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Psychological Flexibility and Depression in New Mothers of Medically Vulnerable Infants: A Mediation Analysis

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Abstract

Objectives.—Maternal depression in the postpartum period is prevalent and associated with negative child outcomes, including behavior problems and cognitive delays. Mothers of children admitted directly after birth to the neonatal intensive care unit (NICU) are at even higher risk for depressive symptoms and infants born premature and/or at low birth weight may be more vulnerable to the adverse effects of maternal depression. Understanding mechanisms, particularly modifiable mechanisms, involved in the development or persistence of depressive symptoms is critically important for developing effective treatments.

Methods.—The longitudinal, secondary analysis investigated the role of psychological inflexibility (rigidly avoiding or attempting to control distressing internal experiences, precluding present moment awareness of contingencies and engagement with important values) as a mediator of the relationship between early (1–2 weeks postpartum) and later (3 and 6 months postpartum) depressive postpartum symptoms among mothers (N = 360) with an infant in the neonatal intensive care unit.

Results.—Psychological inflexibility measured two weeks after infant discharge from the hospital fully mediated the relationship between early and later depressive symptoms at 3 months postpartum, with partial mediation at 6 months, while controlling for factors previously found predictive of postpartum depression.

Conclusions.—Acceptance and Mindfulness therapies which specifically target psychological inflexibility may be promising interventions to reduce depressive symptoms postpartum among new mothers with a NICU infant.

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Conflict of Interest

None.

Ethical Standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Keywords

Postpartum depression; Neonatal intensive care; Maternal mental health; Acceptance and Commitment Therapy; Psychological Flexibility

Introduction

Maternal depression in the postpartum period is not uncommon, with up to 19.2% of women exhibiting symptoms in the first three months postpartum [1]. Poor outcomes related to maternal depression for both mothers and their children have been documented [2, 3]. Untreated depression among mothers in the early postpartum period has been related to increased maternal irritability and hostility and reduced engagement, emotional warmth, and infant play [4]. Infants of mothers experiencing depression are more likely to display lower social engagement, poor emotional/behavioral regulation and increased displays of negative emotion compared to infants of non-depressed mothers [5].

Mothers of NICU infants born premature or at low birthweight may be at increased risk for depressive symptoms [6, 7]. Rogers et al. [8] found that 20% of mothers with infants born at less than 30 weeks reported clinically significant levels of depression at the time of NICU discharge. In a population, tertiary hospital study, 40% of mothers of babies born <32 weeks gestational age reported clinically significant symptoms of depression at one month post-delivery [9]. A systematic review of postpartum depression in women with preterm and low birthweight infants found similar rates [10]. Multiple factors may contribute to the experience of increased and persistent symptoms of depression among mothers of infants in the NICU. These factors include stress related to a disruption in the typical mother-infant experience, the overwhelming sights and sounds of the NICU, balancing NICU visitation with other family responsibilities, and the potential for permanent child disability or death [11].

A variety of demographic, maternal, child, and social characteristics have been explored as risk factors for depressive symptoms postpartum in NICU mothers. For example, younger NICU mothers with less education and income, more current stress in their lives, fewer socioeconomic resources, and low perceptions of social support often exhibit greater depressive symptoms [9, 10, 12]. Additionally, gestational age at birth, ongoing infant illness or disability, and length of stay in the hospital have been associated with maternal depressive symptoms postpartum [10, 13]. These are important findings for understanding who might be at highest risk for depression postpartum; however, most studied factors are not readily changed. Modifiable, individual factors related to symptoms of depression post NICU discharge, when mothers are fully caring for their vulnerable infant, need to be identified, in order to develop effective interventions.

Psychological flexibility deriving from acceptance and commitment therapy [14, 15] is a construct of interest that is gaining support as an important, modifiable risk factor for psychological distress, such as depression and anxiety. Psychological flexibility is a process involving both the acceptance (vs. avoidance) of unpleasant, internal experiences and engagement in behavior based on what an individual perceives as important, i.e., mindfully

persisting in values-driven behavior, without avoidance, in the presence of distressing thoughts, emotions or physical sensations. Anecdotally, we have found that it is not uncommon for new mothers of NICU infants to avoid visiting the hospital until their babies are healthier, off machines, and likely to survive, suggesting psychological inflexibility. A psychologically inflexible stance characterized by experientially avoidant responses may be related to adverse mental health outcomes.

Psychological inflexibility has been associated with most forms of psychopathology and related problems in cross-sectional studies [16, 17], including depression and anxiety [18, 19], post-traumatic stress [20], and substance abuse [21, 22]. Moreover, longitudinal studies suggest that psychological inflexibility is implicated in the onset of mood and anxiety disorders [19]. A number of treatment studies using ACT to target mood or anxiety disorders have reported at least partial mediation of outcomes stemming from psychological flexibility measures [14].

To date, psychological flexibility has not been explored as a mechanism by which to understand depression in the postpartum period, including in mothers of medically vulnerable infants who are under extreme stress. The purpose of this secondary analysis was to explore longitudinally the relations between early depressive symptoms postpartum, psychological flexibility, and depressive symptoms later in the postpartum period among new mothers with an infant admitted to the neonatal intensive care unit. We hypothesized that psychological flexibility would mediate the relationship between early and later, post NICU discharge depressive symptoms, i.e., psychological flexibility would be a mechanism by which early depression was related to later depression postpartum.

Methods

Participants & Design

Data for this secondary analysis was collected as part of the *Baby's Breath II Project*, a parallel, two-group randomized controlled trial to assess a motivational intervention to reduce NICU infant exposure to secondhand smoke post discharge, registered on clinicaltrials.gov (NCT01726062)[23]. Mothers (N = 360) were recruited from a large, 128-bed NICU in an urban children's hospital. There are approximately 1,100 admissions to this NICU per year. Eligibility criteria included: (a) having an infant admitted to the NICU; (b) report of at least one smoker living in the household (mothers were not required to be smokers); (c) English or Spanish literacy; and (d) living within a 50-mile radius of the hospital (due to follow-up home assessments).

Measures

Research assistants conducted a structured interview with mothers at baseline and follow-up. Additional self-report measures were also administered and those relevant to the current study are described.

Sociodemographics and Pregnancy History—The baseline interview provided data related to sociodemographics (e.g., age, education, income), pregnancy and delivery history

(e.g., number of previous children, gestational age at birth, infant birthweight), and smoking history. A review of infant discharge records provided data on length of stay.

Depressive Symptoms—The 20-item Center for Epidemiologic Studies Depression Scale [CES-D:24] measured depressive symptoms over the past week with a four-point Likert scale. Items are summed to produce a continuous score, with higher scores indicative of higher levels of depressive symptoms. The CES-D is a frequently used scale of depressive symptoms with high validity and stability in clinical and community samples and has been used in studies of depression postpartum [10]. A score of 16 or higher is suggestive of significant symptoms of clinical depression [10, 25].

Psychological Inflexibility—The Acceptance and Action Questionnaire-II [26] 7-item scale was used to measure psychological inflexibility on a 7-point Likert scale. Items assess unwillingness to be in contact with distressing internal, private experiences (thoughts, feelings), the need to control these events, and the consequences of such control attempts. Higher scores represent higher levels of psychological inflexibility.

Perceived Stress—The 4-item Perceived Stress Scale [PSS:27] measured the degree to which individuals appraise situations in their lives as stressful. Greater scores represent higher levels of perceived stress.

Procedures: Women were approached in the hospital about the study, which was designed to reduce infant secondhand smoke exposure. The study involved randomization to either a motivational interviewing plus financial incentives intervention (MI+) or conventional care (CC). CC participants received a brief education session in the hospital and an information sheet about child secondhand smoke exposure.

The baseline interview and self-report assessments, approximately 30 – 60 minutes in length, were administered by research staff in the NICU or on the obstetrics floor of the hospital prior to intervention. The *baseline assessment* occurred on average within one to two weeks after delivery and child admission to the NICU. A similar *mid-study assessment* was conducted approximately two weeks after the infant was discharged home from the NICU, and two *follow-up assessments* were conducted, on average, at 2 months (F-up 1) and 5 months (F-up 2) post NICU discharge (See Table 1). All post NICU discharge assessments were conducted in the home. Participants received gift card compensation for completing each assessment. The study was approved by the Committee for the Protection of Human Services of the University of Texas Health Science Center at Houston as well as the associated hospital.

Data Analytic Strategy: Structural equation modeling (SEM) was used to investigate the mediation of depression: the degree to which intermediate variables in a putative causal chain transmit the effect of baseline depression symptoms to depression symptoms at follow-up. In the context of the direct effect of baseline depression, mediational modeling permitted estimates of the indirect effect of baseline level of depression on depression at follow-up via psychological flexibility at mid-study using the product coefficient method. Ninety-five percent confidence intervals were constructed using a bootstrap resampling

approach [28, 29]. Analyses estimated the total effect of baseline depressive symptoms on depressive symptoms at each follow-up, partitioning this effect into the direct contribution of baseline depression on depression at each follow-up, and the indirect effect of depression at baseline on depression at each follow-up via psychological flexibility. Interpretation of unstandardized parameter estimates follows the same logic as unstandardized regression coefficients: a one point increase in outcome is associated with estimated change in the predictor. Indirect effects are interpreted as changes in outcome in the units of the exogenous predictor (as opposed to the mediator). Akiake information criterion (AIC) established the mediation models for both outcomes as better fitting (lower AIC) than alternative models missing each direct effect in turn. Several additional variables were included in each model as predictors of the psychological flexibility mediator and the follow-up depression outcomes in order to rule out, based on previous research, potential confounding relationships: baseline income, marital status, education, perceived stress, smoking status, birth weight, length of stay, and treatment condition. Missingness across the exogenous predictor variables (about 1% of the observations) was addressed using bootstrap aggregation imputation via the `bagImpute` option of the `preProcess()` function in the R package `caret` v. 6.0–76 [30]. Participants who were missing data across both the mediator and the outcome were removed from analysis via listwise deletion. Missingness on either the mediator or the outcome (but not both) and outcome distribution skew were addressed using maximum likelihood with robust standard errors [31]. Data cleaning and preprocessing were performed using the R statistical computing platform [32]. SEM analyses were performed using Mplus v. 7.11 [33].

Results

Participant Characteristics

Thirty-six participants were excluded due to missing data on key variables at F-up 1 and 22 participants were missing data at F-up 2, resulting in final sample sizes of $N = 314$ and $N = 328$, respectively. The majority of mothers were low income, non-Hispanic Black, and non-smoking (See Table 2). Using a score of 16 or higher on the CES-D [24], 43.6% of women reported clinically significant depressive symptoms at baseline.

Model A – Depressive Symptoms at Follow-up 1

Significant direct effects were found for baseline depression on mid study psychological inflexibility (0.285 [0.118, 0.452]) and mid-study psychological inflexibility on F-up 1 depression (0.534 [0.353, 0.715]). A nonsignificant direct effect was found for baseline depression on F-up 1 depression (0.111 [−0.024, 0.246]). A significant indirect effect was found for baseline depression on F-up 1 depression via mid-study psychological inflexibility (0.152 [0.045, 0.260]). The significant indirect effect in the presence of the nonsignificant direct effect suggests full mediation of the relationship between depressive symptoms at baseline and depressive symptoms at F-up 1 by mid-study psychological inflexibility: the direct effect of depressive symptoms at baseline on depressive symptoms at F-up 1 was not statistically significant, while each of the pathways via the mediator were statistically significant. The predictors in Model A yielded variance explained of $R^2 = 0.292$ for the psychological inflexibility mediator and $R^2 = 0.429$ for the depressive symptoms outcome.

Statistically significant baseline covariates in Model A associated with higher psychological inflexibility mid-study included higher stress (0.655 [0.180, 1.129]) and the usual care condition (2.906 [0.696, 5.115]). Lower education (−0.450 [−0.893, −0.008]) was predictive of higher depressive symptoms at F-up 1 (See Figure 1).

Model B – Depressive Symptoms at Follow-up 2

Significant direct effects were found for baseline depression on mid study psychological inflexibility (0.349 [0.181, 0.517]), mid-study psychological inflexibility on F-up 2 depression (0.268 [0.088, 0.449]), and baseline depression on F-up 2 depression (0.155 [0.016, 0.293]). Predictors in Model B (see Figure 1) yielded variance explained of $R^2 = 0.324$ for the psychological inflexibility mediator and 0.325 for the depression outcome at F-up 2. Model B suggests partial mediation of the effect of depressive symptoms at baseline on depressive symptoms at F-up 2. A significant indirect effect was found for baseline depression on follow-up depression via mid study psychological inflexibility (0.094 [0.007, 0.180]). Statistically significant baseline covariates in Model B included the effects of the usual care condition (2.804 [0.420, 5.187]) on higher psychological inflexibility at mid-study and the effects of lower income (−0.485 [−0.968, −0.002]), higher perceived stress (0.535 [0.179, 0.890]), lower birth weight (−2.025 [−3.642, −0.409]), and higher gestational age (0.372 [0.023, 0.721]) related to higher depressive symptoms at F-up 2. Mean AAQ II scores (psychological inflexibility) by the presence or absence of significant depressive symptoms using the CES-D cut score at baseline and follow-ups are presented in Figure 2 for descriptive purposes.

Discussion

This study explored relations between psychological inflexibility and postpartum depressive symptoms in new mothers with an infant in the neonatal ICU. Results indicated that a sizeable minority of women reported clinically significant depressive symptoms at baseline. About half of women with elevated depressive symptoms reported a decrease in symptoms in the months following infant discharge from the hospital, although a few women with lower depressive symptoms at baseline reported an increase in these symptoms at later time points. This pattern is similar to other research reporting on the course of stress and depression among mothers of infants treated in the NICU [6]. As one would expect, depressive symptoms early in the postpartum period were directly associated with later depressive symptoms. However, while controlling for factors previously found predictive of postpartum depression, psychological flexibility measured 2 to 3 weeks after infant discharge fully mediated this relationship at the first follow-up visit, with partial mediation at the second follow-up visit. Specifically, NICU mothers with higher depressive symptoms early in the postpartum period were more likely to be lower in psychological flexibility upon discharge, which was in turn associated with higher depressive symptoms at two time points later in the postpartum period, when infants were approximately 3 and 6 months of age.

Having an infant admitted to the NICU is often disappointing, frightening, and/or overwhelming for new mothers, and therefore it is not surprising that up to 20–40% of NICU mothers report depressive symptoms [9]. Similarly, the discharge of a fragile infant

from the NICU can be overwhelming as NICU infants often require extra care involving medical procedures and equipment, which can be daunting, particularly for socially and economically disadvantaged mothers. Coping with such experiences likely requires a psychologically flexible, non-avoidant stance toward inevitable distressing emotional states, allowing one to adapt to fluctuating situational demands, shift perspectives, and balance competing desires, needs, and life domains [34]. This may be especially difficult for women who are experiencing depressive symptoms as depression is typically characterized by a narrowing of activity and a restricted range of behavioral responses. According to the results in this study, women who reported elevated depressive symptoms after delivery but were able to negotiate the post-discharge period with higher levels of flexibility were indeed experiencing fewer depressive symptoms several months later.

In our model or in other studies, various sociodemographics (e.g., age, education) and infant characteristics (e.g., birthweight, length of hospital stay), as well as social support [25, 35] and stress [36] have been identified as predictors of depression in the postpartum period. Most of these variables are difficult, and some impossible, to influence, and mostly not under a mother's control. For example, stress is likely inherent to mothering a premature or low birth weight NICU infant and the stress may ebb and flow over time but no intervention will effectively eliminate the stress. The way in which mothers approach the stress, however, for example with psychological flexibility, can be targeted. Social support is equally tricky and very challenging to cultivate in the natural environment [37]. Our results suggest that innovative strategies to increase psychological flexibility particularly in the early post discharge period are important, potentially resulting in decreased depressive symptoms at later points in the postpartum period.

Psychological flexibility has been identified in a number of studies as a mechanism by which acceptance and mindfulness based therapies affect change [38], highlighting its importance as a potential treatment target. Among ACT studies investigating mediators of treatment, about 50% of the between group differences in follow-up outcomes can be accounted for by differential levels of psychological flexibility [38]. Specifically regarding depression, several studies have found increases in psychological flexibility to be related to decreased depression [39], with at least two studies demonstrating partial mediation [17, 39]. Findings from previous studies indicate that psychological flexibility is indeed amenable to intervention and acceptance and mindfulness strategies to affect such change are readily available. To date, one group treatment based on ACT has been developed for perinatal mood and anxiety disorders but has yet to be fully evaluated [40].

Interestingly, results indicated that treatment conditions were differentially related to psychological flexibility early in the post NICU discharge period. The intervention in this study was motivational interviewing plus incentives focused primarily on secondhand smoke exposure. Thus, the intervention did not employ concepts or strategies typically used to target psychological flexibility, as would be done with an ACT or similar treatment. The positive association between the MI treatment and psychological flexibility post discharge suggests that psychological flexibility is perhaps a broader, trans-intervention mechanism underlying mental health outcomes. This has been posited previously by others [41] and indicates that psychological flexibility can be augmented using a variety of strategies.

Finally, of note is the finding that psychological flexibility fully mediated the relationship between baseline and postpartum depressive symptoms at 2 months, but only partially mediated this effect at 5 months post NICU discharge. It is possible that the influence of psychological flexibility diminishes with time or perhaps there is something within the context of mothering a NICU infant who is 6 months vs. 2 months of age that exerts influence on depressive symptoms. Our previous research indicated that depression was higher at later time points postpartum and we surmised that common delays in reaching age-appropriate infant milestones may be an important contextual factor independently influencing a mother's mood [12]. Future studies are needed to investigate these findings, attending to contextual variables and using theoretical models amenable to intervention development.

Caveats to this research and its findings must be acknowledged. First, this was a secondary analysis of a sample whose data were gathered for a trial to reduce secondhand smoke exposure in NICU infants' homes. Depressive symptoms and psychological flexibility were of interest as we suspected that either or both may influence the ability of mothers to implement change in their homes, and smoking has been associated with increased depressive symptoms [12]. Second, the sample was not fully representative of all NICU mothers. Third, as we were not studying postpartum depression per se we used a more general yet well-validated measure of depressive symptoms, the CES-D. Studies have found the CES-D and the Edinburgh Postnatal Depression Scale [42] to be highly correlated however, and the CES-D has been used in other studies of depression postpartum among NICU mothers [25, 35, 42]. Finally, the measure of psychological flexibility was added after the intervention trial began, and therefore there are fewer participants with these data, although this did not affect power to detect a mediated effect.

Mothers of infants who are admitted to the NICU are at increased risk of experiencing depressive symptoms, and for those who are psychologically inflexible these symptoms will persist or increase with time. NICU infants are already at increased medical and social risk for poor health outcomes and incur enormous economic expense, making this a population of mothers and infants in need of significant attention and psychosocial intervention. Intervention development and implementation is needed to mitigate poor outcomes associated with maternal depression.

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Significance

What is already known?

Postpartum depressive symptoms among women with medically vulnerable infants are common and few modifiable risk factors have been identified for intervention. Psychological inflexibility has been associated with mental health problems and may be an important process on which to intervene to reduce postpartum depression.

What this study adds?

Psychological inflexibility was found to be a mediator or explanatory mechanism underlying the relationship between early symptoms of depression and symptoms at 6 months postpartum. Interventions to reduce psychological inflexibility when faced with distressing emotional experiences may effectively reduce depressive symptoms postpartum among new mothers.

Figure 1. Mediation of the Relationship between Depression at Baseline and Depression at Follow-Up by Mid-Study Psychological Flexibility.

Figure demonstrates mediation models predicting depression at (A) follow-up 1 and (B) follow-up 2. Unstandardized coefficients are provided next to each pathway and each statistically significant covariate in the model. Standardized coefficients are provided in parentheses next to the unstandardized coefficients. Statistical significance thresholds are provided via asterisks: * = $p < 0.05$, ** = $p < 0.01$, and *** = $p < 0.001$. Obelisk (†) and diesis (§) symbols indicate significant relationships with the mediator and the outcome, respectively. B = Baseline; MS = Mid-study; F1 = First follow-up assessment (2 months post discharge); F2 = Second follow-up assessment (5 months post discharge).

Figure 2. Presence or Absence of Significant Depressive Symptoms at Baseline and Follow-Up by AAQ Scores (measuring Psychological Inflexibility) at Mid-Study.

The CES-D cut score of 16 or higher was used to evaluate changes in depression level (yes, no) from baseline to follow-up and corresponding levels of psychological inflexibility. BL = Baseline; F1 = First follow-up assessment (2 months post discharge); F2 = Second follow-up assessment (5 months post discharge).

Table 1.

Median Age of Infant and Time since Discharge by Assessment Timepoint

	In Hospital	Post-Discharge		
	Baseline	Mid-Study	F-up 1	F-up 2
Age of Infant (weeks)	0.86	6.71	12.71	26.57
Time Since Discharge (weeks)	0.00	2.57	7.86	27.71

Note: F-up 1 = the first post-treatment follow-up assessment; F-up 2 = the second post-treatment follow-up assessment.

Table 2.**Participant Characteristics.**

<i>Variable</i>	<i>N (%)</i>
Race/Ethnicity	
White, Hispanic	60 (18)
White, non-Hispanic	34 (10)
Black, Hispanic	3 (1)
Black, non-Hispanic	203 (62)
Asian	6 (2)
Other	21 (6)
Currently Working	79 (24)
Relationship Status	
Married/Living Together	212 (64)
Single, Widowed, Divorced	116 (35)
Annual Household Income	
< \$15,000	118 (36)
\$15,000-\$24,999	61 (19)
\$25,000-\$34,999	44 (13)
\$35,000-\$44,999	28 (9)
\$45,000-\$54,999	13 (4)
More than \$55,000	39 (12)
Unsure	25 (8)
Breastfeeding	
No, never	73 (22)
Yes, currently	230 (70)
Previously, now finished	25 (8)
Current Smoking (Maternal)	62 (19)
Medicaid Recipient	285 (87)
Study Condition	
MI (Treatment)	161 (49)
CC (Control)	167 (51)
	<i>M(SD)</i>
Age	26.7 (5.8)
Years of education	12.7 (2.0)
Gravidity	3.2 (2.2)
Parity	2.4 (1.5)
Infant Birthweight (kilograms)	2.2 (0.9)
Gestational Age at Delivery (weeks)	33.9 (4.5)
Length of NICU stay (days)	39.4 (46.4)
Baseline CES-D Score	16.4 (10.7)
Midpoint CES-D Score	10.8(8.9)
Follow-up #1 CES-D Score	11.1 (9.4)

<i>Variable</i>	<i>N (%)</i>
Follow-up #2 CES-D Score	11.0 (9.4)

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