Maternal Health After the Birth of a Medically Complex Infant: Setting the Context for Evaluation of Co-Occupational Performance

Kris Pizur-Barnekow

KEY WORDS
• adaptation, psychological
• infant, newborn, diseases
• maternal behavior
• maternal welfare
• stress disorders, post-traumatic

OBJECTIVE. Physical and psychological health indicators of mothers who gave birth to medically complex infants were examined to explore potential risk factors for the development of chronic conditions and to develop a scholarly base that supports the inclusion of maternal health in the scope of early intervention practice.

METHOD. Ten mothers completed the Perinatal Posttraumatic Stress Disorder Questionnaire and the State Trait Anxiety Form Y–1. Nine women completed 24-h Holter recording. Frequency of symptoms of posttraumatic stress disorder (PTSD) and anxiety were determined. High frequency heart rate variability was examined for indicators of autonomic dysregulation.

RESULTS. Nine of 10 women reported symptoms associated with PTSD, and 2 of these women reported more severe symptoms. Two women demonstrated indicators of autonomic dysregulation.

CONCLUSION. Further research examining psychological and physical characteristics in mothers of infants at high risk is important to determine whether these women are at greater risk for chronic health conditions.


During the transition to motherhood, a woman experiences a shift in psychological and bodily processes that may have consequences for roles, mood states, social interactions (Ruble et al., 1990), and aspects of physical health (Rooney & Schauberger, 2002). The dramatic shift in psychological and physical domains is often underestimated because of the common myth that becoming a mother is a blissful event without much stress. The distress associated with the birthing event (DeMier et al., 2000), the stress of subsequent caregiving, and infant characteristics may place mothers of infants who are medically compromised at greater risk for health consequences than mothers of healthy infants (DeMier et al., 2000). In turn, poor maternal health may influence the child’s developmental outcomes, especially if the infant is born at high risk for future developmental delays and chronic conditions.

Frequently, the birth of a medically complex infant is the result of birth trauma (Hynan, 1997). Medically complex infants are identified as high risk and spend a significant amount of time in the hospital. Consequently, their medical risk may lead to maternal perceptions of failure (Minde, 1993). In addition, mothers must cope with the possibility of losing their medically fragile child (Minde, 1993). The experience of postnatal stress after the birth of a medically complex infant is consistent with symptoms of posttraumatic stress disorder (PTSD; Hynan, 1997). Characteristics of PTSD include intrusive memories, a heightened level of arousal, numbing, and avoidance in relation to a traumatic event (American Psychiatric Association, 2000). The everyday
Heart Rate Variability and PTSD

Heart rate variability (HRV) is a noninvasive index of autonomic modulation on the heart. High-frequency (HF) measures of HRV represent the rhythmical shortening and lengthening of heart periods (R–R intervals) at the respiratory frequency (Berntson, Cacioppo, & Quigley, 1993). The change in heart rate (HR) within the respiratory cycle provides an index of the vagal (parasympathetic) influences on the cardiac pacemaker (Akselrod et al., 1981; Berntson et al., 1993) and is also known as vagal tone. As vagal tone increases, HF HRV increases and HR decreases (Berntson et al., 1993). Conversely, as sympathetic tone increases, there is a reduction in HF HRV and HR increases (Berntson et al., 1993). A circadian pattern of HRV exists such that a typical autonomic response includes increases in HF HRV during periods of rest or in the evening and decreases in HF HRV during periods of activity or during the day (Task Force of the European Society of Cardiology & North American Society of Pacing and Electrophysiology, 1996).

People diagnosed with PTSD secondary to combat stress or exposure to violence experience changes in HRV associated with autonomic dysregulation (Cohen et al., 2000; Singh, Kartik, Otsuka, Pella, & Pella 2002). The autonomic dysregulation predisposes people with PTSD to poor health outcomes, including the development of cardiovascular disease (Cohen et al., 2000; Singh et al., 2002). In a study comparing people diagnosed with PTSD, people diagnosed with panic disorder, and healthy control participants, Cohen and colleagues (2000) found that people with PTSD experienced autonomic dysregulation as measured by power spectral analysis of HRV. At rest, people with PTSD demonstrated significantly lower HF components of the power spectrum, compared with people with panic disorder and healthy control participants (Cohen et al., 2000). During recall of a traumatic event, there were no significant differences in HF components from rest to recall in people with PTSD (Cohen et al., 2000). Significant differences in HF components from rest to recall, however, were noted in healthy control participants and participants with panic disorder (Cohen et al., 2000).

These findings indicate that people demonstrating symptoms of PTSD have hyperactivation and autonomic dysregulation compared with healthy control participants and people with panic disorder (Cohen et al., 2000). Autonomic dysregulation associated with HRV is a determinant of myocardial infarction (Singh et al., 2002). In addition, autonomic dysregulation is related to psychological phenomena such as depression, anger, hostility, and social isolation (Bernston, Sarter, & Cacioppo, 2002; Cacioppo et al., 1998; Cohen, 1988). Little is known about the relationship between measures of PTSD, anxiety, and physiological measurements, including HRV in mothers who have experienced a traumatic birthing event resulting in the birth of a medically complex infant. Therefore, the purpose of this study was to describe physical and psychological characteristics in a small sample of women who have given birth to an infant at high risk.

Method

Research Design

Descriptive methods were used to examine physical and psychological characteristics in mothers of infants at high risk. The research questions were as follows: (1) What symptoms of PTSD were self-reported most frequently? (2) Were self-reported symptoms of PTSD and state anxiety as measured by the State–Trait Anxiety Inventory (STAI) Y–1 Form (Spielberger, 1983) related? (3) Do women who self-report symptoms of PTSD demonstrate signs of autonomic dysregulation? (4) What were the physical health characteristics of mothers who have given birth to infants at high risk?

Participants

Ten mothers, who were ≥18 yr old and who had given birth to an infant at high risk completed the psychological screening of the study protocol. Infants were considered high risk if they spent ≥7 days in the NICU immediately after birth. Six of the 10 women were African-American; 3 were White; and 1 was biracial (Asian/White). The age range was 19 to 39 with a mean age of 28. Seven of the 10 women were married, and 3 were single. Six of the 10 had children in addition to the infant...
at high risk. Seven women gave birth through caesarean section, and 3 delivered vaginally. Eight of the women had some college, and 2 had a bachelor’s degree.

To determine sample size, mothers of healthy infants were compared with mothers of at-risk infants using a power analysis of data gathered with the Perinatal Posttraumatic Stress Disorder Questionnaire (PPQ; Callahan & Hynan, 2002; Hynan, 1997). The power analysis indicated that with a desired power of .80, using an effect size of 1.52 and a significance level of .05, 8 mothers would be sufficient to determine whether mothers of infants at high risk would exhibit symptoms of PTSD. For the proposed study, 13 mothers were enrolled. Three of the 13 mothers, however, were unable to be contacted by telephone when appointments were being scheduled. Nine mothers completed all data collection procedures. One mother completed the PPQ and the demographic questionnaire but did not complete the 24-hr HRV recording because of technical difficulties.

The participants were personally recruited from local public health departments, NICUs, childbirth classes, parenting classes, and perinatal follow-up clinics offered by local hospitals. They were given a brochure describing the study, with a telephone number to call if they were interested in participating. Interested women who called were asked a series of questions to determine eligibility for the study. If they agreed to participate, two appointments at each woman’s home were scheduled. The visits were scheduled between the 4th and 8th month of the postpartum period. The appointments were scheduled during this time so that the infants were living at home with the mother during the time of data collection. The first appointment was scheduled between 8 a.m. and 11 a.m. These times were chosen to control for changes in HRV, and blood pressure (BP) related to circadian influences (White & Porth, 2000).

Procedure

The protocol sequence for the first and second appointment was the same for each participant. First, mothers were asked to sit upright in a comfortable chair, and three measurements of HR and BP were taken. HR was determined through palpation of the radial pulse for 30 s. The number of beats was counted and multiplied by 2. HR was obtained on the arm opposite that on which the BP was obtained. The auscultatory method was used to obtain resting BP. Measurement of BP was completed according to the guidelines published by the British Hypertension Society (1997). The average of the three measurements was used in data analysis. Respiratory rate was measured by means of visual inspection of movement of the chest and abdomen for 30 s. The number of observed respirations was multiplied by 2 and recorded as breaths per minute.

Participants were weighed on a standing digital scale that is accurate to 0.1 lb. They were weighed 3 times, and a mean weight was determined. The scale was placed on a hard floor for all weights, and participants were weighed without shoes. The participants’ height was then measured using a standard tape measure and by having participants stand next to a wall. Using a finger, their height was marked on the wall and then measured with the tape measure. Participants were measured 3 times, and a mean was determined. Participants were measured without shoes. Body mass index (BMI) was calculated using the mean weight and height of the mothers and the National Institutes of Health BMI calculation tables found at www.nhlbisupport.com/bmi/ (National Institutes of Health—Partnership for Healthy Weight Management, 2010).

 Mothers completed a bound packet containing the STAI Y–1 Form (Spielberger, 1983), the PPQ (Callahan & Hynan, 2002; Hynan, 1997), and a demographic questionnaire. The demographic questionnaire included questions regarding family history of chronic disease and whether the mother had a history of depression. The questionnaires were completed in the packet before attachment of the electrocardiographic (ECG) leads. Once the questionnaires were completed, the mothers’ skin was prepared for attachment of the ECG leads by cleansing the skin with an alcohol swab and drying the skin with a rough cloth for approximately 30 s. Drying the skin with the cloth ensures that the outer layer of dead cells has been removed to improve the likelihood of sufficient electrical conductance (White & Porth, 2000). Five disposable silver chloride electrodes were placed on the chest, and participants were monitored in modified V_{1} and V_{5} leads. Holter recording began after all leads were properly placed and continued over a 24-hr period. A second appointment was scheduled for 24 hr after the first appointment. The protocol for the second appointment was followed as described previously. The ECG leads were removed, and the recording was stopped. The women were thanked for their participation and were given a $15.00 grocery gift certificate for participation. An institutional review board at a university in the Midwest approved all study procedures.

Instruments

Perinatal Posttraumatic Stress Disorder Questionnaire. The PPQ measures symptoms of posttraumatic stress in mothers who gave birth to infants requiring hospitalization (Callahan & Hynan, 2002; Hynan, 1997). This
questionnaire consists of 14 yes–no questions designed to quantify symptoms of intrusive memories, avoidance, and arousal. Items for the PPQ were selected on the basis of diagnostic criteria for PTSD found in the Diagnostic and Statistical Manual of Mental Disorders (DSM–III; American Psychiatric Association, 1987) and a questionnaire developed to measure combat stress (Hynan, 1997). The PPQ’s α reliability has been reported to be .85, and test–retest reliability was .92 (DeMier, Hynan, Harris, & Manniello, 1996). When compared with other instruments, the PPQ correlated positively with the Impact on Events Scale (r = .61, p < .001) and with the Beck Depression Inventory II (BDI–II: r = .58, p < .001; Callahan & Hynan, 2002). The BDI–II measures severity of depression. Scores on the PPQ were not related to scores on the Openness Scale of the NEO Personality Inventory–Revised (Callahan & Hynan, 2002).

State–Trait Anxiety. The STAI consists of two 20-question self-report assessments designed to measure state and trait anxiety (Spielberger, 1983). Spielberger (1983) defined anxiety as an emotional state accompanied by feelings of nervousness, tension, and worry. In addition, Spielberger differentiated between state and trait anxiety, stating that state anxiety is the measurement of anxiety in the current moment and trait anxiety is a measurement of general anxiety tendencies. The STAI (Form Y–1) measures the participants’ anxiety in the “given moment.” Respondents described the intensity of their feelings on a 4-point Likert scale ranging from “not at all” to “very much so.” The STAI (Form Y–1) takes 5–10 min to complete. Construct validity for both scales has been established through contrasted groups, correlations between the State and Trait Anxiety scales, correlations of the trait with other trait anxiety measures, correlations of the State scale with unrelated measures, and examination of the effects of stress on state anxiety scores. High internal consistency has been found with large, diverse samples with values ranging from .90 to .91 for the trait form (Y–2) and .91 to .93 for the state form (Y–1; Spielberger, 1983).

Methods of Quantification; HRV/Vagal Tone

Electrocardiogram data were collected by Seer Light Ambulatory Holter recorders; data were uploaded and digitized at 128 Hz, by means of a MARS® PC Workstation (GE Medical Systems, Waukesha, WI). Each recording was examined, and electrocardiogram complexes were labeled and categorized as to morphology. Missing or noisy data were identified and quantified, and any recording with >10% unusable data was excluded from the analyses. Interbeat intervals between successive normal complexes were determined, and only sinus electrocardiogram complexes were used in the final analyses (White & Porth, 2000).

Frequency domain measures of HRV were determined by means of power spectral analysis. Power spectral analysis uses mathematical computations to model patterns found within the electrocardiogram signal. The outcome of power spectral analysis is identification of frequency components of variance associated with HRV (Berntson et al., 1997). Power spectral analysis provides information about the variability between R–R peaks that result from periodic oscillations of HR at various frequencies. The HF band, associated with changes in respiration, appears to originate from the parasympathetic nervous system exclusively (Akselrod et al., 1981) and was used to determine vagal tone responses during study conditions.

In adults, the HF band typically extends from 0.15 to 0.40 Hz. The specific bandwidth was determined for each mother individually on the basis of individual respiratory rates. The range of respiratory rates was 30–70 breaths per minute. The low-frequency to high-frequency ratio and HF measures of HRV were quantified in 12-hr periods. These data were used in the analysis.

Data Analysis

Frequency distributions were used to characterize the data, indicating what symptoms of PTSD were self-reported most frequently, the degree of PTSD, and the physical health characteristics of the mothers. The Pearson product–moment correlation coefficient was used to determine whether a relationship existed between self-reported symptoms of PTSD and measures of anxiety. Circadian patterns of HF HRV were determined and frequency distributions of decreases in HF HRV during the evening hours were noted. BMI was calculated using the National Institutes of Health BMI calculation (National Institute of Health—Partnership for Healthy Weight Management, 2010).

Results

What Symptoms of PTSD Are Self-Reported Most Frequently, and to What Degree Do the Mothers Experience PTSD?

Questions 1–3 on the PPQ relate to “re-experiencing” symptoms unique to PTSD (Hynan, 1997). As Figure 1 illustrates, 5 of the 10 mothers responded that they experienced upsetting memories of giving birth or of their baby’s hospital stay. Questions 4–9 reflect avoidance or numbness of responsiveness. In this sample, 5 of the 10
women most frequently indicated that they lost interest in doing things that they usually engaged in (e.g., work and family). Questions 10–14 indicate hyperresponsiveness. In this sample, 7 of the 10 women most frequently identified that they had difficulty falling asleep and staying asleep (Item 10) and that they had greater difficulty concentrating than before they gave birth (Item 14). A minimum of 6 yes responses across the three subcategories indicates that the mother experiences a criterion traumatic event. Nine of the 10 women experienced some symptoms of PTSD, and 2 women experienced more severe symptoms.

**Were Self-Reported Symptoms of PTSD and State Anxiety as Measured by the STAI (Y–1 Form) Related?**

No significant correlations between the mothers’ identification of PTSD symptoms and state anxiety, as measured by the STAI Form Y–1, were found.

**Do Women Who Self-Report Symptoms of PTSD Demonstrate Signs of Autonomic Dysregulation?**

Two of the 9 women who reported symptoms of PTSD and who completed the HRV protocol demonstrated lower HF HRV during the evening hours.

**What Were the Physical Health Characteristics of Mothers Who Have Given Birth to Infants at High Risk?**

One mother reported cigarette use at the time of the study; 9 reported not smoking at the time of data collection. Nine mothers reported using alcohol occasionally; 1 reported never drinking. Four reported a history of high BP (2 were taking BP medication), and 1 reported a significant history of diabetes. Two of the 10 mothers reported a significant history of asthma, and the remaining 8 did not. The mean BMI was 32.41 (range = 25.6–40.8; body mass categories according to the National Institutes of Health are as follows: Underweight = <18.5, normal weight = 18.5–24.9, overweight = 25–29.9, obesity = ≥30).

**Discussion**

**Maternal Psychological and Physical Health**

Two findings from this study are noteworthy and have clinical implications. First, the finding that 9 of 10 women reported symptoms of PTSD suggests that screening for PTSD in mothers of infants at high risk is important. The level of distress experienced with PTSD is associated with infant characteristics (DeMier et al., 2000), such that the severity of the infant’s medical problems, gestational age, and length of hospitalization accounted for 35% of the variance in stress symptoms associated with PTSD (DeMier et al., 1996). These findings suggest that early intervention providers should remain aware of maternal emotional health, particularly when infants have significant medical concerns.

Mothers experiencing poor emotional health may be at risk for decreased maternal sensitivity and responsiveness (Muller-Nix et al., 2004). If a mother experiences poor psychological health secondary to the birth of an infant at high risk, then the quality of the maternal–infant interactions and the subsequent development of the infant may be negatively affected. Women who experience symptoms of PTSD were found to be less sensitive and more controlling with their infants at 6 months during

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**Figure 1. Frequency of responses on the Perinatal Posttraumatic Stress Questionnaire.**

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maternal–child play interactions (Muller-Nix et al., 2004). Pierrehumbert, Nicole, Muller-Nix, Forcada-Guex, and Ansermet (2003) found significant associations between perinatal risk, maternal PTSD, and infant feeding and sleeping outcomes such that the higher the perinatal risk was, the more symptoms of PTSD were reported and the more the infants’ sleeping and eating patterns were reported as problematic.

Second, the decrease in HF HRV measures at night, the increases in BMI, and the reports of hypertension and diabetes suggest that some mothers of infants at high risk may be at greater risk for developing future chronic disease. Two mothers experienced autonomic dysregulation, and all of the mothers had increased BMI scores. Mothers who fail to lose the weight gained during pregnancy are at higher risk for obesity in midlife (Rooney & Schauberger, 2002). Women who gain excessive weight during pregnancy are at greater risk for long-term increases in BMI (Amorim, Rössner, Neovius, Lourenço, & Linné, 2007), and development of chronic diseases, including heart disease, diabetes, and hypertension (Crowell, 1995). Most postpartum weight loss should occur within 6 mo after delivery (Amorim et al., 2007). Factors associated with decreased postpartum weight loss include low educational attainment, low socioeconomic status, high prenatal weight gain, smoking cessation, and increased parity. Mothers who engage in higher amounts of sedentary activities, such as television watching, have increased odds of retaining weight (Oken, Taveras, Popoola, Rich-Edwards, & Gillman, 2007).

In the current study, data were collected during the postpartum period when women typically lose gestational weight. Therefore, it may be that those women who participated in this study did eventually lose the excess gestational weight. Those women who had higher BMI scores may have greater difficulty losing the excess gestational weight and may increase their risk for developing other chronic health conditions. Helping mothers choose healthy occupations and co-occupations may be an additional concern of pediatric occupational therapy practice.

The lack of a significant correlation between self-reported symptoms of PTSD and state anxiety is not surprising, given the sample size. Anxiety is often a comorbid condition of PTSD (American Psychiatric Association, 2000). Moreover, findings have indicated that women who report symptoms of PTSD secondary to a traumatic childbirth also exhibit signs of state anxiety (Kersting et al., 2004). In the current study, it may be that the small sample size led to a lack of statistically significant correlations.

**Limitations**

The limitations of this study are inadequate power because of small sample size and decreased generalizability because of the small sample size.

**Implications for Early Intervention Practice**

The current study examined the physical and psychological health of mothers who have given birth to a medically complex infant at high risk for future developmental delay and chronic conditions. The objective was to develop a scholarly base that supports the inclusion of maternal health in the scope of early intervention practice. Including screening of maternal physical and emotional health in early intervention is consistent with serving the family as a unit of care within the philosophy of family-centered care (Dunst, Johanson, Trivette, & Hamby, 1991). Research has indicated that maternal emotional health is related to maternal–infant relationships (Righetti-Veltema, Conne-Perréard, Bousquet, & Manzano, 2002) and that those relationships influence interactions and subsequent neurobiological development of the infant (Kraemer, 1992). Maternal stress is significantly related to the quality of the maternal–infant interaction (Muller-Nix et al., 2004). Maternal–infant interactions occur during daily co-occupations (Pierce, 2000) and need to be addressed by occupational therapy professionals who use a family-centered framework. Therefore, occupational therapists who screen mothers in the areas of physical and emotional health are better prepared to understand the context for co-occupational performance in early intervention practice.

Family-centered care is a philosophy that espouses the importance of the family in the child’s development (Dunst et al., 1991), and this philosophy underscores the influence of co-occupation on development. When providing family-centered care, early intervention providers attend to the needs of the family as related to the child enrolled in the program, recognize that the family is an expert in relation to their child’s development, and recognize that family members have an active role in planning their child’s intervention. Although early intervention providers rely on family-centered care to guide thinking in early intervention practice, they may not recognize the influence that maternal emotional and physical health have on co-occupational performance and subsequent developmental outcomes.

This preliminary study suggests that early intervention providers may best serve families through expansion of service delivery models and inclusion of intervention approaches such as create and prevent (AOTA, 2008). Disease prevention and health promotion may be essential
aspects in the provision of family-centered care within the context of early intervention practice. Supporting mothers through screening of maternal emotional and physical health may be beneficial for the mother and subsequently the child. Engaging families in support groups may be beneficial in alleviating symptoms and promoting a healthy lifestyle. Provision of care coordination services through identification of national and local resources that are available may link the mothers to appropriate programs.

Future Research
Future research examining autonomic dysregulation in mothers who have symptoms of PTSD may provide evidence for physiological risk factors in mothers of medically complex infants at high risk. Studies investigating maternal PTSD, depression, childbearing attitudes, and routine co-occupational engagement may provide evidence to support that maternal health is related to co-occupational performance. ▲

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References


