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Maternal Anxiety and Depression Following a Premature Infants' Discharge from the NICU: Explanatory Effects of the COPE Program

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Abstract

Background—Understanding the processes through which interventions work for mothers of premature infants is necessary for the advancement of science and the translation of efficacious interventions into clinical practice settings.

Objective—To test a theoretical model examining the processes through which an educational-behavioral intervention program (COPE) influences maternal anxiety and depression 2 months following discharge of their premature infants from the neonatal intensive care unit (NICU).

Methods—A secondary analysis was conducted using data from a randomized controlled trial with 246 mothers of low birthweight (LBW) preterm infants who were randomly assigned to COPE or placebo control conditions. Measures included maternal stress in the NICU, maternal anxiety and depression, and maternal beliefs about their infants and their role. Observers blind to study group condition also rated the quality of mother-infant interaction in the NICU.

Results—Structural equation modeling suggested the model tested provided a reasonable fit to the data ($\chi^2(64_{df}) = 97.67; p = .004; RMSEA = .046; CFI = .97$). Participation in COPE was both directly and indirectly, via associations with increased maternal beliefs and less maternal depression/anxiety in the NICU, related to mothers' decreased post-hospital depression/anxiety. Participation in the COPE program also was associated with higher mother-infant interaction scores.

Conclusion—Implementation of COPE could lessen post-discharge maternal anxiety and depression, which may improve outcomes for both mothers and preterm infants.

Keywords

Premature infants; NICU; mothers

More than 500,000 premature babies are born every year in the United States (U.S.) (Behrman & Butler, 2006; Hamilton, Ventura, Martin, & Sutton, 2005). Between 1994 and 2004, the rate of preterm birth increased by 14 percent (March of Dimes, 2007). Although advances in technology have allowed a greater survival rate of preterm infants, morbidity remains high and imposes great emotional and financial burdens on both families and the health care system. Findings from multiple studies have documented that parents of preterm infants frequently experience emotional distress during their infants' stay in the neonatal intensive care unit (NICU), high levels of depressive and anxiety symptoms, and altered parenting patterns well into their children's pre-school and school-age years (Johnson, Ring, Anderson, & Marlow, 2005; Melnyk et al., 2006; Pinelli, 2000; Teti, Hess, & O'Connell, 2005).

Interventions to enhance coping in parents of low birthweight (LBW) premature infants have not kept pace with the rapid technological advances to sustain survival in preterm infants. Of those parent interventions tested, most have commenced at the time of discharge from the NICU or shortly thereafter, typically after negative parental mental health outcomes, altered parent perceptions of their infants, and dysfunctional parent-infant interaction patterns have taken hold (Johnson et al., 2005). Furthermore, most interventions targeted to parents of preterms have not been theoretically grounded and have not measured mediating variables that may explain the processes through which the interventions impact key outcome variables. These explanations are important to advance science and translate efficacious interventions into clinical practice (Melnyk & Fineout-Overholt, 2002).

The purpose of this study was to empirically test a theoretical model examining the processes through which an educational-behavioral intervention program (COPE= Creating Opportunities for Parent Empowerment) exerts positive effects on mothers' anxiety and depressive symptoms post discharge from the hospital. This study was conducted on data obtained from a full-scale randomized controlled trial (RCT) of the COPE intervention in two NICUs located in Upstate New York. In the original RCT (Melnyk et al., 2006), parents who received the COPE program reported significantly less stress in the NICU as well as less depression and anxiety symptoms at their infants' 2 months-corrected ages than did parents who received a placebo control intervention. Blind observers also rated COPE parents as more positive in their interactions with their infants while in the NICU. In addition, COPE infants, on average, had a 3.8 day shorter NICU length of stay (LOS) (COPE $M = 31.9$ days; control $M = 35.6$ days; $p = .05$) and 3.9 day shorter total hospital LOS (COPE $M = 35.3$; control $M = 39.2$ days; $p = .02$) than did control family infants.

Theoretical Framework

Leventhal and Johnson's self-regulation theory, and Carver and Scheier's control theory guided the development of the COPE program and comprised the theoretical framework for this study. Self-regulation theory (Johnson, Fieler, Jones, Wlasowicz & Mitchell, 1997; Leventhal & Johnson, 1983) contends that the provision of concrete objective information to an individual undergoing a stressful or intrusive procedure facilitates the formation of a cognitive schema that is similar to the real life event. Knowing what to expect in the situation enables the individual to cope more effectively with the stressor through increased understanding, predictability, and confidence in the ability to deal with the stressful event. As a result, coping outcomes are enhanced and the individual has more energy to invest in functional or problem-focused coping.

Melnyk (1994; Melnyk et al., 1997; Melnyk et al., 2001) extended the use of self-regulation theory to parents of hospitalized/critically ill children and premature infants. Guided by this theory, one component of the COPE program provides audio taped and matched written information to the parents regarding their premature infants' physical and behavioral

characteristics, which was expected to strengthen parents' beliefs about their ability to understand and predict their premature infants' cues and behaviors. Strengthened parental beliefs was expected to then lead to less parental stress, anxiety and depression (the emotional outcome of coping) and promote positive parent-infant interaction (the functional outcome of coping).

The second component of the COPE program, parental information and developmentally sensitive parent role activities, was guided by control theory. Control theory contends that a discrepancy between a standard or goal and a current state motivates behaviors that will enable an individual to reach their goal (Carver & Scheier, 1982). When a child is born prematurely, parents typically experience a large discrepancy between the parenting that they envisioned (i.e., providing care to a healthy newborn) and the manner in which they are able to care for their infant in the NICU. According to control theory, this discrepancy should motivate parents to engage in the care of their infant during the NICU stay. However, multiple barriers exist during hospitalization (e.g., anxiety, parental uncertainty) that block the initiation of developmentally sensitive parenting role behaviors. The parent role information and activities in the COPE program are designed to remove the barriers during hospitalization so that parents can engage in their infant's care in a developmentally sensitive manner. Active engagement in their child's care was expected to reduce parental anxiety and depression as a result of feeling less helpless and more empowered during the stressful situation.

Guided by this theoretical framework, it was hypothesized that the COPE intervention effects on mother's post-hospital adjustment are not only direct, but also work via their associations with important mediating variables (see Figure 1). That is, the intervention was expected to: (a) promote more positive maternal beliefs about what to expect in their preterms and their ability to care for their infants, (b) reduce maternal stress related to hospitalization, (c) decrease mothers' anxiety and depression surrounding the NICU experience, and (d) promote more positive mother-infant interaction during the hospital stay. Each of these, in turn, was hypothesized to influence mothers' post-hospital adjustment. It also was postulated that maternal beliefs would mediate the relationships between the COPE intervention and stress in the NICU, anxiety and depression in the NICU, and mother-infant interaction in the NICU. Finally, it was hypothesized that less stress and depression/anxiety in the NICU would be related to better mother-infant interaction in the NICU. Maternal trait anxiety and socioeconomic status were included as important covariates in the model tested as findings from prior research have supported that these variables have potent effects on maternal state anxiety as well as maternal-infant interaction (Melnyk, Crean, Fischbeck-Feinstein, Fairbanks, & Alpert-Gillis, 2007; Olds, 2006; Schiffman, Omar, & McKelvey, 2003).

Methods

This was a secondary analysis of data obtained from mothers who participated in the full-scale primary RCT (Melnyk et al., 2006). Structural equation modeling was used to test the theory-based conceptual model constructed to explain the process through which the COPE intervention impacted maternal anxiety and depression two months after their infants' discharge from the NICU.

Participants

The sample was comprised of 246 mothers and their premature infants who were admitted to the NICUs of two hospitals in Upstate New York. The 246 mothers ranged in age from 18 to 43 years with a mean age of 27.9 years ($SD = 6.57$). Key demographic characteristics of the mothers are presented in Table 1. As noted, there was a trend for COPE mothers to have more second marriages, divorces and separations than control mothers ($\chi^2(6_{df}) = 12.33; p = .055$).

There were no differences on maternal age, ethnicity, education level, or family income, including public assistance.

Table 2 presents infant demographic information by study group. The mean gestational age of the premature infants was 31.4 weeks ($SD = 2.45$; range = 26.0 to 35.0 weeks). The mean birthweight was 1661.2 grams ($SD = 474.6$ grams). As noted, there were no significant COPE versus control group differences on gender of the child, gestational age, birthweight or discharge weight of the child, or illness severity levels of the infants.

Study Conditions

The Experimental Intervention Program—The Creating Opportunities for Parent Empowerment program is a manualized educational-behavioral intervention program. Each phase of COPE provides parents with information on: (a) the appearance and behavioral characteristics of premature infants [infant behavior information (IBI)] and how parents can participate in their infants' care, meet their infants' needs, enhance quality of interaction with their infant, and facilitate their infant's development [parent role information (PRI)]; and (b) activities that assist parents in implementing the COPE information (e.g., identifying infant stress cues and behaviors to alleviate stress; identifying the best times for parent-infant interaction).

An educational-behavioral intervention strategy was used so that participants could practice the behaviors that they were learning about in the audio taped information, which is more likely to produce desired behaviors than information alone (Lorion, Price, & Eaton, 1989). It was decided to implement COPE as a series of audio tapes and prescribed workbook activities so that it could be easily reproduced, widely distributed and used in NICUs throughout the country.

The Placebo Control Program—Mothers in the control group received a structurally equivalent control program that focused on hospital policies and infant immunizations in order to control for the time and attention being spent with the COPE group and to diminish the likelihood that the effects of the COPE program could be attributed to Hawthorne effects. Audio tapes and written materials, similar in style to the COPE intervention, were used to administer the control information. Manipulation checks (i.e., multiple choice tests regarding COPE and control information) completed by the mothers verified that they processed their group-specific information in that COPE mothers answered more of the questions correctly that focused on COPE intervention content and control mothers answered more questions correctly that were related to the content of the placebo control intervention.

Measures

Key variables measured in this study assessed the emotional outcome of maternal coping (i.e., stress surrounding the NICU stay, state anxiety and depressive symptoms) and the functional outcome of coping (maternal-infant interaction in the NICU).

Maternal Stress in the NICU—The Parental Stressor Scale: Neonatal Intensive Care Unit (PSS: NICU; Miles, 1989) assesses parental stress in the NICU arising from 4 dimensions: (a) sights and sounds, (b) infant behavior and appearance, (c) parental role alteration, and (d) staff behaviors and communication. Parents rate their perceptions of the stress level generated by each of the 46 items on a 5-point Likert scale ranging from 1 = *non-stressful* to 5 = *extremely stressful*. Higher total scores indicate greater stress levels. The PSS: NICU has established construct validity and the alpha coefficients for this sample were .94 to .96 (depending on subscale).

State Anxiety—The well known State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1977) was used to measure maternal state and trait anxiety. Current feelings of anxiety are measured with the A-State scale, while an individual's anxiety "proneness" is measured with the 20-item trait scale (A-Trait). A-State was used as a dependent variable to assess parents' current anxiety levels. Trait anxiety was assessed at the first contact point only (baseline) to measure anxiety proneness. Higher scores indicate higher anxiety levels. Cronbach's alpha with this sample was .90 to .95 for maternal state anxiety (depending on the measurement occasion) and .92 for maternal trait anxiety.

Depression—The Beck Depression Inventory (2nd edition) (BDI-II; Beck, Steer, & Brown, 1996), a well known measure of depression with established construct validity, measured maternal depressive symptoms. Subjects indicate how they feel regarding each of 21 items on a 4-point Likert scale ranging from 0 to 3 in terms of severity. Higher scores are indicative of more depressive symptoms. Cronbach's alpha reliability on the BDI-II with this sample ranged from .83 to .90 (depending on measurement occasion).

Mother-Infant Interaction—The Index of Parental Behavior in the NICU (IBPN), developed for the full-scale RCT (Melnyk et al., 2006), measures quality of parenting in the NICU and was one indicator of mother-infant interaction. The instrument is comprised of 20 statements that measure parental behavior related to their infant (e.g., parent decreases stimulation for the infant at appropriate times). Observers, blind to study condition, rated each item on a dichotomous scale (1 = exhibited the behavior; 0 = did not) during a one half hour observation period. Higher scores indicate more developmentally sensitive mother-infant interactions. The scale was developed through a thorough review of the literature and observations of parents in the NICU. Content validity was established by 8 maternal-child experts and an expert in cultural competence. Inter-rater reliability of 90 percent was established and observer drift was assessed and corrected for on a monthly basis. Cronbach's alpha was .85 with this sample. As a second indicator of mother-infant interaction, these same observers rated the overall parent interaction with the infant using a one-item visual analogue scale ranging from 0 to 100, with 100 indicating more positive interaction.

Mothers' Beliefs about their Infant and Role—The 20-item Parental Belief Scale: NICU (PBS) measured mothers' beliefs about their premature infant and their role during hospitalization. The scale was adapted from prior belief scales for parents of hospitalized and critically ill children (Melnyk, 1994; Melnyk et al., 1997; 2004). Mothers were asked to indicate agreement with each item on a 5-point Likert scale (1= *strongly disagree* to 5= *strongly agree*) with higher scores indicating more positive beliefs. Eight neonatal specialists established content validity of the scales. Factor analysis supported the instrument's construct validity with the current sample, including two subscales: (a) parental role confidence (10 items; $\alpha = .85$), and (b) parent knowledge regarding infant behaviors and characteristics (8 items; $\alpha = .87$). Cronbach's alpha with this sample was .85 for the parental role subscale and .87 for the parent knowledge regarding infant characteristics.

Procedure

The Research Subjects Review Board at both NICU sites approved the study protocol prior to its implementation. All mothers 18 years of age and older who could read and speak English, who had not had another infant admitted to the NICU, and whose infants met the following criteria were asked to participate in the study: (a) gestational age of 26 to 34 weeks inclusive, (b) birthweight of less than 2500 grams and appropriate for gestational age, (c) anticipated survival, (d) singleton birth, (e) no severe handicapping conditions including Grade III or IV intraventricular hemorrhage, and (f) born at the study sites. Participating parents were randomly assigned to receive either the COPE or placebo control program by four-week blocks of time

in order to decrease staff-to-parent and parent-to-parent contamination (i.e., the likelihood that mothers in the NICU who were in different study groups would share content that was provided to them in their experimental program). To help ensure treatment fidelity, both groups received an audio taped and written educational-behavioral intervention program (i.e., COPE or control) delivered in a consistent manner by trained interventionists in four phases: (a) Phase I: 2 to 4 days after admission of their infant to the NICU; (b) Phase II: 2 to 4 days after the first intervention, (c) Phase III: 1 to 4 days before discharge from the hospital, and (d) Phase IV: approximately one week after discharge. Table 3 presents a timeline of intervention phases and associated data collection activities.

The Integrative Model

The structural equation model tested outlines the underlying theoretical rationale for how the intervention operates and includes eight latent constructs—three source or exogenous latent constructs (participation in the COPE intervention, socioeconomic status, and maternal trait anxiety), four mediating constructs (maternal beliefs, mother's depression and anxiety while in the NICU, mother's stress in the NICU, mother-infant interaction), and one latent outcome variable (mother's post-hospital depression and anxiety). Figure 1 presents the theoretical model tested (residual variances among the downstream latent constructs have been omitted for clarity as has the residual covariation among the mediating variables of mother's state anxiety and depression in the NICU and mother's stress in the NICU). Theoretical paths of interest are bolded.

Measurement

The exogenous constructs of *Participation in the COPE Intervention*, *Mother's Trait Anxiety*, and *Socioeconomic Status* were measured using single indicators. Participation in COPE was a simple dichotomous item identifying group status (1 = COPE participant; 0 = control group participant). Socioeconomic status was a single item assessing family income (1 = less than \$10,000; 2 = 10,000 to \$15,000 per year; 3 = \$15,001 to \$20,000 per year; 4 = \$20,001 to \$30,000 per year; 5 = \$30,001 to \$40,000 per year; 6 = greater than \$40,000 per year). The residual variances of these single indicators were fixed at zero. The trait anxiety score was used as the indicator of *Mother's Trait Anxiety*, with the residual variance of this indicator fixed at $(1 - \alpha)$ times the variance to help account for (un)reliability in the measure. *Maternal Beliefs* were measured using two subscales of the Parental Beliefs Scale (i.e., beliefs about the infant's physical appearance and behaviors, and beliefs/confidence about the ability to parent the infant in the NICU). *Mother-Infant Interaction* was measured using two indicators (blind observers total score of the mother-infant interaction and the same blind observer's general rating of the quality of the mother-infant interaction). Four subscales were used as indicators of *Mother's Stress in the NICU* (stress associated with the sights and sounds of the NICU, the infant's behavior and appearance, the alteration in the parental role, and the behavior and communication of the NICU staff). *Mother's Depression/Anxiety during the NICU Stay* and *Mother's Post Depression/Anxiety* were measured using the same two indicators (state anxiety and depression) at both time points. The measurement loadings for these indicators were constrained equal over time and the unique residuals of the respective indicators were allowed to correlate across time.

Results

Table 4 presents the means, standard deviations, and correlations among the study variables. The MPLUS statistical package was used in all modeling procedures (Muthen & Muthen, 2006). To provide a metric for the latent constructs and to identify the measurement model, the first construct loading for each of the latent variables was set to 1.00. Typical of many longitudinal intervention studies, missing data was an issue as the amount and timing of data

collection activities was complex. Full-information maximum likelihood estimation was employed as a means of efficiently incorporating all of the available information. Full information estimation has been shown to provide more realistic parameter estimates than other missing data techniques (e.g., listwise, pairwise, mean imputation; Arbuckle, 1996).

Goodness of fit of the model was assessed using the associated chi-square, the root mean square error of approximation (*RMSEA*; Browne & Cudeck, 1993), and the comparative fit index (*CFI*, Bentler, 1990). While a large number of additional fit statistics exist, Fan and Sivo (2005) demonstrate the high relationships that exist among the measures. Those chosen represent the families of exact fit (χ^2), relative fit (*CFI*), and population based misfit (*RMSEA*). In general, the chi-square statistic tests whether there is a significant difference between the model implied covariance matrix and the sample covariance matrix. Ideally, the chi-square should not be significant. However, problems with this exact fit statistic have been well documented (Hu & Bentler, 1999) and include sensitivity to sample size, non-normality in the data, and the testing of trivial discrepancies between the data and the expected data. For these reasons, approximate fit indices are available and have been adopted here. When the null hypothesis of exact fit is not true, the T statistic (observed minus implied covariance = 0) will not be χ^2 distributed, but it may still be distributed as a noncentral χ^2 variate. This distribution is characterized by a quantity called the noncentrality parameter, estimated as the best-fit χ^2 minus the degrees of freedom. The *RMSEA* is based on this noncentrality parameter. In sum, the *RMSEA* is based on the ratio of a rescaled noncentrality parameter to the model's degrees of freedom. It is zero when the noncentrality parameter is zero, and for a given positive value, is lower if the model involves fewer parameters (i.e., has more degrees of freedom). The *CFI*, from the family of relative fit indices, assesses how much better the model fits the data than does a null model which specifies correlations of zero among all variables. Values can range between 0 and 1 with higher values indicating better fit. Finally, the standardized root mean square residual (*SRMR*) is also used. The *SRMR* is a measure of the mean absolute value of the difference between the observed covariances and predicted covariances, standardized.

Hu and Bentler (1999) empirically examined various cutoffs for many of these approximate fit indices and their data suggest that, to minimize Type I and Type II errors under various conditions, one should use a combination of cutoffs for fit assessment. They recommend that adequate fitting models have *CFI* > .95, *RMSEA* < .06, and *SRMR* < .08; such recommendations have been adopted here. The standardized coefficients and the goodness-of-fit indices obtained (χ^2 (64 df) = 97.665; p = .0043; *RMSEA* = .046; 90% *CI* = .026 - .064; *CFI* = .97; *SRMR* = .041) suggest that this model provides a satisfactory fit of the model to the data. We attribute the significant chi-square test of exact fit to be due largely to the complexity of the model and to the significant univariate and multivariate departures from normality in the variables.¹

Measurement Results

As shown in Table 5, the standardized parameter estimates for the measurement model were reasonably high and all were significant (p < .01)². It is important to note that the unique residuals among state anxiety and depression indicators were allowed to correlate across time. This correlation was not significant for state anxiety (r = .02, p = ns), but was for depression (r = .19, p < .001). Given the fluctuation in state anxiety depending on situational circumstances, this finding is to be expected.

¹Following the logic of MacCallum, Browne, and Sugawara (1996), adequate power (> .94; Preacher & Coffman, 2006) to reject a hypothesis of poor fit (*RMSEA* > .08) with 70 degrees of freedom, given a population *RMSEA* of .05, was obtained.

²It is important to note that while the unstandardized results are constrained to equality, the standardizing of the results give the appearance that the equality constraints across time for Mother's Depression and Anxiety don't hold. This is merely the result of standardizing the results for presentation clarity.

While both indicators of *Mother-Infant Interaction* were significant, the general indicator of quality of the mother-infant interaction did not load as strongly as did the more precise ratings. Given the ease of administration and interpretation, it is encouraging that this general measure does relate strongly to the quality of the mother-infant interaction and other outcomes assessed in this model. It also is interesting to note that the stress associated with the infant's behavior and appearance had the strongest loading of *Mother's Stress in the NICU*. Finally, both maternal beliefs about the infant and their role seem to be important underlying components of *Maternal Beliefs*.

Structural Results

Figure 2 presents standardized results from the structural portion of the model tested. As noted, participation in the COPE intervention was associated with higher maternal beliefs that, in turn, were related to less mother depression and anxiety while in the NICU. Depression and anxiety in the NICU were associated with later post-hospital depression and anxiety. The model's indirect effects were tested using the bias-corrected bootstrap confidence limits. Significance was assessed by whether or not the 95% confidence limits contained zero. This approach takes the non-normality of the multiplicative distribution into account (resulting in asymmetric confidence limits) and has been shown to provide the most accurate confidence limits and greatest statistical power when compared with other existing approaches for detecting mediation (MacKinnon, Lockwood, & Williams, 2004). Using 1000 resamples, the COPE intervention's indirect effect (via maternal beliefs and mothers' depression and anxiety in the NICU) on mothers' post-hospital depression and anxiety were significant (*indirect estimate* = -.290; 95% *CI* = -1.413 to -.007). Though modest, the COPE intervention also worked directly to affect post-hospital anxiety and depression.

Participation in the COPE intervention also was directly related to mother-infant interaction in the NICU, with participation in COPE related to higher mother-infant interaction scores. However, mother-infant interaction was not related to mother's post-hospital depression and anxiety. Additionally, participation in the COPE intervention was indirectly associated with maternal perceived stress in the NICU, via maternal beliefs (*indirect estimate* = -.047; 95% *CI* = -.142 to -.004). As previously indicated, participation in COPE was associated with higher levels of maternal beliefs which were, in turn, associated with less perceived stress in the NICU.

Mother's trait anxiety also was directly and indirectly related to mothers' two-month post-hospital depression and anxiety symptoms. Directly, higher trait anxiety was associated with higher levels of post-hospital depression/anxiety. Indirectly (*indirect estimate* = .021; 95% *CI* = .001 to .089), trait anxiety was associated with maternal depression/anxiety in the NICU, which was associated with post-hospital depression/anxiety symptoms. Maternal trait anxiety also was associated with beliefs, with highly anxious mothers' reporting less beliefs/confidence in their parenting. Maternal beliefs, in turn, were associated with maternal depression/anxiety in the NICU, which was related to post-hospital depression/anxiety. Additionally, mother's trait anxiety was directly associated with maternal stress in the NICU; however, the indirect association with post-hospital anxiety and depression via stress was not significant (*indirect estimate* = .003; 95% *CI* = .000 to .010).

Finally, socioeconomic status was found to have direct relationships with maternal post-hospital depression/anxiety and with mother-infant interaction. Here, mothers' with higher SES reported less post-hospital depressive/anxiety symptoms and were rated as having better mother-infant interaction. Socioeconomic status also was indirectly associated with maternal post-hospital depression/anxiety, again via the association with beliefs (*indirect estimate* = .080; 95% *CI* = .003 to .321). However, higher SES mothers reported feeling less confident in their parenting than did lower SES mothers. This was the only anomalous finding in the model tested.

Discussion

This study provides empirical evidence on how the COPE program relates to maternal coping/mental health outcomes during and following their premature infants' NICU stay. Participation in the COPE Program was related to mothers' post-hospital depression and anxiety via important mediating variables, particularly maternal beliefs, maternal stress in the NICU, and maternal depression and anxiety during the NICU stay. As hypothesized, the effects of the COPE program on maternal stress, anxiety and depression in the NICU were indirect, via associations with maternal beliefs about their premature infants and their role during the NICU stay. Mothers who received the COPE program had stronger beliefs about what to expect in their preterms' characteristics/ behaviors and how to parent them, which was associated with less maternal stress as well as less anxiety and depressive symptoms during the NICU stay. As a result of less maternal anxiety and depression during the NICU stay, state anxiety and depressive symptoms were lessened post hospitalization. This evidence supports self-regulation theory and findings from our prior studies that indicate cognitive beliefs can be impacted with an educational-behavioral intervention and that they mediate the effects of the COPE intervention on mothers' emotional adjustment (Melnyk, 1995; Melnyk et al., 2007).

Rather than the COPE program working indirectly through maternal beliefs to positively impact mother-infant interaction, the program directly impacted mother-infant interaction. This finding supports control theory in that, through the COPE information and activities, barriers that typically inhibit mothers from interacting with infants in a developmentally sensitive manner in the NICU were removed (e.g., lack of knowledge about how best to interact with their infants, uncertainty regarding their role). Through the parental role information in the COPE program, mothers learned how best to interact with their infants in a developmentally sensitive manner during hospitalization and were encouraged to be involved in their infants' care, which promoted positive maternal-infant interaction.

Maternal trait anxiety was a potent predictor of stress, state anxiety and depressive symptoms during hospitalization as well as maternal-infant interaction, which then impacted depression and anxiety symptoms 2 months following hospitalization. In addition to routinely screening for postpartum depression (generally done 1-2 weeks post birth; Beck & Gable, 2002), this finding has important clinical implications in that assessment of maternal trait anxiety shortly after their infants' admission to the NICU could flag mothers at highest risk for maternal anxiety and depression. Such screening, coupled with earlier targeted interventions to improve maternal mental health outcomes and mother-infant interaction following the birth of a premature infant, could prevent substantial financial and emotional burden to families and society.

While the associations between SES and mother's post-hospital depression/anxiety (U.S. Department of Health and Human Services, 1999; Zahn-Waxler, Duggal, & Gruber, 2002) and mother infant interaction (Olds, 2006; Schiffman, Omar, & McKelvey, 2003) were perhaps expected, the most surprising finding was the negative association found between SES and maternal beliefs. Here, mothers from lower SES families reported stronger beliefs in their ability to parent their infants than did mothers from higher SES families. However, caution must be used in interpreting this finding as the measure of family income used in this study was capped at "greater than \$40,000" and this measure may only be differentiating poor mothers from others. Nevertheless, it may be that there are clear qualitative differences in how poor, middle class, and higher SES mothers perceive their parental role and have different parenting expectations for themselves. This finding of an inverse relationship between socioeconomic status and maternal beliefs deserves further study.

The unique contribution of this study is that it provides an understanding of the processes through which a theoretically-guided intervention impacts maternal anxiety and depressive symptoms 2 months following NICU hospitalization. The COPE intervention provides mothers with a cognitive schema of their premature infants' characteristics, which enables them to have stronger beliefs about their ability to understand and predict their infants' behaviors. As a result, they have less anxiety and depression during the NICU stay, which leads to less negative emotions following hospitalization. COPE also removes barriers that typically inhibit mothers from being actively involved in the care of their infants, allowing them to interact with their infants in a developmentally sensitive manner. In addition to assessing differences in outcomes between intervention groups, developmentalists urge researchers to examine the processes through which their interventions produce their effects (Berlin, Brooks-Gunn, McCarton, & McCormick, 1998; Kumpfer & Alvarado, 2003). Although parents are viewed as playing a significant role in early intervention programs, little attention has been given to parenting beliefs, emotions, and behaviors as either outcomes or mediating pathways to child development (Berlin et al., 1998).

Despite overall support for the model tested, limitations to this study exist. With the exception of the blinded ratings of mothers' interaction with their infants, all other study measures were completed by the mothers. As a result, shared method variance may account for some of the relationships found in the model tested. Future studies should include additional measures from non-biased objective observers (e.g., clinical interviews by a trained mental health professional to determine levels of depression and anxiety) as well as multiple observations for longer periods of time to establish reliability of the observations. Corroboration from such studies would add to the robustness of the current findings. Another limitation of this study is that a number of competing models may exist that fit the data equally well. While we believe that the model tested does capture important processes regarding how the COPE intervention impacts maternal mental health outcomes, other models should be tested (MacCallum, Wegener, Uchino, & Fabrigar, 1993). Furthermore, other variables outside of those tested (e.g., fathers' emotional adjustment, marital conflict) may likely influence maternal mental health outcomes, but were not examined in this model. Finally, 86% of the mothers in this sample were high school graduates and able to read and write English. Therefore, it is not known whether the intervention would impact variables in the same manner with mothers who are less advantaged.

It is well documented that being a parent of a premature child places one at substantial risk for adverse mental health outcomes both during and following the hospitalization of their infants. Routine implementation of the COPE program may help prevent parents from depression and anxiety disorders, reducing a substantial emotional and cost burden to families and society. The relationship between maternal postpartum depression/anxiety and the emergence of behavioral and developmental problems in children also is well substantiated (Beck, 2001; Georgiopoulos, Bryan, Wollan, & Yawn, 2001; O'Hara, Stuart, Gorman, & Wenzel, 2000). Though not yet tested, the COPE program might prevent more long-term negative developmental and emotional outcomes for prematurely born children as well as parents. Prevention of mental/ behavioral problems in this high-risk population is especially important because effective mental health screening and early intervention services for children and mothers throughout the U.S. continues to be lacking (Melnyk & Moldenhauer, 2006; Melnyk, Brown, Jones, Novak, & Kreipe, 2003). Since COPE is a theory-driven, reproducible intervention program, it can be easily transported into clinical practice settings to improve outcomes for this high risk population of mothers and infants.

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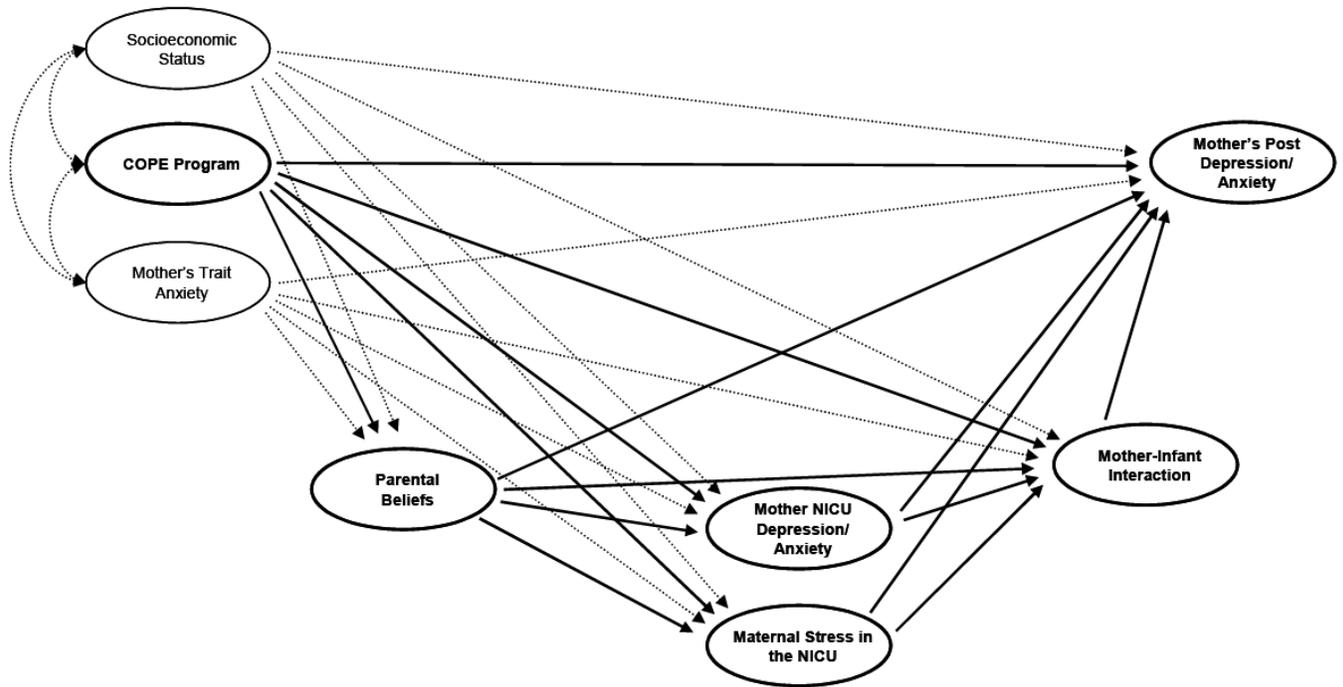


Figure 1.
Theoretical model of COPE intervention effects (COPE effects are bolded).

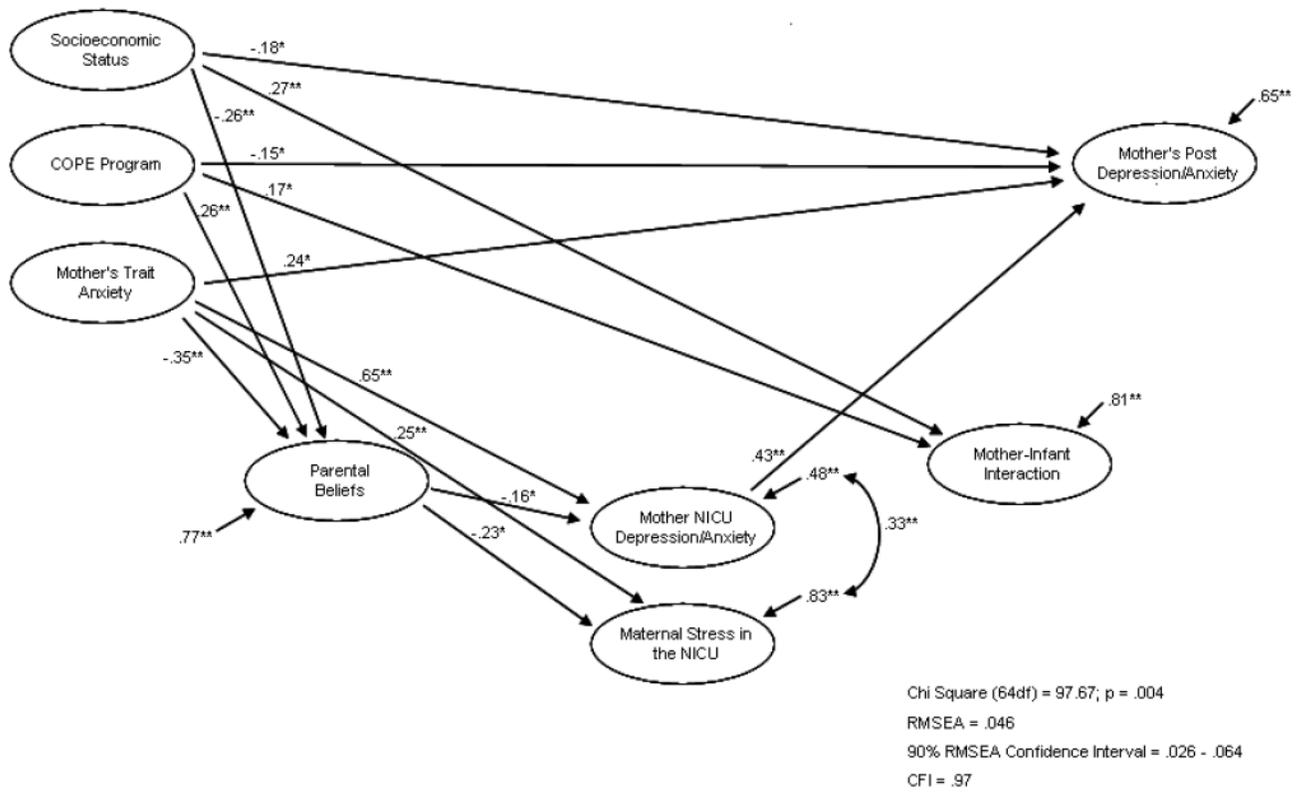


Figure 2. Standardized results of structural equation model predicting post-hospital maternal depression/anxiety. The unlabeled arrows pointing to the endogenous latent variables show the residual (unaccounted for) variance for each of these variables. Note: * p < .05; ** p < .01. The following non-significant, though tested, paths have been omitted for clarity: path from mother-infant interaction to mother's post depression/anxiety; path from maternal stress in the NICU to mother's post depression/anxiety; path from maternal beliefs to mother's post depression/anxiety; path from mother NICU depression/anxiety to mother-infant interaction; path from maternal stress in the NICU to mother-infant interaction; path from maternal beliefs to mother-infant interaction; path from mother's trait anxiety to mother-infant interaction; path from COPE program to mother NICU depression/anxiety; path from socioeconomic status to mother NICU depression/anxiety; path from COPE program to maternal stress in the NICU; path from socioeconomic status to maternal stress in the NICU; and the correlations among socioeconomic status, the COPE program, and mother's trait anxiety.

Table 1

Demographic Characteristics of Participating Mothers by Experimental Condition.

Maternal Demographics	COPE	Control	<i>p</i>
	n (%)	n (%)	
<i>Race</i>			0.27
White, not Hispanic	96 (70.1)	70 (64.2)	
Black, not Hispanic	31 (22.6)	25 (22.9)	
American Indian/Alaskan Native	0 (0)	1 (.9)	
Asian/Pacific Islander	4 (2.9)	3 (2.8)	
Hispanic	5 (3.6)	4 (3.7)	
Other	1 (.7)	6 (5.5)	
<i>Marital Status</i>			0.06
Married (1 st time)	64 (46.7)	61 (56.0)	
Never married	50 (36.5)	44 (40.4)	
Separated	4 (2.9)	0 (0)	
Divorced	4 (2.9)	2 (1.8)	
Widowed	1 (.7)	0 (0)	
Married (2 nd time)	11 (8.0)	2 (1.8)	
Not reported	3 (2.2)	0 (0)	
<i>Education Level</i>			0.21
Junior high school or less	6 (4.4)	4 (3.7)	
Partial high school	16 (11.7)	9 (8.3)	
High school graduate	32 (23.4)	18 (16.5)	
Partial college	30 (21.9)	33 (30.3)	
College/University graduate	38 (27.7)	25 (22.9)	
Graduate/Profession training	14 (10.2)	20 (18.3)	
Not reported	1 (.7)	0 (0)	
<i>Yearly Income for Baby's Household</i>			0.64
Less than \$10,000	14 (10.2)	16 (14.7)	
\$10,000 - \$15,000	15 (10.9)	11 (10.1)	
\$15,001 - \$20,000	15 (10.9)	9 (8.3)	
\$20,001 - \$30,000	17 (12.4)	10 (9.2)	
\$30,001 - \$40,000	15 (10.9)	10 (9.2)	
Greater than \$40,000	53 (38.7)	50 (45.9)	
Not reported	8 (5.8)	3 (2.8)	
<i>On Public Assistance</i>			0.59
Yes	48 (35.0)	35 (32.1)	
No	88 (64.2)	74 (67.9)	
Not reported	1 (.7)	0 (0)	

Note: Probability values (*p*) are based on chi-square analyses.

Table 2

Infant Demographics by Study Group.

	COPE	Control	<i>p</i>
Continuous variable characteristics, <i>mean</i> (SD)			
<i>Gestational age, wk</i>	31.3	31.4	.70
<i>Birthweight, g</i>	1688.7	1627.3	.32
<i>Discharge weight, g</i>	2159.7	2130.4	.61
<i>Severity of illness, CRIB score</i>	1.7	1.7	.99
Categorical variable characteristics, <i>n</i> (%)			
<i>Gender of Infant</i>			.14
Female	65 (47.4)	72 (60.5)	
Male	72 (52.6)	47 (39.5)	

Note: Analyses for age, birthweight, discharge weight, and severity of illness were conducted with t tests. All other findings were based on chi square analyses.

Table 3

Timing of Intervention Phases and Data Collection.

Time	Data Collected & Intervention Phase
Time 1 (2 to 4 days after NICU admission)	Baseline measures Demographic Information Trait anxiety Depression
Time 2 (2 to 4 days after Time 1)	Phase I Intervention Measures State anxiety Depression Maternal stress in NICU Phase II Intervention Measures Maternal Beliefs Scale
Time 3 (1 to 2 days after Time 2)	Measures Maternal-infant interaction - NICU observation
Time 4 (1 to 4 days prior to discharge)	Phase III Intervention
Time 5 (1 week after discharge)	Phase IV Intervention
Time 6 (2 months corrected age of child)	Measures State anxiety Depression

Table 4

Means, Standard Deviations, and Correlations of Study Variables.

Variable	N	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	
1. Group (0 = Control; 1 = COPE)	246	0.560	.50	1.00															
2. Trait Anxiety	246	36.399	7.5	0.02	1.00														
3. Family Income	235	4.281	.87	-0.01	-0.11	1.00													
4. Maternal Beliefs – Understanding Infant	245	36.356	4.5	0.18	0.27	0.25	1.00												
5. Maternal Beliefs – Parental Ability	245	27.965	1.2	0.27	0.25	0.13	0.74	1.00											
6. Stressors – Sights & Sounds	246	2.070	.77	0.03	0.15	0.15	0.17	0.17	1.00										
7. Stressors – Infant Behavior & Appearance	246	1.870	.86	-0.16	0.23	0.06	-0.16	0.18	0.46	1.00									
8. Stressors – Parental Role Alteration	246	2.861	.03	-0.04	0.33	0.05	-0.28	0.24	0.30	0.52	1.00								
9. STRESSORS – STAFF BEHAVIOR & COMMUNICATIONS	246	1.390	.70	-0.10	0.09	-0.10	-0.12	-0.15	0.24	0.47	0.30	1.00							
10. Beck Depression Inventory – T2	246	10.267	.37	-0.00	0.55	0.00	-0.25	0.24	0.28	0.34	0.42	0.15	1.00						
11. State Anxiety – T2	246	38.231	1.970	0.06	0.50	0.03	-0.27	0.29	0.28	0.34	0.38	0.19	0.61	1.00					
12. Mother-Infant Interaction – IPBN	211	8.823	.71	0.11	-0.22	0.22	-0.03	0.00	-0.03	-0.10	-0.09	-0.08	-0.15	-0.17	1.00				
13. Mother-Infant Interaction – Visual Analogue Scale	211	65.772	3.590	0.10	-0.15	0.27	-0.14	0.06	0.00	-0.03	-0.06	-0.05	-0.08	-0.10	0.60	1.00			
14. Beck Depression Inventory – T6	226	6.526	.11	-0.09	0.40	0.18	-0.13	-0.10	0.02	0.12	0.15	0.04	0.50	0.28	-0.15	-0.15	1.00		
15. State Anxiety – T6	226	29.849	.30	-0.08	0.40	-0.18	-0.05	-0.01	0.09	0.09	0.09	-0.01	0.34	0.31	-0.24	-0.20	0.72	1.00	

Note: IPBN = Index of Parental Behavior in the NICU; T2 = 1-2 days after Maternal Beliefs assessment; T6 = 2 months post-discharge.

* p < .05;
 ** p < .01;
 *** p < .001.

Table 5

Standardized Measurement Loadings for the Latent Constructs. All Measurement Loadings Are Significant at the $p < .01$ Level.

	Group	Mother's Trait Anxiety	Family Income	Maternal Beliefs	Mother's Stress in the NICU	Mother's Anxiety & Depression Surrounding Hospital Stay	Mother/ Infant Interac- tion	Mother's Post-Hospital Anxiety & Depression	Residual Variance
COPE PROGRAM									
Group	1.00 ^d							0.00 ^b	
MOTHER'S TRAIT ANXIETY									
Trait Anxiety		0.96 ^d						0.08 ^c	
SOCIOECONOMIC STATUS									
Family Income			1.00 ^d					0.00 ^b	
MATERNAL BELIEFS									
Maternal Beliefs – Understanding Infant				0.84 ^d				0.30	
Maternal Beliefs – Parental Ability				0.88				0.23	
MOTHER'S STRESS IN THE NICU									
Stressors – Sights & Sounds					0.52 ^d			0.73	
Stressors – Infant Behavior & Appearance					0.82			0.33	
Stressors – Parental Role Alteration					0.65			0.57	
Stressors – Staff Behavior & Communications					0.52			0.73	
MOTHER'S ANXIETY & DEPRESSION SURROUNDING HOSPITAL STAY									
Beck Depression Inventory – T2						0.79 ^{d,d}		0.38 ^f	
State Anxiety – T2						0.78 ^e		0.39 ^g	
MOTHER/INFANT INTERACTION									
Mother-Infant Interaction – IPBN							0.77 ^d	0.41	
Mother-Infant Interaction – Visual Analogue Scale							0.79	0.38	
MOTHER'S POSTHOSPITAL ANXIETY & DEPRESSION									
Beck Depression Inventory – T6							0.82 ^{d,d}	0.34 ^f	
State Anxiety – T6							0.88 ^e	0.22 ^g	

^aParameter fixed at 1.00 (unstandardized) to identify construct and establish metric for the latent construct.

^bParameter fixed at 0.00.

^cParameter fixed at [(1 - alpha) * variance] to adjust for measurement error in the construct.

^dParameters constrained equal across time.

^eParameters constrained equal across time.

^fUnique residuals allowed to correlate.

^gUnique residuals allowed to correlate.