Published in final edited form as:

Infant Ment Health J. 2015 ; 36(1): 42–52. doi:10.1002/imhj.21484.

Does an intervention to reduce maternal anxiety, depression and trauma also improve mothers' perceptions of their preterm infants' vulnerability?

Sarah McCue Horwitz, Ann Leibovitz, Emily Lilo, Booil Jo, Anne Debattista, Nick ST. John, and Richard J. Shaw

Introduction

As the rate of premature births has increased and the mortality decreased, more infants and their parents are exposed to the challenges associated with prematurity (Institute of Medicine, 2007; March of Dimes, 2012). Premature infants often have significant medical complications, problems in feeding and establishing sleep schedules, developmental and cognitive challenges as well as numerous mental health issues which include Attention Deficit Hyperactive Disorder (ADHD) and disruptive behavior disorders (Institute of Medicine, 2007; March of Dimes, 2012). Their problems frequently last into adulthood with lower levels of academic achievement, less skilled employment and higher prevalence of major mental health problems (Hack, 2009; Hack et al., 2002; Saigal & Doyle, 2008).

For parents, particularly mothers, premature births and subsequent neonatal intensive care unit (NICU) hospitalizations are commonly experienced as traumatic events and may lead to high rates of symptoms of psychological distress. Compared to parents of full-term infants, parents of premature infants report more mental health problems which include posttraumatic stress disorder (PTSD) and acute stress disorder (ASD), depression and anxiety (Davis, Edwards, Mohay, & Wollin, 2003; Holditch-Davis, Bartlett, Blickman, & Miles, 2003; Institute of Medicine, 2007; Shaw et al., 2009; Shaw, St. John, et al., 2013).

The combination of a neurologically immature, difficult-to-parent infant and a distressed parent produces challenges for infant-parent bonding and optimal parenting. There are considerable data showing a relationship between maternal distress and infant development, including physical health outcomes and cognitive and emotional development (Davis et al., 2003; Roman et al., 1995). Premature infants are rated as more vulnerable by their parents compared to full-term infants and these perceptions of vulnerability persist even after premature infants developmentally mature and grow into healthy children (Bidder, Crowe, & Gray, 1974). Perceived vulnerability is a possible result of the trauma induced in parents by a premature birth and it results in what Thomasgard and Metz (1995) described as Parental Perception of Child Vulnerability. This perceived vulnerability is consistent with Solnit and Green's earlier description of the Vulnerable Child Syndrome (Green & Solnit, 1964) and is often associated with suboptimal parenting behaviors that foster less cognitive

and emotional growth in their infants (Stern & Hildebrandt, 1986; Stern, Karraker, McIntosh, Moritzen, & Olexa, 2006).

To both alleviate parental distress and encourage optimal parent-child interactions, a number of interventions for parents, usually mothers, have been developed (Als et al., 2003; Anderson et al., 2003; Bakermans-Kranenburg, Van Ijzendoorn, & Juffer, 2003; Benzies, Magill-Evans, Hayden, & Ballantyne, 2013; Bernard et al., 2011; Brecht, Shaw, St. John, & Horwitz, 2012; Jotzo & Poets, 2005; Melnyk et al., 2006; Vanderveen, Bassler, Robertson, & Kirpalani, 2009; Zerkowicz et al., 2011). Authors of meta-analyses of interventions for preterm infants and their parents have concluded that: they improve neurodevelopment up to 36 months (Vanderveen et al., 2009); they are most effective in improving anxiety, stress and depression when coupled with psychosocial support (Benzies et al., 2013); and that interventions to improve maternal sensitivity are particularly effective in mother-child dyads with high clinical needs such as prematurity (Bakermans-Kranenburg et al., 2003). However, there has not been an evaluation of whether or not reducing maternal anxiety, depression and trauma leads to changes in mothers' perceptions of their premature infants' vulnerability (Bernard et al., 2011; Brecht et al., 2012). In their review and meta-analysis of early interventions for preterm infants and their parents, Benzies et al. (2013) noted that the most important recommendation for future research is to measure the effects of such interventions to determine whether parent outcomes change and then, subsequently, alter the child's proximal environment.

Given the potential relationships between maternal distress and perception of vulnerability and its importance for parenting behaviors that promote optimal development, we investigated whether an effective intervention to reduce maternal symptoms of anxiety, depression and trauma that also incorporated education about perceptions of vulnerability decreased perceptions of infant vulnerability in mothers of preterm infants. We hypothesized that: (1) women who received the intervention would show statistically significantly lower scores of perceptions of infant vulnerability assessed using the Vulnerable Baby Scale (VBS) (Forsyth, Horwitz, Leventhal, & Burger, 1996; Kerruish, Settle, Campbell-Stokes, & Taylor, 2005) at 6 months post-birth compared to women in the comparison group; (2) lower perceptions of child vulnerability would be mediated by reductions in symptoms of anxiety; and (3) high baseline symptoms of anxiety and trauma would moderate the effects of the intervention on perceptions of child vulnerability.

Methods

Participants

Participants were mothers of premature infants born in or transferred within one week to any of the four participating NICUs associated with the Lucile Packard Children's Hospital all located in the greater Palo Alto, CA area. Mothers were included if they were: English or Spanish speaking; 18 years of age or older; had developed symptoms of trauma, anxiety or depression; and had delivered an infant of gestational age 25–34 weeks who weighed at least 600 grams. Mothers were excluded if their child (or children) had developmental abnormalities or were awaiting cardiac surgery. Additionally, mothers with psychotic symptoms or clinically significant suicidal or infanticidal ideation were excluded.

Procedures

The Stanford University institutional review board approved the protocol. Mothers were identified through a daily review of the NICU admission logs by a member of the Neonatology research staff. Potential participants were provided with an information sheet about the study by a member of NICU staff when they were visiting the NICU and permission to be contacted to learn more about the study was obtained. The project coordinator then met with potential participants to explain the study. After providing written informed consent, participants were evaluated for clinically significant symptoms of Acute Stress Disorder (ASD) (Stanford Acute Stress Reaction Questionnaire score ≥ 3 for the required number of questions in 2 or more of the symptom categories), depression (Beck Depression Inventory-II score ≥ 20) and anxiety (Beck Anxiety Inventory score ≥ 16). Participants meeting the cutoff on one or more of these measures were invited to participate in the intervention. A random number generator was used to assign eligible participants, unblinded, to receive either: (1) the manual driven 6 or 9 session, trauma-focused cognitive behavioral therapy (CBT)-intervention including education on perceptions of vulnerability; or (2) a comparison condition consisting of education about the NICU environment, symptoms of distress and development of their premature infant and a facilitated referral to a parent mentor program. Contact with the mentor program was not measured. The intervention lasted 3–4 weeks with one or two 45–55 minute sessions administered weekly. Of the 135 women who were evaluated, 105 scored above the clinical cutoff on one or more of the scales and 100% were randomized, 62 to the intervention, 43 to the comparison in the planned 60/40 allocation. Five women in the intervention and 2 in the comparison dropped out prior to the 4–5 week assessment. The study size of 100 was chosen to detect an effect size of 0.5 with power to detect an intervention effect of .78 (one-sided, $\alpha=.05$). The study population and effects of the intervention have been described elsewhere (Shaw et al., 2013). Figure 1 displays the study flowchart.

Intervention

The development and content of the 6-session treatment manual, which includes ratings of treatment fidelity and maternal satisfaction has been previously described (Shaw, Sweester, et al., 2013). Principles of trauma-focused CBT were incorporated with the expectation that reducing trauma-related symptoms would help mothers enhance their coping ability, feel more bonded to their infants, and improve their parenting ability. Sessions included: (1) educating mothers about PTSD and common feelings and thoughts of NICU parents; (2) cognitive restructuring to help mothers recognize and challenge erroneous and maladaptive cognitions; (3) progressive muscle relaxation to reduce anxiety; and (4) development and processing of the mother's trauma narrative. The six-session intervention included two additional sessions, adapted with permission from COPE (Melnik et al., 2001) which were developed to enhance the mother-infant relationship by changing the mother's negative perceptions of her infant and the parenting experience and addressing perceived vulnerability. This process, described as *infant redefinition*, is based on the assumption that if parents no longer view their child as abnormal, difficult and vulnerable, they will engage in more normative caregiving interactions that will, in turn, lead to improved child development. Additionally, the participants randomized at baseline to the 9-session

intervention received additional sessions that addressed triggers for PTSD and education about parenting the premature infant.

Participants in the information/usual care comparison group received one 45-minute information session on the policy, procedures and environment of the NICU with education about parenting the premature infant. Mothers were referred to the existing parent mentor program for support and coping strategies. Mothers also received usual NICU care including contacts with social workers, chaplaincy and developmental specialists.

Interventionists were 6 first or second year graduate students in psychology and 1 Licensed Clinical Social Worker. These individuals attended an 8-hour training, and completed two practice interviews that were audio-recorded and rated for fidelity. Additionally, there was weekly group supervision. The intervention sessions were delivered one-on-one in a location convenient for the participant. All sessions were audio-recorded and rated for fidelity. Treatment fidelity to all components of the intervention was high across both sessions and interventionists (Shaw, Sweester et al., 2013). Participants in both conditions were assessed at baseline (1–2 weeks after the birth of the infant), one week after the completion of the intervention or 4–5 weeks post delivery for the comparison group, and 6 months after the birth of the infant for both groups. Recruitment and delivery of the intervention took place between July 1, 2011 and December 31, 2012. Data collection was completed on May 30, 2013.

Measures

Sociodemographic/health characteristics included self-reported age, ethnicity, education, income, marital status, country of birth, language (English or Spanish), number of children, and prior premature infants and bed rest prior to the premature birth. Questions were taken from the Connecticut Early Development Project interview (Horwitz, Briggs-Gowan, Storfer-Isser, & Carter, 2007).

Traumatic Events Questionnaire (TEQ) (Vrana & Lauterbach, 1994)—This 11-item questionnaire, administered at baseline, assesses specific trauma experiences capable of eliciting post-traumatic stress symptoms. The 2-week test-retest reliability for number of events is .91 and for specific events .72–1.0. Results of this questionnaire were scored positive for prior trauma if any event was endorsed or negative if no traumatic events were endorsed. A separate measure, *reproductive trauma*, was scored as positive if women mentioned any reproductive issues (infertility, miscarriages, still births, etc.) as being traumatic.

Davidson Trauma Scale (DTS) (Davidson et al., 1997)—This 17-item scale, administered at baseline and follow-ups, assesses DSM-IV-TR symptoms of PTSD. The scale has solid test-retest reliability (Pearson Product-Moment Correlation = .86) and internal consistency ($\alpha = .99$; internal consistency in this sample = .91). At a score of 4, the DTS achieves an 83% diagnostic accuracy with the SCID.

Stanford Acute Stress Reaction Questionnaire (SASRQ) (Cardeña, Koopman, Classen, Waelde, & Spiegel, 2000)—This 30-item self-report questionnaire used to

assess Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR: American Psychiatric Association, 2000) symptoms of ASD was administered at baseline. Psychometric properties of the SASRQ show good internal consistency (range across several study samples $\alpha = .80-.95$; internal consistency in this sample = .91), test-retest reliability ($r = .69$), and predictive validity (Cardeña et al., 2000).

Parental Stressor Scale: Neonatal Care Unit (PSS: NICU) (Miles, Funk, & Carlson, 1993)—This 35-item scale, administered at baseline, evaluates parents' perceptions of the stressors due to the infants' NICU stay in three areas: physical environment of the NICU, infant's behavior/appearance and alterations in parental role. The PSS: NICU is internally consistent ($\alpha > .70$ for all scales; internal consistency in this sample = .94).

Beck Depression Inventory-II (BDI-II) (Beck, Steer, & Brown, 1996)—This 21-item questionnaire, administered at baseline and follow-ups, assesses depressive symptoms with a one week test-retest reliability of .92. Internal consistency in this sample was .88.

Beck Anxiety Inventory (BAI) (Beck, Epstein, Brown, & Steer, 1988)—This 21-item self-report measure, administered at baseline and follow-ups, assesses symptoms of anxiety. The scale has good internal consistency (internal consistency in this sample = .90) and one week test-retest reliability of .75.

MINI International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998)—This structured diagnostic interview, administered at baseline and follow-ups, was used to establish the DSM-IV-TR diagnoses of any major depressive episode, any anxiety disorder and PTSD. Results from a multicenter study that compared the diagnoses by general practitioners obtained using the MINI with the diagnoses obtained by psychiatrists using non-structured interviews showed a kappa coefficient between .41 and .68, sensitivity between .41 and .86, and specificity between .84 and .97.

Illness Health Severity Index—A probability of death index (range 0–1) was calculated using a multivariable model, designed to capture important factors related to an infant's risk of death based upon Vermont Oxford network (VON) model (Horbar, 1999; Zupancic et al., 2007) with modifications tailored to the California Perinatal Quality Care Collaborative (CPQCC) data. The multivariable model includes terms for gestational age, gestational age squared, race, sex, location of birth, prenatal care, 5-minute Apgar score, small size for gestational age (lowest 10th percentile), major birth defect, and California Children's Services (CCS) NICU level. The CCS NICU levels are designated as Intermediate, Community or Regional with Regional NICUs providing the highest level of care.

Outcome Measures

The Vulnerable Baby Scale (VBS) is a 10-item scale measuring a parent's perception of their child's vulnerability. The scale has good internal consistency ($\alpha = .70$) (Kerruish et al., 2005). Internal consistency in this sample = .59. Higher scores indicate higher perceptions of vulnerability. The VBS was derived from the Vulnerable Child Scale, which has good

internal consistency ($\alpha = 0.74$) (Forsyth et al., 1996). The VBS was administered at 4–5 weeks post delivery or after the completion of the intervention and at the 6-month follow-up.

Baseline demographics and clinical features of mothers and infants are presented in Table 1. The sample consisted of primarily married and well-educated women. There were no statistical differences between the intervention and comparison groups on most baseline variables including maternal ratings of trauma, anxiety and depression, prior trauma history and current psychiatric diagnoses of major depression, dysthymia or anxiety. With the exception that the intervention group was older (33.76 vs. 30.7 years, $p=0.011$) and more likely to have delivered their first child (69.4% vs. 48.8%, $p=0.034$) there were no differences in the sociodemographic variables. Mothers assigned to the intervention group rated their NICU experience as being more stressful compared with the comparison mothers ($p=0.02$).

Analyses

Means and standard deviations were used to summarize continuous variables while counts and proportions were used to summarize categorical measures. Two-sample t -tests (for continuous variables) and chi-square tests (for categorical variables) were used to compare baseline measures across the intervention and comparison groups (two-sided, $\alpha = .05$) to check that the assumption of randomization was met. No adjustment for multiple testing was made as is customary in reporting baseline comparisons in RCTs. A standard linear mixed effects modeling (Raudenbush & Bryk, 2002; Singer & Willet, 2003) was employed to model longitudinal change of the main outcome from the 4–5 week assessment (post-intervention) to 6-month assessments. We included all randomized individuals in the analyses for whom data were available from at least one of the assessments. Among 105 individuals randomized either to the intervention or to the comparison condition, 98 individuals had the outcome data at one or two assessment points and were included in the analysis ($N=98$ at 4–5 weeks and $N=95$ at 6-month assessment). The rate of loss to follow-up was comparable between the intervention and comparison groups ($\chi^2(1)=0.475$, $p=0.394$ at 1 month, $\chi^2(1)=0.374$, $p=0.387$ at 6 month). Data points that were not available were treated as missing at random conditional on observed information using a maximum likelihood estimation (Little & Rubin, 2002). We incorporated the MacArthur framework (Kraemer, Kiernan, Essex, & Kupfer, 2008; Kraemer, Wilson, Fairburn, & Agras, 2002) in this longitudinal modeling framework for our exploratory moderator/mediator analysis. The Mplus Program version 7.11 (Muthen & Muthen, 1998–2013) was used to conduct the maximum likelihood estimation for all of the longitudinal mixed effects analyses.

Results

Primary Outcome

A mixed effects longitudinal analysis ($N=98$) was conducted to model the change from 4–5 weeks to 6 months for the primary outcome, perception of the child's vulnerability as measured by the VBS. At 4–5 weeks, VBS scores were: $\mu = 32.74$, $SD= 4.06$ for the intervention women and $\mu = 33.46$, $SD= 4.55$ for those in the comparison condition. At 6 months, VBS scores were $\mu = 28.00$, $SD= 4.53$ for women receiving the intervention and $\mu =$

29.34, $SD = 6.06$ for women in the comparison group. In both the intervention and control conditions, perceptions of the child's vulnerability showed a significant decline from 4–5 weeks to 6 months (4.33 points in the control, 4.74 points in the intervention condition, both $p's < .001$). However, there was no significant difference between groups either at post-intervention (4–5 weeks from the baseline) or at the 6-month assessment. The rate of change from 4–5 weeks to 6 months also showed no significant group differences (Figure 2).

Moderator Analysis

We examined potential moderators of the intervention effect on perceptions of vulnerability measured at the 6-month assessment. We considered 15 baseline variables as potential candidates (anxiety, depression, trauma, reproductive trauma, bed rest, parity, infant medical severity score, prior trauma measured at baseline, NICU overall stress, major depressive episode current, education, maternal age, income, White/Non-White, Hispanic and non-Hispanic). In our linear mixed effects model for the moderator analysis, the key parameter of interest is the effect of interaction between the intervention status and a potential moderator on perceived vulnerability at the 6-month assessment. Among the 15 baseline variables we examined, the baseline prior trauma measure was identified as a moderator of intervention effect on perceived vulnerability ($p = 0.025$). Table 2 displays the differential effects of the intervention depending on the baseline prior trauma variable. These data show that mothers who reported no trauma events at baseline reported about the same level of perceived vulnerability at the 6-month follow-up regardless of the intervention status ($p = 0.984$, Cohen's $d = 0.01$). However, mothers who reported at least one trauma event at baseline reported much lower perceptions of vulnerability under the intervention than under the comparison condition ($p = 0.010$, Cohen's $d = -0.86$), indicating a striking impact of the intervention on these mothers who started with baseline reports of prior traumatic events.

Predictors

Among the 15 baseline variables we examined as potential moderators, NICU overall stress (PSS: NICU), anxiety, depression, and trauma symptoms measured with the DTS (all with $p's < .001$) were identified as predictors of perceived vulnerability, meaning that they did not moderate the intervention effect, but significantly predicted perceived vulnerability. That is, mothers who reported higher scores at baseline reported higher perceptions of vulnerability at 6 months regardless of their intervention status. We also conducted Receiver Operator Characteristic (ROC) analysis to identify a subgroup of mothers who are most likely to report higher perceptions of vulnerability scores at 6 months (Kraemer, 1992; Yesavage & Kraemer, 2007). This analysis included all 15 baseline variables as potential risk factors of reporting a high perceived vulnerability score. Among these 15 variables, only baseline depression was identified as a significant risk factor. This finding was also confirmed based on a confirmatory regression analysis including the four predictors in the model. The results showed that the baseline depression was the strongest predictor and the rest were no longer significant predictors of perceived vulnerability at 6 months in the presence of depression ($R^2 = 0.43$ with depression only and 0.46 with all four predictors).

Mediator Analysis

Consistent with the McArthur approach, we examined three intermediate variables, anxiety, depression and trauma symptoms measured with the DTS assessed at 1 month as hypothesized potential mediators of the intervention effect on later 6-month perceptions of vulnerability. None of these three variables was identified as intervention effect mediators.

Discussion

Given that there are data to suggest that decreasing maternal psychological distress in parents of premature infants improves their infants' outcomes and that the authors of recent meta-analyses of interventions for premature infants and their parents strongly recommended that research focus on whether or not, when interventions produce changes in parents, these changes then produce changes in the infants' environments such as being perceived as vulnerable (Benzies et al., 2013), we examined whether a CBT-based intervention with education about perceptions of vulnerability that has been shown to be effective in reducing maternal anxiety, trauma and depression symptoms subsequently changed the mothers' perception of their infants' vulnerability as measured by the VBS (Forsyth et al., 1996; Kerruish et al., 2005). We found that both the intervention and comparison conditions showed statistically significant declines in perceptions of vulnerability as measured by the VBS and, although the decline in the intervention group was somewhat higher (4.74 versus 4.33 points), this difference did not reach statistical significance. This was somewhat surprising given the effect of the intervention on maternal symptoms (Shaw, St. John, et al., 2013) but is likely due to one of four possibilities. First, many of the studies examining maternal perceptions of vulnerability examined these perceptions when the children were older. It may be that mothers' perceptions of vulnerability change as children develop and that the impact of the intervention will not be seen until the children are older (Culley, Perrin, & Chaberski, 1989; Estroff, Yando, Burke, & Synder, 1994). Second, although the intervention contained educational material about perceptions of vulnerability and its impact on parenting behaviors, the perception of an infant as vulnerable was not specifically addressed using the cognitive restructuring techniques that were found helpful in altering other maternal perceptions. It is possible given the intervention's substantial impact on symptoms of maternal distress that perceptions of vulnerability could also be greatly diminished if addressed directly using cognitive restructuring techniques rather than just education. Testing an augmented version of the intervention with one session focused on reframing perceptions of infant vulnerability would be an important next step in testing this hypothesis. Third, it may be that the information supplied to and the attention paid to the comparison mothers through the various study assessments may have sensitized them to the need to be cautious about perceiving their children as vulnerable. The lack of effect between intervention and comparison conditions in assessments of psychosocial interventions is not unique to this study (Horowitz et al., 2013). Finally, the internal consistency for the VBS in this study sample was low, $\alpha = 0.59$, and there could be measurement error.

When we examined 15 potential moderators of the intervention on perceived vulnerability, only baseline prior trauma proved to be significant. Mothers who reported prior traumatic

events at baseline reported much lower perceived infant vulnerability as measured by the VBS at 6 months under the intervention compared to the control condition ($p=0.010$, $d=-0.86$), suggesting that the intervention was extremely effective in changing perceived vulnerability in women with previous trauma, a group of mothers we had hypothesized would be particularly responsive to the intervention. Prior trauma exposure likely sensitizes mothers and makes them hypervigilant to future traumatic events including a premature birth and the stress of the NICU environment. Thus, these women are more likely to misinterpret changes in their infants as indicating illness and, therefore, report more perceived vulnerability. Since the intervention targeted PTSD symptoms, we expected this group to show the greatest change in perceptions of vulnerability. Given that women who experience trauma endorse distorted views of their infants including high levels of perceived vulnerability, changing perceptions in this subgroup of women have many important implications for subsequent parenting behaviors, child healthcare utilization, child social, emotional and behavioral issues and child development (Miles, 1989; Ross & McLean, 2006; Schechter et al., 2005). That sociodemographic characteristics or the infant medical severity score do not moderate the effect of the intervention on perceived vulnerability suggests that these findings do not differ by important characteristics such as age, ethnicity, or education nor are they influenced by the infant's medical condition. However, we note that the moderate sample size of our study was not ideal for detecting moderators, and therefore reexamination of these potential moderators in larger scale studies is advised.

Finally, we identified four predictors of perceptions of vulnerability at 6-months. We found that when four baseline variables were elevated (perception of NICU as stressful, anxiety, depression and trauma), they were all related to higher perceived vulnerability at 6 months. In particular, women with high depression scores at baseline were most likely to have high perceived vulnerability at 6 months. None of the other predictors of perceived vulnerability were significantly related to perceived vulnerability after controlling for maternal depression. Depression has been linked to perceptions of vulnerability in prior research which suggests that women with high ratings of depressive symptoms following a premature birth should be targeted for intervention around perceiving their children as vulnerable (Burger, Horwitz, Forsyth, Leventhal, & Leaf, 1993; Teti, Hess, & O'Connell, 2005).

Our study has several limitations. The study population was limited to one geographical area and, although representative of that area, had few African-American women. It is unknown whether the findings are generalizable across racial and ethnic groups. The study population was also skewed towards mothers of higher socioeconomic status although sociodemographic characteristics did not moderate the effect of the intervention on perceived vulnerability. With the exception of infant medical severity, all variables are self reported and may be subject to response biases. The outcome variable, maternal perceptions of their infants' vulnerability, measured by the Vulnerable Baby Scale (Kerruish et al., 2005), had a Cronbach Alpha of .59 in this study indicating low internal consistency in this sample. Additionally, although the mothers in the comparison condition received an educational session with all of the content material contained in the intervention and a facilitated referral to the parent mentoring program, we do not know whether the attention paid to the comparison condition was equal to that of the intervention. Finally, only mothers

were included in the study. We have no information on fathers' perceptions or on how their perceptions influence those of the mothers.

Conclusions

Maternal perceptions of vulnerability can produce parenting behaviors that do not foster optimal child development. An intervention designed to reduce maternal symptoms of anxiety, depression and trauma while having no overall impact on perceived vulnerability when compared to a comparison group does appear to substantially reduce perceptions of vulnerability in one subgroup of women, those who at baseline report previous traumatic experiences. Given that these women are highly likely to endorse distorted views of their infants including perceiving them as vulnerable, this intervention may have important implications for subsequent parenting behaviors, increased healthcare use, disruptive behavior problems and child development. Additionally, given the impact of this intervention on maternal symptoms it is possible that augmenting the current intervention with evidence-based activities to improve mother-infant interaction and treating the perception of vulnerability with cognitive restructuring techniques rather than education will also lessen maternal perceptions of vulnerability.

Acknowledgments

Dr. Horwitz was funded by NIH grant R34-MH08657902.

References

- Als H, Gilkerson L, Duffy F, Mcanulty G, Buehler D, Vandenberg K, Ringer S. A three-center, randomized, controlled trial of individualized developmental care for very low birth weight preterm infants: medical, neurodevelopmental, parenting, and caregiving effects. *Journal of Developmental & Behavioral Pediatrics*. 2003; 24(6):399–408. [PubMed: 14671473]
- Anderson G, Chiu S, Dombrowski M, Swinith J, Albert J, Wada N. Mother-Newborn contact in a randomized trial of kangaroo (skin-to-skin) care. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*. 2003; 32(5):604–611.
- Bakermans-Kranenburg M, Van Ijzendoorn M, Juffer F. Less is more: meta-analyses of sensitivity and attachment interventions in early childhood. *Psychological bulletin*. 2003; 129(2):195. [PubMed: 12696839]
- Beck A, Epstein N, Brown G, Steer R. An inventory for measuring clinical anxiety: psychometric properties. *Journal of consulting and clinical psychology*. 1988; 56(6):893. [PubMed: 3204199]
- Beck, A.; Steer, R.; Brown, G. *Beck Depression Inventory*. 2. San Antonio, TX: Pearson Education, Inc. Halcourt Assessment; 1996.
- Benzies K, Magill-Evans J, Hayden K, Ballantyne M. Key components of early intervention programs for preterm infants and their parents: a systematic review and meta-analysis. *BMC Pregnancy and Childbirth*. 2013; 13(Suppl 1):S10. [PubMed: 23445560]
- Bernard R, Williams S, Storfer-Isser A, Rhine W, Horwitz S, Koopman C, Shaw R. Brief cognitive-behavioral intervention for maternal depression and trauma in the neonatal intensive care unit: A pilot study. *Journal of traumatic stress*. 2011; 24(2):230–234.10.1002/jts.20626 [PubMed: 21438016]
- Bidder R, Crowe E, Gray O. Mothers' attitudes to preterm infants. *Archives of disease in childhood*. 1974; 49(10):766–770. [PubMed: 4429359]
- Brecht C, Shaw R, St John N, Horwitz S. Effectiveness of therapeutic and behavioral interventions for parents of low-birth-weight premature infants: A review. *Infant Mental Health Journal*. 2012; 33(6): 651–665. [PubMed: 24532861]

- Burger J, Horwitz S, Forsyth B, Leventhal J, Leaf P. Psychological Sequelae of Medical Complications During Pregnancy. *Pediatrics*. 1993; 91(3):566–571. [PubMed: 8441560]
- Cardeña E, Koopman C, Classen C, Waelde L, Spiegel D. Psychometric properties of the Stanford Acute Stress Reaction Questionnaire (SASRQ): A valid and reliable measure of acute stress. *Journal of traumatic stress*. 2000; 13(4):719–734. [PubMed: 11109242]
- Culley B, Perrin E, Chaberski M. Parental perceptions of vulnerability of formerly premature infants. *Journal of Pediatric Health Care*. 1989; 3(5):237–245. [PubMed: 2778593]
- Davidson J, Book S, Colket J, Tupler L, Roth S, David D, Smith R. Assessment of a new self-rating scale for post-traumatic stress disorder. *Psychological medicine*. 1997; 27(1):153–160. [PubMed: 9122295]
- Davis L, Edwards H, Mohay H, Wollin J. The impact of very premature birth on the psychological health of mothers. *Early human development*. 2003; 73(1):61–70. [PubMed: 12932894]
- Estroff DB, Yando R, Burke K, Synder D. Perceptions of preschoolers' vulnerability by mothers who had delivered preterm. *Journal of pediatric psychology*. 1994; 19(6):709–721. [PubMed: 7530300]
- Forsyth B, Horwitz S, Leventhal J, Burger J. The Child Vulnerability Scale: an instrument to measure parental perceptions of child vulnerability. *Journal of pediatric psychology*. 1996; 21(1):89–101. [PubMed: 8820075]
- Green M, Solnit A. Reactions to the Threatened Loss of a Child: A Vulnerable Child Syndrome. *Pediatric Management of the Dying Child, Part III. Pediatrics*. 1964; 34(1):58–66. [PubMed: 14181986]
- Hack M. Adult outcomes of preterm children. *Journal of Developmental & Behavioral Pediatrics*. 2009; 30(5):460–470. [PubMed: 19823140]
- Hack M, Flannery D, Schluchter M, Cartar L, Borawski E, Klein N. Outcomes in young adulthood for very-low-birth-weight infants. *New England Journal of Medicine*. 2002; 346(3):149–157. [PubMed: 11796848]
- Holditch-Davis D, Bartlett T, Blickman A, Miles M. Posttraumatic stress symptoms in mothers of premature infants. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*. 2003; 32(2):161–171.
- Horbar J. The Vermont Oxford Network: evidence-based quality improvement for neonatology. *Pediatrics*. 1999; 103(Supplement E1):350–359. [PubMed: 9917477]
- Horowitz JA, Murphy CA, Gregory K, Wojcik J, Pulcini J, Solon L. Nurse Home Visits Improve Maternal/Infant Interaction and Decrease Severity of Postpartum Depression. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*. 2013; 42(3):287–300.
- Horwitz S, Briggs-Gowan M, Storfer-Isser A, Carter A. Prevalence, correlates, and persistence of maternal depression. *Journal of Women's Health*. 2007; 16(5):678–691.
- Behrman, R.; Butler, A., editors. *Institute of Medicine. Preterm birth: causes, consequences and prevention*. Washington, DC: National Academy Press; 2007.
- Jotzo M, Poets C. Helping parents cope with the trauma of premature birth: an evaluation of a trauma-preventive psychological intervention. *Pediatrics*. 2005; 115(4):915–919. [PubMed: 15805364]
- Kerruish N, Settle K, Campbell-Stokes P, Taylor B. Vulnerable Baby Scale: development and piloting of a questionnaire to measure maternal perceptions of their baby's vulnerability. *Journal of paediatrics and child health*. 2005; 41(8):419–423. [PubMed: 16101975]
- Kraemer, H. *Evaluating medical tests: Objective and quantitative guidelines*. Newbury Park, CA: Sage Publications; 1992.
- Kraemer H, Kiernan M, Essex M, Kupfer DJ. How and why criteria defining moderators and mediators differ between the Baron & Kenny and MacArthur approaches. *Health Psychology*. 2008; 27(2S):S101–S108. [PubMed: 18377151]
- Kraemer H, Wilson G, Fairburn C, Agras W. Mediators and moderators of treatment effects in randomized clinical trial. *Archives of General Psychiatry*. 2002; 59(10):877–883. [PubMed: 12365874]
- Little, R.; Rubin, D. *Statistical Analysis with Missing Data*. New York, NY: J Wiley & Sons; 2002.
- March of Dimes. *March of Dimes 2012 Premature birth report card*. White Plains, NY: 2012.
- Melnyk B, Alpert-Gillis L, Feinstein N, Fairbanks E, Schultz-Czarniak J, Hust D, Sinkin R. Improving cognitive development of low-birth-weight premature infants with the COPE program: A pilot

study of the benefit of early NICU intervention with mothers. *Research in Nursing & Health*. 2001; 24(5):373–389.10.1002/nur.1038 [PubMed: 11746067]

Melnik B, Feinstein N, Alpert-Gillis L, Fairbanks E, Crean H, Sinkin R, Gross S. Reducing premature infants' length of stay and improving parents' mental health outcomes with the Creating Opportunities for Parent Empowerment (COPE) neonatal intensive care unit program: a randomized, controlled trial. *Pediatrics*. 2006; 118(5):e1414–e1427. [PubMed: 17043133]

Miles M. Parents of critically ill premature infants: Sources of stress. *Critical Care Nursing Quarterly*. 1989; 12(3):69–74. [PubMed: 2819538]

Miles M, Funk S, Carlson J. Parental Stressor Scale: neonatal intensive care unit. *Nursing Research*. 1993; 42(3):148–152. [PubMed: 8506163]

Muthen, L.; Muthen, B. MPlus User's Guide. Los Angeles, CA: Muthen & Muthen; 1998–2013.

Raudenbush, S.; Bryk, A. Hierarchical Linear Models: Applications and Data Analysis Methods. Thousand Oaks, CA: Sage; 2002.

Roman L, Lindsay J, Boger R, DeWys M, Beaumont E, Jones A, Haas B. Parent-to-parent support initiated in the neonatal intensive care unit. *Research in Nursing & Health*. 1995; 18(5):385–394. [PubMed: 7676072]

Ross LE, McLean LM. Anxiety disorders during pregnancy and the postpartum period: a systematic review. *depression*. 2006; 6:9.

Saigal S, Doyle W. An overview of mortality and sequelae of preterm birth from infancy to adulthood. *The Lancet*. 2008; 371(9608):261–269.

Schechter DS, Coots T, Zeanah CH, Davies M, Coates SW, Trabka KA, Myers MM. Maternal mental representations of the child in an inner-city clinical sample: Violence-related posttraumatic stress and reflective functioning. *Attachment & Human Development*. 2005; 7(3):313–331. [PubMed: 16210242]

Shaw R, Bernard R, DeBlois T, Ikuta L, Ginzburg K, Koopman C. The Relationship between acute stress disorder and posttraumatic stress disorder in the neonatal intensive care unit. *Psychosomatics*. 2009; 50(2):131–137. [PubMed: 19377021]

Shaw R, St John N, Lilo E, Jo B, Benitz W, Stevenson D, Horwitz S. Prevention of traumatic stress in mothers with preterm infants: A Randomized Controlled Trial. *Pediatrics*. 2013; 132(4):e886–e894. [PubMed: 23999956]

Shaw R, Sweester C, St John N, Lilo E, Corcoran J, Jo B, Melnyk B. Prevention of postpartum traumatic stress in mothers with preterm infants: manual development and evaluation. *Issues in mental health nursing*. 2013; 34(8):578–586. [PubMed: 23909669]

Sheehan D, Lecrubier Y, Sheehan K, Amorim P, Janavs J, Weiller E, Dunbar G. The Mini-International Neuropsychiatric Interview (MINI): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of clinical psychiatry*. 1998; 59(S20):22–33. [PubMed: 9881538]

Singer, J.; Willet, J. *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*. New York, NY: Oxford University Press; 2003.

Stern M, Hildebrandt K. Prematurity stereotyping: Effects on mother-infant interaction. *Child development*. 1986; 57(2):308–315. [PubMed: 3956315]

Stern M, Karraker K, McIntosh B, Moritzen S, Olexa M. Stereotyping and Mothers' Interactions with their Premature and Full-term Infants during the First Year. *Journal of pediatric psychology*. 2006; 31(6):597–607. [PubMed: 16079419]

Teti D, Hess C, O'Connell M. Parental Perceptions of Infant Vulnerability in a Preterm Sample: Prediction from Maternal Adaptation to Parenthood during the Neonatal Period. *Journal of Developmental & Behavioral Pediatrics*. 2005; 26:283–292. [PubMed: 16100501]

Thomasgard M, Shonkoff J, Metz W, Edelbrock C. Parent-child relationship disorders. Part II. The vulnerable child syndrome and its relation to parental overprotection. *Journal of Developmental & Behavioral Pediatrics*. 1995; 16(4):251–256. [PubMed: 7593660]

Vanderveen J, Bassler D, Robertson C, Kirpalani H. Early interventions involving parents to improve neurodevelopmental outcomes of premature infants: a meta-analysis. *Journal of perinatology*. 2009; 29(5):343–351. [PubMed: 19148113]

- Vrana S, Lauterbach D. Prevalence of traumatic events and post-traumatic psychological symptoms in a nonclinical sample of college students. *Journal of traumatic stress*. 1994; 7(2):289–302. [PubMed: 8012748]
- Yesavage, J.; Kraemer, H. Signal Detection Software for Receiver Operator Characteristics (Version 4.22) [Computer Software]. Palo Alto, CA: 2007. Retrieved from www.stanford.edu/~yesavage/ROC.html
- Zelkowitz P, Feeley N, Shrier I, Stremler R, Westreich R, Dunkley D, Papageorgiou A. The cues and care randomized controlled trial of a neonatal intensive care unit intervention: effects on maternal psychological distress and mother-infant interaction. *Journal of Developmental & Behavioral Pediatrics*. 2011; 32(8):591–599. [PubMed: 21720259]
- Zupancic J, Richardson D, Horbar J, Carpenter J, Lee S, Escobar G. Revalidation of the score for neonatal acute physiology in the Vermont Oxford Network. *Pediatrics*. 2007; 119(1):e156–e163. [PubMed: 17158947]

Figure 1.
Consort Diagram

Figure 2.
Change in Maternal Perceptions of Infant Vulnerability from 1 month to 6 months Post Birth

Table 1

Participant Demographic and Clinical Characteristics

Baseline Characteristics and Measures	Intervention (N =57)	Comparison (N =41)	Between Group Difference
Maternal Demographics			
Mother's age (<i>M, SD</i>)	33.84 (6.48)	30.51 (5.37)	$t(96)=-2.692, p=0.008$
Mother's education: less than college degree vs. college or more (<i>N, %</i>)	18 (31.6%)	18 (43.9%)	$\chi^2(1)=1.558, p=0.212$
Mother's race: White (vs. non-White) (<i>N, %</i>)	39 (68.4%)	21 (51.2%)	$\chi^2(1)=2.972, p=0.085$
Mother's Ethnicity: Hispanic (vs. non-Hispanic) (<i>N, %</i>)	16 (28.1%)	13 (31.7%)	$\chi^2(1)=0.151, p=0.697$
Mother is: Native born (vs. Foreign born) (<i>N, %</i>)	34 (59.6%)	23 (56.1%)	$\chi^2(1)=0.124, p=0.725$
Married/partnered (vs. single/divorced) (<i>N, %</i>)	53 (93.0%)	41 (100%)	$p=0.137^*$
Household Income: (<i>N, %</i>) [*]			
< \$50,000	15 (27.3%)	9 (25.7%)	$\chi^2(1)=0.027, p=0.871$
\$50,000 – \$99,000	9 (16.4%)	5 (14.3%)	$\chi^2(1)=0.070, p=0.791$
\$100,000	31 (56.4%)	21 (60.0%)	$\chi^2(1)=0.116, p=0.733$
Parity: First Child	43 (69.4%)	21 (48.8%)	$\chi^2(1)=4.491, p=0.034$
Interview Language: English (vs. Spanish) (<i>N, %</i>)	50 (87.7%)	35 (85.4%)	$\chi^2(1)=0.115, p=0.735$
Trauma Events Questionnaire: Yes (<i>N, %</i>)	29 (50.9%)	13 (31.7%)	$\chi^2(1)=3.578, p=0.059$
Reproductive Trauma: Yes (<i>N, %</i>)	9 (15.8%)	7 (17.1%)	$\chi^2(1)=0.029, p=0.865$
Bed Rest: Yes (<i>N, %</i>)	14 (24.6%)	6 (19.4%)	$\chi^2(1)=0.310, p=0.578$
Maternal Clinical			
Davidson Trauma Scale (<i>M, SD</i>)	49.21 (25.59)	40.73 (25.15)	$t(96)=1.630, p=0.106$
Beck's Depression Inventory-II (<i>M, SD</i>)	20.47 (9.82)	17.37 (10.87)	$t(96)=1.477, p=0.143$
Beck's Anxiety Inventory (<i>M, SD</i>)	21.98 (11.76)	20.20 (12.70)	$t(96)=0.718, p=0.475$
Stanford Acute Stress Reaction Questionnaire: Yes (<i>N, %</i>)	51 (89.5%)	38 (92.7%)	$p=0.731^*$
Parental Stressor Scale: NICU (<i>M, SD</i>):			
Global Index	3.03 (0.74)	2.63 (0.87)	$t(96)=2.466, p=0.015$
Sights and Sounds of the NICU	2.88 (0.86)	2.65 (1.14)	$t(96)=1.167, p=0.246$
Infant Behavior and Appearance	3.13 (0.98)	2.54 (0.99)	$t(96)=2.930, p=0.004$
Alteration in Parental Role	3.87 (0.83)	3.48 (1.12)	$t(96)=1.969, p=0.052$
MINI:			

Baseline Characteristics and Measures	Intervention (N =57)	Comparison (N =41)	Between Group Difference
Major Depressive Episode: (N, %)	47 (82.5%)	35 (85.4%)	$\chi^2(1)=0.148, p=0.701$
Anxiety Disorder: (N, %)	7 (12.3%)	2 (4.9%)	$p=0.297^*$
Child			
Infant gestational age weeks (M, SD)	30.63 (2.86)	31.51 (2.64)	$t(96)=1.554, p=0.124$
Infant Severity Score (M, SD)	0.049 (0.055)	0.035 (0.029)	$t(96)=1.512, p=0.134$

* Fisher's exact test *p*-value is reported if there are cells with expected count less than 5.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 2
Baseline Trauma As a Moderator of the Intervention Effect on Perceived Vulnerability at 6 Months

	Intervention	Comparison	Intervention Effect	95% CI	p-value	Cohen's <i>d</i>
No Trauma (N=57)	27.250	27.226	0.024	[-2.328, 2.375]	0.984	0.005
Trauma (N=41)	28.724	33.372	-4.648	[-8.170, -1.126]	0.010	-0.863