Maternal and Child Health Journal (2019) 23:821–829
https://doi.org/10.1007/s10995-018-02699-9

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

Angela L. Stotts[1,2] · Yolanda R. Villarreal[1] · Michelle R. Klawans[1] · Robert Suchting[1,2] · Lillian Dindo[3] · Allison Dempsey[1] · Mackenzie Spellman[1] · Charles Green[2] · Thomas F. Northrup[1]

Published online: 4 January 2019

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 symptoms among mothers with an infant in the NICU. *Results* Psychological inflexibility measured 2 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 for Practice* Psychological inflexibility may be a mechanism by which postpartum depressive symptoms persist after hospital discharge among new mothers with a NICU infant. Acceptance and Mindfulness therapies which specifically target psychological inflexibility may be promising interventions to reduce depressive symptoms postpartum.

Keywords Postpartum depression · Neonatal intensive care · Maternal mental health · Acceptance and commitment therapy · Psychological flexibility

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 promote psychological flexibility when faced with distressing emotional experiences may effectively reduce depressive symptoms postpartum among new mothers.

✉ Angela L. Stotts
Angela.L.Stotts@uth.tmc.edu

[1] Department of Family and Community Medicine, McGovern Medical School at UTHealth, 6431 Fannin, JJL 324, Houston, TX 77030, USA

[2] Department of Psychiatry and Behavioral Science, McGovern Medical School at UTHealth, 1941 East Rd., Houston, TX 77054, USA

[3] Baylor College of Medicine, 1 Baylor Plaza, Houston, TX 77030, USA

Introduction

Maternal depression in the postpartum period is not uncommon, with up to 19.2% of women exhibiting symptoms in the first 3 months postpartum (O'hara and McCabe 2013). Poor outcomes related to maternal depression for both mothers and their children have been documented (Goodman et al. 2011). 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 (Field 2010). 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 (Feldman et al. 2009).

Mothers of neonatal intensive care unit (NICU) infants born premature or at low birthweight may be at increased risk for depressive symptoms (Gray et al. 2013; Huhtala et al. 2012). Hagan et al. (2004) found that 27% of mothers with infants born at < 33 weeks were diagnosed with minor or major depression within 12 months postpartum. In a population, tertiary hospital study, 40% of mothers of babies born < 32 weeks gestational age reported clinically significant symptoms of depression at 1 month postdelivery (Miles and Holditch-Davis 2003). A systematic review of postpartum depression in women with preterm and low birthweight infants found similar rates (Vigod et al. 2010). 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 (Miles et al. 2007).

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 (Miles and Holditch-Davis 2003; Vigod et al. 2010). 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 (Vasa et al. 2014; Vigod et al. 2010). These are important findings for understanding who might be at highest risk for depression postpartum; however, most studied factors cannot be 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 (ACT) (Hayes et al. 2013) 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. 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 (Fledderus et al. 2013), including depression and anxiety (Kashdan et al. 2013; Spinhoven et al. 2016), post-traumatic stress (Thompson et al. 2013), and substance abuse (Stotts et al. 2012; Stotts and Northrup 2015). Moreover, longitudinal studies suggest that psychological inflexibility is implicated in the onset of mood and anxiety disorders (Spinhoven et al. 2016). A number of treatment studies using ACT to target mood or anxiety disorders have reported at least partial mediation of outcomes by psychological flexibility measures (Hayes et al. 2013).

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 NICU. 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 and 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) (Stotts et al. 2013). Mothers (N = 360) were recruited from a large, 128-bed NICU in an urban children's hospital. There

are approximately 1100 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: Radloff 1977) 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 (Vigod et al. 2010). A score of 16 or higher is suggestive of significant symptoms of clinical depression (McManus and Poehlmann 2011; Vigod et al. 2010). The CES-D measures depressive symptoms only and does not offer a clinical depression diagnosis.

Psychological Inflexibility

The Acceptance and Action Questionnaire-II (Bond et al. 2011) 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 four-item Perceived Stress Scale (PSS: Cohen et al. 1983) 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 min 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 1–2 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, and all participants provided informed consent prior to study inclusion.

The MI + intervention consisted of four counseling sessions based on Motivational Interviewing (Miller and Rollnick 2002; Rollnick et al. 2008) specifically focused on reducing infant secondhand smoke exposure; two sessions were conducted in the hospital and two were conducted post discharge in the home. In addition, financial incentives were provided for attendance and for obtaining a "0" on an infant urine cotinine (nicotine's metabolite) dipstick at the two post discharge sessions (Stotts et al. 2013).

Table 1 Median age of infant and time since discharge by assessment timepoint

	In hospital	In home 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)	–	2.57	7.86	27.71

F-up 1 the first post-treatment follow-up assessment, *F-up 2* the second post-treatment follow-up assessment

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 (MacKinnon et al. 2002, 2004). 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). Akaike 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 (Kuhn 2016). 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 (Yuan and Bentler 2000). Data cleaning and preprocessing were performed using the R statistical computing platform (R Core Team 2016). SEM analyses were performed using Mplus v. 7.11 (Muthén and Muthén 1988–2012).

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 women were low income, non-Hispanic Black, and non-smoking (See Table 2). Using a score of 16 or higher on the CES-D (Radloff 1977), 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 Fig. 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 Fig. 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

Table 2 Participant characteristics

Variable	N (%)
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)
	M(SD)
Age	26.7 (5.8)
Years of education	12.7 (2.0)
Gravidity	3.2 (2.2)
Parity	2.4 (1.5)
Infant birthweight (kg)	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)
Follow-up #2 CES-D Score	11.0 (9.4)

(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 Fig. 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.

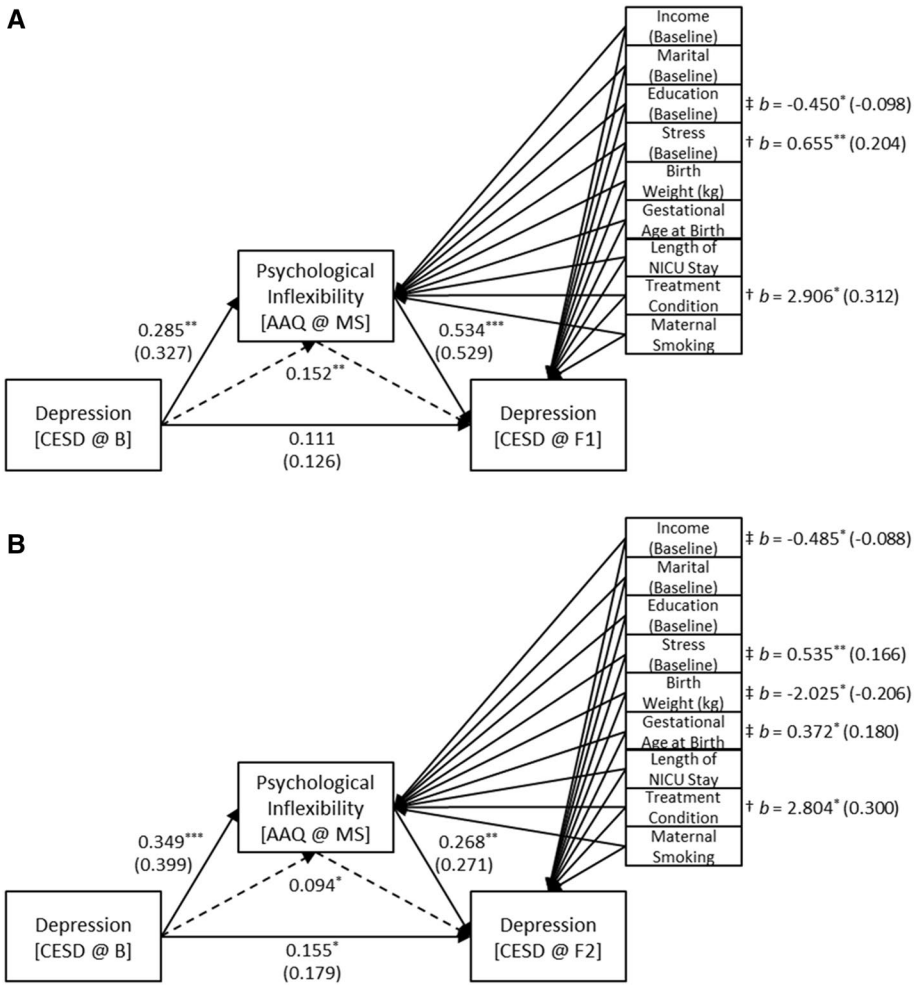

Fig. 1 Mediation of the relationship between depression at baseline and depression at follow-up by mid-study psychological flexibility. Figure demonstrates mediation models predicting depression at follow-up 1 (**A**) and follow-up 2 (**B**). Unstandardized coefficients are provided next to each pathway 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)

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 (Gray et al. 2013). 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 2–3 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.

Few mothers expect their newborns to need intensive hospital care after birth. Further, mothers of NICU infants find themselves in highly medicalized environments with foreign sights and sounds (e.g., ventilators, breathing tubes, heart monitors), often eliciting feelings of disappointment and fear. Thus, it is not surprising that up to 20–40% of NICU mothers report depressive symptoms (Miles and Holditch-Davis 2003). Similarly, the discharge of a fragile infant, although exciting, is typically hectic and overwhelming as parents learn to care for the infant themselves. NICU infants often require extra care involving medical procedures and equipment, with multiple follow-up medical appointments, 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 (Kashdan and Rottenberg 2010). For example, women with a NICU baby at home ideally will stay present, open, and mindful of their own needs (e.g., needing a break),

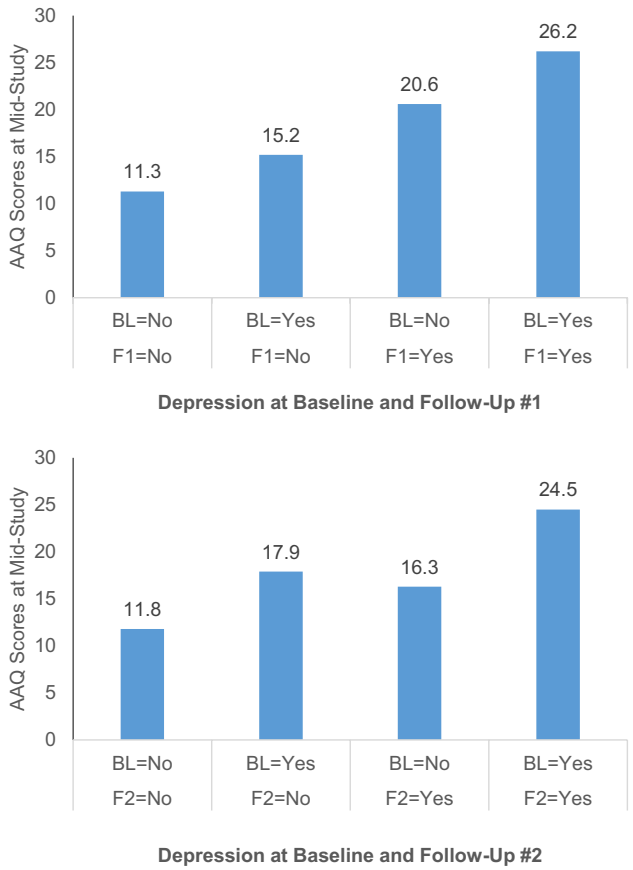

Fig. 2 Presence or absence of significant depressive symptoms at baseline and follow-up by AAQ Scores (measuring psychological inflexibility) at mid-study. The CES-D cut score of 16 or higher was used to evaluate changes in depression (yes, no) from baseline to follow-up and corresponding levels of psychological inflexibility. *BL* baseline, *F1* first follow-up assessment (2 months post discharge); *F2* second follow-up assessment (5 months post discharge)

and avoid becoming completely preoccupied with worry, grief, or unfairness, which may translate into poor parenting. 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 and in other studies, various sociodemographics (e.g., age, education) and infant characteristics (e.g., birthweight, length of hospital stay), as well as social support (McManus and Poehlmann 2011) and stress (Poehlmann et al. 2012) 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. 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 later postpartum.

Psychological flexibility has been identified in a number of studies as a mechanism by which acceptance and mindfulness based therapies affect change (Hayes et al. 2013), 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 (Hayes et al. 2013). Specifically regarding depression, several studies have found increases in psychological flexibility to be related to decreased depression (Hayes et al. 2013), with at least two studies demonstrating partial mediation (Hayes et al. 2013). 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 (Bonacquisti et al. 2017).

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 treatments. 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 (Hayes et al. 2004) 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 versus 2 months of age that exerts influence on depressive symptoms. Our previous research with NICU mothers indicated that depression was higher at later time points postpartum

and we surmised that common delays in reaching age-appropriate infant milestones or chronic medical complications may be an important contextual factor independently influencing a mother's mood (Northrup et al. 2013). Notably, lower birth weight and gestational age at birth were related to higher depression at 6 months but not at 2 months, perhaps altering the influence of psychological flexibility at this time point. Higher medical complexity and child deficits may become more salient and present more challenges as children age regardless of coping strategies. 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 (Northrup et al. 2013). Second, the sample was not fully representative of all NICU mothers as the trial selected for families with a smoker in the home. 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 (Cox et al. 1987) to be highly correlated however, and the CES-D has been used in other studies of depression postpartum among NICU mothers (Cox et al. 1987; McManus and Poehlmann 2011). 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 may persist or increase with time. Untreated maternal depression can interfere with parenting and result in social, behavioral and cognitive child deficits, and is also associated with a lower likelihood of attending well-child visits, completing immunizations, or using home safety devices (O'hara and McCabe 2013). 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.

Acknowledgements This work was supported by grants awarded by the U.S. National Institutes of Health (National Heart, Lung and Blood Institute (Grant No. NHLBI R01 HL107404); National Institute on Drug Abuse (Grant No. NIDA R34 DA041465).

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval 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.

References

Bonacquisti, A., Cohen, M. J., & Schiller, C. E. (2017). Acceptance and commitment therapy for perinatal mood and anxiety disorders: Development of an inpatient group intervention. *Archives of Women's Mental Health, 20*(5), 645–654.

Bond, F. W., Hayes, S. C., Baer, R. A., Carpenter, K. M., Guenole, N., Orcutt, H. K.,…, Zettle, R. D. (2011). Preliminary psychometric properties of the Acceptance and Action Questionnaire–II: A revised measure of psychological inflexibility and experiential avoidance. *Behavior Therapy, 42*(4), 676–688.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*, 386–396.

Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *The British Journal of Psychiatry, 150*(6), 782–786.

Feldman, R., Granat, A., Pariente, C., Kanety, H., Kuint, J., & Gilboa-Schechtman, E. (2009). Maternal depression and anxiety across the postpartum year and infant social engagement, fear regulation, and stress reactivity. *Journal of the American Academy of Child & Adolescent Psychiatry, 48*(9), 919–927.

Field, T. (2010). Postpartum depression effects on early interactions, parenting, and safety practices: A review. *Infant Behavior and Development, 33*(1), 1–6.

Fledderus, M., Bohlmeijer, E. T., Fox, J.-P., Schreurs, K. M., & Spinhoven, P. (2013). The role of psychological flexibility in a self-help acceptance and commitment therapy intervention for psychological distress in a randomized controlled trial. *Behaviour Research and Therapy, 51*(3), 142–151.

Goodman, S. H., Rouse, M. H., Connell, A. M., Broth, M. R., Hall, C. M., & Heyward, D. (2011). Maternal depression and child psychopathology: A meta-analytic review. *Clinical Child and Family Psychology Review, 14*(1), 1–27.

Gray, P. H., Edwards, D. M., O'Callaghan, M. J., Cuskelly, M., & Gibbons, K. (2013). Parenting stress in mothers of very preterm infants—influence of development, temperament and maternal depression. *Early Human Development, 89*(9), 625–629.

Hagan, R., Evans, S. F., & Pope, S. (2004). Preventing postnatal depression in mothers of very preterm infants: A randomised controlled trial. *BJOG: An International Journal of Obstetrics & Gynaecology, 111*(7), 641–647.

Hayes, S. C., Levin, M. E., Plumb-Vilardaga, J., Villatte, J. L., & Pistorello, J. (2013). Acceptance and commitment therapy and contextual behavioral science: Examining the progress of a distinctive model of behavioral and cognitive therapy. *Behavior Therapy, 44*(2), 180–198.

Hayes, S. C., Strosahl, K., Wilson, K. G., Bissett, R. T., Pistorello, J., Toarmino, D., & Polusny, M. A. (2004). Measuring experiential avoidance: A preliminary test of a working model. *The Psychological Record, 54*(4), 553–578.

Huhtala, M., Korja, R., Lehtonen, L., Haataja, L., Lapinleimu, H., Rautava, P., & Group, P. S. (2012). Parental psychological well-being and behavioral outcome of very low birth weight infants at 3 years. *Pediatrics, 129*(4), e937–e944.

Kashdan, T. B., Farmer, A. S., Adams, L. M., Ferssizidis, P., McKnight, P. E., & Nezlek, J. B. (2013). Distinguishing healthy adults from people with social anxiety disorder: Evidence for the value of experiential avoidance and positive emotions in everyday social interactions. *Journal of Abnormal Psychology, 122*(3), 645.

Kashdan, T. B., & Rottenberg, J. (2010). Psychological flexibility as a fundamental aspect of health. *Clinical Psychology Review, 30*(7), 865–878. https://doi.org/10.1016/j.cpr.2010.03.001.

Kuhn, M. (2016). caret: Classification and regression training. R package version 6.0-76. Retrieved from https://CRAN.R-project.org/package=caret.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods, 7*(1), 83–104.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the produce and resampling methods. *Multivariate Behavioral Research, 39*(1), 99–128.

McManus, B. M., & Poehlmann, J. (2011). Maternal depression and perceived social support as predictors of cognitive function trajectories during the first 3 years of life for preterm infants in Wisconsin. *Child: Care, Health, and Development*. https://doi.org/10.1111/j.1365-2214.2011.01253.x.

Miles, M. S., & Holditch-Davis, D. (2003). Enhancing nursing research with children and families using a developmental science perspective. *Annual Review of Nursing Research, 21*(1), 1–20.

Miles, M. S., Holditch-Davis, D., Scwartz, T. A., & Scher, M. (2007). Depressive symptoms in mothers of prematurely born infants. *Journal of Developmental & Behavioral Pediatrics*. https://doi.org/10.1097/01.DBP.0000257517.52459.7a.

Miller, W. R., & Rollnick, S. (2002). *Motivational interviewing: Preparing people for change* (2nd ed.). New York: Guilford Press.

Muthén, L. K., & Muthén, B. O. (1988–2012). *Mplus User's Guide* (7 ed.). Los Angeles: Muthén & Muthén.

Northrup, T., Evans, P. W., & Stotts, A. L. (2013). Depression among mothers of high-risk infants in a neonatal intensive care unit. *MCN: The American Journal of Maternal/Child Nursing, 38*(2), 89–94.

O'hara, M. W., & McCabe, J. E. (2013). Postpartum depression: Current status and future directions. *Annual Review of Clinical Psychology, 9*, 379–407.

Poehlmann, J., Hane, A., Burnson, C., Maleck, S., Hamburger, E., & Shah, P. E. (2012). Preterm infants who are prone to distress: Differential effects of parenting on 36-month behavioral and cognitive outcomes. *Journal of Child Psychology and Psychiatry, 53*(10), 1018–1025.

R Core Team. (2016). A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from https://www.R-project.org.

Radloff, L. S. (1977). The CES-D Scale: a self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*, 385–401.

Rollnick, S., Miller, W. R., & Butler, C. C. (2008). *Motivational interviewing in health care*. New York: The Guilford Press.

Spinhoven, P., Drost, J., de Rooij, M., van Hemert, A. M., & Penninx, B. W. (2016). Is experiential avoidance a mediating, moderating, independent, overlapping, or proxy risk factor in the onset, relapse and maintenance of depressive disorders? *Cognitive Therapy and Research, 40*(2), 150–163.

Stotts, A. L., Green, C., Masuda, A., Grabowski, J., Wilson, K., Northrup, T. F.,…, Schmitz, J. M. (2012). A Stage I pilot study of acceptance and commitment therapy for methadone detoxification. *Drug and Alcohol Dependence, 125*, 215–222. https://doi.org/10.1016/j.drugalcdep.2012.02.015.

Stotts, A. L., & Northrup, T. F. (2015). The promise of third-wave behavioral therapies in the treatment of substance use disorders. *Current Opinion in Psychology, 2*, 75–81.

Stotts, A. L., Northrup, T. F., Schmitz, J. M., Green, C., Tyson, J., Velasquez, M. M.,…, Hovell, M. F. (2013). Baby's Breath II protocol development and design: A secondhand smoke exposure prevention program targeting infants discharged from a neonatal intensive care unit. *Contemporary Clinical Trials, 35*(1), 97–105. https://doi.org/10.1016/j.cct.2013.02.012.

Thompson, B. L., Luoma, J. B., & LeJeune, J. T. (2013). Using acceptance and commitment therapy to guide exposure-based interventions for posttraumatic stress disorder. *Journal of Contemporary Psychotherapy, 43*(3), 133–140.

Vasa, R., Eldeirawi, K., Kuriakose, V. G., Nair, J., Newsom, C., & Bates, J. (2014). Postpartum depression in mothers of infants in neonatal intensive care unit: Risk factors and management strategies. *American Journal of Perinatology, 31*(05), 425–434.

Vigod, S. N., Villegas, L., Dennis, C. L., & Ross, L. E. (2010). Prevalence and risk factors for postpartum depression among women with preterm and low-birth-weight infants: A systematic review. *BJOG, 117*(5), 540–550. https://doi.org/10.1111/j.1471-0528.2009.02493.x.

Yuan, K. H., & Bentler, P. M. (2000). Three likelihood-based methods for mean and covariance structure analysis with nonnormal missing data. *Sociological Methodology, 30*(1), 165–200.