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A Mindfulness-Based Intervention for Urban, Low-Income, Pregnant African American Women

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A Mindfulness-Based Intervention for Urban, Low-Income, Pregnant African American Women

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An Abstract of
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James T. Laney School of Graduate Studies of Emory University
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Abstract

Pregnancy is generally viewed as a positive experience, but research has shown that prenatal maternal stress occurs in nearly half of all pregnancies. Physical, psychological, and financial challenges are often experienced and are compounded for African American women from urban, low-income environments. The current study focused on a mindfulness-based intervention for a group of urban, low-income, pregnant African American women with the purpose of improving maternal well-being and obstetric outcomes. This randomized controlled pilot study involved a 2 X 4 mixed model design, comparing treatment as usual (TxAU) with the Mindful Motherhood intervention on several outcomes at pre-intervention, post-intervention, one month post-intervention, and one month postpartum. A total of 65 adult participants (31 TxAU, 34 Mindful Motherhood) met the inclusion criteria and participated in the study. Due to significant attrition in both assessments and intervention participation, dose-effect analyses were employed to test treatment effects on outcome variables with repeated measures ANOVA and multiple linear regressions. Preliminary findings support the efficacy of the Mindful Motherhood training in improving levels of mindfulness, reducing reactive cortisol response, and reducing pregnancy-related stress at post-intervention; improving pregnancy-related positive experience and reducing depressive symptoms at one month follow-up; and improving sustained attention at one month postpartum. However, none of these effects appeared to have lasting impact on the participants, and treatment did not appear to impact stressful life events, perceived stress, baseline salivary cortisol levels, coping strategies, or obstetric outcomes. This pilot study is believed to be the first empirical research on a mindfulness-based intervention with a group of urban, low-income, pregnant African American women. These preliminary results support the efficacy of mindfulness-based interventions with this minority population and encourage efforts to optimize recruitment and retention of underprivileged participants to decrease health care disparities.

Key words: African American women, pregnancy, mindfulness, attention, stress, depressive symptoms, coping, birth outcomes

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A Mindfulness-Based Intervention for Urban, Low-Income, Pregnant African American Women

Introduction

Pregnancy is often perceived as a positive experience. In the meantime, it is associated with considerable levels of maternal stress and major changes in psychological, physiological, and anatomical functioning (Dunkel Schetter, 2011; Forsyth, Skouteris, Wertheim, Paxton, & Milgrom, 2011; Numan & Woodside, 2010; Voegtline et al., 2013). Several studies have shown that maternal stress is associated with these changes and is common among pregnant women, occurring in nearly half of all pregnancies (Dunkel Schetter & Tanner, 2012; Faisal-Cury & Rossi Menezes, 2007; Rubertsson, Wickberg, Gustavsson, & Radestad, 2005). Symptoms such as low energy, fatigue, sleep disturbances, and concentration problems, which resemble typical symptoms of depression, appear frequently during pregnancy (W. A. Hall et al., 2009; Tsai, Lin, Kuo, & Thomas, 2012). In addition to the common stress that is generally experienced by pregnant women, the life of urban, low-income, pregnant African American women is confronted with more chronic stressors, including financial constraints, violence exposure, and discrimination (Bloom, Glass, Curry, Hernandez, & Houck, 2013; Leis, Mendelson, Perry, & Tandon, 2011; Seng, Kohn-Wood, McPherson, & Sperlich, 2011).

In the past decade, mindfulness-based interventions have gained increasing support as they have been found to be effective in stress reduction. To reduce the disparity of mental health services and outcome from which this population suffers, this current study focused on a mindfulness-based intervention for urban, low-income,

pregnant African American women with the purpose of improving maternal well-being and obstetric outcomes. The following review starts with an examination of the existing literature on prenatal maternal stress and its effect on postpartum adult and newborn outcomes. Second, the rationale for mindfulness-based interventions is presented based on their impact on improving mindfulness, attention, and approach-based coping strategy and on reducing stress, depressive symptoms, and avoidance-based coping strategy. Third, the efficacy of mindfulness-based interventions for prenatal maternal stress is discussed in light of several pilot studies. Fourth, the unique stress that urban, low-income, pregnant African American women experience is explored and mindfulness-based interventions are proposed as appropriate treatment options for this population. Finally, the study hypotheses for this randomized controlled clinical trial are proposed.

Maternal Stress during Pregnancy

One theoretical model that has been widely cited in the maternity literature is the Stress, Appraisal, and Coping Theory developed by Lazarus and Folkman (Chuang et al., 2012; Dunkel Schetter, 2011; Lazarus & Folkman, 1984; Pluess et al., 2012). Lazarus and Folkman (1984) believed that the nature of stress cannot be simply captured by one's environmental stimuli or by one's response but is rather multidimensional. They stated that "psychological stress is a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being (Lazarus & Folkman, 1984, p. 19)." Therefore they proposed a more comprehensive approach, which encompasses several aspects of stress: stimuli (e.g., major life events or daily hassles that may trigger personal responses), personal responses (e.g., emotion or distress in response to stimuli), and personal factors

that may mediate or moderate the effect of environmental conditions (e.g., genetic factors, appraisal, coping strategies).

This framework has widely impacted the maternal stress literature for decades and is still frequently referenced (Chen, Grobman, Gollan, & Borders, 2011; Lobel, 1994; Nast, Bolten, Meinlschmidt, & Hellhammer, 2013). Researchers have investigated the impact of various maternal stress indicators and have studied their effect on maternal and babies' outcomes. Most attention has been focused on stressful life events and subjective stress, including stressful life events, perceived stress, pregnancy-specific stress, and hormonal response (e.g. cortisol level change in response to stress). A broader conceptualization of stress also regards maternal mood as an indicator of stress response (Dunkel Schetter & Tanner, 2012; Lazinski, Shea, & Steiner, 2008).

Stressful Life Events

Among the different types of maternal stress, stressful life events have been extensively studied for their impact on maternal well-being and obstetric outcomes, such as birth weight and gestational weight (Hobel, Goldstein, & Barrett, 2008; Swendsen & Mazure, 2000). Some researchers have examined large-scale, traumatic life events and their impact on pregnancy outcomes (Lederman et al., 2004). Nevertheless, the vast majority of the maternal stress literature has focused on commonly experienced life events (Alder, Fink, Bitzer, Hösli, & Holzgreve, 2007; Ando et al., 2011; Hobel et al., 2008; Pinheiro et al., 2013; Robinson et al., 2011).

Commonly experienced stressful life events, such as the loss of a loved one and unemployment, have been implicated as predictors of major depression (Conway et al., 2012; Risch et al., 2009). For example, a large Swedish prospective study on

approximately 2500 women showed that stressful life events were associated with depressive symptoms during pregnancy, two months after delivery, and one year after delivery (Rubertsson et al., 2005). These findings are consistent with an earlier review of similar studies over the past two decades (Swendsen & Mazure, 2000). Likewise, a later meta-analysis also supports that prenatal stressful life events served as moderate to strong predictors of postpartum depression (Robertson, Grace, Wallington, & Stewart, 2004). In sum, postpartum depression is a widely researched maternal outcome, and prenatal stressful life events have been indicated by multiple studies as a risk factor for maternal postpartum depression.

Researchers have also examined the impact of maternal stressful life events on obstetric outcomes (M. P. Austin & Leader, 2000; Zhu, Tao, Hao, Sun, & Jiang, 2010). For example, in a large study of nearly 6000 women, Hedegaard and colleagues (1996) reported that stressful life event predicted premature birth, after controlling for maternal age, parity, past obstetric history, marital status, drinking, and smoking. In another large study that recruited nearly 2500 women, the authors also documented an association between stressful life events and preterm labor (Nordentoft et al., 1996). Furthermore, in Dole et al.'s (2003) evaluation of approximately 2000 women, stressful life events were also related to preterm birth, with participants in the highest stress group experiencing the highest rates of preterm delivery. A handful of studies also have indicated an association between stressful life events and birth weight (Hobel & Culhane, 2003; Wadhwa, Sandman, Porto, Dunkel-Schetter, & Garite, 1993; Zhu et al., 2010).In general, stressful life events have been more linked to gestational age than to birth weight.

Perceived Stress

In contrast to major life events, which are regarded as acute incidents, perceived stress and daily stressors are understood as indicators of chronic stress. Because maternal chronic stress has been widely suggested as having an adverse impact on babies' health, prenatal maternal perceived stress has been mostly studied for its association with birth outcomes (Keim et al., 2011; Latendresse, 2009). For instance, a rigorous study of 1399 Russian women tested the impact of mothers' substance use, living situation, and perceived stress on the birth weight of newborns, controlling for factors such as maternal education, age, occupation, marital status, and parity (Grjibovski, Bygren, Svartbo, & Magnus, 2004). The results indicate that perceived stress, independent of drinking, smoking, crowdedness of living conditions, and family support, is a predictor of infants' birth weight. In another study with a sample of 78 mother-neonate dyads, perceived stress, associated with corticotrophin-releasing hormone, accounted for up to 27% of the variance in gestational age (Ruiz, Fullerton, Brown, & Schoolfield, 2001). The same research team also found that increases in perceived stress over the course of pregnancy was associated with higher risk for early delivery (Ruiz, Fullerton, Brown, & Dudley, 2002). Similar findings were also reported by Gennaro, Shults, and Garry (2008) who studied 57 African American women. They discovered that the participants with early delivery had experienced higher perceived stress during pregnancy than their counterparts with full term delivery.

However, another research group, which also recruited African American participants, failed to identify an association between perceived stress and gestational age, or between perceived stress and adjusted birth weight, after controlling for potential

confounding variables such as maternal age and weight gain (Dominguez, Schetter, Mancuso, Rini, & Hobel, 2005). Instead, they found stressful life events to be strongly related to the duration of pregnancy. Similarly, a recent study on 1602 Canadian women also failed to support a connection between perceived stress and birth outcomes, whereas body mass index, smoking, obstetric history, and maternal health were identified as risk factors for adverse pregnancy outcomes (St-Laurent, De Wals, Moutquin, Niyonsenga, & Noiseux M, 2008). Given the inconclusiveness in current maternal stress literature, meta-analyses of existing studies, replication of similar studies, and identification of potential confounding factors are desirable steps to take in order to generate a clear picture of these relationships.

Hormonal Response to Maternal Stress

In addition to psychological measures, studies also have incorporated biological markers to assess physiological responses to prenatal maternal stress (e.g., hormones, heart rate, and blood pressure, etc.; Hobel et al., 2008). Particularly, stress hormones associated with activity of the hypothalamic-pituitary-adrenocortical (HPA) axis, such as cortisol, β-endophin, and corticotrophin-releasing hormone, have been widely examined for their roles in pregnancy outcomes (Gangestad, Caldwell Hooper, & Eaton, 2012; Kramer et al., 2013; Yim et al., 2010). Indeed, recent studies suggest that the HPA axis plays a key role in the etiology of adverse birth outcomes (Glover, O'Connor, & O'Donnell, 2010). Some investigators have further proposed that the HPA axis hormones mediate the relationship between maternal stress and birth outcomes (Kramer et al., 2013). This evidence is discussed below.

As the final product of the HPA axis, cortisol is involved in a variety of activities, including cognition, emotion, development, and reproduction (Field & Diego, 2008). In coordination with other stress-regulatory systems, cortisol also plays a crucial role in modulating physiological and behavioral responses to stress. Particularly, it has been hypothesized that increased maternal psychological stress leads to higher levels of maternal stress hormones (Wadhwa et al., 2001). Several studies have suggested that psychological stress is associated with cortisol activity (Kalra, Einarson, Karaskov, Van Uum, & Koren, 2007; Obel et al., 2005; Valladares, Peña, Ellsberg, Persson, & Högberg, 2009). For instance, a study that examined pregnant Nicaraguan women showed that perceived stress, in addition to partner violence and low social economic status, predicted high salivary cortisol levels (Valladares et al., 2009). Furthermore, higher numbers of stressful life events experienced during the second trimester has also been linked to higher maternal cortisol levels (Obel et al., 2005). Maternal emotional stress, including prepartum depression, anxiety, and anger, has also been linked to high maternal cortisol levels (Field & Diego, 2008; Field, Diego, Hernandez-Reif, Gil, & Vera, 2005; Field et al., 2003a). Particularly, anxiety regarding anticipated pregnancy complications was found to increase salivary cortisol levels (Obel et al., 2005). Additionally, two studies have reported negative associations between social support and cortisol levels, further suggesting the influence of psychosocial stress on neuroendocrine activities (Nierop, Wirtz, Bratsikas, Zimmermann, & Ehlert, 2008; Wadhwa, Dunkel-Schetter, Chicz-DeMet, Porto, & Sandman, 1996). Together, these findings support part of the mediating role of the HPA hormones in human stress response (Baron & Kenny, 1986).

However, results from other studies failed to support a positive connection between the HPA hormones and psychological measures during pregnancy (Field et al., 2003b; Harville, Savitz, Dole, Herring, & Thorp, 2009; Mancuso, Schetter, Rini, Roesch, & Hobel, 2004; Pluess, Bolten, Pirke, & Hellhammer, 2010; Wadhwa et al., 1996). For example, a recent investigation with approximately 1600 women conducted during both the second and the third trimesters did not detect any association between various psychological stress measures and biological measures, including levels of cortisol and corticotrophin-releasing hormone (Harville et al., 2009). Similarly, a review article that integrated results from 14 rigorous field studies failed to draw a connection between biological stress markers and psychological stress measures (Hjortskov, Garde, Ørbæk, & Hansen, 2004). Despite positive associations predicted by stress theories, the prevailing evidence has been meager for a link between physiological stress and psychological stress. Accordingly, researchers have proposed various possible explanations to account for the mixed results (Harville et al., 2009; Hjortskov et al., 2004; Kudielka, Hellhammer, & Wust, 2009). One plausible explanation is that the HPA hormonal responses may lag behind psychological responses to stress (Harville et al., 2009; Schlotz et al., 2008). This may account for the difficulty in some cross-sectional studies to detect a connection. It is also possible that the association between the HPA hormonal levels and the self-report stress measures exist in a nonlinear manner (Kudielka et al., 2009). Particularly, when a pregnant woman encounters extremely high chronic stress, her bodily stress response system may experience desensitization and exhaustion. To conclude, longitudinal studies with rigorous designs are desired to better capture the relationships between psychological and physiological responses to stress.

Regarding cortisol and offspring outcomes, many human studies suggest that the HPA axis plays an important predicting role (Harville et al., 2009; McLean et al., 1995). A recent review by Field and Diego (2008) summarized the research on the function of maternal cortisol during pregnancy. The review drew lines between high pre-labor maternal cortisol levels and pregnancy conditions, including spontaneous abortion, irregularity in fetal activity, and impeded fetal growth. Some studies have also suggested that elevated cortisol levels contribute to shortened pregnancy duration and lower birth weight (for review, Field & Diego, 2008; Valladares et al., 2009). Chances of problems later in life, such as conduct problems, mental disorders, and chronic health conditions, also appear to be higher for those whose mother had high cortisol levels during pregnancy. Additionally, the mediator hypothesis of the neuroendocrine system is supported by the finding that pregnant women who exhibited more depressive symptoms had higher cortisol levels, and their babies were at higher risk for preterm birth and low birth weight, suggesting maternal cortisol serving a mediating role between maternal depressive symptoms and birth outcomes (Field et al., 2004; Field et al., 2006). However, more investigations are needed to test the mediation models involving psychological stress, physiological stress, and offspring outcomes.

Pregnancy-Specific Stress

The majority of the maternal stress literature has relied on general stress measures designed for a wide range of respondents (Chen et al., 2011; Huizink, Mulder, de Medina, Visser, & Buitelaar, 2004). Nevertheless, a criticism of these general stress scales is their failure to address particular challenges and concerns related to the experience of pregnancy (Dunkel Schetter & Tanner, 2012). In fact, pregnancy-specific stress (i.e.,

stress associated with the experience of pregnancy) is found to have unique impact on expectant mothers and their babies (Huizink, Mulder, de Medina, et al., 2004; Huizink, Robles de Medina, Mulder, Visser, & Buitelaar, 2003). For example, a descriptive study on perinatal maternal stress revealed that the content of pregnancy-specific stress is primarily based on the fears of fetal death- and health-related problems (Brockington, Macdonald, & Wainscott, 2006). These fears are followed by concerns about incompetence as mothers and difficulties associated with child birth (Brockington et al., 2006).

The importance of pregnancy-specific stress can be understood in light of the Roy Adaption Model, which has been frequently cited in the nursing literature (Aktan, 2012; Fawcett, 2013; Lee, Tsang, Wong, & Lee, 2011; Roy, 1984). Similar to the Lazarus and Folkman model, the Roy Adaptation Model views each individual as one adaptive system that responds to stimuli with various coping mechanisms, and these coping mechanisms result in different responses (Tulman & Fawcett, 2003). Both models conceptualize stimuli as stressors or challenges that may trigger personal responses. Particularly, the Roy model emphasizes the focal stimulus, the stimulus that concerns an individual most. For a woman, becoming pregnant and transitioning to parenthood are major life events that can be stressful and even life threatening (Kayataş, Eser, Cam, Cogendez, & Guzin, 2010; Spielman & Taubman - Ben-Ari, 2009). Although very little early effort was made to identify specific stress experienced by pregnant women, the studies that did explore prenatal maternal stress revealed high rates of pregnancy-specific stressors (Arizmendi & Affonso, 1987; Barnett, Hanna, & Parker, 1983). These investigations strongly support the speculation that pregnancy can be the focal stimulus for a woman. However, most

stress measures in the maternity literature have failed to pinpoint pregnancy-specific events (Bergner, Beyer, Klapp, & Rauchfuss, 2008; Ghosh, Wilhelm, Dunkel-Schetter, Lombardi, & Ritz, 2010; Glynn, Schetter, Hobel, & Sandman, 2008; Kramer et al., 2009; Pluess et al., 2010). Therefore, a more comprehensive assessment of maternal stress should identify both the focal and contextual stimuli for pregnant women to fully capture their prenatal experience.

Fortunately, several pregnancy-specific stress measures have been more frequently used in recent years (DiPietro, Christensen, & Costigan, 2008; Dunkel Schetter & Tanner, 2012; Huizink, Mulder, & Buitelaar, 2004; Rini, Dunkel-Schetter, Wadhwa, & Sandman, 1999). Most of these scales assess common themes that were reported by pregnant women, such as fears about child birth and inadequacies as a mother (Brockington et al., 2006; Sjogren, 1997). For instance, Ghosh and colleagues (2010) adopted two items (i.e., concerns about abnormal birth and worries about baby' health) from the Pregnancy-Related Anxiety Scale (Rini et al., 1999) to study 1000 pregnant women. The authors detected a significant relationship between pregnancy anxiety and preterm delivery, showing that higher scores on either item predicted higher chances of preterm delivery.

However, researchers have not yet reached a consensus about the unique effect of pregnancy-specific stress on obstetric outcomes. An earlier meta-analysis that examined prenatal anxiety symptoms failed to support the role of pregnancy-specific stress in predicating undesirable perinatal outcomes (Littleton, Breitkopf, & Berenson, 2007; Zelkowitz & Papageorgiou, 2012). Additionally, a newly published prospective study with over 7,000 pregnant women also failed to detect the association between pregnancy-

specific stress and adverse birth outcomes (Loomans et al., 2013). A possible explanation for the inconsistency is that pregnancy is commonly approached by expectant parents as being both stressful and joyful, and that simply assessing pregnancy in the context of stress might fail to capture the overall impact of pregnancy on individuals (Dunkel Schetter, 2011). However, among the handful of measures of pregnancy-specific stress, very few scales cover both aspects of pregnancy (Alderdice, Lynn, & Lobel, 2012; Nast et al., 2013). Notably, Dipietro and colleagues (2008) developed a brief scale that assesses both pregnancy-related positive experience and pregnancy-related stress, namely, uplifts and hassles respectively. This measure has been found to have good psychometric properties and good predictive validity for newborns' neurological maturity. For these reasons, the *Pregnancy Experience Scale - Brief Version* was used in the current study along with other stress indicators (DiPietro et al., 2008).

Maternal Mood

Studies with various populations of pregnant women have suggested a strong link between levels of prenatal depressive symptoms and postpartum maternal mood disturbance (Davey, Tough, Adair, & Benzies, 2011; Field, 2011; Miao, Wong, Szeto, & Yiu, 2009; Siu, Leung, Ip, Hung, & O'Hara, 2012). Heightened levels of maternal depressive symptoms during pregnancy are also found to be a risk factor for infant and child temperament development and future behavioral and attentional problems (Field, 2011). A less supported hypothesis has also been discussed regarding the relationships between depressive symptoms and offspring birth outcomes (Lazinski et al., 2008). For instance, an investigation of nearly 700 French women revealed that pregnant women with higher depressive symptoms were at higher risk for delivering preterm babies

(Dayan et al., 2006). Similarly, two other studies with more diverse populations have also supported the link between prenatal depressive symptoms and preterm childbirth (Orr, James, & Blackmore Prince, 2002; Steer, Scholl, Hediger, & Fischer, 1992). One of these two studies also suggests an association between depressive symptoms and growth restriction (Steer et al., 1992). A more recent meta-analysis also supports the connection between prenatal maternal depressive symptoms and preterm birth and fetal growth restriction, and the effect was more salient for women with low socioeconomic status (Grote et al., 2010). In contrast, two other studies failed to draw a connection between maternal depression and preterm birth, or maternal depression and low birth weight (Andersson, Sundstrom-Poromaa, Wulff, Astrom, & Bixo, 2004; Berle et al., 2005). Therefore, more prospective studies would help better capture the relationships between maternal mood problems and birth outcomes.

To summarize, prenatal maternal stress and mood disturbance has strong implications for adverse maternal and offspring outcomes, particularly for new mothers. Psychosocial interventions are desirable to improve the well-being for both mothers and their babies.

Mindfulness-Based Interventions and Maternal Stress

Psychosocial Treatments during Pregnancy

Given the adverse effect of prenatal maternal stress, studies have examined the effect of psychological interventions on maternal stress and obstetric outcomes (Freeman & Davis, 2010; Hodnett, Fredericks, & Weston, 2010; Paarlberg, Vingerhoets, Passchier, Dekker, & Van Geijn, 1995; Vieten & Astin, 2008). Earlier efforts focused on *additional psychosocial support*, which is defined as "some form of emotional support (e.g.,

counseling, reassurance, sympathetic listening) with or without additional information or advice, or both, occurring during home visits, clinical appointments, and/or by telephone (Hodnett et al., 2010, p. 3).” Findings are mixed with regard to the effect of additional psychosocial support on enhancing birth outcomes, and a limited number of studies that investigated diverse racial groups suggest a more salient effect for African American women than for women of other cultural backgrounds (Heins, Nance, McCarthy, & Efird, 1990; Moore et al., 1998).

In comparison to psychosocial support, more recent intervention research has shifted focus to empirically supported treatments (see review, L. S. Cohen et al., 2010; Nonacs & Cohen, 2003). To date, interpersonal psychotherapy has been investigated more frequently than other contemporary psychosocial treatments (Boath, Bradley, & Henshaw, 2005; Crockett, Zlotnick, Davis, Payne, & Washington, 2008; Duncan & Bardacke, 2010; Freeman & Davis, 2010; Grote et al., 2009; Miller, Gur, Shanok, & Weissman, 2008; Vieten & Astin, 2008). *Interpersonal psychotherapy* is a brief empirically supported depression treatment that centers on recipients’ current interpersonal context (Miller et al., 2008). It emphasizes four essential components: grief, role transitions, and interpersonal deficits and conflicts (Nonacs & Cohen, 2003). A pregnant woman may benefit specifically from addressing her role transition into motherhood and her role dispute with her partner (Spinelli, 1997). For impoverished single mothers, particularly for teenage mothers, interpersonal psychotherapy might be particularly beneficial if high levels of interpersonal conflicts are present (Miller et al., 2008). Markedly, available data have shown considerable effort from researchers to serve minority mothers with low socioeconomic status (Crockett et al., 2008; Grote et al., 2009;

Miller et al., 2008; Spinelli, 1997; Spinelli & Endicott, 2003; Zlotnick, Miller, Pearlstein, Howard, & Sweeney, 2006). In a nutshell, prenatal interpersonal psychotherapy studies have largely focused on low-income African American and Latina women and have generally shown efficacy in alleviating depressive symptoms, reducing rates of postpartum depression, and improving social functioning (Crockett et al., 2008; Grote et al., 2009; Spinelli, 1997; Spinelli & Endicott, 2003). These findings support the suitability of interpersonal psychotherapy for disadvantaged minority women with prenatal depression.

Mind-Body Interventions

Another burgeoning group of psychosocial treatments is mind-body interventions (Faucher, 2013; Fisher, Hauck, Bayes, & Byrne, 2012; Marc et al., 2011; Perez-Blasco, Viguer, & Rodrigo, 2013). Mind-body interventions include treatment modalities such as yoga, meditation, and relaxation training (Beddoe & Lee, 2008; Marc et al., 2011). An earlier article reviewed mind-body based treatment programs that served pregnant women in the past thirty years, suggesting that mind-body therapies are conducive in reducing maternal stress and improving women's well-being (Beddoe & Lee, 2008). For instance, Narendran et al. (2005) studied the impact of mindful yoga practice on over 300 pregnant Indian women and their offspring. In their study, women in the treatment group were taught to practice physical postures, breathing, and meditation. In comparison, women in the control group received treatment as usual. The results were promising, supporting that women in the yoga group had lower blood pressure post-intervention. Moreover, these women's offspring were found to have higher birth weight, lower rates of preterm birth, and better weight for gestational age. Two more recent articles on prenatal yoga practice

also revealed its impact of reducing depressive symptoms, improving maternal sleep quality, and enhancing mother-fetus bonding (Beddoe, Lee, Weiss, Kennedy, & Yang, 2010; Faucher, 2013).

In addition to the studies on mindful yoga practice, a recent investigation focused on 70 expectant mothers in Korea who practiced Qi, a form of mind-body intervention which is similar to yoga practice and has three key components: stretching, breathing, and meditation (Ji & Han, 2010). Similar to the findings for mindful yoga practice, this study supported the benefit of Qi practice in decreasing depressive symptoms, reducing bodily discomfort, and improving mothers' attentiveness toward fetuses, but not in ameliorating anxiety symptoms. Further, an integrative mind-body intervention that contained massage, aroma therapy, prayer, and meditation were presented to child-bearing women in New Orleans post-Katrina (Savage et al., 2010). The investigation revealed participant satisfaction with this treatment approach, as 95% of them reported experience of practice during their pregnancy. However, a common problem in many of these mind-body interventions is that very few of them adopted randomized controlled designs, and this calls into question the conclusions of these studies (Beddoe & Lee, 2008; Marc et al., 2011). For instance, a recent review that exclusively focused on randomized clinical trials of mind-body interventions had to exclude over 40 studies because of methodological weaknesses and only kept eight randomized controlled interventions for analyses (Marc et al., 2011). The conclusions based on the eight more rigorously designed intervention studies were with dampened enthusiasm, yet the findings still suggest the efficacy of mind-body interventions, particularly those using imagery techniques, in reducing prenatal maternal anxiety (Marc et al., 2011).

Mindfulness-Based Interventions

Among various mind-body interventions, meditation has gained increased attention in past two decades (Beddoe & Lee, 2008). *Meditation* has been defined by Astin (2003 , p. 132) as the "intentional self-regulation of attention" and "a systematic mental focus on particular aspects of inner or outer experience." Originated from the Buddhist tradition, meditation has been believed by many health care professionals to be effective for secular practitioners (Beddoe & Lee, 2008). Two forms of meditation have been most frequently studied: transcendental meditation and mindfulness meditation (Astin, 2003 ; Barnes, Treiber, & Davis, 2001; Chiesa & Serretti, 2010; Hofmann, Sawyer, Witt, & Oh, 2010; Schneider et al., 2005). Transcendental meditation focuses on repetition of a single word or a phrase (i.e., a mantra) for the purpose of obtaining peace of mind (Canter & Ernst, 2003). Researchers have found transcendental meditation to effectively reduce blood pressure (Barnes et al., 2001; Schneider et al., 2005).

Among various mind-body interventions, mindfulness-based interventions have gained increased attention in the past two decades (Chiesa & Malinowski, 2011; Harnett & Dawe, 2012; Harper, Webb, & Rayner, 2013). *Mindfulness* is defined by Kabat-Zinn (1994, p. 4) as "paying attention in a particular way: on purpose, in the present-moment, and nonjudgmentally." Bishop and colleagues (2004) further proposed a two-component model of mindfulness. The first element involves bringing attention to the present moment. The second element involves fostering curiosity, openness, and acceptance toward current experience. Besides the most known form of mindfulness, mindful meditation, mindfulness can also be practiced in various other forms including mindful

movement (e.g., walking and yoga) and mindful practice of daily activities (e.g., brushing teeth) (Allen, Blashki, & Gullone, 2006).

Mindfulness differs from habitual thinking and action in that it cultivates moment-to-moment awareness of one's internal and external experiences (Allen et al., 2006). Mindfulness is also different from goal-directed activities (e.g., transcendental meditation and cognitive behavioral therapy). Particularly, instead of pursuing additional effect, such as bodily relaxation, the emphasis of mindfulness practice is simply on allowing the self to fully experience current mental and emotional events as they occur (Vieten, 2012b). The purpose of mindfulness is also not to correct faulty thoughts or beliefs, but to change how the person relates to his/her thinking and emotional processes at a meta-cognitive level. However, stress reduction, symptom amelioration, and changes of maladaptive thinking patterns may ensue as secondary gains (Allen et al., 2006).

Effect of Mindfulness-Based Interventions on Mindfulness and Attention

The association between mindfulness and psychological health has been intensively examined, and evidence has linked higher levels of mindfulness to higher levels of desirable psychological outcomes, including life satisfaction, agreeableness, conscientiousness, effective emotion regulation, vitality, self-esteem, empathy, autonomy, competence, optimism, memory capacity, and response flexibility (Davis & Hayes, 2011; Keng, Smoski, & Robins, 2011). Additionally, levels of mindfulness have also been found to correlate negatively with levels of undesirable experiences, including depressive symptoms, neuroticism, absentmindedness, social anxiety, emotional regulation difficulties, and experiential avoidance (Keng et al., 2011). Therefore, mindfulness appears to be critically associated with measures of mental health.

Given the benefits associated with mindfulness, emerging efforts have been made recently to enhance levels of mindfulness through mindfulness-based interventions (Davis & Hayes, 2011). Recently, both original investigations and systematic reviews have generally shown the promise of these treatments in boosting degrees of mindfulness (Jensen, Vangkilde, Frokjaer, & Hasselbalch, 2012; Keng et al., 2011; Klatt, Buckworth, & Malarkey, 2009; Nedeljkovic, Wirtz, & Ausfeld-Hafter, 2012; Robins, Keng, Ekblad, & Brantley, 2012). Common treatment choices include Mindfulness-Based Stress Reduction, Mindfulness-Based Cognitive Therapy, Dialectic Behavioral Therapy, and Acceptance and Commitment Therapy, and intervention participants have ranged from healthy to medically ill populations.

Since the nature of mindfulness involves a particular way to guide one's attention, attention has been regarded as a key element of mindfulness and has been also frequently explored as a measure of treatment effect (Kang, Gruber, & Gray, 2013; Shapiro, Carlson, Astin, & Freedman, 2006). Sustained attention in the framework of mindfulness refers to paying attention to one's fluid internal experiences and gently and firmly bringing one's attention back to the present moment when the mind has drifted away (Kang et al., 2013). Engagement in sustained attention has been shown to predict lessened levels of rumination and anxiety (Bostanov, M. Keune, Kotchoubey, & Hautzinger, 2012; Kang et al., 2013). Similar to their impact on levels of mindfulness, mindfulness-based interventions have been shown to enhance sustained attention in both healthy participants and medically depressed patients (Bostanov et al., 2012; Jensen et al., 2012; Tang et al., 2007; Valentine & Sweet, 1999). For instance, a group of 91 patients who experienced depression relapse were randomly assigned to either a Mindfulness-

Based Cognitive Therapy intervention group or a waitlist control group (Bostanov et al., 2012). The intervention group patients showed better performance on a cognitive task which assesses one's ability to focus his/her attention on present moment and away from ruminative thinking, which is a significant risk factor for depression relapse. Further, neuroimaging evidence has revealed that certain brain regions, especially several cerebral areas that are involved in the function of attention have been activated during mindfulness meditation practice (Chiesa & Serretti, 2010; Davis & Hayes, 2011). Therefore, both cognitive tasks and neuroimaging techniques have supplemented evidence for the positive impact of mindfulness-based interventions on sustained attention.

Effect of Mindfulness-Based Interventions on Stress and Depressive Symptoms

Similar to the maternal stress literature, studies on mindfulness-based interventions have utilized diverse operationalizations of stress, including major life events, perceived stress, and cortisol levels in response to stress. However in the mindfulness literature, research on stressful life events has mainly centered on participants who were impacted by traumatic life experiences, instead of more common stressors (Lynn, Malakataris, Condon, Maxwell, & Cleere, 2012; R. W. Thompson, Arnkoff, & Glass, 2011). Two recent literature reviews have suggested the feasibility of mindfulness-based approaches in reducing a hallmark symptom of Post-Traumatic Stress Disorder, experiential avoidance, and in enhancing psychological flexibility and adjustment (Lynn et al., 2012; R. W. Thompson et al., 2011).

In comparison to stressful life events, perceived stress has drawn more attention from investigators of mindfulness-based interventions, and relevant research has largely

focused on non-clinical populations (Baer, Carmody, & Hunsinger, 2012; Jensen et al., 2012; Klatt et al., 2009; Warnecke, Quinn, Ogden, Towle, & Nelson, 2011). Exemplified by the Mindfulness-Based Stress Reduction program, mindfulness-based interventions have been shown to significantly reduce perceived stress in randomized controlled trials (Jensen et al., 2012; Klatt et al., 2009). Interestingly, medical students who were instructed to listen to a guided mindfulness meditation CD over the course of eight weeks also endorsed more reduction in levels of perceived stress than the control group students in a randomized controlled study (Warnecke et al., 2011). In addition, a recent study with adults who endorsed significant stress from chronic illness or chronic pain also supported the efficacy of mindfulness-based interventions in reducing their perceived stress (Baer, Carmody, et al., 2012). However, more sufficient dose of treatment might be a required condition for this group of interventions to have significant impact, as one newly published randomized controlled trial for university employees with low dose of mindfulness training failed to prove its influence on perceived stress (Malarkey, Jarjoura, & Klatt, 2013).

Unlike the generally consistent findings for perceived stress, treatment effects of mindfulness-based interventions on cortisol levels are more mixed in the mindfulness literature. For instance, there have been studies with clinically depressed and non-clinical populations that reported change in salivary cortisol levels after a full course of Mindfulness-Based Stress Reduction training, and notably awakening saliva was collected in most of these studies (Brand, Holsboer-Trachsler, Naranjo, & Schmidt, 2012; Jensen et al., 2012; Witek-Janusek et al., 2008). In addition, a correlational study on the relationship between HPA axis activity and mindfulness-based meditation practice effect

revealed that awakening salivary cortisol levels were negatively associated with length of practice in long-term meditators (Brand et al., 2012). However, several treatment studies failed to find main effects of mindfulness-based interventions on cortisol levels (Bränström, Kvillemo, & Åkerstedt, 2013; Galantino, Baime, Maguire, Szapary, & Farrar, 2005; Nyklíček, Mommersteeg, Van Beugen, Ramakers, & Van Boxtel, 2013; Oken et al., 2010). One of these studies identified a moderation effect in a randomized controlled trial in that cancer patients in the intervention group with lower levels of baseline awakening cortisol had higher levels of cortisol post-intervention, and patients in the group with higher levels of awakening cortisol pre-intervention had lower levels of cortisol post-intervention (Bränström et al., 2013). Among the studies that did not detect cortisol level differences after mindfulness-based interventions, most of them did not collect morning awakening saliva samples, this factor might have contributed to the observation that treatment had main effects on some other psychological and physiological measures, but not on cortisol levels (Galantino et al., 2005; Nyklíček et al., 2013). However, the fact that a more rigorously designed randomized controlled trial that ensured strict saliva collection procedures also failed to show treatment effects on cortisol levels calls for more investigations in this area (Oken et al., 2010).

In comparison to research on baseline cortisol levels, treatment impact on levels of cortisol response to stress has been less frequently examined (K. W. Brown, Weinstein, & Creswell, 2012; Tang et al., 2007). However, existing data have suggested the importance of investigating short-term hormonal response in addition to studying baseline cortisol levels. For instance, a recent correlational study reported that higher levels of mindfulness predicted lower levels of cortisol response to a moderately stress-

provoking condition (K. W. Brown et al., 2012). Overall, understanding both hormonal levels and hormonal response to stress is encouraged for the purpose of better understanding the treatment effects of mindfulness-based interventions.

The impact of mindfulness-based interventions on depressive symptoms has been among the most intensively studied among the interested outcomes. In fact, due to the sustained enthusiasm for this line of research, a good number of systematic reviews and meta-analyses have been published in recent years (Chiesa & Serretti, 2009; Coelho, Canter, & Ernst, 2013; Fjorback, Arendt, Ørnbøl, Fink, & Walach, 2011; Galante, Iribarren, & Pearce, 2013; Hofmann et al., 2010; Piet & Hougaard, 2011; Toneatto & Nguyen, 2007; Vøllestad, Nielsen, & Nielsen, 2012). Predominant evidence based on randomized controlled clinical trials has suggested that participants with a history of depression who attended Mindfulness-Based Stress Reduction training or Mindfulness-Based Cognitive Therapy fared better than control group on relapse rates (Coelho et al., 2013; Fjorback et al., 2011; Galante et al., 2013). In addition, Mindfulness-Based Cognitive Therapy was found to effectively reduce depressive symptoms in a sample of college students (Kaviani, Hatami, & Javaheri, 2012). In a different study, the treatment effect of mindfulness-based interventions were comparable to the treatment effect of anti-depressants in symptom reduction (Piet & Hougaard, 2011). It appears that for these empirically supported programs, such as Mindfulness-Based Cognitive Therapy, a follow-up step is to compare treatment groups to active control groups to discern the unique effect of mindfulness-based protocol (Coelho et al., 2013; Galante et al., 2013).

Treatment Mechanisms of Mindfulness-Based Interventions

As the efficacy of mindfulness-based interventions for enhancing well-being has been strongly supported by empirical investigations, a few researchers have begun to examine the potential processes of change in this cluster of interventions (Carmody & Baer, 2008; Chiesa, Serretti, & Jakobsen, 2013; Garland, Gaylord, & Park, 2009; Hanley, Garland, & Black, 2013; Jain et al., 2007; Sears & Kraus, 2009; Shapiro, Brown, & Biegel, 2007; Weinstein, Brown, & Ryan, 2009). In light of the framework of Stress, Appraisal, and Coping theory (Lazarus & Folkman, 1984), some newly published inquires on relevant treatment processes have assessed the nature of mindfulness in relation to positive reappraisal and adaptive coping strategies (Chiesa et al., 2013; Garland et al., 2009; Hanley et al., 2013; Weinstein et al., 2009). Positive reappraisal is understood as the process of re-interpretation of stressors as more benign, valuable, and meaningful stimuli (Garland et al., 2009). This reflects a restructuring of cognitive processing similar to cognitive restructuring in traditional cognitive theory (Moffitt, Brinkworth, Noakes, & Mohr, 2012). Given that the process of mindfulness facilitates reconstructing stressful events with a nonjudgmental, curious, and compassionate stance, it appears that mindfulness-based practice involves positive reappraisal (Chiesa et al., 2013). This way of transforming negative emotions has been found to be more adaptive than attempts to suppress or avoid unwanted emotions (Chiesa et al., 2013). A newly published study has supported the speculation that positive reappraisal has been commonly implemented by experienced meditators and that meditators' length of mindfulness-based practice and frequency of practice correlated positively with levels of positive reappraisal (Hanley et al., 2013).

In addition to positive reappraisal, coping skills have also been explored as potential mediators of change in mindfulness-based treatments (Tacón, McComb, Caldera, & Randolph, 2003; Walach et al., 2007; Weinstein et al., 2009). Lazarus and Folkman (1984) explained that coping involves cognitive and behavioral approaches to dealing with internal or external stimuli that cost the individual attention and effort. Researchers have discussed for a long time ways to improve adaptive coping skills and decrease maladaptive coping skills (Bergomi, Ströhle, Michalak, Funke, & Berking, 2013; Hanley et al., 2013; Neacsiu, Rizvi, Vitaliano, Lynch, & Linehan, 2010; Weinstein et al., 2009). A handful of studies in the past decade have generally supported the beneficial effects of mindfulness on coping styles (Tacón et al., 2003; Walach et al., 2007; Weinstein et al., 2009). For instance, Weinstein and colleagues (2009) reported a decrease in avoidance-based coping and an increase in approach-based coping in a group of students trained in mindfulness. Furthermore, avoidance-based coping, along with threat appraisal, was found to mediate the effect of mindfulness training on emotional well-being. A follow-up question is to test whether or not this mediational mechanism can be replicated in more diverse populations.

Mindfulness and Pregnancy

Pregnancy and early motherhood are characterized by major changes that are uncontrollable and unalterable (Vieten, 2012b). These changes include sleep disturbance, enlargement of body figures, formation of stretch marks, and constant nurturing requests from newborns (Vieten, 2012b). Notably, studies have suggested that perception of self-control does not correlate with mental well-being in a simple linear fashion, particularly when individuals are confronted by unchangeable events (Friese, Messner, & Schaffner,

2012; Tamagawa et al., 2013). Instead, a strong determination to improve unchangeable situations may lead to unfavorable adaptation (Friese et al., 2012). Similarly, attempts to suppress emotions and thoughts may cause further psychological distress and may lead to depletion of mental and physical resources (Friese et al., 2012; Muraven & Baumeister, 2000). In fact, some researchers have speculated that efforts to inhibit emotions and thoughts could instead worsen the problems or could even become the very source of problems (B. Thompson, Luoma, & LeJeune, 2013). Given the above considerations, a pregnant woman may adjust poorly if she deliberately controls the emotions, thoughts, and conditions that rise naturally during her new motherhood (Vieten, 2012b). In contrast, an acceptance-based mindfulness training program may help her fully experience the unalterable events and cope better with the challenges.

In addition to emotional and physical changes during pregnancy, emerging evidence has suggested the impairment of cognitive function as a result of pregnancy (de Groot, Vuurman, Hornstra, & Jolles, 2006). For instance, a prospective study reported that pregnant women's memory skills were significantly lower than a matched non-pregnant sample (de Groot et al., 2006). These childbearing women in the study also performed worse than their counterparts on information processing tasks after delivery. As discussed earlier, despite the methodological flaws, mindfulness interventions have shown promise in enhancing mindfulness trainees' cognitive functioning, particularly sustained attention (Chambers, Lo, & Allen, 2008; Jha, Krompinger, & Baime, 2007; Newman, 2003; Valentine & Sweet, 1999). Therefore, pregnant women may benefit particularly from the improvement in cognitive abilities after receiving mindfulness-based interventions, in addition to learning healthier coping skills.

Given the potential that mindfulness-based interventions have shown to alleviate maternal stress, improve cognitive function, and promote maternal and offspring well-being, some researchers have developed mindfulness-based programs that specifically target pregnant women and new mothers (Beddoe & Lee, 2008; Duncan & Bardacke, 2010; Dunn, Hanieh, Roberts, & Powrie, 2012; Fisher et al., 2012; Perez-Blasco et al., 2013; Vieten & Astin, 2008). To date, there have been four published pilot studies that primarily focused on prenatal mindfulness-based interventions (Duncan & Bardacke, 2010; Dunn et al., 2012; Fisher et al., 2012; Vieten & Astin, 2008). The earliest investigation was conducted by Vieten and Astin (2008). These researchers developed an eight-week program named the Mindful Motherhood (Vieten, 2012b), which was derived from common mindfulness- and acceptance-based interventions, including Mindfulness-Based Stress Reduction (Kabat-Zinn, 1990), Mindfulness-Based Cognitive Therapy (Segal, 2002), and Acceptance and Commitment Therapy (Hayes, 2004). Modifications from these mindfulness programs led to the creation of the Mindful Motherhood Manual, in order to address pregnancy-related experiences and to expand mindfulness meditation practice to mindful walking and mindful moving (Vieten & Astin, 2008). The results of this randomized waitlist controlled trial support the efficacy of the Mindful Motherhood intervention. Particularly, participants in the treatment group reported significant reductions in levels of anxiety and negative affectivity but no change in levels of positive affectivity.

A later study was based on another pregnancy-specific mindfulness program, the Mindfulness Based Childbirth and Parenting Program (Duncan & Bardacke, 2010). Formally derived from Mindfulness-Based Stress Reduction (Kabat-Zinn, 1990), the

Mindfulness Based Childbirth and Parenting Program is a ten-session mindfulness-based stress reduction program for expectant parents (Duncan & Bardacke, 2010). In Duncan and Bardacke's study, participants not only reported reductions in anxiety, depressive symptoms, and negative affectivity but also reported improvement in positive affectivity post-intervention. However, the study was a pretest and posttest design, instead of a randomized controlled trial, therefore the authors were unable to control for some potential confounding variables.

The two more recent investigations were adapted either from Mindfulness-Based Stress Reduction or Mindfulness-Based Cognitive Therapy protocols, with modifications made to fit the study population of pregnant women in Australia (Dunn et al., 2012; Fisher et al., 2012). One of the two studies was a qualitative design that identified two prevalent themes: the experience of being empowered for realization of one's potential and a sense of community with other parents who went through a similar process (Fisher et al., 2012). The other study was a quasi-experiment design that revealed desirable treatment effects on stress, anxiety, and depressive symptoms, and the effects were maintained postpartum (Dunn et al., 2012).

In sum, these pilot studies support the efficacy of mindfulness-based treatments in alleviating maternal stress during pregnancy. However, one common limitation in mindfulness-based research, including these four pregnancy-specific studies, is that participants of most studies are of Caucasian descent with high socioeconomic status (Chiesa & Serretti, 2009). A necessary extension of this study is to examine whether or not the beneficial results can be replicated in minority populations of low socioeconomic status. Furthermore, none of these four studies tested whether or not these mindfulness-

based pregnancy programs had enhanced the participants' mindfulness skills. In addition, none of these four studies explored the potential impact of these mindfulness programs on birth outcomes. Given the implications of maternal stress on offspring obstetric and developmental outcomes, it is another important direction for further investigation.

Mindfulness for Urban, Low-Income, Pregnant African American Women

As an underserved population, urban, low-income, pregnant African American women are less likely than their Caucasian counterparts to utilize mental health services (Johnson, Mills, DeLeon, Hartzema, & Haddad, 2009; Leis et al., 2011). Struggling with poverty, low-income pregnant African American women are also at high risk for stress, prenatal depression, and intense feelings of loneliness and isolation (Bloom et al., 2013). In addition, the low socioeconomic status has predicted the high risk for impoverished African American women to develop postpartum depression (Goyal, Gay, & Lee, 2010). Further, it has been known for a while that pregnant African American women tend to have more adverse obstetric outcomes than Caucasian Americans, including higher infant mortality rate (Rosenthal & Lobel, 2011). Especially for low-income, pregnant African American women, chronic racism, discrimination, abuse, anxiety, and neighborhood disorganization contribute to poorer pregnancy outcomes, including fetal growth restriction (Dunkel Schetter & Tanner, 2012; Holland, Kitzman, & Veazie, 2009; Rosenthal & Lobel, 2011).

Given the various stressors that urban, low-income, pregnant African American women encounter, it appears that they might benefit from mindfulness-based interventions for the following reasons. First, mindfulness-based interventions would normalize pervasive problems during pregnancy, and this might help change the stigma

attached to mental health services (Grote, Zuckoff, Swartz, Bledsoe, & Geibel, 2007; Leis et al., 2011). Second, mindfulness-based interventions can benefit a large number of expectant mothers who are coping with maternal stress (Faisal-Cury & Rossi Menezes, 2007). Third, a good number of mindfulness-based interventions have centered on stress reduction (Kabat-Zinn, 1990, 1994) and have gained good empirical support for its efficiency in stress alleviation (Woods-Giscombé & Black, 2010). Sue (1998) reported that cognitive match (i.e., the degree of match between the goals of a therapist and of a client and the suitability of treatment strategies) predicted intervention efficacy. For this reason, mindfulness training might be superior in facilitating stress management.

Notably, Woods-Giscombé (2010) also proposed from a theoretical framework that African American women as a cultural group are likely to benefit from learning mindfulness-based coping strategies, including a compassionate relationship with one's emotions, open and non-judgmental stance, and self-acceptance. She reasoned that mindfulness-based coping strategies are very different from the "Superwoman Schema" which is prevalent in the African American community, and the acceptance-based perspective might help them relate differently to their stress. Although the implementation of mindfulness-based interventions for urban, low-income, pregnant African American women has been limited to very few investigations with closely-related populations (Woods-Giscombé & Black, 2010), a handful of recently published pilot studies appear to support the idea that this cluster of treatments can be beneficial to the population of impoverished, socially-disadvantaged, minority women (Dutton, Bermudez, Matás, Majid, & Myers, 2013; Garland, Gaylord, Boettiger, & Howard, 2010; Mendelson et al., 2010; Palta et al., 2012; Sibinga et al., 2011).

Although the limited number of earlier studies with African American participants mainly emphasized the effect of transcendental meditation on participants' physiological response (Black, Milam, & Sussman, 2009), more recent explorations have shifted focus to mindfulness-based interventions, including Mindfulness-Based Stress Reduction and Mindfulness-Based Cognitive Therapy (Dutton et al., 2013; Sibinga et al., 2011). Two of these recent mindfulness-based intervention studies centered on urban, low-income, predominantly African American female youths (Mendelson et al., 2010; Sibinga et al., 2011). Despite the methodological drawbacks of these two studies, both presented evidence for the efficacy of this type of treatment and improvement was identified in the areas of emotion regulation, stress reduction, physical health, and interpersonal relationships. In a sample primarily consisting of urban, low-income, African Americans, a randomized controlled study also revealed that a mindfulness-based intervention helped to alter the maladaptive mechanisms in alcohol dependence and had the great potential to reduce drinking behavior (Garland et al., 2010). In addition, a newly published article discussed the feasibility of applying a Mindfulness-Based Stress Reduction program with a group of urban, low-income, predominantly African American women who were impacted by traumatic life experiences (Dutton et al., 2013). Although the project was in its early stage, available information has suggested the feasibility and acceptability of this mindfulness-based intervention with the interested at-risk population.

In sum, both empirical evidence and theoretical predictions have suggested that mindfulness-based interventions might be a good fit for urban, low-income, pregnant African American women by reducing maternal stress and empowering them with a perspective of self-acceptance and mindfulness attention to the present moment. Research

with this population would not only help reduce health disparities, but also might enhance the physical and mental well-being of their babies.

Hypotheses

The general purpose of this pilot study was to conduct a randomized controlled trial with urban, low-income, pregnant African American women, and to examine the effect of a mindfulness-based maternal stress reduction program (i.e., Mindful Motherhood; Vieten, 2012) on maternal and offspring well-being. Based on the information presented in the maternity and mindfulness literature, the current study specifically addressed the following hypotheses:

(1) The Mindful Motherhood group would experience greater improvement in mindfulness than the treatment as usual (TxAU) group at post-intervention and follow-up – including one month post-intervention and one month postpartum.

(2) The Mindful Motherhood group would be more able to maintain sustained attention than the TxAU group at post-intervention and follow-up – including one month post-intervention and one month postpartum.

(3) The Mindful Motherhood group would evidence more reductions in general maternal stress than the TxAU group at post-intervention and follow-up – including one month post-intervention and one month postpartum. Specifically, general maternal stress in this hypothesis included stressful life events, perceived stress, baseline cortisol levels, and reactive cortisol response.

(4) The Mindful Motherhood group would endorse more pregnancy-related positive experience and less pregnancy-related stress than the TxAU group at post-intervention and one month follow-up.

(5) The Mindful Motherhood group would report lower levels of Depressive symptoms than the TxAU group at post-intervention and follow-up – including one month post-intervention and one month postpartum.

(6) The Mindful Motherhood group would result in higher levels of approach-based coping and lower levels of avoidance-based coping than the TxAU group at post-intervention and follow-up – including one month post-intervention and one month postpartum.

(7) The Mindful Motherhood group would evidence greater delivery outcomes, including higher birth weight and greater gestational age of their babies, than the TxAU group.

Method

I. Study Design

The current study was a pilot randomized controlled study with a 2 X 4 mixed model design. The between-subjects variable was group condition (TxAU, Mindful Motherhood) and the within-subjects variable was assessment time (pre-intervention (T1), post-intervention (T2), one month post-intervention follow-up (T3), and one month postpartum follow-up (T4).

II. Participants and Procedures

Participants

The study participants were recruited from two settings in succession: (1) Stinson & Associates in Dekalb County, a state-supported pregnancy program, which provides routine services to Temporary Assistance for Needy Family (TANF) recipients; and (2) Grady Memorial Hospital, a large, urban, university-affiliated hospital that provides health care to low-income, minority patients. The study portion with Stinson & Associates lasted from October 2011 to February 2012 when the program was forced to close due to financial difficulties. The Emory University's Institutional Review Board approved this portion of the study prior to its inception. The study portion with Grady Memorial Hospital began in April 2012 and ended in March 2013, and participants were recruited from the Grady Memorial Hospital OB/GYN Department. The Emory University's Institutional Review Board and Grady Memorial Hospital's Research Oversight Committee approved this part of the study prior to its inception.

The participant flow charts, including participants at two separate locations and in combination of the two locations, are shown in Figures 1-3. Overall, a total of 1440 prospective participants were approached by undergraduate research assistants for recruitment. These individuals were informed of the nature and purpose of this study, confidentiality, possible risks and benefits. Those who agreed to participate signed the consent forms for screening, assessments, and intervention. Once the consent form was obtained, the research assistants conducted a ten-minute screening to assess eligibility and collect basic demographics (i.e., age, ethnicity, and income). Exclusion criteria included active psychosis, history of psychosis, current intake of psychotropic

medication, and severe cognitive impairments. The Mini-Mental State Exam was administered to assess participants' cognitive functioning (Folstein, Folstein, McHugh, & Fanjiang, 2001). The Psychotic Screen, developed by the Grady Nia Project, was administered to assess the existence of psychotic symptoms.

The initial inclusion criteria of the study included English speakers, age range from 18 – 45, carrying singleton pregnancies, with 12-31 weeks of pregnancy, and self-identified as African Americans. Sixty-nine pregnant females ended up participating in the T1 assessment and were randomly assigned to the TxAU condition *(n* = 33*)* or the Mindful Motherhood condition (*n* = 36). All of the participants were carrying singleton pregnancies during the initial assessment, English speakers, and self-identified as African Americans. A woman with 35 weeks of pregnancy was inadvertently recruited at the Stinson & Associates location, and data from this participant were excluded from analyses due to late pregnancy. At the Grady location, three participants younger than 18 years old were inadvertently recruited (one 15 years old and two 17 years old). The protocol deviation was reported to the Emory Institutional Review Board and data from the three minors were excluded from analyses as requested. The demographic background and pregnancy information of the remaining 65 participants are shown in Table 1.

Procedures

Individuals who met the inclusion criteria were scheduled for initial assessment (T1), second assessment (T2) that occurred about 4 weeks after T1, third assessment (T3) that occurred about 4 weeks after T2, and final assessment (T4) that occurred one month following delivery. For the Mindful Motherhood group, 8-session mindfulness training

was conducted between T1 and T2 assessments. The research assistants contacted each participant via telephone prior to each assessment to optimize participant adherence. Each assessment lasted approximately one hour. The research assistants were blind to the nature of the current study and the research hypotheses. During each assessment, the following measures were administered to the participants: the *Toronto Mindfulness Scale*, the *Life Experiences Survey*, the *Perceived Stress Scale*, the *Beck Depression Inventory-II*, and the *COPE Inventory*. In addition, participants were administered the *Wilkin Counting Test* following all the paperwork, and afterwards they were instructed to listen to a 2-minute audio clip of a baby's cry, which was employed in this study as a mild ecologically valid stressor.

Furthermore, saliva samples were collected upon the participants' arrivals, prior to the audio clip, and immediately after the audio clip. Although efforts were made to optimize morning saliva sample collection in order to control for the impact of collection time and to improve the reliability of the cortisol measure (Franz et al., 2010), due to research assistants' and participants' schedule restrictions, only 59.6% of the total number of interviews had the first saliva samples collected between 8:30 AM and 12:00 PM. Results from independent t-tests did not reveal a significant saliva collection time difference between the TxAU group and the Mindful Motherhood group in any of the interviews, $p > 0.05$. During each saliva collection, each participant was asked to wet a cotton stick in her mouth, and the saliva sample was squeezed from the cotton stick into a tube using a syringe. Empirical support has shown that the cotton stick procedure does not impair the measurement of salivary cortisol level (Shirtcliff, Granger, Schwartz, & Curran, 2001). Collected saliva samples were immediately stored in -20 °C until the time

of cortisol assays. The cortisol assays were performed in a neuroendocrine research laboratory with a wealth of experience in cortisol assays (Pace et al., 2009). The Salimetrics cortisol kits (Salimetrics, PA) and the Stat Fax 2100 microplate reader (MIDSCI, MO) were used to test the saliva cortisol levels, and the assay protocol strictly followed the procedure provided by Salimetrics (2011).

Additionally at T1 assessment, we gathered demographic information by administering the *Demographic Information Questionnaire*, randomly assigned each participant into one of the two intervention conditions, and administered the *Pregnancy Experience Scale – Brief Version*. The *Pregnancy Experience Scale – Brief Version* was also administered at T2 and T3 assessment time points. In addition, delivery information, including newborns' birth weight and gestational age, was mostly collected at T4 assessment time point. Some participants shared information of their newborns' birth weight and gestational age through phone contact with research assistants.

The randomization was determined by a "lottery ticket" process when each participant was asked to pick a ticket from a box containing even- and odd-numbered tickets with numbers hidden inside. Those who chose an odd-numbered ticket were placed in the TxAU group, and those who chose an even-numbered ticket were placed in the Mindful Motherhood group. Participants at the Stinson & Associates location were presented with a box containing tickets labeled 1-100, and participants at the Grady location were presented with a box containing tickets labeled 101-200. Tickets were drawn without replacement.

Participants in the two sites were presented with different incentives. Specifically, at the Stinson & Associates location, participants were paid $10 for each prenatal

assessment, and they were promised with a compensation of $40 for T4 assessment if they completed all T1-T3 assessments, $30 if they completed two previous assessments, and $20 if they only participated in T1 assessment. The Mindful Motherhood group participants of the Stinson & Associates location were not provided with monetary compensation for attending the intervention sessions. At the Grady location, participants were paid $20 for T1 and T2 assessments, $30 for T3 assessment, and $40 for T4 assessment. In addition, the Mindful Motherhood group participants received $10 for participation in each intervention session. The participant attrition rates at each site sites and the two sites combined are shown in Table 2. At the Stinson & Associates location, reasons for participant attrition included: program being closed, participants dropping out of the program, participant voluntary withdrawal from the study, participant pregnancy complications, and participant preterm delivery. Particularly, the sudden closure of the Stinson & Associates program in February 2012, which was the leading cause of attrition at this location (approximately 40%), led to the cessation of this portion of the project. In addition, dropping out of the program (25%) and voluntary withdrawal (15%) are common reasons for attrition at the Stinson & Associates location. At the Grady location, reasons for attrition included: disconnection of participants' phone number, participants' schedule conflict, lack of backup childcare service, participants' no shows to the assessment, and participants' withdrawal from the study. The leading cause of attrition at the Grady location was disconnection of the participant's phone number (72%).

III. Measures

Demographic Information

Demographic Information Questionnaire. The *Demographic Information Questionnaire* assesses background information, including education, occupation, sex, age, birthplace, and economic status. For the current study, questions with regard to weeks of pregnancy and pregnancy complications were added to the questionnaire.

Mindfulness

Toronto Mindfulness Scale. The *Toronto Mindfulness Scale* (Lau et al., 2006) was used to assess participants' levels of mindfulness. The *Toronto Mindfulness Scale* is a 13-item self-report measure of an individual's ability to attune him/herself to his/her internal experiences with a stance of curiosity and willingness. It is a 5-point Likert scale ranging from 0 (*not at all*) to 4 (*very much*). Sample items are "I remained open to whatever thoughts and feelings I was experiencing" and "I was receptive to observing unpleasant thoughts and feelings without interfering with them." Total scores range from 0 to 40, with higher scores indicating higher levels of mindfulness. The *Toronto Mindfulness Scale* has been shown to sensitively detect different levels of mindfulness with practice. Adequate internal consistency ($\alpha = .76$) was reported in literature and found in the current study ($\alpha = .85$). Good construct validity is suggested by as the developers reported moderate correlations between the *Toronto Mindfulness Scale* with measures of self-awareness and openness (Lau et al., 2006).

Sustained Attention

Wilkin's Counting Test. The Wilkin's Counting Test is a measure of sustained attention and has been used in mindfulness research (Valentine & Sweet, 1999; Wilkins,

Shallice, & McCarthy, 1987). The test consists of four acts, and each act has 12 sets of bleeps that were pre-recorded in an audio cassette tape. Each set starts with 'Ready' and ends with 'Stop.' The task for a participant is to count and report the number of bleeps by the end of each set. For the four assessments in the current study, a different act was played to participants each time. The accumulative error rate of reporting the 12 sets of bleeps during each assessment represents sustained attention: the lower the error rate, the better the sustained attention.

General Maternal Stress

General maternal stress was assessed using two psychological measures and two physiological stress measures. The two psychological stress measures were the Life Experience Survey and the Perceived Stress Scale. The two physiological measures were baseline cortisol levels and reactive cortisol response.

Life Experiences Survey. The *Life Experiences Survey* is a 57-item scale that assesses the life incidents that happened in the past year and their impact on the respondent (Sarason, Johnson, & Siegel, 1978). It is composed of two sections: the first section contains 47 items related to life events that are common to an individual in a wide variety of situations. The second section contains ten items that are only for school-related experiences. Only the first section was used for the current study. Participants were asked to rate each experienced life event on a seven-point Likert scale ranging from -3 (*extremely negative*) to 3 (*extremely positive*). If an event did not occur, the item was coded as 0. The total scores of the scale, which is the sum of all the subjectively rated scores, range from -141 to 141. In the current study, the total scores were reversely coded so that higher scores indicate higher levels of stressful life events. Sample items are

"trouble with in-laws" and "being fired from job." As the survey developers noted, the test-retest reliability might not be a good indicator of the psychometric property of the scale because new events may occur during the interval. Because the items on the Life Experiences Survey are presumably independent of each other, no psychometric data of the scale have been reported (Herrington, Matheny, Curlette, McCarthy, & Penick, 2005).

Perceived Stress Scale. The *Perceived Stress Scale* is a 14-item measure, which asks participants to rate the extent to which they have felt their life to be stressful within the past month (S. Cohen, Kamarck, & Mermelstein, 1983). It measures the degree of self-appraised stress in one's life. It is a 5-point Likert scale with 1 representing *never* and 5 representing *very often.* Sample items from the scale include "In the last month, how often have you been upset because of something that happened unexpectedly?" and "In the last month, how often have you found that you could not cope with all the things that you had to do?" Seven items were reversely coded so that higher total score on the Perceived Stress Scale reflects higher subjective stress. The Perceived Stress Scale has demonstrated good internal consistency and construct validity (Roberti, Harrington, & Storch, 2006). In the current study the Cronbach's α of the *Perceived Stress Scale* was .87. The total score of the scale was used to evaluate the level of subjective stress.

Physiological Measures. The cortisol levels from the salivary samples collected at the beginning of each assessment were regarded as *baseline cortisol levels*, and the cortisol level changes in response to the administration of the audio clip of a baby's cry were regarded as *reactive cortisol response*. The audio clip is a pre-recorded mp3 clip of a real baby's cry, which lasts for approximately two minutes. The mp3 clip was downloaded from a video clip from Youtube, which is unambiguously a part of the public

domain as a matter of law. It was proposed in the current study to serve as an ecologically valid stress stimulus.

Pregnancy-Related Experience

Pregnancy Experience Scale - Brief Version. The *Pregnancy Experiences Scale-Brief Version* is a short version of the *Pregnancy Experiences Scale*, a measure of maternal appraisal of daily ongoing experience specific to pregnancy (Janet A. DiPietro, Christensen, & Costigan, 2008; J. A. DiPietro, Ghera, Costigan, & Hawkins, 2004). This scale was implemented in this study to measure pregnancy-related positive experience and pregnancy-related stress. The *Pregnancy Experience Scale – Brief Version* consists of ten commonly endorsed uplifts and ten commonly endorsed hassles. All items are rated on a 4-point Likert scale from 0 (*not at all*) to 3 (*a great deal*). Sample items from the uplifts subscale are "how much the baby is moving" and "feeling about being pregnant at this time." Sample items from the hassles subscale are "your weight" and "clothes/shoes don't fit." The total scores on either the uplifts or the hassles subscale are sum of responses on the ten items on either subscale. Frequency of uplifts or hassles was defined as the total number of items that were not endorsed as 0 on either subscale. Intensity of uplifts or hassles was defined as the quotient of the total score divided by frequency on each subscale. The *Pregnancy Experiences Scale—Brief Version* has been indicated to have good internal reliability, test-retest reliability, and convergent validity (Janet A. DiPietro, et al., 2008; J. A. DiPietro, et al., 2004). In the current study, the Cronbacn's α for the uplifts subscale and the hassle subscale were .84 and .82 respectively. The uplifts intensity was used to measure pregnancy-related positive experience and the hassles intensity was used to measure pregnancy-related stress.

Depressive Symptoms

Beck Depression Inventory - II. The Beck Depression Inventory-II is a 21-item scale that measures the severity of depressive symptoms (Beck, Steer, & Brown, 1996). Participants are expected to rate on a four-point Likert scale with total scores ranging from 0-63. Sample items are "Sadness: (0) I do not feel sad, (1) I feel sad much of the time, (2) I am sad all of the time, (3) I am so sad or unhappy that I can't stand it;" and "Pessimism: (0) I am not discouraged about my future, (1) I feel more discouraged about my future than I used to be, (2) I do not expect things to work out for me, (3) I feel my future is hopeless and will only get worse." High internal consistency ($\alpha = .90$) and good construct validity were reported for the Beck Depression Inventory II (Beck et al., 1996; Dozois, 1998). The Cronbach's α of the scale in the current study was .91. The total scores of the scale were used to assess levels of depressive symptoms in the current study.

Coping Strategies

The COPE Inventory. Derived from Lazarus's (1984) transactional model of stress and the behavioral self-regulation model (Scheier & Carver, 1988), the COPE Inventory is a well developed measure of coping strategies (Carver, Scheier, & Weintraub, 1989). This four-point Likert scale asks participants to rate the frequency of using different coping strategies when responding to stress-provoking situations. The choices on each item range from 1 (*I usually don't do this at all*) to 4 (*I usually do this a lot*). Good internal consistency has been reported for various clusters of the COPE Inventory (Weinstein et al., 2009). The current study adopted three clusters (i.e., denial, behavioral disengagement, and mental disengagement) to measure avoidance-based

coping subscale and another three clusters (i.e., active coping, acceptance, positive interpretation and growth) to form an approach-based coping subscale (Weinstein et al., 2009). Sample items from the approach-based coping subscale are "I try to grow as a person as a result of the experience" and "I concentrate my efforts on doing something about it." Sample items from the avoidance-based coping subscale are "I turn to work or other substitute activities to take my mind off things" and "I admit to myself that I can't deal with it, and quit trying." The Cronbach's α for the approach-based subscale and the avoidance-based coping subscale were .88 and .72 respectively in the current study.

IV. Group Conditions

All the participants were randomly assigned to one of the following two groups during T1 assessment: TxAU and Mindful Motherhood. The TxAU group received routine care as usual. Specifically, the TxAU group at the Stinson & Associates location attended regular vocational rehabilitation training courses and prenatal care educational sessions provided by the program. The TxAU group at the Grady Hospital location received routine prenatal care from the hospital. In addition to receiving routine care, the Mindful Motherhood group was presented with the Mindful Motherhood intervention within two weeks of T1 assessment.

All the Mindful Motherhood group sessions in the current study were led by one facilitator. The facilitator of the group, who was also the Principle Investigator of the current study, was an advanced Ph.D. student at the Emory University Clinical Psychology Program. Prior to directing the group, the facilitator had intensive training experience at the Grady Memorial Hospital with African American patients and co-led mindfulness- and compassion-based intervention groups. The facilitator also attended the

Mindful Motherhood online training course (Vieten, 2012a) and reviewed the relevant training materials before group sessions (Vieten, 2009, 2012b).

The Mindful Motherhood intervention is an eight-session mindfulness- and acceptance-based intervention program for pregnant and postpartum women, and it focuses on experiences related to pregnancy and early parenting (Vieten, 2009, 2012b; Vieten & Astin, 2008). The protocol of the Mindful Motherhood intervention was adapted from empirically-supported mind-body interventions, including Mindfulness-Based Stress Reduction, Mindfulness-Based Cognitive Therapy, Acceptance and Commitment Therapy, and Dialectic Behavior Therapy. The Mindful Motherhood intervention aims at "helping new mothers become more aware of their present moment experience, increasing their ability to tolerate and regulate distressing affect without resorting to unhealthy behaviors, and cultivate the mothers' capacity to be fully present more often, with themselves and their child(ren) (Vieten, 2012b, p. 4)." Specific goals of the intervention include stress reduction, improvement in healthy coping strategies, reductions in negative mood and improvement in positive affect, improvement in self-care, parenting skills, and connection with the baby.

Three key mindfulness-based exercises are emphasized throughout the intervention to help achieve the goals: mindful sitting, mindful movement, and mindfulness in everyday life. "Mindful sitting" is equivalent to sitting meditation, which incorporates a variety of sitting meditation techniques, including mindful breathing, awareness of internal experiences, body scan, mindful bonding with the baby, and loving kindness meditation. "Mindful movement" refers to mild body movement that is suitable for pregnant women, particularly gentle yoga and mindful walking. In the present study,

only mindful walking was employed during the intervention sessions. “Mindfulness in everyday life” is defined as bringing mindfulness into daily life practice, including being mindfully aware of routine activities by being attentive to the experiences of one’s five senses (e.g., taking a shower and eating), mindfully fostering healthy self-care behaviors, and making mindful decisions on relationships.

Vieten (2012b) proposes the following session structure: opening/mindful movement (20 minutes), check-in (20 minutes), discussion of mindful awareness topic (20 minutes), mindfulness awareness practices (20 minutes), homework and readings review (5-10 minutes), and closing meditation (5-10 minutes). The group sessions starts with a brief 5 minutes sitting meditation, followed by mindful movement. During the check-in, participants are prompted to share their ongoing internal experiences, including thoughts, feelings, and bodily sensations. For each session, there is a general theme. Therefore during the discussion of mindful awareness topic, the facilitator generally introduces the theme, provide examples or relevant exercises, and help the group members understand the relevance of the topic to their well-being in daily life. The following list shows key themes of each session – Session One: introduce the key concepts of mindful sitting, mindful movement, and mindfulness in everyday practice; Session Two: discuss the nature of mindfulness (e.g., how it is different from the concept of control and price paid for effort to control) and lead an exercise that fosters mindfulness and acceptance (e.g., don’t think about chocolate cake exercise); Session Three: discuss the concept on self-as-context, introduce four components of internal experiences (i.e., thoughts, feelings, bodily sensations, and awareness) and provide metaphors to help process the concepts (e.g., sky metaphor and chess metaphor); Session

Four: facilitate the understanding that thoughts are transient phenomena that are not literal truth and use metaphors to illustrate the points (e.g., train of thoughts and two computer metaphor); Session Five: highlight the importance of present moment focus and bring exercises to experience the present moment (e.g, mindful listening and mindful eating); Session Six: present the concept of awareness, and elaborate on the qualities of awareness, including nonstriving and beginner's mind; Session Seven: introduce the concept of self-compassion and its connection with one's well-being; Session Eight: encourage group members to form plans and take committed action to practice mindfulness in daily life.

Following the discussion of mindfulness topic, mindfulness awareness practice is usually done in the form of sitting meditation which ties to the mindfulness topic of each session. Homework includes reading assignment and mindfulness practices, and the purpose of homework is to strengthen understanding of concepts and foster mindfulness practices in daily living. The brief closing meditation exercise focuses on the present moment experience and ends with loving-kindness meditation.

In the current study, session structure was generally consistent with the format provided in the manual. Fatigue and attentional problems were taken into consideration for the study population of pregnant women, and modifications from the manual were made so that the two meditation exercises close to the end of the session were collapsed into one mediation exercise. Each session lasted approximately 90 minutes instead of two hours, and it followed a common sequence: mindful movement and debriefing (20 minutes), check-in (20 minutes), discussion of mindful awareness topic (20 minutes),

mindfulness awareness practices (20 minutes), and homework and readings review (10 minutes).

In the current study, each cycle of eight sessions was provided over the course of four weeks with two sessions each week. Each group session consisted 1-6 participants. Rooms for the group intervention sessions were provided by the Stinson & Associates Program at the program's location and by the Grady Memorial Hospital Midwife Program at Grady Memorial Hospital location. Although the original design was for the Mindful Motherhood group participants to attend all the eight sessions, only a small percentage of participants completed a full course of training, and the participation of each de-identified participant is shown in Table 3.

Results

Statistical Analyses and Sample Characteristics

Data were entered into the SPSS 20.0 software and were checked and corrected for data entry errors prior to analyses. The demographic background and pregnancy information of the 65 participants are shown in Table 1, and the descriptive statistics of intervention variables are shown in Tables 6 through 17. Chi-square and independent t-tests for categorical and continuous variables respectively were conducted to compare the TxAU and the Mindful Motherhood groups at T1 assessment. Analyses of the sample characteristics of these two groups did not reveal differences in demographic background, pregnancy information, or intervention variables, including age, complications during pregnancy, weeks of pregnancy, relationship status, monthly income, number of children, levels of mindfulness, sustained attention, stressful life events, perceived stress, baseline cortisol levels, reactive cortisol response, pregnancy-related positive experience,

pregnancy-related stress, depressive symptoms, and approach-based coping and avoidance-based coping. Similarly, sample characteristics of T2 – T4 assessments completers and non-completers at T1 assessment were compared respectively using Chi-square and independent t-tests. No group differences were found in demographic background, pregnancy information, or intervention variables between T2 completers (n = 32) and non-completers (n = 33). Although not statistically significant, there was a trend that the T2 assessment non-completers endorsed lower levels of mindfulness than the T2 assessment completers at T1 assessment, $t(63) = 1.94$, $p = .058$. For T3 assessment completers (n = 22) and non-completers (n = 43), the two groups differed in that the completers were fewer weeks pregnant and endorsed higher levels of mindfulness than the non-completers at T1 assessment, $t(63) = -2.17$, $p < .05$, and $t(63) = 2.59$, $p < .05$ respectively. For T4 assessment completers (n = 21) and non-completers (n = 44), the completers endorsed lower levels of perceived stress and depressive symptoms than the non-completers at T1 assessment, $t(63) = -2.12$, $p < .05$, and $t(63) = -2.22$, $p < .05$ respectively.

High attrition rates did not only occur in assessments but also in intervention sessions, such that only three out of the 36 participants randomly assigned to the Mindful Motherhood condition completed the eight-session training. Given the small number of intervention completers, it was not statistically meaningful to compare the three intervention completers to the TxAU group. Nevertheless, because there was wide variability in the number of training sessions that the Mindful Motherhood group participants attended, dose-effect analysis was employed to test the treatment effect on outcome variables. *Dose* in this study refers to the number of intervention sessions, which

is different from drug dose in clinical trials on medications. Although the intensity of cognitive rehearsals could also be understood as dose in behavioral intervention studies, it was not investigated in the current study.

In the mindfulness literature there have been very few studies on dose-effect analysis. Based on the available information there are two major approaches to dose-effect analysis: minimal effective dose analysis and linear correlation between outcome variables and training session numbers (Sachse, Keville, & Feigenbaum, 2011; Teasdale et al., 2000). *Minimal effective dose* is defined by participation in at least four out of the total eight sessions, which was found to be sufficiently effective in preventing depression relapse (Teasdale et al., 2000). Linear correlation between outcome variables and number of sessions was applied in a more recent investigation, which revealed that session number correlated positively with levels of mindfulness and negatively with levels of experiential avoidance, state anxiety, and somatoform dissociation (Sachse et al., 2011).

Hypotheses 1 through 6 pertained to the maternal outcomes, including mindfulness, sustained attention, general maternal stress, pregnancy-related experience positive experience, pregnancy-related stress, depressive symptoms, and coping strategies. The correlations among these maternal outcome measures at T1 assessment time point are shown in Table 4. These six hypotheses were tested with the two aforementioned dose-effect analyses (Sachse et al., 2011; Teasdale et al., 2000). First, repeated measures analysis of covariance (ANOVA) was used to analyze scores of outcome measures among three groups across the first three assessments (Howell & Lacroix, 2012). Based on the definition of minimal effective dose from the mindfulness literature, the three groups were: the TxAU group, the Mindful Motherhood group

women who attended fewer than four sessions of training, and the Mindful Motherhood group women who attended at least four sessions (Teasdale et al., 2000). Because repeated measures ANOVA assumes equal interval between adjacent assessment time points, data from T4 assessment were excluded from repeated measures ANOVA analyses. The advantage of repeated measures ANOVA in the current study was the benefit of tracking the pattern of change among the three groups across three time points. However, because of participant attrition at T2 and T3 assessments, the analyses only applied to a subgroup of participants who attended both T2 and T3 assessments, causing a reduction in statistical power. All outcome measures except levels of cortisol response were tested this way as the cortisol assays for reactive cortisol response were not conducted for either T3 or T4 assessment due to practical difficulties. Results of relevant descriptive statistics of outcome measures are shown in Table 5, and the main effects of group condition and the interactions between group condition and assessment time are shown in Table 6.

Second, as suggested by the recent study using dose-effect analysis, multiple linear regressions were used to analyze the effect of number of training sessions on outcome measures controlling for pre-intervention levels of the same outcome measures (Sachse et al., 2011). In the current study, although multiple linear regressions did not have the advantage of tracking pattern of change across various assessments, they optimized statistical power by including all the participants who participated in post-intervention and follow-up assessments. The results of multiple linear regressions are shown in Tables 7-17. The statistically significant results from multiple linear regressions are summarized in Table 19.

Hypothesis 7, which focused on treatment effects on birth outcomes, was also tested using multiple linear regressions by analyzing the effects of number of training sessions on the two outcome measures, and the results are shown in Table 18.

Impact of Intervention on Mindfulness

The first hypothesis pertained to the impact of intervention condition on levels of mindfulness, which were measured using the Toronto Mindfulness Scale. Results from repeated measures ANOVA did not reveal a significant main effect of group condition or an interaction between group condition and assessment time. However, multiple linear regressions showed that number of sessions had a positive association with levels of mindfulness controlling for pre-intervention levels of mindfulness at T2 assessment time point, $B = .821$, $t\ (30) = 1.69$, $p = .05$, *partial* $\eta^2 = .087$ (medium effect size). However, the effect of session numbers on levels of mindfulness was not sustained at the time of the T3 or T4 assessment time point. The results are also shown in Tables 5, 6, and 7. Thus, findings partially support the hypothesis in that there was a dose effect of mindfulness training on levels of mindfulness post-intervention. However, the dose effect did not last following post-intervention assessment, nor was treatment effect shown with a subgroup of participants using repeated measures ANOVA.

Impact of Intervention on Sustained Attention

The second hypothesis focused on the impact of intervention condition on levels of sustained attention, which were measured using Wilkin Counting Test. Results from repeated measures ANOVA did not reveal a main effect of group condition or an interaction between group condition and assessment time. Although multiple linear regressions also did not detect any effect of number of sessions on counting error rates at

T2 or T3 assessment time point, session number appeared to be negatively associated with counting error rates at T4 assessment time point, B = -.7(%), t (16) = -2.52, $p < .01$, *partial* η^2 = .289 (large effect size). The results are shown in Tables 5, 6, and 8. Thus, findings partially support the hypothesis in that number of sessions was negatively correlated with counting errors one month postpartum. However, the dose effect was not shown at post-intervention time point, one month post-intervention time point, or with a subgroup of participants using repeated measures ANOVA.

Impact of Intervention on General Maternal Stress

The third hypothesis related to the impact of intervention condition on general maternal stress. In the current study measures of general maternal stress included stressful life events, perceived stress, baseline cortisol levels, and levels of reactive cortisol response. Stressful life events and perceived stress were measured using the Life Experiences Survey and Perceived Stress Scale respectively.

The use of repeated measures ANOVA to examine levels of stressful life events did not yield any significant results of main effect of group condition or interaction between group condition and assessment time. Likewise, multiple linear regressions also failed to detect a significant relationship between session number and levels of stressful life events at T2, T3 assessment time point, or T4 assessment time point. The results are shown in Tables 5, 6, and 9.

In addition, neither any main effect of group condition nor any interaction between group condition and assessment time was found significant for levels of perceived stress using repeated measures ANOVA. Similarly, no association between

session number and levels of perceived stress was found at T2, T3, or T4 assessment time point. The results are displayed in Tables 5, 6, and 10.

For baseline cortisol levels, results from repeated measures ANOVA did not support any main effect of group condition or any interaction between group condition and assessment time. In line with the results from repeated measures ANOVA, multiple linear regressions did not suggest that session number was associated with baseline cortisol levels at T2, T3 or T4 assessment time point. The results are shown in Tables 5, 6, and 11.

With regard to levels of reactive cortisol response, only one multiple linear regression was conducted because of the lack of data for the T3 and T4 assessments. Interestingly, the results supported that number of sessions was negatively associated with reactive cortisol response at T2 assessment time point controlling for pre-intervention levels of reactive cortisol response, $B = -.021$, $t(22) = -2.90$, $p < .01$, *partial* $\eta^2 = .227$ (large effect size). The Results are shown in Table 12.

Thus, the second hypothesis was largely unsupported except the indication that the levels of reactive cortisol response were impacted by session number post-intervention. However, intervention did not seem to have impact on any other stress indicators, including levels of baseline cortisol, stressful life experience, and perceived stress.

Impact of Intervention on Pregnancy-Related Positive Experience and Pregnancy-Related Stress

The fourth hypothesis was concerned about whether or not intervention had impact on pregnancy-related positive experience and pregnancy-related stress, which

were measured respectively using the intensity of pregnancy-related uplifts subscale and the intensity of pregnancy-related hassles subscale from the Pregnancy Experience Scale – Brief Version. Results from repeated measures ANOVA did not show any main effect of group condition, but an interaction between group condition and assessment time, $F(2, 19) = 2.04$, $p < .05$, *partial* $\eta^2 = .217$ (large effect size). The means of intensity of pregnancy-related uplifts in the first three assessments broken down by the three groups were displayed in Figure 4.

Post-hoc pairwise comparisons of simple main effects were made using a subcommand of repeated measures ANOVA to evaluate the effect of the three groups on levels of pregnancy-related uplifts at each of the three assessment time points. The results showed that the Mindful Motherhood group that attended at least four sessions reported lower levels of pregnancy-related uplifts than the TxAU group at T1 assessment time point, $p < .05$. However, the differences diminished at both the T3 and T4 assessment time points. In addition, multiple linear regressions reveled that number of sessions was positively associated with perceived levels of intensity of pregnancy-related uplifts at T3 assessment time point controlling for pre-intervention levels of uplifts intensity, $B = .047$, $t(19) = 1.78$, $p < .05$, *partial* $\eta^2 = .141$ (large effect size). However, the effect was not shown at T2 or T4 assessment time point. The results are shown in Tables 5, 6, and 13.

For the intensity of pregnancy-related hassles, repeated measures ANOVA did not reveal any main effect of group condition or any interaction between group condition and assessment time. However, the results of multiple linear regressions confirmed the significant negative association between number of sessions and intensity of pregnancy-

related hassles at T2 assessment time point, B = -.067, t (29) = -2.54, p < .01, *partial* η^2 = .182 (large effect size). Although not statistically significant, there was also a trend of continuation of the relationship between number of sessions and intensity of pregnancy-related hassles at T3 assessment time point, B = -.051, t (19) = -1.50, p = .075, *partial* η^2 = .105 (large effect size). The results are shown in Tables 5, 6, and 14.

Thus, the results partially support the hypothesis in that session number appears to positively predict pregnancy-related positive experience one month post-intervention and negatively predict pregnancy-related stressful experiences post-intervention. However, the dose effect of mindfulness training was not shown repeatedly with multiple linear regression analyses or with a subgroup of participants using repeated measures ANOVA.

Impact of Intervention on Depressive Symptoms

The fifth hypothesis related to the impact of intervention condition on levels of depressive symptoms, which were measured using the Beck Depression Inventory – II. Results from repeated measures ANOVA did not show any main effect of group condition or any interaction between group condition and assessment time. Interestingly, analyses from multiple linear regressions revealed a negative association between number of sessions and depressive symptoms at T3 assessment time point controlling for pre-intervention levels of the same variable, B = -.883, t (19) = -1.89, p < .05, *partial* η^2 = .159 (large effect size). However, no any similar effect was shown at T2 or T4 assessment time point. The results are shown in Tables 5, 6, and 15. Thus, findings partially support the hypothesis in that number of training sessions showed negative impact on levels of depressive symptoms one month post-intervention. Nevertheless, the

dose effect was not shown immediately post-intervention or with a subgroup of participants using repeated measures ANOVA.

Impact of Intervention on Coping Strategies

The sixth hypothesis pertained to the effect on intervention on two coping strategies, approach-based coping and avoidance-based coping, which were measured respectively using subscales from the COPE Inventory. Results from repeated measures ANOVA did not show significant results of any main effect of group condition or any interaction between group condition and assessment time for approach-based coping. Similarly, multiple linear regressions did not show a relationship between session number and levels of approach-based coping at T2, T3, or T4 assessment time point. The results are shown in Tables 5, 6, and 16.

For avoidance-based coping, findings from repeated measures ANOVA did not show any main effect of group condition, but showed an interaction effect between group condition and assessment time, $F(2, 19) = 3.73$, $p < .05$, *partial* $\eta^2 = .282$ (large effect size). The means of intensity of avoidance-based coping in the first three assessments broken down by the three groups are displayed in Figure 5. Post-hoc pairwise comparisons of simple main effects were made using a subcommand of repeated measures ANOVA to evaluate the effect of the three groups on levels of avoidance-based coping at each of the three assessment time points. Unfortunately, the results failed to show differences among the three groups at any time point of the three assessments. Likewise, multiple linear regressions failed to find the association between session number and levels of approach-based coping at T2, T3, or T4 assessment time pont. The

results are shown in Tables 5, 6, and 17. Thus, the results did not support the fifth hypothesis.

Impact of Intervention on Birth Outcomes

The seventh hypothesis centered on the impact of intervention condition on birth outcomes, including birth weight and gestational age. Results from simple linear regressions failed to support the hypothesis that session number was positively associated with birth weight or gestational age. The descriptive statics of these two outcome variables broken down by session number and results of simple linear regressions are detailed in Table 18.

Discussion

The current study is believed to be the first empirical investigation that attempted to use a randomized controlled design to examine the efficacy of a mindfulness-based intervention with urban, low-income, pregnant African American women. However given the high attrition rates, the ability to compare intervention completers to the TxAU group could not be accomplished. Nevertheless, given the variability in the number of training sessions that the intervention group participants attended, number of sessions served well as an intervention variable for hypothesis testing (Sachse et al., 2011; Teasdale et al., 2000). Preliminary findings indicate the efficacy of the Mindful Motherhood training in improving levels of mindfulness, reducing reactive cortisol response and pregnancy-related stress at post-intervention, improving pregnancy-related positive experience and reducing depressive symptoms at one month follow-up, and improving sustained attention at one month postpartum. However, none of these effects appeared to have lasting impact on the participants, and treatment did not appear to impact stressful life

events, perceived stress, baseline salivary cortisol levels, coping strategies, or obstetric outcomes.

Impact of Intervention on Mindfulness

The first hypothesis targeted intervention effects on a key outcome variable, mindfulness. Findings from multiple linear regressions analyses partially supported this hypothesis in that the post-intervention levels of mindfulness were dependent on the number of sessions participants attended. However, there was no relationship between levels of mindfulness and number of sessions attended at the one month post-intervention or one month postpartum follow-up assessment. Nonetheless, the medium effect size number of sessions attended and levels of mindfulness at the post-intervention assessment time point suggests that the intervention was effective for boosting levels of mindfulness.

This finding is consistent with those from other recent studies that also used the Toronto Mindfulness Scale to measure state mindfulness, which reflects one's progress of mindfulness practice with an open, accepting, and curious position (Bieling et al., 2012; Gayner et al., 2012; Jacobs, Cardaciotto, Block-Lerner, & McMahon, 2013). Further, given the aforementioned health benefits associated with mindfulness (e.g., improvement in effective emotion regulation and reductions in depressive symptoms), the current study also adds external validity to the mindfulness literature. Specifically, an urban, low-income minority group of expectant mothers are likely to improve their overall well-being through learning mindfulness-based practice (Jensen et al., 2012; Keng et al., 2011; Klatt et al., 2009; Nedeljkovic et al., 2012; Robins et al., 2012). Therefore, although there is no literature to date on using the Toronto Mindfulness Scale in studies involving

African American participants, findings from the current study suggest the applicability of this assessment tool in evaluating a key factor of mindfulness-based interventions with more diverse populations.

In addition to a lack of relationship between number of sessions and levels of mindfulness at the two follow-up assessment time points, repeated measures ANOVA analyses also revealed no any treatment effect of the mindfulness intervention. Because the sample sizes for these analyses were smaller than the sample size for the post-intervention analyses using linear multiple regressions, it is possible that a reduction of statistical power might partly explain these nonsignificant results. However, it is important to investigate this further given that these findings may also indicate that the treatment effect is temporary and begins to fade away at one month post-intervention. Therefore, it would be helpful for future studies to seek to determine whether or not a full course of intervention would optimize the maintenance of treatment gains.

Impact of Intervention on Sustained Attention

The second hypothesis pertained to treatment effects on levels of sustained attention. This hypothesis was partly supported in that the Mindful Motherhood group committed fewer errors in a test that assessed sustained attention at one month postpartum time point. However, no group differences were detected at post-intervention or the other follow-up assessment time points. While only one third of the participants remained for the final assessment may limit the genenalizability of these results, they still provide preliminary evidence for the potential of the Mindful Motherhood intervention to have a delayed effect on enhancing participants' attentiveness. Such an implication is in line with an earlier study which, using the same counting test, revealed a treatment effect

of a mindfulness-based intervention on sustained attention (Valentine & Sweet, 1999). Likewise, other studies using different measures found the efficacy of mindfulness-based training in improving sustained attention (Bostanov et al., 2012; Jensen et al., 2012).

Mindfulness-based practices have been proposed to improve one's sustained attention by facilitating his or her ability to pay attention to the present moment experience even when distracted (Kang et al., 2013). However in the current study, the effect of session number on levels of mindfulness was nonsignificant at the postpartum assessment. Therefore the current study results suggest that, although an important aspect of mindfulness, attention is distinct from the characteristics of openness and acceptance to one's internal experiences, as measured by the Toronto Mindfulness Scale.

Impact of Intervention on General Maternal Stress

While the third hypothesis that the Mindful Motherhood intervention would alleviate general maternal stress was largely unsupported, reactive cortisol response was found to be associated with number of sessions that participants attended. Such findings are not completely unexpected, given that in the mindfulness literature, results have been mixed regarding treatment effects on cortisol levels (Brand et al., 2012; Bränström et al., 2013; Galantino et al., 2005; Jensen et al., 2012; Nyklíček et al., 2013; Oken et al., 2010; Witek-Janusek et al., 2008).

In Brief, it appears that most studies reporting a treatment effect on the reduction of cortisol levels utilized salivary samples gathered first thing in the morning, whereas the majority of the studies that failed to detect treatment effects did not. Findings from other studies have indicated that cortisol levels in salivary samples obtained upon awakening are least likely to be impacted by daily activities and are more reliable

measurement of HPA axis than those gathered at other time points (Brand et al., 2012; Jensen et al., 2012; Witek-Janusek et al., 2008). In the current study, logistical barriers made it difficult to do gather early morning salivary samples, and the collection times ranged from morning to afternoon. It is likely that the variability in collection time contributed to measurement errors that made it more difficult to ascertain treatment effects on the reduction of cortisol levels. In addition, as cortisol levels change drastically throughout the course of pregnancy (Jung et al., 2011), it is also likely that the relationship between prenatal cortisol levels in response to the mindfulness-based intervention may have been confounded by both the impact of HPA axis activity and pregnancy phase.

In comparison, although the ecologically valid stimulus (i.e., a baby's cry), did not seem to increase respondents' cortisol levels, session number was found to predict reactive cortisol response with a very large effect size, such that attending more training sessions predicted more reductions in reactive cortisol response post-intervention. Although this has been a less frequently researched area of investigation, preliminary data seem to indicate that reactive cortisol response is an informative tool for measuring the relationship between hormonal stress response and mindfulness-based interventions (K. W. Brown et al., 2012; Tang et al., 2007). It is possible that reactive cortisol response might be a more desirable measure of physiological stress during pregnancy, as higher prenatal cortisol levels are not necessarily associated with greater stress levels during that time. In fact, a more effective stressor, such as Trier Social Stress Test, may be needed in order to assess whether or not the treatment effect on reactive cortiol response can be

duplicated in the context of a moderately stress provoking situation (K. W. Brown et al., 2012).

For stressful life events, the number of sessions was not found to be predictive of stress levels at post-intervention or either of the two follow-up assessments. Such findings are not necessarily unexpected as, although stressful life events have been commonly used in prenatal maternal stress literature, it has been seldom used repetitively within longitudinal designs (Entringer et al., 2011; Zhu et al., 2010). As a result, it is possible that the measure of stressful life events does not have good reliability. More specifically, it may be better to use another measure with proven test-retest reliability when considering the use of repeated measures inherent within clinical trials of a longitudinal design.

Finally, unexpectedly, the current study failed to detect any intervention effect on levels of perceived stress. Perceived stress, as a critical stress indicator, has been used intensively in the mindfulness literature (Baer, Carmody, et al., 2012; Jensen et al., 2012; Klatt et al., 2009; Warnecke et al., 2011), and plethora of evidence has suggested that mindfulness-based interventions are effective in reducing perceived stress. Nevertheless, given non-specificity for pregnancy-related stress, it remains unknown as to whether or not perceived stress is a most suitable measurement of stress for pregnant women.

Unfortunately, none of the available investigations on mindfulness-based interventions for pregnant women had included perceived stress as an outcome variable (Duncan & Bardacke, 2010; Dunn et al., 2012; Faucher, 2013; Vieten & Astin, 2008). Instead, studies have focused more on emotional response, pregnancy-specific anxiety, depressive symptoms, and behavioral responses to various treatments. Notably, Duncan

and Bardacke (2010) reported treatment effect of the Mindfulness-Based Childbirth and Parenting program on the reduction in pregnancy-specific anxiety, likely to be a more sensitive tool to track prenatal maternal stress and should be utilized in future investigations that seek to build upon the results from the current study.

Impact of Intervention on Pregnancy-Related Positive Experience and Stress

The fourth hypothesis, focusing on intervention effect on pregnancy-related positive experience and stress, was partially supported by the findings from this current investigation. More specifically, the number of sessions positively predicted pregnancy-related positive experience at the one month follow-up assessment time point and negatively predicted pregnancy-related stress at the post-intervention assessment time point. Although replication and further exploration is necessary in order to make strong claims, it appears that relative to measures of general perceived stress, measures of pregnancy-related positive experience and pregnancy-related stress have better sensitivity in tracking the effect of mindfulness-based interventions on prenatal stress. However, while the aforementioned findings by Duncan and Bardacke (2010) also suggest the effectiveness of using pregnancy-specific anxiety measures to discern treatment effects, their study was merely a pretest and posttest design. As a result, claims that post-intervention decrease in levels of pregnancy-specific anxiety was caused by the treatment require replication and further exploration before they can be strongly made.

Impact of Intervention on Depressive Symptoms

The fifth hypothesis pertaining to intervention effect on levels of depressive symptoms, was partially supported. In fact, the number of training sessions was negatively associated with depressive symptoms at one month follow-up assessment.

However, they were not associated at the post-intervention or one month postpartum assessment time point. Significant findings are consistent with the mindfulness literature that supports the treatment effect on reductions in depressive symptoms (Chiesa & Serretti, 2009; Coelho et al., 2013; Fjorback et al., 2011; Galante et al., 2013; Hofmann et al., 2010; Piet & Hougaard, 2011; Toneatto & Nguyen, 2007; Vøllestad et al., 2012). However, because the treatment effect on depressive symptoms was delayed and did not last at postpartum assessment time point, it would be worthwhile to improve the intervention design in a manner that can result in a faster and longer-lasting impact on prenatal depressive symptoms.

Impact of Intervention on Coping Strategies

The sixth hypothesis centered on intervention effect on coping strategies, i.e., on approach-based coping and avoidance-based coping. Findings failed to support the expectation that the Mindful Motherhood group would evidence greater improvement in approach-based coping and more reductions in avoidance-based coping than the TxAU group. As a result, these findings are in contrast with an earlier study which showed expected treatment effect of mindfulness training on college students' approach-based and avoidance-based coping strategies (Weinstein et al., 2009). This calls into question the assumption that coping strategies have served as mediators of mindfulness-based interventions on outcome variables of interest, such as depressive symptoms and stress. Because the nature of both approach-based and avoidance-based coping strategies involves behavioral elements, which are distinct from changes on a psychological level, it is not surprising that intent to change one's behavior is an important impetus that does not necessarily lead to action (P. A. Hall, Zehr, Ng, & Zanna, 2012). In fact, various

factors (e.g., environmental resources and strength of intent), also directly affect one's action. Therefore, it is possible that the Mindful Motherhood training is most beneficial to the enhancement of expectant mothers' psychological well-being, while overt action-oriented approaches (e.g., Acceptance and Commitment Therapy) may have greater impact on behavioral changes in taking committed action (Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007).

Impact of Intervention on Birth Outcomes

The last hypothesis focused on the effect of intervention on birth outcomes, including birth weight and gestational age. While is believed to be the first empirical investigation that attempted to ascertain treatment effect of a mindfulness-based intervention on offspring birth outcomes, unfortunately, the study failed to establish an association between the number of training sessions and either of the two birth outcomes. However, further investigations into the relationship between this intervention and these birth outcomes is warranted. In particular, given the various confounding factors embedded in the current study, including small sample size, serious attrition problems, and liberal inclusion criteria for length of pregnancy required. Undoubtedly, whether or not mindfulness-based interventions can improve obstetric outcomes is a question worth further inquiry.

Study Limitations

The current study has suffered from serious attrition rates, such that only about half of the participants completed the post-intervention assessment, and only about one third of the participants completed the two follow-up assessments. As a result, the assumption of random assignment between the two groups has been seriously

compromised. In particular, because completers and non-completers differed significantly on some critical variables (e.g., levels of mindfulness and perceived stress) at one month and postpartum follow-up assessment time points, generalizability of study results is limited. In addition to the impact on assessment data, most participants in the Mindful Motherhood group did not complete the full course of treatment. Hence, the decision to use dose-effect analyses to determine whether or not this intervention might have effect on outcome variables of interest. Nonetheless, because of the variability in number of sessions completed by intervention group participants, even those analyses that revealed significant associations between outcome variables and number of sessions completed, results may have reflected differences in confounding participant characteristics rather than treatment effects and should be interpreted with caution.

Such limitations are not necessarily unique to this study alone. In fact, several other investigations of importance have observed that underprivileged African Americans tend to under-utilize mental health services and have higher attrition rates (Alvidrez, Snowden, & Patel, 2010; A. Austin & Wagner, 2010; V. L. S. Thompson, Bazile, & Akbar, 2004). Among the barriers to treatment observed are stigma associated with seeking psychological services, lack of knowledge about psychological services, problems with affordability, lack of trust, and problems with cultural understanding (Alvidrez et al., 2010; Alvidrez, Snowden, Rao, & Boccellari, 2009; C. Brown et al., 2010; Leis et al., 2011; V. L. S. Thompson et al., 2004). Specific to the implementation of mindfulness-based interventions for urban, low-income, African American women, similar challenges have been documented (Dutton et al., 2013). More particularly, despite efforts to adapt a Mindfulness-Based Stress Reduction program for a group of urban,

low-income, trauma-impacted, predominately African American women, attrition rate was still found to be higher than the attrition rate of participants with middle-class background (Dutton et al., 2013). Within that comparison study, barriers to treatment continuation included lack of understanding of the key concepts and conflict with one's own religious practices. Further, a qualitative investigation that focused on a sample most relevant to the current study (i.e., urban, low-income, perinatal African American women) revealed that the participants generally held negative perceptions regarding mental health services, viewed mental health care providers as being emotionally unavailable and detached, and believed that mental health services are unhelpful (Leis et al., 2011). Taken together, these studies indicate that the aforementioned factors need to be taken into consideration when attempting to employ mindfulness-based interventions with samples of disadvantaged pregnant women from minority groups.

Finally, the study also suffered a lack of sufficient staff members. While the Mindful Motherhood Training Manual (Vieten, 2012b) recommends two co-facilitators for the intervention group, only one facilitator was involved in this current study and may have negatively impacted the effectiveness of intervention implementation. In addition, while that facilitator had mindfulness-based training experience in Acceptance and Commitment Therapy and Mindful Motherhood intervention, she did not have training in Mindfulness-Based Stress Reduction or Mindfulness-Based Cognitive Therapy prior to the study, both of which were integrated into the Mindful Motherhood intervention. This could have impeded the effective implementation of the treatment manual. It would be of benefit to ensure that future treatment facilitators be formally trained on the recommended interventions prior to treatment implementation. Finally, despite extensive

prior experience working with underprivileged African American women, it is possible that being from a different cultural and ethnic background may have been a contributing factor for attrition rates (Cabral & Smith, 2011).

Conclusions and Future Directions

Despite the aforementioned methodological limitations, to the best of our knowledge, this pilot study the first empirical investigation examining a mindfulness-based intervention with a group of urban, low-income, pregnant African American women. While preliminary findings from the current study indicate the potential efficacy of the Mindful Motherhood intervention in improving levels of mindfulness, sustained attention, and pregnancy-related positive experiences, as well as reducing stress response, pregnancy-related stress, and depressive symptoms. However, until further investigations replicate and extend these findings, caution should be taken about making strong claims about effectiveness given that none of these effects appeared to have lasting impact on participants, and treatment did not seem to be associated with stressful life events, perceived stress, salivary cortisol levels, or obstetric outcomes of interest.

At the same time, this preliminary study opens up a variety of avenues for future research. First, for intervention studies with African American participants, factors that contribute to treatment barriers need to be considered and efforts need to be made to improve participation and adherence (Dutton et al., 2013; Entringer et al., 2011; Kaslow et al., 2010). Such barriers should be addressed at different stages of research, including study design, recruitment and retention efforts, intervention implementation, and during follow-up assessment. In designing treatment programs for low-income, African Americans, resilience- and empowerment-based programs (e.g., mindfulness-based

interventions) are strongly recommended as they have the potential to reduce stress and improve well-being as well as, remove stigma associated with mental health services (Burton, Pakenham, & Brown, 2010; Dunkel Schetter, 2011). For the process of recruitment, demystifying mental health services and disseminating the knowledge about mental health services seems to be helpful to increase the chance of successful engagement (Alvidrez et al., 2009). For the treatment phase, efforts can also be made to reduce attrition rates, including removing logistic barriers (e.g., need of childcare during treatment) and matching the ethnic background of providers with care receivers. For instance, Kaslow and colleagues (2010) developed an evidence-based treatment program for African American women with a recent history of intimate partner violence and a suicide attempt. In order to optimize treatment adherence, the treatment protocol required that one of the co-facilitators needed to be an African American woman.

Second, modifications of the Mindful Motherhood Training protocol are recommended to make it more suitable for urban, low-income, minority populations that struggle with various life- and pregnancy-related stressors. It is suggested that examples and stories relevant to the lives of these populations be employed when explaining key mindfulness concepts. In addition, instead of assigning abstract readings on mindfulness, more concrete homework that is briefer, more accessible, and more attainable would increase the likelihood that the participants would complete practice exercises. Furthermore, incorporating feedback from the population of interest would also be helpful, as anecdotal feedback from participants in the current study included a suggestion to discourage the use of mindful standing as part of mindful movement exercise due to the physical discomfort a good number of them experienced.

Finally, it is desirable to replicate the current study with optimal participant retention in both assessment and intervention. Given the drawbacks of the high attrition rates in the current study, it would be important to re-test the research hypotheses by directly comparing the two groups, i.e., the TxAU group and the intervention group that completed a full course of training, on the outcome variables. The results and conclusions based on a randomized controlled clinical trial with sufficient participation would be more compelling than the implications from the current study. Once the efficacy of mindfulness-based interventions for low-income, pregnant African American women is established, it would be critical for future studies to examine intervention mechanisms, such as the potential mediator's role that key intervention factors (e.g., mindfulness and attention) might have played (Baer, Lykins, & Peters, 2012; Greason & Cashwell, 2009; Keng, Smoski, Robins, Ekblad, & Brantley, 2012; Richards, Campenni, & Muse-Burke, 2010).

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Figure 1. *Participant Flowchart at the Stinson & Associates Location*

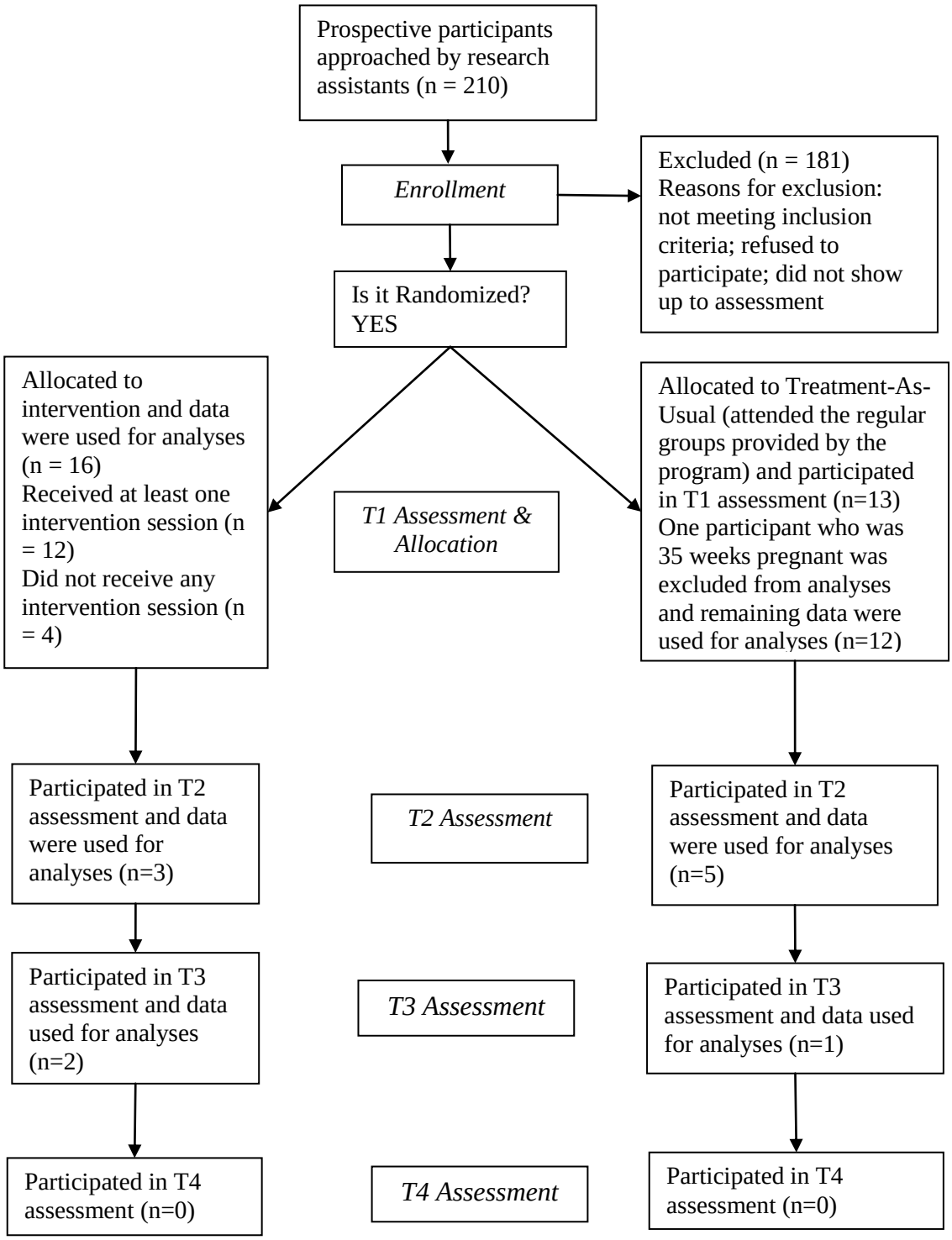

Figure 2. *Participant Flowchart at Grady Memorial Hospital Location*

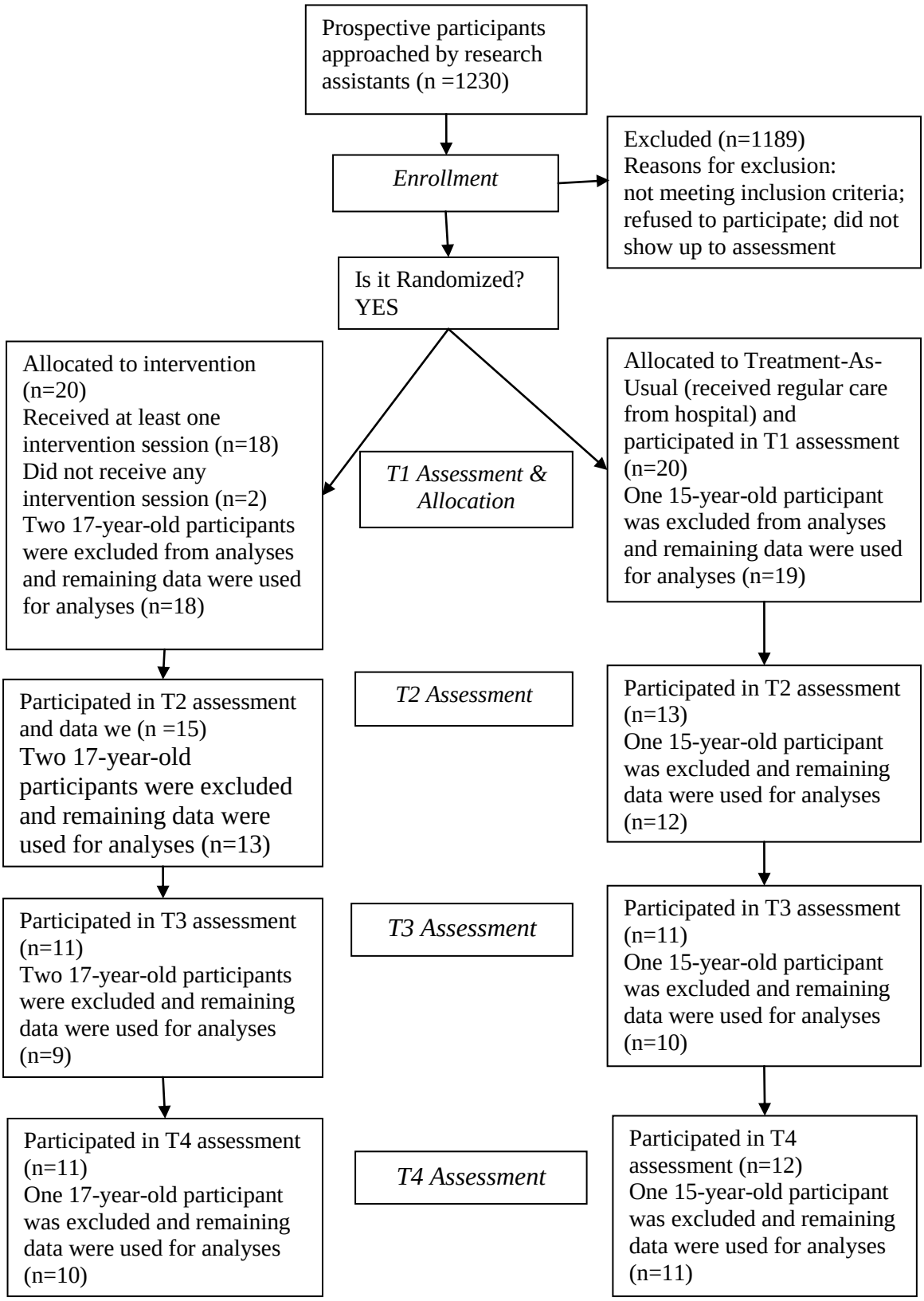

Figure 3. *Combined Participant Flowchart*

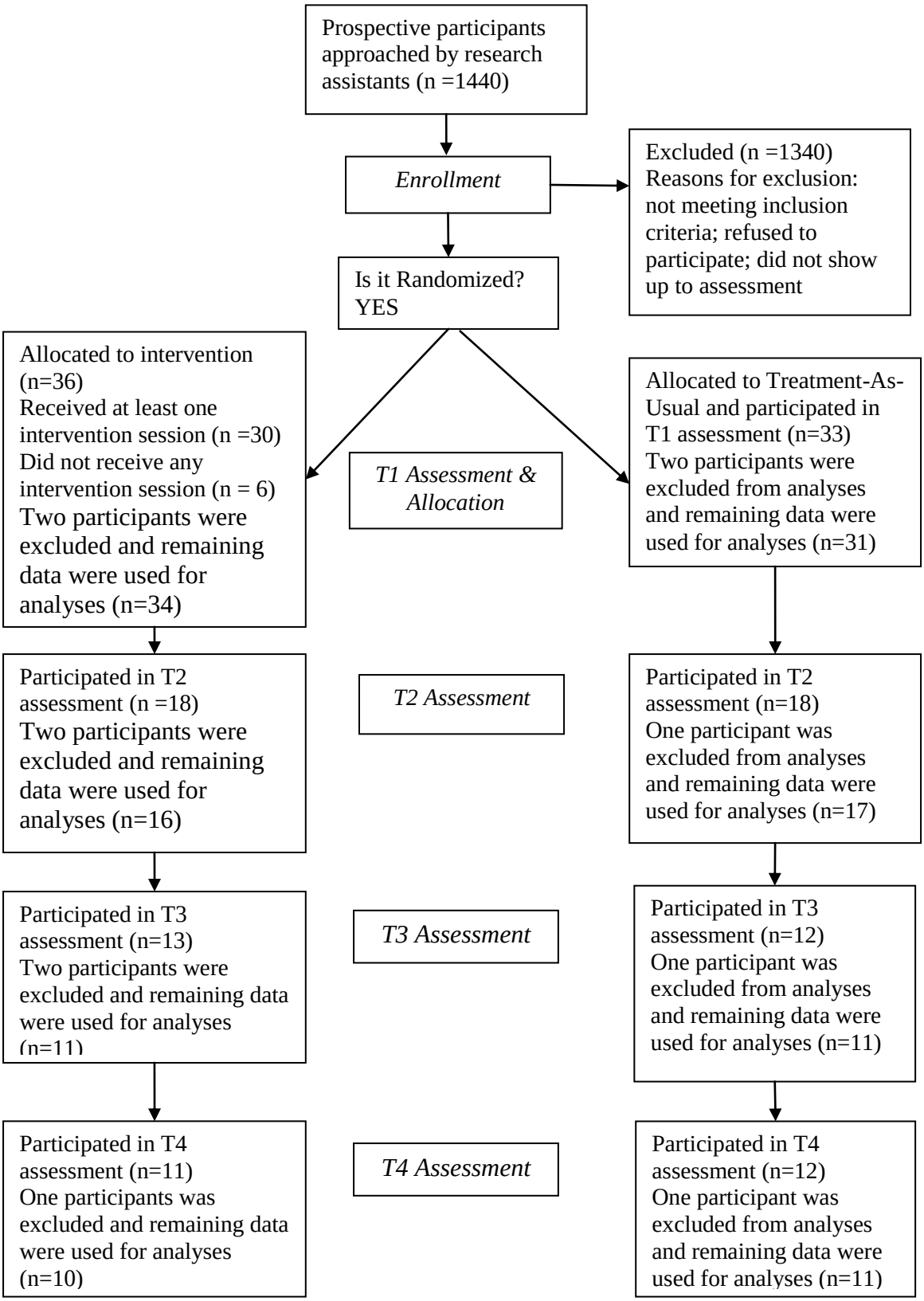

Figure 4. *Means of Pregnancy-Related Experiences – Brief Version: Uplifts Intensity in the First Three Assessments Broken Down by Three Groups*

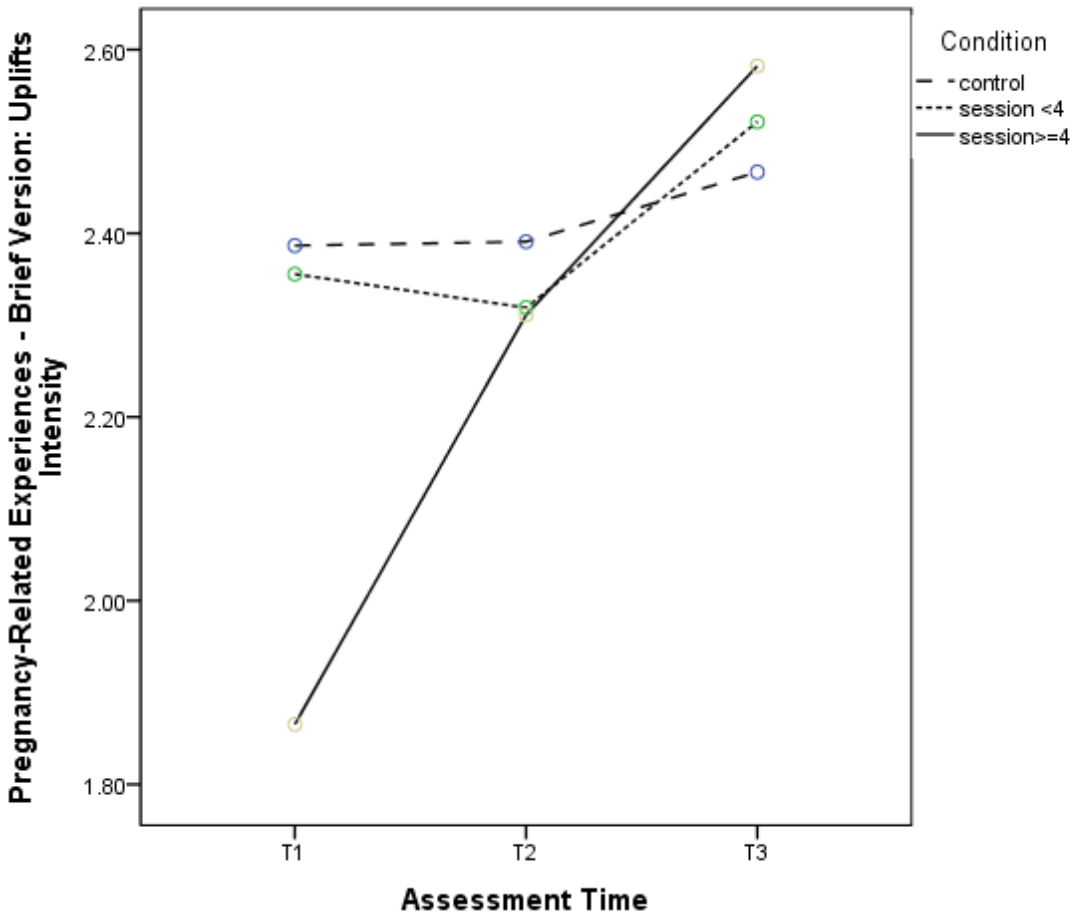

Figure 5. *Means of COPE Inventory: Avoidance-based Coping in the First Three Assessments Broken Down by Three Groups*

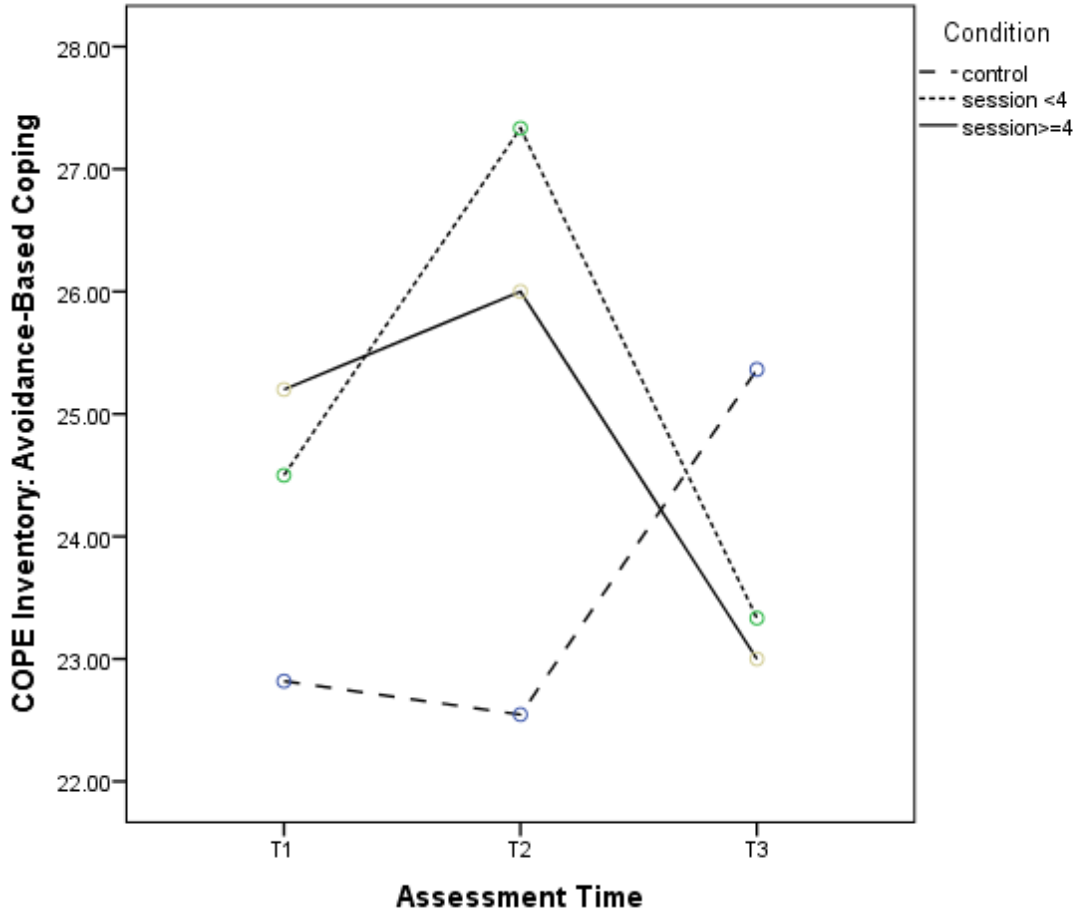

Table 1. *Demographic Characteristics and Pregnancy Information of the Participants*

Demographic Characteristics	Descriptive Statistics
Age (mean, SD)	25.3, 4.6
Weeks of pregnancy (mean, SD)	21.5, 5.1
Complication during pregnancy (%)	32.3
Relationship status (%)	
Single or never married	29.4
With partner, not living together	19.1
With partner, living together, not married	38.2
Married	13.2
Have children (%)	
Unemployed (%)	84.6
Individual monthly income (%)	
$0-$249	32.3
$250-$499	30.8
$500-$999	29.2
>$999	7.7

Table 2. *Study Participant Attrition Rates (%)*

Participant Location	T1 Assessment	T2 Assessment	T3 Assessment	T4 Assessment
Stinson & Associates	0	72	90	100
Grady Hospital	0	29	41	39
Two Sites Combined	0	47	63	66

Table 3. *Intervention Group Participants' Attendance in Mindful Motherhood Training and Assessments*

Number of Intervention Sessions	Participant ID				
	Intervention Participation	T1 Assessment	T2 Assessment	T3 Assessment	T4 Assessment
8	50	50	50	50	
	114	114	114	114	114
	142	142	142		142
7	130	130	130		130
	146	146	146	146	
	150	150	150		
6	32	32			
	40	40	40		
5	12	12			
4	6	6			
	14	14	14	14	
	128	128	128	128	
3	30	30			
	48	48			
	108	108	108		108
	116	116	116	116	116
	138	138	138	138	138
2	56	56			
	102	102	102	102	102
	132	132	132	132	132
	134	134			134
1	8	8			
	10	10			
	54	54			
	106	106			
	118	118	118	118	118
	122	122			
	136	136	136	136	
0	4	4			
	20	20			
	24	24			
	28	28			
	104	104			
	120	120			

Note. Participants 1-99 were recruited from Stinson & Associates; participants 100 and above were recruited from Grady Memorial Hospital.

T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment; T4: one month postpartum follow-up assessment

Table 4. *Pearson Correlations of Maternal Outcome Measures at T1 Assessment*

	1	2	3	4	5	6	7	8	9	10	11
1	--	-.101	.050	.018	-.098	.014	.220	.207	.001	.535**	.367**
2	--	--	.284*	-.130	.159	-.245	.113	.030	-.227	-.179	-.011
3	--	--	--	-.529**	-.007	-.172	.257*	-.173	-.626**	.052	-.015
4	--	--	--	--	-.036	.341**	-.028	.281*	.733**	-.353**	.170
5	--	--	--	--	--	-.133	-.025	-.148	.045	-.172	-.158
6	--	--	--	--	--	--	-.016	.125	.116	.026	-.112
7	--	--	--	--	--	--	--	.132	-.317*	.239	.216
8	--	--	--	--	--	--	--	--	.312*	.096	.312*
9	--	--	--	--	--	--	--	--	--	-.284*	.131
10	--	--	--	--	--	--	--	--	--	--	.217
11	--	--	--	--	--	--	--	--	--	--	--

** Differences are significant at $p < .01$; * Differences are significant at $p < .05$

Note. 1: Toronto Mindfulness Scale; 2: Counting Test Error Rate (%);3: Life Experiences Survey; 4: Perceived Stress Scale; 5: Baseline Cortisol (µg/dL); 6: Reactive Cortisol Response (µg/dL); 7: Pregnancy Experience Scale – Brief Version: Uplifts Intensity; 8: Pregnancy Experience Scale – Brief Version: Hassles Intensity; 9: Beck Depression Inventory-II; 10: COPE Inventory: Approach-Based Coping; 11: COPE Inventory: Avoidance-Based Coping

Table 5. *Descriptive Statistics of Outcome Measures in the First Three Assessments Broken Down by Three Groups Analyzed by Repeated Measures ANOVA*

Outcome Measures	Assessment time	TxAU *n* = 11		I-Group1 *n* = 6		I-Group2 *n* = 5	
		M	SD	M	SD	M	SD
Toronto Mindfulness Scale	T1	35.3	6.90	34.8	6.90	30.0	6.90
	T2	32.0	8.28	36.3	8.28	34.0	8.28
	T3	35.1	7.44	35.5	7.43	35.0	7.43
Counting Test Error Rate (%)[a]	T1	4.60	5.64	4.60	4.90	4.20	5.14
	T2	1.10	1.99	1.50	1.71	0.20	1.79
	T3	3.80	5.64	6.80	4.90	.094	2.1
Life Experiences Survey[b]	T1	.727	9.68	-.667	9.69	-.200	9.68
	T2	-2.18	11.0	-6.67	11.0	-2.00	11.0
	T3	4.09	12.9	-6.67	12.9	1.60	12.9
Perceived Stress Scale	T1	40.9	8.29	38.0	8.29	44.4	8.29
	T2	39.8	9.18	40.7	9.19	40.0	9.19
	T3	40.6	10.1	38.0	10.1	44.2	10.1
Baseline Cortisol (μg/dL)[c]	T1	.271	.176	.225	.216	.348	.197
	T2	.247	.172	.160	.211	.257	.192
	T3	.259	.156	.165	.191	.275	.174
Pregnancy Experience Scale – Brief Version: Uplifts Intensity	T1	2.39	.468	2.36	.468	1.87	.470
	T2	2.39	.345	2.32	.345	2.31	.347
	T3	2.47	.305	2.52	.306	2.58	.304

(to be contd.)

Table 5. (*contd.*)

Outcome Measures	Assessment Time	TxAU *n* = 11		I-Group1 *n* = 6		I-Group2 *n* = 5	
		M	SD	M	SD	M	SD
Pregnancy Experience Scale – Brief Version: Hassles Intensity	T1	2.07	.584	2.11	.583	2.20	.584
	T2	2.08	.544	1.88	.546	1.90	.546
	T3	2.15	.600	2.03	.603	2.03	.602
Beck Depression Inventory-II	T1	16.1	10.5	13.2	10.5	24.6	10.5
	T2	16.5	9.10	14.2	9.10	23.4	9.10
	T3	19.3	10.9	14.2	10.9	21.6	10.9
COPE Inventory: Approach-Based Coping	T1	35.2	5.88	35.5	5.88	33.2	5.88
	T2	35.3	5.51	39.2	5.51	33.0	5.51
	T3	37.0	4.44	38.3	4.44	35.0	4.44
COPE Inventory: Avoidance-Based Coping	T1	22.8	5.68	24.5	5.69	25.2	5.68
	T2	22.5	6.90	27.3	6.90	26.0	6.90
	T3	25.4	6.58	23.3	6.58	23.0	6.59

[a] *N* = 16 (TxAU *n* = 7; I-Group1 *n* = 5; I-Group2 *n* = 4)

[b] Total scores of the scale were reversely coded to represent general maternal stress

[c] *N* = 19 (TxAU *n* = 11; I-Group1 *n* = 4; I-Group2 *n* = 4)

Note. TxAU = treatment as usual; I-Group1 = Mindful Motherhood women who attended fewer than 4 training sessions; I-Group2 = Mindful Motherhood women who attended 4 training sessions or more; T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment

Table 6. *Results of Three Group Differences in Outcome Measures across First Three Assessments Analyzed by Repeated Measures ANOVA*

Outcome Measures	Main Effect of Group Condition				Interaction Between Group Condition and Assessment Time		
	df	*F*	*p*	η_p^2	*F*	*p*	η_p^2
Toronto Mindfulness Scale[a]	19	.252	.780	.026	.969	.433	.093
Counting Test Error Rate (%)[a]	13	1.65	.230	.202	.947	.437	.127
Life Experiences Survey	19	.678	.519	.067	.840	.509	.081
Perceived Stress Scale	19	.304	.742	.031	1.12	.356	.106
Cortisol (µg/dL)[a]	16	1.15	.343	.125	.096	.978	.012
Pregnancy Experience Scale – Brief Version: uplifts intensity	19	.510	.608	.051	2.04	.049	.217
Pregnancy Experience Scale – Brief Version: hassles intensity [a]	19	.074	.929	.008	.721	.572	.071
Beck Depression Inventory-II[a]	19	1.28	.301	.119	1.37	.262	.126
COPE Inventory: Approach-Based Coping	19	1.00	.386	.095	.733	.575	.072
COPE Inventory: Avoidance-Based Coping [a]	19	.141	.869	.051	3.73	.012	.282

[a] Sphericity was not assumed, and interaction results were based on Greenhouse-Geisser correction

Note. Three Groups = treatment as usual, Mindful Motherhood women who attended fewer than 4 training sessions, and Mindful Motherhood women who attended 4 training sessions or more

Table 7. *Descriptive Statistics of Toronto Mindfulness Scale Scores across Four Assessments Broken Down by Session Number and Results of Three Multiple Linear Regressions with Toronto Mindfulness Scale Scores against Session Number*

Group Condition	Session Number	T1			T2			T3			T4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
TxAU	0	31	30.1	9.44	17	31.1	9.94	11	35.1	8.89	11	32.7	11.3
Mindful Motherhood	0	6	29.8	14.3	--	--	--		--	--	--	--	--
	1	7	29.1	13.9	2	32.0	1.41	2	37.5	.707	1	39.0	--
	2	4	35.8	13.7	2	44.0	4.24	2	31.5	9.19	3	41.0	4.58
	3	5	27.6	10.1	3	33.0	7.00	2	37.5	4.95	3	38.3	8.96
	4	3	38.3	1.53	2	31.5	4.95	2	38.0	.00	--	--	--
	5	1	29.0	--	--	--	--	--	--	--	--	--	--
	6	2	23.5	10.6	1	25.0	--	--	--	--	--	--	--
	7	3	24.7	7.02	3	37.3	4.51	1	39.0	--	--	--	--
	8	3	31.3	5.51	3	37.0	9.00	2	30.0	4.24	2	21.0	22.6
Total	0-8	65	30.1	10.2	33	33.0	8.67	22	35.2	7.07	20	34.0	11.6
Results of Multiple Linear Regressions					*B*	*t*	η_p^2	*B*	*t*	η_p^2	*B*	*t*	η_p^2
					.821	1.69*	.087	.372	.619	.020	-1.35	-1.65	.138

* Differences are significant at $p < .05$

Note. T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment; T4: one month postpartum follow-up assessment

Table 8. *Descriptive Statistics of Counting Test Error Rate (%) across Four Assessments Broken Down by Session Number and Results of Three Multiple Linear Regressions with Counting Test Error Rate (%) against Session Number*

Group Condition	Session Number	T1			T2			T3			T4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
TxAU	0	27	5.61	6.00	15	3.00	4.06	10	3.10	4.71	11	5.10	6.06
Mindful Motherhood	0	6	8.53	8.56	--	--	--	--	--	--	--	--	--
	1	6	5.74	5.66	2	5.19	7.33	2	7.04	1.95	1	0.00	--
	2	3	3.09	3.57	2	.470	.661	2	2.83	0.00	3	0.00	0.00
	3	5	6.92	3.23	2	3.30	3.33	2	11.2	3.97	3	3.74	4.28
	4	3	2.26	2.37	2	.470	.667	2	0.00	0.00	--	--	--
	5	1	1.89	--	--	--	--	--	--	--	--	--	--
	6	2	1.89	1.33	1	1.40	--	--	--	--	--	--	--
	7	2	4.64	5.10	3	1.25	1.08	1	4.72	--	1	.940	--
	8	3	5.78	4.25	3	3.14	5.45	2	0.00	0.00	2	1.40	.661
Total	0-8	58	5.52	5.56	30	3.04	4.25	21	3.71	4.56	21	3.38	4.98
Results of Multiple Linear Regressions					*B*	*t*	η_p^2	*B*	*t*	η_p^2	*B*	*t*	η_p^2
					.1	.515	.011	-.3	-.701	.032	-.7	-2.52**	.289

** Differences are significant at $p < .01$

Note. T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment; T4: one month postpartum follow-up assessment

Table 9. *Descriptive Statistics of Life Experiences Survey Scores across Four Assessments Broken Down by Session Number and Results of Three Multiple Linear Regressions with Life Experiences Survey Scores against Session Number*

Group Condition	Session Number	T1			T2			T3			T4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
TxAU	0	31	-.387	9.10	17	-2.76	10.2	11	4.09	14.4	11	.091	14.1
Mindful Motherhood	0	6	6.83	19.6	--	--	--	--	--	--	--	--	--
	1	7	-3.86	9.53	2	-2.50	3.54	2	-2.50	10.6	1	4.00	--
	2	4	-3.25	11.1	2	-12.5	16.3	2	-12.5	6.36	3	-14.7	7.57
	3	5	3.40	8.23	3	-7.33	8.96	2	-5.00	8.49	3	-9.33	5.51
	4	3	.00	13.1	2	3.00	14.1	2	10.5	21.9	--	--	--
	5	1	20.0	--	--	--	--	--	--	--	--	--	--
	6	2	27.0	12.7	--	--	--	--	--	--	--	--	--
	7	3	-1.00	9.17	3	-7.00	1.73	1	-4.00	--	--	--	--
	8	3	2.33	11.2	3	-4.67	3.06	2	-4.50	4.95	2	-2.50	.707
Total	0-8	65	1.29	11.7	33	-4.58	9.71	22	-.591	13.2	21	-4.48	12.6
Results of Multiple Linear Regressions					*B*	*t*	η_p^2	*B*	*t*	η_p^2	*B*	*t*	η_p^2
					-.654	-1.16	.043	-1.02	-.996	.050	-1.17	-1.25	.080

Note. Total scores were reversely coded to represent stressful life events; T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment; T4: one month postpartum follow-up assessment

Table 10. *Descriptive Statistics of Perceived Stress Scale Scores across Four Assessments Broken Down by Session Number and Results of Three Multiple Linear Regressions with Perceived Stress Scale Scores against Session Number*

Group Condition	Session Number	T1			T2			T3			T4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
TxAU	0	31	39.5	8.22	17	38.9	8.62	11	40.6	8.48	11	37.6	9.44
Mindful Motherhood	0	6	41.8	10.2	--	--	--	--	--	--	--	--	--
	1	7	42.0	10.4	2	41.0	1.41	2	42.5	12.0	1	47.0	--
	2	4	40.3	9.91	2	36.5	.707	2	28.5	3.54	2	27.0	12.7
	3	5	44.2	10.1	3	42.3	4.04	2	43.0	2.83	3	38.0	5.57
	4	3	50.0	8.19	2	41.0	8.49	2	43.0	12.7	--	--	--
	5	1	53.0	--	--	--	--	--	--	--	--	--	--
	6	2	56.0	11.3	1	39.0	--	--	--	--	--	--	--
	7	3	47.7	8.02	3	41.7	6.11	1	54.0	--	1	45.0	--
	8	3	35.3	12.7	3	35.7	16.5	2	40.5	21.9	2	31.5	3.53
Total	0-8	65	41.8	9.50	33	39.3	7.96	22	40.7	9.83	20	36.9	9.06
Results of Multiple Linear Regressions					*B*	*t*	η_p^2	*B*	*t*	η_p^2	*B*	*t*	η_p^2
					-.199	-.525	.009	.260	.423	.009	.159	.263	.004

Note. T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment; T4: one month postpartum follow-up assessment

Table 11. *Descriptive Statistics of Baseline Cortisol Levels (µg/dL) across Four Assessments Broken Down by Session Number and Results of Three Multiple Linear Regressions with Cortisol Levels against Session Number*

Group Condition	Session Number	T1			T2			T3			T4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
TxAU	0	30	.314	.167	17	.307	.188	11	.259	.189	11	.236	.158
Mindful Motherhood	0	6	.385	.129	--	--	--	--	--	--	--	--	--
	1	7	.309	.086	1	.020	--	2	.290	.099	1	.260	--
	2	4	.200	.097	2	.215	.092	2	.145	.035	3	.080	.056
	3	4	.200	.075	3	.290	.125	1	.150	--	2	.140	.042
	4	3	.253	.055	1	.300	--	2	.325	.092	--	--	--
	5	1	.330	--	--	--	--	--	--	--	--	--	--
	6	2	.240	.014	1	.330	--	--	--	--	--	--	--
	7	3	.347	.194	2	.260	.014	1	.170	--	1	.070	--
	8	3	.360	.316	3	.297	.147	2	.270	.000	2	.210	.255
Total	0-8	63	.305	.151	30	.286	.160	21	.249	.147	20	.194	.146
Results of Multiple Linear Regressions					*B*	*t*	η_p^2	*B*	*t*	η_p^2	*B*	*t*	η_p^2
					-.002	-.194	.001	-.004	-.313	.005	-.011	-.902	.046

Note. T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment; T4: one month postpartum follow-up assessment

Table 12. *Descriptive Statistics of Reactive Cortisol Response (µg/dL) during Post-intervention assessment Broken Down by Session Number and Results of Multiple Linear Regression with Reactive Cortisol Response against Session Number*

Group Condition	Session Number	T1			T2		
		N	M	SD	N	M	SD
TxAU	0	27	-.027	.053	16	-.003	.114
Mindful Motherhood	0	6	.015	.102	--	--	--
	1	7	-.020	.029	1	.070	--
	2	4	.015	.024	2	-.040	.042
	3	4	.020	.028	2	.170	.283
	4	3	-.003	.040	2	.045	.035
	5	1	.100	--	--	--	--
	6	2	-.010	.057	1	-.020	--
	7	3	.007	.045	2	-.290	.198
	8	3	-.120	.173	2	-.050	.014
Total	0-8	60	-.015	.068	28	-.012	.144
Results of Multiple Linear Regression					*B*	*t*	η_p^2
					-.021	-2.90**	.227

** Differences are significant at $p < .01$

Note. T1: initial assessment; T2: post-intervention assessment

Table 13. *Descriptive Statistics of Pregnancy Experience Scale – Brief Version: Uplifts Intensity Scores across Three Assessments Broken Down by Session Number and Results of Two Multiple Linear Regressions with Uplifts Intensity Scores against Session Number*

Group Condition	Session Number	T1			T2			T3		
		N	M	SD	N	M	SD	N	M	SD
TxAU	0	30	2.34	.510	17	2.40	.375	11	2.47	.250
Mindful Motherhood	0	6	2.06	.755	--	--	--	--	--	--
	1	7	2.18	.458	2	2.40	.000	2	2.70	.283
	2	4	2.18	.458	2	1.91	.273	2	2.16	.374
	3	5	2.41	.287	3	2.60	.266	2	2.70	.424
	4	3	2.47	.147	2	2.50	.000	2	2.56	.314
	5	1	2.10	--	--	--	--	--	--	--
	6	2	1.72	.393	1	2.38	--	--	--	--
	7	3	2.03	.929	3	2.03	.781	1	2.30	--
	8	3	2.09	.824	3	2.59	.390	2	2.75	.354
Total	0-8	64	2.27	.529	33	2.38	.400	22	2.51	.294
Results of Multiple Linear Regressions					*B*	*t*	η_p^2	*B*	*t*	η_p^2
					.011	.463	.007	.047	1.78*	.141

* Differences are significant at $p < .05$

Note. T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment

Table 14. *Descriptive Statistics of* Pregnancy *Experience Scale – Brief Version: Hassles Intensity Scores across Three Assessments Broken Down by Session Number and Results of Two Multiple Linear Regressions with Hassles Intensity Scores against Session Number*

Group Condition	Session Number	T1			T2			T3		
		N	M	SD	N	M	SD	N	M	SD
TxAU	0	30	2.22	.494	16	2.19	.610	11	2.15	.602
Mindful Motherhood	0	6	1.98	.613	--	--	--	--	--	--
	1	7	1.85	.667	2	1.90	.566	2	1.89	.786
	2	4	2.26	.210	2	1.65	.212	2	1.88	.774
	3	5	2.22	.446	3	2.08	.176	2	2.31	.126
	4	3	2.50	.152	2	2.25	.354	2	2.60	.141
	5	1	1.86	--	--	--	--	--	--	--
	6	2	1.89	.018	1	2.25	--	--	--	--
	7	3	2.00	.866	3	1.85	.492	1	2.10	--
	8	3	1.93	.591	3	1.33	.416	2	1.42	.589
Total	0-8	64	2.03	.508	32	2.02	.551	22	2.09	.576
Results of Multiple Linear Regressions					*B*	*T*	η_p^2	*B*	*t*	η_p^2
					-.067	-2.54**	.182	-.051	-1.50	.105

** Differences are significant at $p < .01$

Note. T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment

Table 15. *Descriptive Statistics of Beck Depression Inventory-II Scores across Four Assessments Broken Down by Session Number and Results of Three Multiple Linear Regressions with Beck Depression Inventory-II Scores against Session Number*

Group Condition	Session Number	T1			T2			T3			T4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
TxAU	0	30	14.2	8.97	17	15.2	7.70	11	19.3	9.82	11	10.3	6.56
Mindful Motherhood	0	6	16.8	11.7	--	--	--	--	--	--	--	--	--
	1	7	18.1	8.51	2	13.5	3.53	2	18.5	13.4	1	31.0	--
	2	4	11.3	7.27	2	7.50	2.12	2	7.00	2.83	3	5.00	3.00
	3	5	17.6	5.55	3	18.0	7.00	2	17.0	9.90	3	13.3	5.69
	4	3	18.3	4.73	2	17.5	3.54	2	15.5	10.6	--	--	--
	5	1	32.0	--	--	--	--	--	--	--	--	--	--
	6	2	36.5	16.3	1	26.0	--	--	--	--	--	--	--
	7	3	22.0	20.2	3	23.0	19.7	1	42.0	--	1	14.0	--
	8	3	18.3	16.2	3	16.7	11.7	2	17.5	14.8	2	5.50	2.12
Total	0-8	64	16.7	10.4	33	16.2	8.94	22	18.4	10.8	21	10.7	7.47
Results of Multiple Linear Regressions					*B*	*t*	η_p^2	*B*	*t*	η_p^2	*B*	*t*	η_p^2
					.291	1.10	.040	-.883	-1.89*	.159	-.116	-.320	.006

* Differences are significant at $p < .05$

Note. T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment; T4: one month postpartum follow-up assessment

Table 16. *Descriptive Statistics of COPE Inventory: Approach-based Coping Scores across Four Assessments Broken Down by Session Number and Results of Three Multiple Linear Regressions with Approach-based Coping Scores against Session Number*

Group Condition	Session Number	T1			T2			T3			T4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
TxAU	0	31	34.6	7.04	17	35.6	5.10	11	36.9	3.24	11	35.4	6.67
Mindful Motherhood	0	6	34.4	10.6	--	--	--	--	--	--	--	--	--
	1	7	30.9	7.01	2	35.5	12.0	2	33.0	8.49	1	31.0	--
	2	4	40.3	7.14	2	44.5	4.95	2	44.0	2.83	3	45.7	.577
	3	5	32.4	9.74	3	36.3	4.04	2	38.0	4.24	3	35.7	2.08
	4	3	38.7	3.21	2	33.5	2.12	2	35.5	.707	--	--	--
	5	1	38.0	--	--	--	--	--	--	--	--	--	--
	6	2	25.5	3.53	1	30.0	--	--	--	--	--	--	--
	7	3	33.0	13.0	3	33.0	8.54	1	29.0	--	1	42.0	--
	8	3	36.0	7.00	3	37.7	1.53	2	37.5	.707	2	37.0	.000
Total	0-8	65	34.3	7.73	33	35.8	5.60	22	36.9	4.39	21	37.1	6.22
Results of Multiple Linear Regressions					*B*	*t*	η_p^2	*B*	*t*	η_p^2	*B*	*t*	η_p^2
					-.109	-.377	.005	.010	.029	.000	-.172	-.407	.009

Note. T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment; T4: one month postpartum follow-up assessment

Table 17. *Descriptive Statistics of COPE Inventory: Avoidance-based Coping Scores across Four Assessments Broken Down by Session Number and Results of Three Multiple Linear Regressions with Avoidance-based Coping Scores against Session Number*

Group Condition	Session Number	T1			T2			T3			T4		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD
TxAU	0	31	22.0	6.05	17	23.5	6.36	11	25.4	6.65	11	22.5	7.46
Mindful Motherhood	0	6	21.7	3.14	--	--	--	--	--	--	--	--	--
	1	7	19.6	3.26	2	28.5	7.78	2	25.5	4.95	1	25.0	--
	2	4	20.5	5.20	2	21.0	1.41	2	17.0	1.41	3	22.0	2.65
	3	5	24.2	6.57	3	29.7	6.66	2	27.5	2.12	3	25.3	7.09
	4	3	27.3	5.51	2	27.0	4.24	2	18.5	7.78	--	--	--
	5	1	13.0	--	--	--	--	--	--	--	--	--	--
	6	2	20.5	3.54	1	26.0	--	--	--	--	--	--	--
	7	3	26.3	2.08	3	29.6	1.15	1	31.0	--	1	28.0	--
	8	3	25.0	4.58	3	23.7	5.86	2	23.5	7.78	2	22.0	4.24
Total	0-8	65	22.2	5.47	33	25.1	5.94	22	24.3	6.36	21	23.1	6.09
Results of Multiple Linear Regressions					*B*	*t*	η_p^2	*B*	*t*	η_p^2	*B*	*t*	η_p^2
					.127	.544	.010	-.486	-1.31	.083	-.228	-.580	.018

Note. T1: initial assessment; T2: post-intervention assessment; T3: one month post-intervention follow-up assessment; T4: one month postpartum follow-up assessment

Table 18. *Descriptive Statistics of Birth Weight and Gestational Age Broken Down by Session Number and Results of Multiple Linear Regressions with Birth Weight and Gestational Age against Session Number Respectively*

		Birth Weight (lbs)			Gestational Age (week)		
Group Condition	Session Number	N	M	SD	N	M	SD
TxAU	0	14	6.40	1.40	14	37.8	2.44
Mindful Motherhood	0	--	--	--	--	--	--
	1	1	7.63	--	1	39.0	--
	2	3	5.11	3.62	3	35.0	7.81
	3	3	6.17	.811	3	37.7	1.53
	4	1	6.44	--	2	39.7	.403
	5	1	7.06	--	1	38.0	--
	6	1	8.00	--	1	38.0	--
	7	1	6.56	--	1	29.7	--
	8	2	6.78	1.73	2	39.0	1.41
Total	0-8	27	6.39	1.59	28	37.4	3.53
Results of Simple Linear Regressions		*B*	*t*	η^2	*B*	*t*	η^2
		.064	.544	.012	-.076	-.308	.004

Table 19. *Summary of Statistically Significant Results from Multiple Linear Regressions*

Assessment	Outcome Measures	*df*	*B*	*t*	η_p^2	Effect Size
T2 Assessment (Post-Intervention)	Toronto Mindfulness Scale	30	.821	1.69*	.087	Medium
	Reactive Cortisol Response (µg/dL)	22	-.021	-2.90**	.227	Large
	Pregnancy-Experience Scale – Brief Version: Hassles Intensity	29	-.067	-2.54**	.182	Large
T3 Assessment (One Month Post-Intervention Follow-up)	Pregnancy-Experience Scale – Brief Version: Uplifts Intensity	19	.047	1.78*	.141	Large
	Beck Depression Inventory-II	19	-.883	-1.89*	.159	Large
T4 Assessment (One Month Postpartum Follow-up)	Counting Test Error Rate (%)	16	-.7(%)	-2.52**	.289	Large

* Differences are significant at $p < .05$; ** Differences are significant at $p < .01$