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The Effects of Mindfulness-Based Yoga During Pregnancy on Maternal Psychological and Physical Distress

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ABSTRACT

Objective: To examine the feasibility and level of acceptability of a mindful yoga intervention provided during pregnancy and to gather preliminary data on the efficacy of the intervention in reducing distress.

Design: Baseline and post-treatment measures examined state and trait anxiety, perceived stress, pain, and morning salivary cortisol in a single treatment group. Postintervention data also included participant evaluation of the intervention.

Setting: The 7 weeks mindfulness-based yoga group intervention combined elements of Iyengar yoga and mindfulness-based stress reduction.

Participants: Sixteen healthy pregnant nulliparous women with singleton pregnancies between 12 and 32 weeks gestation at the time of enrollment.

Methods: Outcomes were evaluated from pre- to postintervention and between second and third trimesters with repeated measures analysis of variance and *post hoc* nonparametric tests.

Results: Women practicing mindful yoga in their second trimester reported significant reductions in physical pain from baseline to postintervention compared with women in the third trimester whose pain increased. Women in their third trimester showed greater reductions in perceived stress and trait anxiety.

Conclusions: Preliminary evidence supports yoga's potential efficacy in these areas, particularly if started early in the pregnancy.

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Evidence suggests that psychological distress during pregnancy is associated with adverse perinatal outcomes. The characteristics of psychological distress include anxiety, impaired concentration, depressed immune function, poor coping, muscle tension, and somatic complaints. During pregnancy, stress has been associated with alcohol use (Albrecht & Rankin, 1989), smoking (McCormick et al., 1990), prolonged sick leave (Andersson, Sundstrom-Poromaa, Wulff, Astrom, & Bixo, 2004), and increased number of care provider visits (Andersson et al.). Distress places a woman at risk for obstetric and neonatal complications including unplanned Cesarean delivery (Saunders, Lobel, Veloso, & Meyer, 2006), lower birth weight (Paarlberg et al., 1999), prematurity (Dayan et al., 2002; Dole et al., 2003), and postpartum depression (Beck, 2001). Additionally, maternal anxiety in the third trimester has been associated with difficult temperament in infancy (Van Den Bergh, 1990) and behavioral and emotional problems in children (O'Connor, Heron, Golding, Beveridge, & Glover, 2002).

Physical pain during pregnancy is linked to psychological distress and is often overlooked in stress research (Otchet, Carey, & Adam, 1999). For example, daily stressors and lack of control at work place a pregnant woman at greater risk for developing pain (Albert, Godskesen, Korsholm, & Westergaard, 2006; Field, Hernandez-Reif, Diego, Schanberg, & Kuhn, 2006). Pain is often reported as the cause of sleep disturbance (Kristiansson, Svardsudd, & von Schoultz, 1996; Wang et al., 2004). Approximately 70% of pregnant women experience low back pain (LBP) that may start as early as the first trimester (Kristiansson et al.; Wang et al.). Peak onset of LBP occurs in the second and third trimesters, and pain intensity worsens with ad-

vancing gestation (Fast et al., 1987). Pain has been linked to disability, functional impairment (Wang et al.), and work absenteeism (Kristiansson et al.).

Cortisol, secreted from the adrenal cortex, is an indicator of hypothalamic-pituitary-adrenal axis activation and is an important variable in stress research. However, cortisol undergoes a two- to threefold increase throughout pregnancy and peaks in the third trimester making cortisol evaluation challenging (Mastorakos & Ilias, 2003). Nonetheless, Meulenberg and Hofman (1990) demonstrated the reliability of salivary cortisol levels, and others have shown that its circadian rhythmicity is maintained during pregnancy (Allolio et al., 1990; Lindholm & Schultz-Moller, 1973). Report of stressful life events in early pregnancy predicts higher cortisol levels in late pregnancy (Obel et al., 2005) and higher cortisol values earlier in pregnancy have been significantly associated with preterm birth (Sandman et al., 2006) and third trimester anxiety and pain (Field et al., 2006). These results suggest that psychological and physiological distress converge in pregnancy, giving rise to negative emotions and somatic complaints with potential deleterious effects for both mother and infant.

Psychological distress during pregnancy is a significant risk factor in predicting adverse perinatal outcomes. Yet stress is not routinely assessed during prenatal care. The prevalence of anxiety is estimated in the general population at 16.4% and affects twice as many women as men (U.S. Department of Health and Human Services [DHHS], 1999). Its prevalence does not diminish during pregnancy (Breitkopf et al., 2006). Higher stress or anxiety is linked to a variety of pregnancy outcomes, and pain and other somatic complaints often occur with mood disorder in pregnant women (Kelly, Russo, & Katon, 2001). Research demonstrates that yoga and meditation can effectively reduce psychological and physical distress (Rosenzweig, Reibel, Greeson, Brainard, & Hojat, 2003; Williams, Kolar, Reger, & Pearson, 2001) including anxiety (Michalsen et al., 2005; Woolery, Myers, Sternlieb, & Zeltzer, 2004) and back pain (Williams et al., 2005), and the National Institute of Mental Health (DHHS) has endorsed group interventions as promising modalities for people who experience stressful life events. These data suggest the potential for yoga and meditation as an appropriate intervention during pregnancy. Yet few studies using group interventions have evaluated the potential to reduce psychological or physical distress associated with pregnancy. Prenatal yoga is popular (Wang et al., 2005), yet no published studies have evaluated its effectiveness for reducing perceived stress, anxiety, or pain during pregnancy.

Pain and other somatic complaints often occur with mood disorder in pregnant women.

Several researchers have considered the effects of psychological and physiological relaxation on pregnancy. During a prenatal visit, a simple reminder to avoid stress and participate in things that increase relaxation lowered salivary cortisol levels, reduced depression scores, and improved mood in a sample of low-income Latina women (Urizar et al., 2004). A randomized trial evaluated self-reported anxiety, maternal heart rate, and serum cortisol concentrations before and after 45 minutes periods of active and passive relaxation in 58 pregnant women, and outcomes in both groups significantly improved from pre- to post-treatment (Teixeira, Martin, Prendiville, & Glover, 2005). Bastani, Hidarnia, Kazemnejad, Vafaei, and Kashanian (2005), and Bastani, Hidarnia, Montgomery, Aguilar-Vafaei, and Kazemnejad (2006) conducted a randomized clinical trial of 110 healthy Persian primiparae undergoing a progressive relaxation program. Their data revealed significant decreases in anxiety and perceived stress in the relaxation group compared with controls. Mean birth weight of infants born to mothers in the relaxation group was higher ($p = .009$) than control infants, and Cesarean birth rate in the relaxation group was significantly lower. Narendran, Nagarathna, Narendran, Gunasheela, and Nagendra (2005) tested the effects of a yoga and meditation intervention on perinatal outcomes in a study of 335 healthy pregnant women in India. Significantly fewer treatment group infants were small for gestational age or preterm compared with infants born to control mothers and for a subgroup of 121 women with Doppler abnormalities, infant birth weight was higher (2.78 ± 0.52 kg) compared with controls (2.55 ± 0.52 kg, $p < .02$) (Narendran et al.).

A mind/body program provided during pregnancy may alter stress appraisal, offer new ways of coping with psychological and physical distress, and form the basis of personal resources needed to cope with stressful life events during pregnancy and childbirth. The primary purpose of this study was to examine the feasibility, acceptability, and potential efficacy of a yoga and mindfulness meditation or "mindful yoga" intervention during pregnancy. To date, no published studies have examined the effects of mindful yoga on pregnant women's

Perceived stress, anxiety, physical pain, and salivary cortisol levels were assessed first at baseline and again after the yoga intervention.

perceived stress, anxiety, and somatic complaints. In this pilot feasibility study, the authors tested the hypotheses that a 7 weeks mindful yoga intervention would reduce salivary cortisol levels as well as self-reports of distress operationalized as perceived stress, anxiety, and pain. A third aim was to examine the acceptability of the mindful yoga intervention to the women.

Methods

Procedures

The pilot study was intended to gather data to estimate the effect size required for a larger cohort of subjects and evaluate the feasibility of the intervention. The study used a one-group pre–post-intervention design. Baseline and post-treatment assessments included self-report measures of psychological distress (perceived stress and anxiety) and physical distress (pain and salivary cortisol levels). Acceptance of the intervention by participants was also examined after completion. Data were collected before the first day of the group intervention (Time 1) and immediately after completion of the seven weekly intervention sessions (Time 2).

Subjects

The Committee on Human Research at the University of California, San Francisco approved the study. Participation was voluntary; each subject was assured confidentiality and freedom to withdraw from the study at any time. A community sample was recruited from posting approved flyers in offices of prenatal care providers and county-sponsored perinatal programs. Childbirth education programs hand-delivered or mailed flyers and 5 minutes presentations were made at childbirth education classes. The flyers and minipresentations explained the purpose of the study and that women would be paid up to $100 for participating. Women meeting eligibility criteria and interested in participating were enrolled in the study.

Eligible women were at least 18 years old, able to read and write English, expecting a first baby, carrying a singleton pregnancy, planning a hospital birth, and between 12 and 32 weeks gestation when the intervention began. Women were excluded from the study if they reported current psychiatric illness; currently used medications for pain, sleep, depression, or anxiety; worked nightshift; or had diabetes, hypertension, HIV infection, or history of back surgery. The researchers screened 42 pregnant women for eligibility and enrolled 23 women; 19 were able to meet on the day and time of the mindful yoga group. Two women left the study due to pregnancy complications (one on bed rest for preterm labor without preterm birth after the third class, the other with preterm birth after the second class). The final group at Time 2 was comprised of 17 subjects. However, one had incomplete baseline data and was excluded from the analysis.

Measures

Perceived Stress

The 10-item Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) was used to estimate the degree to which a person perceives life situations as unpredictable, uncontrollable, or taxing. Responses are rated on a 5-level scale (1 = *never true* to 5 = *almost always*). Data from Cohen et al. support good internal consistency ($\alpha = .84$) and test-retest stability (.85). The Cronbach α coefficient in this sample was .91.

Pregnancy Stress

The Prenatal Psychosocial Profile (PPP) stressor subscale (Curry, Burton, & Fields, 1998) asks women to indicate on a 4-level scale (1 = *no stress* to 4 = *severe stress*) the extent to which each of 11 items (e.g., financial worries and feeling "generally overloaded") is a current stressor or hassle. Average PPP scores have been between 18 and 20 (range = 11-44) in studies of culturally diverse pregnant women. Available data suggest good internal consistency ($\alpha = .73$-$.78$) and test-retest stability (.82) (Curry, Campbell, & Christian, 1994). The Cronbach α coefficient in this sample was .78.

Trait Anxiety

The trait subscale of the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1989) consists of 20 statements in which respondents are asked to describe how they generally feel on a 4-level scale (1 = *not at all*; 4 = *very much so*). Data from Spielberger et al. support good internal consistency ($\alpha = .65$-$.86$) and test-retest stability (.87-.92). Internal consistency reliability in this sample was .94.

State Anxiety

The six-item state STAI (Marteau & Bekker, 1992) is a short-form version of the State STAI that uses a 4-level scale (1 = *not at all*; 4 = *very much*), adjusted

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to yield a similar range of scores to those obtained with the full 20-item version. It has been validated with several populations and has shown good internal consistency ($\alpha = .82$). The Cronbach α for this sample was .85.

Pain

Pain was assessed using a modified version of the Brief Pain Inventory (BPI) (Daut, Cleeland, & Flanery, 1983) with two dimensions: pain intensity and pain interference with daily activities. The BPI asks subjects to rate the frequency of current pain intensity from 0 = *no pain* to 10 = *worst pain imaginable*. Pain interference is composed of seven items that assess the degree to which pain interferes with daily activities. Subjects are asked to rate the extent to which pain interfered with activities during the last week from 0 = *does not interfere* to 10 = *completely interferes*. Data suggest good internal consistency reliability of this scale (Cronbach α coefficient = .88) (Tan, Jensen, Thornby, & Shanti, 2004) and an α of .91 in the present study. Total hours of pain was calculated by multiplying hours per day of pain by number of days that pain interfered with mood or activities during the past week. Physical location of pain was not monitored.

Cortisol

Hypothalamic-pituitary-adrenal axis activity, an objective measure of physiological stress, was estimated by salivary cortisol concentration on three consecutive mornings at baseline and postintervention. Cortisol levels in saliva reflect the active unbound compound and there is a strong correlation between levels in saliva and the amount available to enter the target tissues (Kirschbaum & Hellhammer, 1994). To control for circadian rhythmicity of cortisol secretion, participants were instructed to obtain a salivary sample at first rising just after getting up, and not to smoke, eat, brush their teeth, use mouthwash, or take medication before collecting samples in order to avoid contamination by factors known to interfere with analysis (Groschl, Wagner, Rauh, & Dorr, 2001). Each participant was instructed in the passive drool collection method, specimen labeling, and immediate freezer storage until pick up. Samples were transported in an iced cooler to the central freezer and then sent in batch to Germany (Fachbereich I, Universität-Trier, Abt. Klinische und theoretische Psychobiologie, Trier, Germany) for analysis.

Acceptability

Acceptability was measured at Time 2 with a questionnaire asking respondents to rate their experience and satisfaction with the intervention. The instrument was modified from an evaluation tool used in a prior perinatal study and from a follow-up questionnaire from the Stress Reduction Program at University of Massachusetts.

Intervention

The 7 weeks, mindfulness-based yoga intervention combined elements of the yoga methods of Iyengar (1979) and the curriculum of mindfulness-based stress reduction (MBSR), a relaxation and stress management program developed by Kabat-Zinn (1990). The primary author facilitated the intervention. She has studied Iyengar yoga for 20 years, received extensive training in MBSR through the University of Massachusetts, Center for Mindfulness (MBSR), and has taught MBSR since 2002.

An aim of the intervention was to maintain fidelity with MBSR's emphasis on mindfulness. Mindfulness is a purposive process of learning how to pay attention from moment-to-moment to one's present experience while noticing and learning to let go of judgments and reactivity (Kabat-Zinn, 1990). The intervention in this study differed from MBSR in its focus on principles of Iyengar yoga, a form of postural yoga that emphasizes the use of props to attain particular poses, careful anatomic alignment, and correct muscular actions. In weekly sessions, mindfulness meditation skills were taught to help participants discover relationships between mindful practice and ability to cope more effectively with stress using the following techniques: (a) body scan, a progressive relaxation in which participants direct attention and observe sensations; (b) sitting meditation, involving observation of one's breathing, sensations, emotions, sound, and thoughts; (c) postural yoga, involving gentle physical poses integrated with breathing to develop strength, flexibility, and balance, no more strenuous than a 30 minutes walk on flat ground; and (d) walking meditation, involving slow and observant walking. The sessions also explored use of mindfulness in daily life, the psychological and physiological effects of stress, and the possibilities of using mindfulness during birth.

The yoga poses used in this study were designed for women late in pregnancy. Each session lasted about 75 minutes with guided instruction throughout each pose, safe ways to get in and out of the positions, pose modification, and use of props to suit needs and limitations of each woman. For instance the seated twist can be done on a chair rather than on the ground. Blankets, cushions, belts, and other props were used to maintain body

alignment, structural support, and comfort. Emphasis was placed on building length along the spine while maintaining neutrality of spinal position, keeping awareness of the breath, and using breath and sensations within the body to anchor attention to the present moment. The emphasis was not on flexibility per se.

Data Analyses

Data from all instruments were evaluated for completeness. Frequency distributions were checked for extreme or inconsistent values. Descriptive statistics were used to characterize the sample. Repeated measures analysis of variance was used to examine change from pre- to postintervention as the within-subjects factor and group (second vs. third trimester) as the between-subjects factor. Because of small sample, differences between baseline and postintervention scores were analyzed *post hoc* using nonparametric Wilcoxon's signed ranks tests to ascertain significant change over time and Mann-Whitney *U* tests to compare groups. These analyses were done using SPSS version 14 for Windows. Because of small sample size and the pilot nature of the study, the α level was set at .10.

Results

Baseline Characteristics

Of the 19 primiparous women eligible to participate, 16 participated in the intervention and completed the study. They were college-educated, married women averaging 30.4 years of age with middle-class combined household income. None reported currently smoking cigarettes, taking prescription drugs, illicit drugs, or having medical problems. All planned on attending childbirth education class, intended to breastfeed, and wanted a vaginal birth. Eight women were 27 to 32 weeks' gestation when the intervention began and 8 women were in their second trimester (13-26 weeks). A baseline demographic comparison of the 8 women in their third trimester when the intervention began versus 8 women in their second trimester revealed no difference in marital status, age, income, education, and ethnicity. Most women were planning to work after the baby was born ($n = 13$, 81%). Although none of the women reported current mental health problems, nearly one third ($n = 5$) reported a history of depression or anxiety.

Psychological Distress

At baseline, participants reported moderate levels of perceived stress (14.8 ± 8.0). There was a significant decrease in perceived stress ($p = .05$) from baseline to postintervention; however, this decline appeared to be from intervention effects on the third trimester group as shown in the time by group interaction (Table 1). Trimester group itself had no direct effect on postintervention stress. Stressors and hassles unique to pregnancy were measured with the PPP stressor subscale. At baseline, participants reported low levels of stressors (18.1 ± 4.6). The decrease from baseline to postintervention showed only a trend toward significance ($p = .10$) and there was no group-by-time interaction (Table 1). The decrease in stressors and hassles was greater for women in the third-trimester group but this difference was not significant. Women reported moderate trait anxiety (36.3 ± 13.6) and state anxiety (28.8 ± 9.7) at baseline. Trait anxiety decreased significantly postintervention ($p = .03$). This reduction in trait anxiety was due to lower scores for third-trimester women compared with second-trimester women ($p = .02$). Although state anxiety for second-trimester women increased, it was not significant. There was no change in state anxiety for either group.

Pain

Pain was common in this sample. Prevalence of pain was similar by trimester at the baseline measure (75% for second trimester and 62% for third trimester), and there were large group variances even after excluding 2 women without pain (see Table 2). Repeated measures analysis of variance indicated no significant changes over time, and no differences in pain parameters between trimester groups at baseline. At postintervention, only 2 women, both in the third-trimester group, reported no pain. There was a time-by-group effect for the overall BPI scale ($p = .04$) and for the pain interference subscale ($p = .04$), with *post hoc* analysis indicating that second-trimester women had significantly lower BPI scores (Mann-Whitney $U = -2.4$, $p = .02$) after the intervention and had less pain interference after the intervention (Mann-Whitney $U = -2.4$, $p = .05$) compared with the third-trimester group. There were significant group differences in pain intensity and hours of pain at both time points (see Table 1). Pain intensity remained higher after the intervention for third-trimester women compared with second-trimester women (Mann-Whitney $U = 2.5$, $p = .01$). For second-trimester women, hours of pain decreased after the intervention compared with an increase for third-trimester women. After the intervention, the third-trimester group still reported significantly more hours of pain than second-trimester women (Mann-Whitney $U = -2.0$, $p = .05$).

Table 1: Means (*SD*) and Repeated Measures Analysis of Variance (RMANOVA) Tests for Differences by Time and Trimester Group

	Means (*SD*)				RMANOVA		
	Second Trimester ($n = 8$)		Third Trimester ($n = 8$)		Mean Square (1) Within (2) Between (3) Time by Group	*F* (*df* 1,14)	Significance (Two-Tailed)
	Baseline	Postintervention	Baseline	Postintervention			
PSS	14.0 (9.7)	13.9 (12.2)	15.4 (6.9)	10.3 (6.6)	54.4	4.6	.05
					8.5	0.1	*ns*
					48.6	4.1	.06
PPP	17.7 (3.4)	16.4 (5.1)	19.2 (5.4)	17.5 (5.1)	7.4	3.1	.10
					24.6	0.6	*ns*
					3.7	1.5	*ns*
STAI-T	33.6 (17.0)	33.7 (17.8)	38.4 (10.9)	34.1 (9.2)	34.1	5.8	.03
					54.1	0.2	*ns*
					38.9	6.6	.02
STAI-S	26.7 (5.4)	31.4 (16.0)	30.4 (12.1)	31.9 (9.0)	76.7	1.0	*ns*
					33.5	0.2	*ns*
					21.2	0.3	*ns*
Cortisol[a]	12.5 (2.9)	64.7 (26.7)	13.6 (4.4)	62.4 (19.5)	20,062.3	98.5	$<.000$
					3.16	0.009	*ns*
					23.5	0.12	*ns*

Note. BPI = Brief Pain Inventory; *ns* = not statistically significant at $p < .10$; PPP = Prenatal Psychosocial Profile; PSS = Perceived Stress Scale; STAI-S = short form of State Anxiety; STAI-T = Trait Anxiety.
[a]Cortisol was averaged across 3 days.

Cortisol

Cortisol data were tested for stability over 3 days with intraclass correlation coefficients (ICC). An ICC of at least .60 reflects acceptable reliability. The three morning salivary cortisol values were not stable at baseline (ICC = .02) but were stable at postintervention (ICC = .85). The average morning salivary cortisol level increased from baseline (3.2 ± 3.7 nmol/L) to Time 2 (16.1 ± 5.4 nmol/L; $t = 3.06$; $p < .01$). There were no significant differences in cortisol levels by trimester.

Acceptability of the Group Intervention

Participant satisfaction was assessed postintervention. Most (94%, $n = 15$) reported being satisfied with the class and would recommend it to others; 81% said the class had been important to them. As a direct result of the class, 63% ($n = 10$) reported feeling more hopeful and confident, having a greater knowledge of what is stressful in their lives and knowing how to take better care of themselves, having greater awareness of a stressful situation at the time it occurs, and having the ability to appropriately handle stressful situations. Eight of the 16 women said they were taking better care of themselves as a result of mindful yoga. Half the women characterized attendance as easy. They lived near where the mindful yoga sessions were held or drove by the site between work and home. Half the women found it difficult to attend and they lived further from the facility.

Discussion

This is the first study to examine change in perceived stress, anxiety, and pain following a 7 weeks program with weekly group sessions of a mindfulness-based yoga intervention. It is also the first prenatal study using yoga principles set forth by Iyengar (1979). This study suggests that women do experience certain benefits at the end of the intervention.

Perceived Stress and Anxiety

There were significant improvements in perceived stress and trait anxiety as well as trends toward effects for pregnancy stress and hassles. For women beginning the intervention in third trimester, anxiety and perceived stress had greater attenuation. For women beginning the intervention in second trimester, the physical pain that normally increases over time was minimized. These pilot data describe an underlying pattern whereby second-trimester women appeared to develop increased physical well-being over the 7 weeks sessions while third-trimester women did not experience increased physical well-being but had less psychological distress.

An alternative explanation for group differences is to ascribe reductions in perceived stress and trait anxiety to normal changes of pregnancy that dampen physiological arousal (DiPietro, Costigan, & Gurewitsch, 2003). Glynn, Schetter, Wadhwa, and Sandman (2004) and Glynn, Wadhwa, Dunkel-Schetter, Chicz-Demet, and Sandman (2001) showed that advanced gestation attenuates perceived stress. However, this study found no trimester group differences in anxiety or stress that were a direct effect of trimester status. Instead, trait anxiety and perceived stress were attenuated for the third-trimester group as an apparent result of the intervention. Trait anxiety did show change over time. In contrast, state anxiety did not. Other studies have demonstrated attenuation of trait anxiety following a mind-body intervention (Gupta, Khera, Vempati, Sharma, & Bijlani, 2006; Michalsen et al., 2005; Woolery et al., 2004) that, in some cases, was significantly lowered even when state anxiety was not. These results challenge the notion that trait anxiety yields enduring scores. Alteration in the more stable trait anxiety is desirable, and may indicate neuroplasticity.

Pain

Low back and pelvic pain is a frequent complaint that usually worsens as pregnancy progresses (Wang et al., 2004). Unlike the third-trimester group, however, second-trimester women did not experience worse pain between time points. The prevalence of pain in this study was 69% at Time 1 (11 women out of 16), similar to previous studies (Kristiansson et al., 1996; Wang et al.). Low back pain during pregnancy becomes more intense with advancing gestation (Fast et al., 1987; Kristiansson et al.), yet second-trimester women in this sample did not experience worsening pain over the 7 weeks intervention. In fact, women in the second trimester of pregnancy had significantly less hours of pain and less pain interference with activity from baseline to postintervention as they moved into their third trimester (see Table 2). A mindful yoga intervention may have a more positive effect on pain earlier in pregnancy, when good postural habits and awareness of movement can best influence the trajectory of physical stress and pain. In contrast, the increasing physical discomfort experienced by women in their third trimester may counteract any potential effects of the intervention on their physical well-being. It may also be that mindfulness skills, when obtained earlier in pregnancy, alter how physical stress is perceived, and leads to reduction in pain, an important finding, as pregnant women ascribe pain as the reason for sleep disturbance, impaired activities, and work absenteeism (Kristiansson et al.; Wang et al.).

Cortisol

This study was consistent with others who found that cortisol increased over time in pregnancy. The intervention appeared to have no effect on attenuation of these biologically driven increases. The fact that there were no significant differences in cortisol between second- and third-trimester groups may have been due to a ceiling effect where second-trimester participants already had undergone the largest pregnancy-related increase in cortisol at baseline. Because cortisol showed improved day-to-day stability at postintervention, these data suggest stronger circadian rhythmicity as a result of the intervention. To measure physiological stress, the researchers measured first rising cortisol values when concentrations peak and are less influenced by daytime interactions. Obel et al. (2005) suggested that evening nadir cortisol values may better reflect stress.

Mindfulness Practice

Most participants reported practicing yoga, mindfulness skills, and body scan they learned in class sessions either in their homes or in situations outside of class, but the actual dose of mindful yoga was not directly measured. Duration and frequency in the practice of mindful yoga may be an important element in relieving stress and pain. Some mindfulness-based studies have identified a dose response in practice (Beddoe & Murphy, 2004; Speca, Carlson, Goodey, & Angen, 2000) while another has not (Carlson, Speca, Patel, & Goodey, 2003). Assessment of adherence and preference for mindfulness-based techniques are recommended in future research.

Limitations

Limitations of this study include the absence of a placebo control group and small sample size, both

of which threaten validity. The sample may have been inadvertently biased by selection process, because participation was partially dependent on subjects' work schedules and the distance they lived from the location of the intervention. Another limitation is sampling for cortisol in the morning only. Future studies should include an evening sample to assess for diurnal variation. In addition to salivary cortisol, α-amylase as a marker of sympathetic activation should be considered as a stress measure that may respond to mindfulness and yoga. Despite these limitations, this feasibility study served as a starting point for studying effects of prenatal mindful yoga on physical and psychological distress, and acceptability. This intervention, if started early, may be important for limiting physical and psychological distress during pregnancy. In view of the results and women's satisfaction, further research is merited to learn more about minimizing distress during pregnancy.

There are currently no recommendations from professional organizations regarding the safety of yoga during pregnancy and experts do not always agree on the efficacy of certain poses during pregnancy. Therefore, studies that evaluate efficacy of a specific program of yoga practice are crucial. Traditional goals of childbirth education have been to reduce pain and anxiety through relaxation techniques that have their roots in yoga (Collins, 1998) and include breathing techniques, focusing attention, and adopting specific physical positions. Mindfulness-based strategies extend childbirth preparation to include posture and breath awareness, cultivation of nonjudging, acceptance of how things are, opening to difficulties without avoidance, and nonreactive observation of personal experience. Mindfulness-based practices have been found to increase pain tolerance (Kingston, Chadwick, Meron, & Skinner, 2007) and predict level of functioning despite pain (McCracken, Gauntlett-Gilbert, & Vowles, 2007).

Women who began the yoga intervention in the second trimester reported less pain and pain interference than women who began in the third trimester.

This feasibility study is the first known in which a mindful yoga intervention has been applied to pregnant women and evaluated for effects on

Table 2: Pain Parameters for Second- and Third-Trimester Groups Before and After the Intervention ($N = 14$ Who Experienced Pain)

	Means (*SD*)				RMANOVA		
	Second Trimester ($n = 8$)		Third Trimester ($n = 6$)		Mean Square (1) Within (2) Between (3) Time by group	*F* (*df* 1, 12)	Significance (Two-Tailed)
	Baseline	Postintervention	Baseline	Postintervention			
BPI	23.5 (20.8)	16.1 (11.7)	33.3 (29.0)	43.3 (23.9)	11.3	0.1	*ns*
					2,359.4	2.9	.12
					520.9	5.5	.04
Pain interference	14.3 (15.0)	9.1 (9.2)	16.2 (14.7)	22.0 (10.7)	0.9	0.0	*ns*
					375.1	1.3	*ns*
					205.9	5.4	.04
Pain intensity	4.8 (4.5)	4.5 (3.2)	9.0 (8.6)	11.3 (5.5)	7.4	0.9	*ns*
					210.6	4.0	.07
					11.4	1.4	*ns*
Hours of pain	4.5 (3.3)	1.6 (2.8)	20.5 (24.1)	30.5 (45.6)	87.0	0.3	*ns*
					3452.2	4.3	.06
					284.	0.9	*ns*

Note. BPI = Brief Pain Inventory; *ns* = not statistically significant; RMANOVA = repeated measures analysis of variance.

mindfulness, psychosocial distress, and physical pain. Despite the increasing popularity of yoga during pregnancy and its potential role as a protective factor in mental and physical health and perinatal outcomes, little is known about its effects. The potential to enhance protective factors during pregnancy and the early puerperium is great. Pregnancy presents a unique window of opportunity to enhance well-being, minimize distress, and improve perinatal outcomes. This pilot study suggested that a mindfulness-based pregnancy intervention is feasible and preliminary evidence from this sample supports its potential efficacy in these areas, particularly if started early in the pregnancy.

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