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Self-Reported Parenting Stress and Cortisol Awakening Response Following Mindfulness-Based Stress Reduction Intervention for Parents of Children With Developmental Delays: A Pilot Study

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Abstract

Background: Many parents of children with developmental delays (DDs) experience high levels of parental stress, and young children with DDs are likely to exhibit clinical levels of behavioral problems. The reciprocal relationship between the two issues makes these families vulnerable to stress-related health risks. To address this, the current study aims to investigate the effectiveness of mindfulness-based stress reduction (MBSR) at reducing parent stress, as measured by both psychological self-report and a physiological biomarker. **Method:** A pretest–posttest design with a 6-month follow-up assessment was used to establish effectiveness with analyses of within-subject effects. Parents ($N = 47$) of children (2.5–5 years of age) with DDs participated in a standard 8-week MBSR intervention. Measures included the Parenting Daily Hassles, a self-report measure of perceived frequency and intensity of parenting stress, and salivary samples for measurement of the cortisol awakening response (CAR), a biological marker of stress response. **Results:** Both self-reported parenting stress and CAR decreased following MBSR for parents of children with DDs. The greatest difference in means over time was between baseline and follow-up, where changes in effect size were even stronger for biological markers than for self-report measures. **Conclusion:** The MBSR intervention reduced both perceived and physiologic stress. Health-care professionals caring for these families might consider encouraging parents to participate in MBSR as both treatment and prevention of parenting stress.

Keywords

salivary cortisol, cortisol awakening response, biomarker, mindfulness-based stress reduction (MBSR), parenting stress, health risk

Parents of children with developmental delays (DDs) experience higher levels of self-reported stress compared to parents of neurotypically developing children (Dabrowska & Pisula, 2010; Gupta, 2007; Neece, Green, & Baker, 2012), and children with DDs often exhibit significantly higher levels of behavior problems than their neurotypically developing peers (Emerson & Einfeld, 2010). The reciprocal relationship between the parental stress and the behavioral issues makes these families vulnerable to stress-related health risks. Roughly one- to two thirds of parents of children with DDs experience clinical levels of parental stress (Davis & Carter, 2008). Parenting stress has been associated with greater parental depression (Hastings & Beck, 2004), greater marital conflict (Kersh, Hedvat, Warfield, Hauser-Cram, & Warfield, 2006), and poorer parental physical health (Eisenhower, Baker, & Blacher, 2009). These studies provide a strong empirical basis for identifying families of children with DDs as a population at risk of poor outcomes and prime candidates for therapeutic intervention.

Mindfulness-based stress reduction (MBSR) is an 8-week, manualized training program that was developed by Jon Kabat-Zinn (1990) at the University of Massachusetts in 1979 to reduce stress and treat chronic pain through a series of standardized meditation practices. Studies have demonstrated that

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MBSR is not only feasible for parents of children with DDs (Roberts & Neece, 2015) but also beneficial across multiple outcome measures. Parents of children with DDs who complete the MBSR training report significantly less stress (Bazzano et al., 2015; Dykens, Fisher, Taylor, Lambert, & Miodrag, 2014; Neece, 2014), greater practice and experience of mindfulness (Bazzano et al., 2015; Singh et al., 2007, van der Oord, Bögels, & Peijnenburg, 2012), increased parenting and life satisfaction (Dykens et al., 2014; Neece, 2014; Singh et al., 2007), greater self-compassion and sense of well-being (Bazzano et al., 2015; Dykens et al., 2014), more social interactions with their children (Singh et al., 2007), better sleep (Dykens et al., 2014), lower levels of depression (Dykens et al., 2014; Neece 2014), lower levels of anxiety (Dykens et al. 2014), and lower parental distress (Chan & Neece, 2018; Neece, 2014). Thus, while research in this area is still developing, initial self-report findings are promising regarding the effects of MBSR interventions on reducing the day-to-day levels of parenting stress that parents of children with DDs often experience.

Stress, however, induces both psychological and physiological change. Thus, to better understand the impact of stress on an individual, it is important to measure both types of changes in specific groups. Indeed, studies within the MBSR literature highlight the importance of having an objective biomarker to confirm self-reported stress reductions (Matousek, Dobkin, & Preussner, 2010; Matousek, Preussner, & Dobkin, 2011). There are multiple accurate and validated self-report stress scales, which are useful for measuring perceived changes in an individual's psychological stress levels (Abidin, 1995; Cohen, Kamarck, & Mermelstein, 1994; Crnic & Greenburg, 1990); however, these scales are limited by their reliance on recall (Schlotz, 2018). To measure physiological changes in stress, researchers commonly use vital signs such as blood pressure, pulse, respiration, and hormonal biomarkers such as cortisol (Taylor et al., 2010). These physiological measures and biomarkers offer an objective methodology to complement self-reported stress findings among a population like parents of children with DDs as such measures are not affected by the subjectivity of psychological self-report measures and recall bias. Because both physiological and psychological stress are potentially detrimental to health (Clayton & McCance, 2014; Matousek et al., 2011), accurate measurement of both types of stress indicators is necessary to evaluate intervention outcomes.

Cortisol, the primary glucocorticoid in the body, is responsible for activating a variety of protective functions in response to stress (Clayton & McCance, 2014) and is a reliable indicator of the human body's physiological response to stress (McEwen, 1998). The cortisol awakening response (CAR), part of the diurnal cortisol cycle, is the natural increase in free cortisol that occurs during the first hour after waking from sleep (Stalder et al., 2016) and positively correlates with levels of general life stress (Duan et al., 2013). Though its function is to enhance survival, research has identified prolonged dysregulation in the CAR as a trigger or exacerbating factor for many health issues including autoimmune disorders, sleep deprivation, increased blood pressure, increased appetite, cognitive impairment, and a more extreme diurnal cortisol cycle (Clayton & McCance, 2014; Matousek et al., 2011; Stalder et al., 2016). In more chronic situations, such as posttraumatic stress, the CAR flattens or reduces as chronic stress symptoms increase and the body's physiological stress response is suppressed (Chida & Steptoe, 2009). Calculating the area under the curve (AUC) reflecting the CAR offers a noninvasive technique for obtaining a quick, reliable measurement of the CAR that accounts for baseline cortisol levels (Chida & Steptow, 2009; Stalder et al., 2016), has within-person stability, and provides reliable detection of between-person difference in cortisol levels (Ice & James, 2006).

The use of cortisol as a biomarker for the measurement of stress thus has the potential to confirm self-reported MBSR outcomes and provide a simple objective measure for stress reduction interventions for parents of children with DDs (Dykens & Lambert, 2013; Seltzer et al., 2010). Findings, however, have been inconsistent. While a number of studies have found that improvements in cortisol regulation are associated with participation in a mindfulness intervention (Brand, Holsboer-Trachsler, Naranjo, & Schmidt, 2012; Galantino, Baime, Maguire, Szapary, & Farrar, 2005; Kang & Oh, 2012; Lengacher et al., 2012), others have failed to find similarly significant results (Klatt, Buckworth, & Malarkey, 2009; Lipschitz, Kuhn, Kinney, Donaldson, & Nakamura, 2013; Matchim, Armer, & Stewart, 2011). Researchers have looked into the impact of mindfulness specifically using the CAR (Brand et al., 2012; Christopher et al., 2015; Daubenmier et al., 2011; Matousek et al., 2010; Matousek et al., 2011), diurnal cortisol slope (Carlson et al., 2013; Daubenmier et al., 2011; Gex-Fabry et al., 2012; Malarkey, Jarjoura, & Klatt, 2013), and cross-sectional cortisol levels (Jacobs et al., 2013; Lengacher et al., 2012). However, with regard to parenting stress, findings on the impact of mindfulness interventions on cortisol levels have been inconsistent and sometimes contradictory (Dykens & Lambert 2013; Seltzer et al., 2010). This inconsistency may be partially attributable to variability in intervention standards. Standard MBSR is manualized for consistent delivery, whereas other mindfulness-based interventions are often modified versions of MBSR or other manualized mindfulness interventions that may include lower dose (e.g., less time each week and/or fewer weeks), customization for a specific population, adaptations in delivery or application, or poorer treatment instruction and fidelity (Beddoe, Yang, Kennedy, Weiss, & Lee, 2009).

A review on the impact of mindfulness-based interventions on salivary cortisol by O'Leary, O'Neill, and Dockray (2016) indicates that further research in this area is necessary due to (1) the inconsistent and sometimes contradictory findings, (2) the increasing incorporation of mindfulness interventions into empirical studies, and (3) the intersection of two previously independent fields of research (i.e., mindfulness and salivary cortisol research). Furthermore, recommendations for additional research include the use of robust methodological standards (i.e., control groups and randomized study design),

sampling protocols (i.e., when and how saliva is collected), and intervention selection (i.e., quality and type of mindfulness-based intervention). Per O'Leary et al.'s (2016) call for more rigorous methodological standards and treatment fidelity in mindfulness-based cortisol research, they suggest utilizing the empirically supported, standardized MBSR intervention treatment.

To address this need, in the current study we aimed to investigate the effectiveness of standard MBSR at reducing day-to-day parenting stress for parents of children with DDs, as measured by both psychological self-report and physiological biomarker readings. Specifically, we aimed to satisfy O'Leary and colleagues' (2016) recommendations for greater methodological standards through the incorporation of both subjective self-report and objective biomarker readings as well as the recommendation for greater treatment fidelity through the use of the empirically supported, manualized MBSR intervention in order to better address the larger question regarding the relationship of mindfulness and cortisol. We hypothesized that there would be a reduction in both parent self-reported stress and the overall CAR postintervention, as larger CAR is associated with greater general life stress, and the stress-reducing impact of the MBSR intervention would be expected to reduce both perceived and physiologic stress.

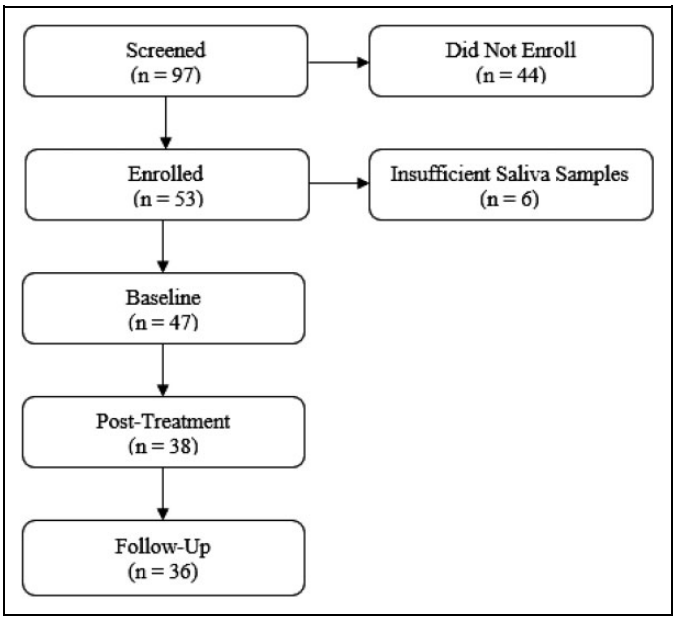

Figure 1. Participant flow diagram. Analysis was via repeated-measures analysis of variance using the mixed-model procedure with least squares means for missing data; therefore, all participants who provided an initial cortisol sample ($N = 47$) were included in the final analyses.

Method

Design

We utilized a pretest–posttest design with a 6-month follow-up assessment. This design is suitable for establishing efficacy and effectiveness as it allows analyses of within-subject effects (Kinser & Robins, 2013).

Participants

We drew data for the current study from a broader study, the Mindful Awareness for Parenting Stress (MAPS) Project, which investigated the impact of MBSR on parental stress and the subsequent effect of parental stress reduction on child behavior problems. The broader study included parents of children aged 2.5–5 years with a DD. Participants were primarily recruited through the Inland Regional Center, a local agency that contracts services for children with DD. The Inland Regional Center also determined whether the child had a developmental delay. Children were considered to have a DD if they were deemed to have significant limitations in one or more of the following areas: self-care, language, learning, social/emotional or motor development, self-direction, or future capacity for independent living and economic self-sufficiency. Staff at the Inland Regional Center selected families who met the inclusion criteria from their databases, and the families were sent a letter and brochure informing them of the study. Information about the study was also posted on a website that allowed interested parents to submit their information.

Criteria for inclusion in the study were (1) having a child aged 2.5–5 years, (2) child was determined by the Inland Regional Center (or by an independent assessment) to have a DD disability, (3) parent reported more than 10 child behavior problems (the recommended cutoff score for screening children for treatment of conduct problems) on the Eyberg Child Behavior Inventory (Robinson, Eyberg, & Ross, 1980), (4) the parent was not receiving any form of psychological or behavioral treatment at the time of referral (e.g., counseling, parent training, parent support group), (5) parent agreed to participate in the intervention, and (6) parent spoke and understood English or Spanish. Exclusion criteria included having a child with debilitating physical disabilities or severe intellectual impairments that prevented the child from participating in a parent–child interaction task (i.e., child- and parent-led free-play tasks and cleanup task) that was a part of the larger laboratory assessment protocol (e.g., child is not ambulatory).

In order to be included, parents also needed to complete all initial measures and attend the initial assessment before the beginning of the first MBSR session. A total of 97 families were screened for the larger study, 80 were determined to be eligible, 79 enrolled in the program, and of the 64 who completed the intervention, 53 voluntarily chose to participate in salivary cortisol sample collections for the current study; however, saliva samples from six participants were insufficient (too little volume), leaving a final sample of 47 participants for the present study (see Figure 1), yielding a retention rate of 88.6%. The 11 participants from the larger intervention study who chose not to participate in the current study noted reasons such as time and effort involved in collecting saliva samples. There were no demographic differences between participants who completed the intervention and those who dropped out of the

Table 1. Demographic Characteristics of Parents Participating in Cortisol Collection Study.

Characteristic	*n* (%)
Mother participant	43 (91.5)
Father participant	4 (8.5)
Marital status	
Married	36 (76.6)
Separated/divorced	6 (12.8)
Never married	5 (10.6)
Education	
High school or less	15 (31.9)
>High school	32 (68.1)
Income	
<$50,000/year	23 (48.9)
>$50,000/year	24 (51.1)
Age in years	*M* (*SD*)
Mother	38.77 (6.7)
Father	40.0 (8.0)
Child with DD	4.3 (1.0)

Note. $N = 47$. DD = developmental disability.

study. Table 1 depicts the demographic characteristics of the current sample. The majority of the parents participating were mothers (91.5%), married (76.6%), had more than a high school education (68.1%), and had a family income of less than $50,000/year (48.9%). Our sample was less educated and poorer than the broader population of San Bernardino county, where 79.2% of those over age 25 years are high school graduates or higher, and 27.3% report an income below the poverty line (U.S. Census Bureau, 2010). At baseline, the mean Perceived Stress Scale score was 23.74 ($SD = 4.53$), considerably higher than the national average of 15.21 ($SD = 7.28$; Cohen & Janicki-Deverts, 2012).

Procedures

Institutional review board approval was obtained for the protection of human subjects prior to commencing this intervention study. Interested parents contacted the MAPS Project by phone or postcard or by submitting their information on the project website. Study personnel then conducted a phone screening to determine the eligibility of the parent(s) and, if the parent(s) met inclusion criteria, to schedule an intake laboratory assessment. Prior to the initial assessment, study personnel mailed parents a packet of questionnaires to complete before they arrived for the lab assessment. The initial assessment took place in the MAPS lab. At this assessment, study staff reviewed the written informed-consent form with parents and asked them to sign (Neece, 2014).

The MBSR intervention followed the manual outlined by Dr. Jon Kabat-Zinn at the University of Massachusetts Medical Center (Kabat-Zinn, Massion, Kristeller, & Peterson, 1992). This intervention consisted of three main components: (1) didactic material covering the concept of mindfulness, the psychology and physiology of stress and anxiety, and ways in which mindfulness can be implemented in everyday life to facilitate more adaptive responses to challenges and distress; (2) mindfulness exercises during the group meetings and as homework between sessions; and (3) discussion and sharing in pairs and in the larger group. The intervention included eight weekly 2-hr sessions, a daylong 6-hr meditation retreat after the sixth class, and daily home practice based on audio CDs with instruction. Formal mindfulness exercises included the body scan, sitting meditation with awareness of breath, and mindful movement. The instructor for the group had over 20 years' experience practicing mindfulness and teaching MBSR, had completed the Advanced MBSR Teacher Training at the University of Massachusetts Medical Center, and had received supervision with senior MBSR teachers through the Center for Mindfulness at the University of Massachusetts Medical Center. Simultaneous professional translation using headsets enabled monolingual Spanish-speaking parents to participate. The Spanish translator had over 20 years' experience of professional translation in a variety of settings, including special education and prior MBSR experience. The intervention had strong adherence to the manual, as measured by ratings of components delivered, treatment dose, quality, and context (Roberts & Neece, 2015). After completing the MBSR program, parents participated in a posttreatment assessment as well as a 6-month follow-up assessment.

Measures

Demographic data. Study personnel collected demographic data during an interview with the participating parent. Data included parent and child age and ethnicity, marital status, family income, and parent education levels.

Parenting daily hassles (PDH). The PDH Questionnaire is a 44-item measure that assesses perceived frequency and intensity of parenting stress and has an internal consistency that ranges from .96 to .98 (Crnic & Greenburg, 1990). Items ask about the frequency and intensity of general life hassles (e.g., misplacing or losing things; planning, shopping, and meal preparation; and unexpected company) and hassles more specific to child and family events (e.g., continually cleaning up messes of toys or food, sibling arguments, kids interrupting adult conversations). Subscales derived from the PDH include General Life Hassles—Frequency, General Life Hassles—Intensity, Child and Family Hassles—Frequency (CFHF), and Child and Family Hassles—Intensity (CFHI). We chose to use the CFHF and CFHI subscales for the current study because they are closely aligned to the interplay between parenting stress and child behavior. Researchers have used the PDH widely with samples of parents of young children with and without DD (Belsky, Crnic, & Woodworth, 1995; Gerstein, Crnic, Blacher, & Baker, 2009; Smith, 2011), and it was reliable for the current study sample ($\alpha = .97$ at initial assessment).

Salivary cortisol. We collected salivary cortisol samples by passive drool method (Hall et al., 2011) at pre-, post-, and 6-month

Table 2. Repeated-Measures Analyses for Clinical and Self-Reported Variables.

Variable	Baseline *M* [CI]	Posttest *M* [CI]	6-Month Follow-Up *M* [CI]	*F* (*df*)	*p*[a]
Child and family hassles intensity	52.0 [47.4, 56.6]	49.7 [45.0, 54.3]	47.6 [42.2, 52.9]	2.3 (2, 56)	.11
Child and family hassles frequency	62.2 [58.3, 66.0]	63.5 [59.6, 67.4]	56.4 [51.5, 61.2]	4.8 (2, 56)	.01
Cortisol AUC ground	39.5 [34.7, 44.4]	38.2 [31.4, 45.0]	28.6 [24.2, 32.9]	12.9 (2, 56)	<.001

Note. $N = 47$. AUC = area under the curve.
[a]Tukey-adjusted post hoc test.

follow-up. At each time point, participants collected four vials of saliva over the course of an hour: (1) upon awakening, (2) 30 min after awakening, (3) 45 min after awakening, and (4) 60 min after awakening. We reminded participants of saliva collection days in person and/or by phone the evening before, verified collection by phone the next morning, and confirmed arrangements for sample pickup within the day. The nurse researcher (L.R.R.) developed the saliva sample protocol to ensure standardization. The protocol instructed participants to avoid drinking alcohol the night before collection and to avoid eating or drinking anything but water and brushing/flossing teeth within the hour before collecting samples (Inder, Dimeski, & Russell, 2012). Sugar-free gum was allowed if needed to stimulate salivary flow (Kudielka, Gierens, Hellhammer, Wüst, & Schlotz, 2012). Participants completed and returned a checklist with their samples indicating any deviance from protocol or additional factors such as medication, which could affect cortisol levels or analysis. Study research assistants picked up samples and mailed them to BioHealth Laboratory according to their lab protocol.

Analysis

Analysis included PDH (self-report) and salivary cortisol measured at baseline, immediately following MBSR intervention (posttest), and at 6-month follow-up, to detect within-subjects changes across these three time points. The 47 participants with adequate salivary samples were included in analyses. We examined the distributions of the PDH and AUC ground (AUCg) for normality and the presence of outliers at each time point. AUC is an estimation of total cortisol output that can be computed in several ways. We chose AUCg, as it estimates the total cortisol secreted within the first hour of waking with respect to baseline, within-person stability, and reliable detection of between-person difference in cortisol levels and is linked to affective responses (Admon et al., 2017; Ice & James, 2006; Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). We considered data points that were more than three standard deviations above or below the mean of a variable to be outliers. We analyzed demographic and quantitative data using SPSS version 24, including descriptive statistics, and repeated-measures analysis of variance (ANOVA) using the mixed-model procedure to explore longitudinal outcomes.

Results

Protocol Adherence

Participant adherence to the protocol was very high across all assessment time points (baseline, immediate postintervention, and 6-month follow-up). Upon awakening, only water was permitted during the 1-hr saliva sample collection period, and 99.4% of our participants complied with instructions to avoid any other food/beverage intake. All participants recorded physical activity, with most (92.5%) self-reporting sitting or light activity, 5% noting moderate activity, and 2.5% reporting strenuous activity. With the baseline sample, two participants noted medication use: One recorded using levothyroxine at the time of the second of four samples collected at the baseline measurement, but this participant did not complete posttreatment and follow-up salivary sample collections; the other participant noted a dose of Norco during the first saliva sample collection of the baseline measure but no subsequent medications with any of the samples of any measurement time points.

Repeated Measures

To investigate the effectiveness of the standard MBSR intervention at reducing parent stress, we analyzed within-subject changes over time for PDH (psychological self-report) and cortisol AUCg (physiological biomarker) with repeated-measures ANOVA using the mixed-model procedure with least squares means for missing data. Therefore, we included all participants who provided an adequate saliva sample ($N = 47$) in the final analyses. The frequency of occurrence of daily child and family hassles was significantly reduced ($p = .012$) over time, but though the intensity of the hassles trended in the desired direction, it did not reach statistical significance ($p = .112$). AUCg was significantly reduced over time ($p < .001$). See Table 2 for details of the repeated-measures analyses. In addition, the magnitudes of the differences in means over time are illustrated in Table 3, with the highest mean difference of approximately 11 between baseline and follow-up.

Discussion

Parents' perceived frequency of child and family hassles was significantly reduced at the 6-month follow-up after MBSR intervention. There was also a significant reduction in salivary cortisol measured as AUCg at the 6-month follow-up, possibly

Table 3. Mean Differences in Clinical and Self-Reported Variables by Time Points.

Characteristic	Baseline vs. Posttest[a] Mean Difference [95% CI]	Baseline vs. 6-Month Follow-Up[a] Mean Difference [95% CI]	Posttest vs. 6-Month Follow-Up[a] Mean Difference [95% CI]
Child and family hassles intensity	2.3 [−1.7, 6.3]	4.4 [−0.8, 9.6]	2.1 [−2.9, 7.2]
Child and family hassles frequency	−1.3 [−5.8, 3.1]	5.8 [0.10, 11.5]	7.1 [1.5, 12.8]
Cortisol AUC ground	1.3 [−5.4, 8.1]	11.0 [5.6, 16.4]	9.7 [2.8, 16.6]

Note. AUC = area under the curve.
[a]Tukey-adjusted post hoc test

indicating less reactivity to stress (Di Corrado, Agostini, Bonifazi, & Perciavalle, 2014), which is one of the central tenants of MBSR. Our results indicate that MBSR is effective for reducing the frequency of daily parenting hassles as well as morning levels of cortisol, which further underscores the impact of MBSR in reducing both psychological and physiological stress. Of note, as seen in Table 3, effect sizes for changes in the biological marker (cortisol AUCg) were even stronger than they were for the self-report variable. Self-report is more susceptible to mood changes (Belsky et al., 1995); therefore, having a biological marker change in the same direction as the self-reported change in stress is confirmatory.

Results regarding the changes in parents' perceived daily hassles indicate that parents are experiencing fewer day-to-day stressors after receiving the MBSR intervention, though the intensity of these hassles did not significantly change. It may be that, rather than objectively reducing the number and intensity of external stressors in their day-to-day life, MBSR training merely changed the ways that parents perceived them. The creator of MBSR defines mindfulness as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2003, p. 145). It is possible that the nonjudgmental, present-moment awareness taught during the MBSR intervention led parents to experientially perceive fewer moment-to-moment stressors through selectively attending to different aspects of their day-to-day life, though the same profile of stressors may exist in the external environment. There is ample research to suggest that external demands and perception of stress are significant factors to consider regarding parenting stress (Gerstein et al., 2009), and the present findings appear to support such claims. This notion is further supported by prior findings that implicate MBSR training in the reduction of parental distress (Chan & Neece, 2018; Neece, 2014), and it may be that day-to-day stressors, regardless of their number or intensity, are less associated with a stressful parenting experience after parents receive MBSR training. Such findings are promising for families of children with DD, as MBSR training may be an effective means of managing the additional day-to-day stressors that come with raising a child with DD.

Cortisol levels were collected prior to beginning the intervention, immediately following the intervention, and at 6 months after completion of the intervention. While cortisol levels decreased slightly at the end of the intervention, they were significantly reduced at follow-up. This pattern possibly reflects ongoing practice of mindfulness skills learned during the MBSR intervention as well as contemplation of new knowledge and application of mindfulness practices in everyday life, which in turn lowers the daily physiologic stress response. This proposition is consistent with findings in the literature suggesting a dose–response relationship between mindfulness practice and reductions in stress measured by self-report as well as physiological measures (Baer, Carmody, & Hunsinger, 2012; Khoury, Sharma, Rush, & Fournier, 2015; Sharma & Rush, 2014; Snippe, Dziak, Lanza, Nyklicek, & Wichers, 2017). Future longitudinal studies with a control group are needed to add rigor and examine longer term health outcomes with reduced physiological and perceived parenting stress. Additionally, longitudinal research should determine whether longer term changes in cortisol are associated with continued practice of mindfulness.

In the present study, we examined reductions in physiological and self-reported psychological stress among parents of young children with DD within an MBSR intervention (Cachia, Anderson, & Moore, 2016; Ruiz-Robledillo, Sariñana-González, Pérez-Blasco, González-Bono, & Moya-Albiol, 2015). Strengths of the study include the use of the standard, manualized MBSR protocol, which increases treatment fidelity; multiple measures of stress, which helps mitigate self-report bias; high compliance with the saliva sampling protocol; and measurement of the CAR using four time points for each assessment for accurate assessment of AUC, which has good within-person stability and reliable identification of between-person difference (Ice & James, 2006). Nevertheless, we must note several limitations. As with most pilot studies, we had a small sample size, which limits analyses and generalizability. The findings warrant replication using more rigorous cortisol sampling techniques involving multiple consecutive days of testing. Additionally, as this was a community-based study, we did not monitor participants for compliance with the saliva collection protocol, relying on self-report. While this study design allows findings to add to our understanding of stress experienced by participants in their everyday life, noncompliance with the collection protocol could have biased results (Schlotz, 2018). Alternate explanations for the observation of only a slight reduction of cortisol level at posttest could involve confounders such as parenting stress involved with getting children ready to return to school after the summer break; however, seasonal variation of cortisol levels is

well-documented, which supports our findings. Future studies that do not cross seasons would allow for analysis without this potentially confounding effect.

Conclusion

In the present study, we explored the effects of an MBSR intervention on self-reported stress and a cortisol-response biomarker among parents of children with DD, a population with high levels of parenting stress. We believe the findings of reduced self-reported parenting stress and reduced cortisol AUCg indicate the positive psychological and physiological impact of the MBSR intervention on parenting stress and represent a valuable contribution to the literature.

Given the prevalence of DD and concomitant parenting stress, nurses are likely to encounter related health issues in their daily practice. The reduction in parenting stress through MBSR is promising for highly stressed parents of children with DD, decreasing the likelihood of child behavior complications as well as myriad parental comorbidities and poor mental health sequelae. Nurses and other health-care professionals caring for these families should consider including MBSR as both treatment and prevention recommendations to help parents as they deal with day-to-day parenting stress.

Authors' Note

The authors alone are responsible for the content and writing of the paper.

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Authors' Contribution

Lisa R. Roberts contributed to conception and design, acquisition, analysis, and interpretation; drafted the manuscript; critically revised the manuscript; and gave final approval; and agrees to be accountable for all aspects of work ensuring integrity and accuracy. G. Griffin Boostrom contributed to acquisition; drafted the manuscript; critically revised the manuscript; gave final approval; and agrees to be accountable for all aspects of work ensuring integrity and accuracy. Salem O. Dehom contributed to analysis and interpretation, critically revised the manuscript, gave final approval, and agrees to be accountable for all aspects of work ensuring integrity and accuracy. Cameron L. Neece contributed to conception and design, acquisition, analysis, and interpretation; critically revised the manuscript; gave final approval; and agrees to be accountable for all aspects of work ensuring integrity and accuracy.

Declaration of Conflicting Interests

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