such as looking and gestures, towards their 3-year-old prematurely born girls than boys, and girls were more likely to respond to their mothers (Cho, Holditch-Davis, & Belyea, in press), but whether these mothers were depressed was not studied. Thus, more research is needed on the effects of maternal depressive symptoms and infant gender on the interactions of mothers and their medically at-risk infants in order for nurses to target their interventions to the mothers and infants at greatest risk. If some aspects of the maternal depressive symptoms are related to gender of infant, depressed mothers with boys may need to receive more attention and intervention from researchers and clinicians to reduce their psychological dysfunction and infants' negative health outcomes as well as to improve infants' cognitive, language, and socioemotional development.

The present study examined whether the levels of maternal depressive symptoms differed between infant genders and between groups of medically at-risk infants; whether mother-medically at-risk infant interactions differed by level of maternal depressive symptoms; and whether the effects of gender on mother-medically at-risk infant interactions were moderated by maternal depressive symptoms (i.e., whether depressive symptom effects were different for boys and girls). The cognitive theory of depression (Beck, 1976) and the theory of maternal postpartum role collapse (Amankwaa, 2005) were the guiding frameworks for this study.

According to these theories, maternal depressive symptoms are related to negative thoughts about self, dysfunctional beliefs about the surrounding environment, and role collapse due to role stress and strain. Mothers who had more difficulties in adjusting their caregiver roles because of the severity of the infant's illness and mother's social problems were expected to show more depressive symptoms. Also, depressed mothers were expected to show less positive mother-infant interactions with boys than girls because depressed mothers

perceived more parenting difficulties with boys than girls (Grace, Evindar, & Stewart, 2003; Hart et al., 1998).

Three groups of medically at-risk infants were chosen for study in order to examine the differential effects of infant illness severity, maternal illness, and maternal social problems in combination with maternal depressive symptoms. The effects of infant health problems on mother-infant interactions were examined in premature and medically fragile infants. Infants seropositive for HIV were studied to examine the effects of mother's health and social problems on mother-infant interactions.

Method

Participants

Longitudinal descriptive secondary analysis was conducted with samples from three studies: 108 premature infants and their mothers (Holditch-Davis, Scher, & Schwartz, 2004; Miles et al., 2007), 67 medically fragile infants and their mothers (Holditch-Davis, Tesh, Goldman, Miles, & D'Auria, 2000; Miles et al., 1999), and 83 infants seropositive for HIV and their primary caregivers (16 of whom were relatives or foster mothers; Holditch-Davis et al., 2001; Miles et al., 1997). Each study and the secondary analysis were approved by the Institutional Review Board. ANOVAs indicated that infant birthweight, gestational age, maternal age, and the years of mother's education differed significantly among the three groups. Chi-Square tests indicated that the groups differed significantly on percent of preterm infants, race, and maternal marital status (see Table 1). Socio-demographic characteristics of the groups did not differ by infant gender except that medically fragile boys were more likely to be preterm than girls ($\chi^2 = 4.09$, p = 0.04) and boys seropositive for HIV were more likely to be preterm than girls ($\chi^2 = 6.63$, p = 0.01).

Measures

Mother-infant interactions—Data about the interactions of mothers and their medically at-risk infants were obtained from observations conducted in the home for 45 minutes to 1 hour (Holditch-Davis, Bartlett, & Belyea, 2000) and the Home Observation for Measurement of the Environment (0–3 year version, HOME; Caldwell & Bradley, 1980). Videotapes of interactions were used for premature infants and direct observations were used for medically fragile infants and infants seropositive for HIV. Videotapes and direct observations were scored using the same coding system (Holditch-Davis et al., 1999, 2001; Holditch-Davis, Schwartz, Black, & Scher, 2007). The mother was asked to do what she would typically do when with the infant and to act as though the videotaper or observer were not present. The presence or absence of mother and infant behaviors were recorded every 10-seconds using predefined single character codes (Holditch-Davis et al., 2007). Multiple occurrences of the same behavior during a 10-second interval were not recorded. During direct observations, the end of each 10-second period was signaled audibly to the observer through an earphone from a small electronic timer. For videotape scoring, the coders used the time listed on the videotape.

Definitions of six combined maternal (positive, negative, talk, look, interact, uninvolved) and five combined infant interactive behaviors (positive, negative, talk, look, interact) used in this study are presented in Table 2. Interrater reliabilities (Cohen's kappa) for the behavioral variables ranged from .85 to .95 for the premature infants and .66 to .92 for their mothers (Holditch-Davis et al., 2007), from .51 to .94 for the medically fragile infants and .53 to .98 for their mothers (Holditch-Davis et al., Cox, et al., 2003), and .66 to .80 for the infants seropositive for HIV and .72 to .90 for their HIV-positive mothers (Holditch-Davis et al., 2001).

Four new global interactive dimensions were constructed - mother attention, mother restrictiveness, infant social behaviors, and infant negativism - from the 11 combined mother and infant interactive variables based on conceptual sense and extracted partially from factor analyses, using principal component with promax rotation, which provided better classification for new variables than other rotations (see Table 2). The variables were calculated by summing the *Z*-scores of the behaviors in each variable. To maintain age-related differences, *Z*-scores were calculated using means and standard deviations over age. Mother attention I consisted of mother positive, look, talk, interact, and the reverse of uninvolved and had internal consistency of .86 for premature infants, .81 for medically fragile infants, and .90 for infants seropositive for HIV. Infant social behaviors consisted of child talk, look, positive, and interact and had internal consistency of .64 for premature infants, .61 for medically fragile infants, and .74 for infants seropositive for HIV. Mother restrictiveness I and child negativism were one variable each: mother negative and child negative. Higher scores of mother restrictiveness I indicated mothers showed negative interactive behaviors, such as frown and scold, more frequently to the infant. Higher scores of infant negativism indicate infants showed negative interactive behaviors, such as grimace and cry, more frequently to their mothers.

The Home Observation for Measurement of the Environment (HOME)—Three subscales of the infant-toddler version of the HOME Inventory (Caldwell & Bradley, 1980) were used to represent mother attention and mother restrictiveness in the present study: emotional and verbal responsivity of mother, acceptance of the child's behaviors, and maternal involvement with child. Each item was scored as present or absent, and the total score equaled the number of present items. Higher scores meant the home environment provided better quality stimulation for child development. Internal consistency of the three HOME subscales for the premature infants at 6 and 18 months ranged from .42 to .69, for the medically fragile infants at 6 and 12 months ranged from .30 to .64 (Holditch-Davis et al., 2000), and for the infants seropositive for HIV at 12, 18, and 24 months ranged from .69 to .83 (Holditch-Davis et al., 2001).

Mother attention II was created from the scores of the first and fifth HOME subscales (emotional and verbal responsivity of mother and maternal involvement with child). Mother restrictiveness II was created from the reverse score of the second HOME subscale (acceptance of the child's behaviors). The new variables were calculated by summing the *Z*-scores of the subscales. These Z-scores were calculated using means and standard deviations over age. Internal consistency of mother attention II ranged from .30 to .37 for premature infants, .65 to .56 for medically fragile infants, and .68 to .80 for the infants seropositive for HIV.

Maternal depressive symptoms—Maternal depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977). The CES-D assesses the frequency of depressive symptoms such as blues, difficulty concentrating, crying, and sleep problems in the previous week (Radloff, 1977). The 20 items are rated on a 4-point scale from 0 "rarely" to 3 "frequently." Scores range from 0 to 60 with higher scores indicating more depressive symptoms. A score of 16 is the critical point for identifying individuals at risk of experiencing depression (Radloff, 1977).

The CES-D is correlated with other measures of depression (Radloff, 1977). Scores of mothers of medically at-risk infants were related to other indicators of psychological well-being such as hospital environmental stress, mastery, worry about the child's health, and posttraumatic stress symptoms (Mew et al., 2003; Miles et al., 1999; Holditch-Davis, Bartlett, et al., 2003). Internal consistency of the CES-D ranged from .84 to .90 in studies of mothers of medically at-risk infants (Holditch-Davis et al., 2001; Mew et al., 2003; Miles et

al., 1999). Internal consistency of the CES-D scores in the present study for mothers of preterm infants at 6 and 18 months was .79 and .81, for mothers of medically fragile infants at 6 and 12 months was .74 and .73, and for HIV-positive mothers at 12, 18, and 24 months was .92, .89, and .77. Mothers with elevated depressive symptoms in the premature and medically fragile infant studies were screened for suicidal ideation and given referrals for treatment. This was not done for the mothers of the infants seropositive for HIV because they were followed by social workers in the pediatric infectious disease clinic throughout the study.

Demographic characteristics—Maternal demographic data for each study were obtained using an interview and questionnaires at enrollment. Infant characteristics and medical course were obtained through medical record reviews.

Procedures

The mothers and premature infants were enrolled in the study when the infants in the NICU were no longer critically ill. The mothers and medically fragile infants were enrolled during hospitalization once the infant's medically fragile status was confirmed and the infant was not experiencing a medical crisis. The mothers of the infants seropositive for HIV were initially contacted by a member from pediatric infectious disease team in clinic and then referred to the data collection team. In all three studies, the purpose was explained and consent was obtained. The appropriate county social service agency was asked for permission to enroll the infant seropositive for HIV when the infant was in foster care. Questionnaires including demographics were completed at enrollment by the mother. When the preterm infants were 6 and 18 months corrected ages, they were videotaped with their mothers for 45 minutes in their homes. Mothers and medically fragile infants were observed for 1 hour in the hospital at enrollment (about 6 weeks chronological age) and at home at 6 and 12 months corrected ages. HIV-positive mothers and their infants were observed for 1 hour in the home at 12, 18, and 24 months. After the videotaping or direct observation, a research assistant administered the HOME Inventory and the CES-D.

Data Analysis

T-tests were used to determine whether levels of maternal depressive symptoms differed between genders and between groups of medically at-risk infants and whether interactive behaviors differed depending on whether mothers had normal or elevated depressive symptoms. General linear mixed models (Holditch-Davis, Edward, & Helms, 1998) were used to determine whether the interactions of mothers and their medically at-risk infants differed longitudinally by maternal depressive symptoms and infant gender and whether the effects of gender were moderated by maternal depressive symptoms. Different contact time points were applied within individuals, while gender was applied between individuals.

Results

Maternal Depressive Symptoms in Mothers of Medically At-Risk Infants

The mean CES-D scores for three groups of mothers averaged less than 16 throughout the study; however, 12% and 10% mothers of premature infants at 6 and 18 months; 39% and 34% mothers of medically fragile infants at 6 and 12 months; and 23%, 14%, and 19% of HIV-positive mothers at 12, 18, and 24 months reported high depressive symptoms (CES-D scores ≥16). Also, 1 mother of a premature infant, 17 (25%) mothers of medically fragile infants, and 7 (8.4%) HIV-positive mothers reported high depressive symptoms at two adjacent time points 6 months (or 12 months for the mothers of premature infants) apart. The range of elevated CES-D scores was 16 to 41 in mothers of premature infants, 18 to 27 in mothers of medically fragile infants, and 22 to 53 in HIV-positive mothers. The level of

depressive symptoms did not differ significantly between mothers of boys and mothers of girls in the three groups (see Table 3).

Maternal depressive symptoms were compared between each pair of medically at-risk group at the ages they both had data (see Table 4). Mothers of medically fragile infants showed significantly higher level of depressive symptoms than mothers of premature infants at 6 months. The level of depressive symptoms of the three groups of mothers did not differ at any other age.

Normal versus Elevated Maternal Depressive Symptoms and Interactions

T-tests at 6 and 18 months indicated that the interactions between mothers and premature infants did not differ whether or not maternal depressive symptoms were elevated (p >.05 for all analyses). For medically fragile infants, mothers with CES-D scores of 16 or above showed significantly less mother attention I [$t (1, 51) = 2.31$, $p = 0.03$] and II [$t (1, 57) = 2.58$, $p = 0.01$] than the mothers with normal levels of depressive symptoms at 12 months corrected age, and the medically fragile infants of mothers with elevated levels of depressive symptoms showed more negativism at 6 months corrected age [$t (1, 57) = −2.27$, $p = 0.03$]. HIV-positive mothers with elevated CES-D scores showed significantly more mother restrictiveness II than the mothers with normal levels of CES-D scores at 12 months [$t (1, 53 = −2.82$, $p = 0.01$], but no differences were found between mothers with normal and elevated depressive symptoms at 18 and 24 months.

Moderator Effects of Maternal Depressive Symptoms and Gender

Table 5 shows the results of the general linear mixed models, examining the effects of gender and depressive symptoms longitudinally. The only effect of gender on the interactions was that medically fragile boys showed more negativism than the medically fragile girls. Infant negativism increased over time. The interactions of preterm infants were not affected by maternal depressive symptoms. More depressed mothers of medically fragile infants were less attentive and more restrictive to their infants and their infants showed more negativism over time. HIV-positive mothers with higher depressive symptoms were less attentive to their infants and their infants showed significant less negativism over time. The interactions between mothers and their medically at-risk infants were not moderated by maternal depressive symptoms or gender over time, as shown by the lack of any significant interactions between gender and depressive symptoms.

2. Depressed mothers of medically fragile infants and infants seropositive for HIV were less attentive and more restrictive to their infants than non-depressed mothers.

Discussion

Maternal depressive symptoms had a somewhat negative effect on the interactions between mothers and most groups of medically at-risk infants. Mothers of medically fragile infants had more depressive symptoms than mothers of premature infants at 6 months corrected age. When mothers of medically fragile infants had more depressive symptoms, they were less attentive and more restrictive to their infants and the medically fragile infants showed increased negativism. Similarly, mothers of the infants seropositive for HIV and who had higher depressive symptoms were less attentive to their infants. These findings are consistent with the findings of studies of healthier infants that mothers with more depressive symptoms are more restrictive and negative and showed less affection and more disengagement during interactions with their infants (Feldman et al., 1999).

The levels of maternal depressive symptoms and their moderating effects on mother-infant interactions were compared between each pair of medically at-risk group at the ages they

both had data as these symptoms were assumed to have commonalities and differences in their effects based on mother's and infant's health and social situations even after controlling for infant's age. Interactions of mothers and prematurely born infants did not appear to be affected by depressive symptoms, possibly due to the mothers' low mean CES-D scores (< 9) at 6 and 18 months. Low levels of maternal depressive symptoms for mothers of premature infants after 6 months corrected age have been found regardless of infant's maturity, birthweight or neonatal illnesses (Miles et al., 2007; Pridham et al., 2005; Pridham, Lin, & Brown, 2001; Pridham, Schroeder, & Brown, 1999; Pridham, Schroeder, Brown, & Clark, 2001). Mothers of very low birthweight infants (mean CES-D scores = 7.0 to 10.3), premature infants with bronchopulmonary dysplasia (mean CES-D scores =8.8 – 10.7), and premature infants with respiratory distress syndrome (mean CES-D scores = 7.8 – 10.1) averaged low levels of depressive symptoms throughout the first year (Pridham et al., 1999; Pridham, Lin, et al., 2001).

Mothers of medically fragile infants appeared to have more depressive symptoms than mothers of premature infants possibly due to more serious medical problems of their infants. Medically fragile and premature infants are often confounded because more than 60% of medically fragile infants are premature (Cross, Leonard, Skay, & Rheinberger, 1998; Holditch-Davis et al., 2000). Medically fragile infants, however, have more serious medical conditions than most premature infants and are technologically dependent and require prolonged and often repeated hospitalizations (Miles et al., 1999). The presence of serious medical complications in the infant is one of strongest predictors of PTSD (Beck, 2004; Callahan & Hynan, 2002; DeMier et al., 2000) and PTSD contributes to a multitude of psychological symptoms (Callahan & Hynan, 2002; Holditch-Davis, Bartlett, et al., 2003). In addition, mothers with technology-dependent infants did not view their lives as normal because of the uncertainty and unpredictability in their lives (O'Brien, 2001; Thyen, Kuhlthau, & Perrin, 1999).

These life situations might result in increased depressive symptoms. On the other hand, the mean CES-D scores did not differ between mothers of medically fragile infants and HIV-positive mothers although the prevalence of elevated depressive symptoms was somewhat higher in mothers of medically fragile infants. Further study on the interactions between mothers and medically fragile infants needs to focus on the influence of infant biological factors such as birth characteristics and medical complications as such factors are found to be significant predictors of PTSD symptoms as well as depressive symptoms (Callahan & Hynan, 2002; DeMier et al., 2000; Holditch-Davis, Bartlett, et al., 2003).

The elevated depressive symptoms of mothers of the infants seropositive for HIV are probably due to their own health and social factors rather than their perceptions of infant health problems since their infants have fewer health problems than the premature or medically fragile infants (American Academy of Pediatrics Committee on Pediatric AIDS, 1997; Mellins et al., 2003). Most of these mothers were HIV positive, and other studies have found that high CES-D scores in HIV-positive mothers were predicted by social factors such as maternal ethnicity and marital status (Jones, Beach, Forehand, & the Family Health Project Research Group, 2001; Kotchick et al., 1997). Elevated depressive symptoms of HIV-positive mothers may also be affected by HIV complications and HIV-related physical symptoms including fatigue, sleep disturbances, and low energy (Hudson, Kirksey, & Holzemer, 2004; Murphy et al., 2002). Thus, future studies on the interactions between HIV-positive mothers and their infants may need to focus more maternal illness characteristics and demographic factors than on infant characteristics.

The effects of gender on the interactions between mothers and medically at-risk infants were not moderated longitudinally by maternal depressive symptoms although the previous

literature found gender differences in the interactions between depressed mothers and healthy infants (Grace, Evindar, & Stewart, 2003; Hart et al., 1998; Righetti-Veltema, Bousquet, & Manzano, 2003). One possible explanation for the lack of moderator effects in this study is that most mothers showed mild depressive symptoms, and the level of depressive symptoms did not differ between mothers of boys and girls in the three groups of medically at-risk infants. Another possible explanation is that the sample size may not have been large enough to identify small interactive effects of gender on maternal depressive symptoms. Also, fewer effects of gender occurred than would be expected by chance, possibly due to the specific age periods studied. The infants might have been too young to detect the effects of gender on interactions with mothers.

The global mother-infant interactive dimensions studied here were made up from the 11 combined mother and infant interactive variables to examine common concepts of mother-infant interactions and reduce the possibility of multi-collinearities. However, global interactive dimensions did not seem to capture specific differences between boys and girls. Further research would be needed to examine the main effects of gender on the interactions between mothers and medically at-risk infants using specific mother and infant interactive behaviors such as look and talk since these interactive behaviors have been found to differ by infant's gender.

The present study had several limitations. First, the internal consistency of mother-infant interactive variables, such as infant social behaviors and mother attention II for premature infants and medically fragile infants, was lower than .70. However, the internal consistency may not be an appropriate way of testing reliability for the HOME Inventory and observational methods as these measurements are causal indicator tools, which are influenced by multiple latent variables outside of the model rather than by high correlations among indicators of the same concept (Bollen & Lennox, 1991). Another limitation was that statistical power based for the repeated measures analyses was less than .80, particularly for the 67 medically fragile infants with a power of .64. However, the present study was conducted in three partial replications with three groups of medically at-risk infants. The probability of an actual difference due to gender or maternal depressive symptoms not being found in any of the groups was less than 4%. The heterogeneous samples and the different data collection times may have also contributed to the failure to detect differences.

> 3. Depressed mothers of medically at-risk infants could benefit from early mother-focused interventions to reduce depressive symptoms and maintain high quality mother-infant interactions.

Overall, the findings of this study provide evidence that depressed mothers of medically at-risk infants, especially mothers of medically fragile infants, could benefit from early interventions to reduce depressive symptoms and establish high quality mother-infant interactions. Although most mothers in this study showed mild depressive symptoms, some were highly depressed and had symptoms for at least 6 months. Mother-focused early nursing interventions, ideally immediately after birth, could help mothers with chronically elevated depressive symptoms to reduce their negative thoughts and beliefs. The mothers can be assured by clinicians that their symptoms are not rare and they are not alone. Dysfunctional beliefs about their environments could also be changed by presenting information from books and support groups (Wisner, Parry, & Piontek, 2002) and providing intervention such as cognitive behavioral therapy, interpersonal psychotherapy, and/or somatic therapies like antidepressants and hormonal supplements (Gaynes et al., 2005; Markowitz et al., 1998; Newport, Hostetter, Arnold, & Stowe, 2002; Stowe, 2007).

Early identification of the symptoms, using self-report screening tools, is a critical step in helping depressed mothers of medically at-risk infants (Beck, Records, & Rice, 2006;

Fowler & Horowitz, 2006; Heneghan, Silver, Bauman, & Stein, 2000; Logsdon, Wisner, & Pinto-Foltz, 2006; Olson, Dietrich, Prazar, & Hurley, 2006). Mothers of medically at-risk infants may feel failure and grief when they learn about the infant's medical problems. Such psychological distress of mothers related with infant's illnesses should be assessed as predictors of PTSD and depressive symptoms. The symptoms of the PTSD in mothers of medically at-risk infants also need to be assessed. Measurement of maternal depressive symptoms without concurrent assessment of posttraumatic stress symptoms may miss a major mental health issue that these mothers face. In addition, mothers should be asked about prior depression as depression before or during pregnancy is the most significant predictor of depression after childbirth.

If elevated symptoms are identified, nurses may educate mothers that depressive symptoms are amenable to change. Nurses should also include information and referrals for mental health, child care, and early intervention programs in their discharge plans. Strategies such as empowerment, which has been introduced as a key domain in early intervention programs for mothers of medically fragile infants (Dunst & Trivette, 1996), could eventually help mothers overcome their negative thoughts and role collapse and normalize both their lives and the lives of their infants. Normalization, which is a goal of intervention for depressed mothers (Wisner, Parry, & Piontek, 2002), may require some period of time for mothers of medically at-risk infants to achieve, especially when the mothers perceive their situations as negative. However, since infant health and developmental problems often improve over time, mother's depressive symptoms and interactive abilities should also improve. Mothers who effectively normalize their cognitive and social functioning can better master the infants' treatment regimens, adapt family routines and budgets to the demands of the infants' illness, and negotiate with health care professionals as well as growth in their parenting roles.

Acknowledgments

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Table 1

Socio-Demographic Characteristics of the Three Groups of Mothers and Medically At-Risk Infants at Enrollment

	Prematurity	Medically fragile	Seropositive for HIV	Comparison of the 3 groups	
	N = 108	N = 67	N = 83		
	M(SD)	M(SD)	M(SD)	F(2,253)	χ²(2)
Gender of Baby: % Male	52.8	62.7	54.2		2.6
Birth Weight in Grams	1230(430)	20611038	3030(1341)	107.3***	
Boys	1230(466)	1927(956)	3138(857)		
Girls	1229(389)	2286(1149)	2897(882)		
Gestational Age in Weeks	28.9(2.7)	33.9(5.6)	38.3(2.7)	154.0***	
Boys	28.5(2.7)	32.6(5.5)	38.8(1.9)		
Girls	29.2(2.6)	34.8(5.6)	37.7(3.4)		
% Preterm	100.0	59.7	13.3		132.7***
Boys	100.0	69.1	4.4		
Girls	100.0	44.0	23.7		
Mother's Age in years	28.5(6.5)	27.1(5.9)	26.2(5.7)	3.5*	
Boys	28.5(6.4)	26.8(5.9)	26.5(5.6)		
Girls	28.5(6.7)	27.7(5.9)	25.8(5.8)		
Mother's Education in years	13.8(2.3)	13.4(2.4)	10.8(2.3)	31.6***	
Boys	13.6(2.3)	13.5(2.3)	10.4(2.8)		
Girls	13.9(2.4)	13.2(2.6)	11.1(1.5)		
Mother's Marital Status: % Single	38.9	31.3	59.3		28.7***
Boys	42.1	61.9	59.4		
Girls	35.3	60.0	59.3		
Ethnicity: % African American	44.4	34.3	85.9		43.9***
Boys	38.6	35.7	86.1		
Girls	51.0	32.0	85.7		

*
$p = <.05$.

***
$p = <.001$

Table 2

Four Global Mother-Infant Interactive Dimensions from the Naturalistic Observation of Mother-Child Interactions

Dimension	Variables	Definition
Mother attention I (alpha =.81 –.90)	Mother positive	Directs positive affect to infant (smile, praise, or affectionate touching)
	Mother look	Looks at the infant
	Mother talk	Speaks words to infant
	Mother interact	Touches, gestures toward, or plays with infant
	Reverse of caregiver uninvolved	Does not interact with the infant
Mother restrictiveness I	Mother negative	Directs negative affect to infant (frown, scold, hit)
Infant social behaviors (alpha =.61 –.74)	Child talk	Speaks words to mother
	Child look	Looks at the mother
	Child positive	Direct positive affect to mother (smile, affectionate touching)
	Child interact	Touches, gestures toward, or plays with mother
Infant negativism	Child negative	Directs negative affect to mother (grimace, cry, or whine)

Table 3

Maternal CES-D Scores Compared Between Genders of Medically At-Risk Infants

		N	M	SD	t(df)	N	M	SD	t(df)	N	M	SD	t(df)
			Premature Infants										
			@ 6 months				@ 18 months						
Gender	(F)	44	8.55	6.60	0.61(90)	37	6.84	5.87	−0.81(83)				
	(M)	48	7.67	7.07		48	8.02	7.19					
			Medically Fragile Infants										
			@ 6 months				@ 12 months						
Gender	(F)	22	13.86	9.90	−0.52(59)	23	12.04	9.34	−0.89(60)				
	(M)	39	15.56	13.31		39	14.36	10.17					
			Infants Seropositive for HIV										
			@ 12 months				@ 18 months				@ 24 months		
Gender	(F)	24	12.50	7.64	−0.28(54)	31	8.55	8.35	−0.94(61)	29	10.07	8.51	−0.77(59)
	(M)	32	13.33	13.02		32	10.94	11.45		32	12.16	12.29	

Note: F = female, M = male

Table 4

Maternal CES-D Scores Compared Between Groups of Medically At-Risk Infants

		N	M	SD	t(df)
Premature Infants vs Medically Fragile Infants @ 6 months					
Group	(Pre)	92	8.10	6.80	−4.64(152)***
	(MF)	62	15.20	12.30	
Medically Fragile Infants vs Infants Seropositive for HIV @ 12 months					
Group	(MF)	63	13.80	10.10	0.44(117)
	(HIV)	62	15.20	12.30	
Premature Infants vs Infants Seropositive for HIV @ 18 months					
Group	(Pre)	94	7.70	6.70	−1.53(155)
	(HIV)	63	9.80	10.10	

Note: Pre = premature infants, MF = medically fragile infants, HIV = infants seropositive for HIV

***
p <.0001

Table 5

Results of Mixed Model Analyses of CES-D on the Interactions Between Mothers and Their Medically At-Risk Infants

Interactive Variables		C	G	T	CxG	GxT	CxT	CxGxT
Premature Infants @ 6 and 18 months								
Mother attention I	β	-0.01	-1.66	-1.98	0.17	0.85	0.08	-0.12
	F(1,86)	1.64	1.90	2.67	2.28	0.20	0.04	0.37
Mother restrictiveness I	β	0.20	-0.01	0.03	0.01	0.32	0.04	-0.09
	F(1,86)	0.13	0.49	4.82#	0.02	0.46	0.09	3.36#
Infant negativism	β	0.02	0.54	-0.14	-0.05	-0.55	-0.01	0.01
	F(1,86)	0.18	2.64	3.02#	2.87#	1.32	0.02	0.03
Infant social behaviors	β	-0.07	-1.52	-0.06	0.14	2.43	0.11	-0.25
	F(1,86)	0.01	2.80	3.08#	2.79#	3.39	0.04	3.61#
Mother attention II	β	0.01	-0.41	0.24	0.02	0.33	0.01	-0.01
	F(1,88)	0.65	1.60	2.89#	0.35	0.48	0.00	0.04
Mother restrictiveness II	β	0.02	0.27	0.25	-0.01	-0.12	0.02	-0.04
	F(1,88)	0.64	0.95	0.67	0.24	0.06	0.01	0.64
Medically Fragile Infants @ 6 weeks, 6 months, and 18 months								
Mother attention I	β	-0.12	-1.62	-1.36	0.09	2.47	0.01	-0.13
	F(1,55)	3.00#	1.07	0.01	0.98	0.73	0.34	0.51
Mother restrictiveness I	β	0.02	-0.08	-0.74	-0.02	0.33	-0.02	0.02
	F(1,55)	0.24	0.02	2.07	0.69	0.16	0.18	0.11
Infant negativism	β	0.01	-0.60	0.33	0.03	1.11	-0.01	-0.05
	F(1,55)	4.75*	5.21*	6.81**	3.84#	2.67	1.99	1.12
Infant social behaviors	β	-0.02	0.48	0.53	-0.01	-0.27	-0.03	-0.03
	F(1,55)	1.17	0.27	0.32	0.04	0.04	1.08	0.12
Mother attention II[a]	β	-0.03	-0.01	-0.07	-0.01	0.44	-0.01	-0.04
	F(1,56)	10.38** 0.00	0.28	0.27	0.57	2.99#	1.15	
Mother restrictiveness II[a]	β	0.02	-0.36	-0.07	0.02	0.38	-0.02	-0.01
	F(1,56)	8.02** 0.66	0.14	0.83	0.36	1.01	0.05	
Infants Seropositive for HIV @ 12, 18, & 24 Months								

Interactive Variables		C	G	T	CxG	GxT	CxT	CxGxT
Mother attention I	β	−0.04	1.35	0.83	−0.10	−2.00	−0.04	0.09
	F(1,86)	3.18#	0.74	0.12	1.08	3.92#	0.02	1.62
Mother restrictiveness I	β	0.01	−0.13	−0.05	−0.01	0.09	0.01	0.01
	F(1,86)	0.57	0.14	0.01	0.04	0.13	0.64	0.24
Infant negativism	β	−0.01	0.20	−0.27	−0.01	−0.28	0.01	0.02
	F(1,86)	1.84	0.17	7.08**	0.15	0.83	2.19	1.25
Infant social behaviors	β	0.01	0.73	0.90	0.02	−1.08	−0.03	0.07
	F(1,86)	0.59	0.68	1.31	0.79	2.85#	0.17	2.73
Mother attention II	β	−0.02	0.13	0.07	−0.01	−0.03	0.01	0.01
	F(1,86)	6.77** 0.17	1.04	0.45	0.03	0.09	0.08	
Mother restrictiveness II	β	0.02	0.39	0.08	−0.03	−0.07	−0.01	0.01
	F(1,86)	0.39	1.27	−0.07	−0.01	−0.03	0.01	0.01

Note: C = CES-D, G = gender, T = time, C x G = CES-D x gender, G x T = gender x time, C x T = CES-D x time, C x G x T = CES-D x gender x time

[a] = Mother attention II and mothers restrictiveness II were scored at only 6 and 12 months

* $p < .05$,

** $p < .01$,

# $p < .10$