Original contribution

Effects of a mindfulness-based intervention during pregnancy on prenatal stress and mood: results of a pilot study

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Summary

Stress and negative mood during pregnancy increase risk for poor childbirth outcomes and postnatal mood problems and may interfere with mother–infant attachment and child development. However, relatively little research has focused on the efficacy of psychosocial interventions to reduce stress and negative mood during pregnancy. In this study, we developed and pilot tested an eight-week mindfulness-based intervention directed toward reducing stress and improving mood in pregnancy and early postpartum. We then conducted a small randomized trial ($n = 31$) comparing women who received the intervention during the last half of their pregnancy to a wait-list control group. Measures of perceived stress, positive and negative affect, depressed and anxious mood, and affect regulation were collected prior to, immediately following, and three months after the intervention (postpartum). Mothers who received the intervention showed significantly reduced anxiety (effect size, 0.89; $p < 0.05$) and negative affect (effect size, 0.83; $p < 0.05$) during the third trimester in comparison to those who did not receive the intervention. The brief and nonpharmaceutical nature of this intervention makes it a promising candidate for use during pregnancy.

Keywords: Mindfulness; depression; anxiety; pregnancy; stress

Introduction

As many as 18% of pregnant women are depressed during their pregnancy, with 13% having an episode of major depression, and 14% having a new episode of depression during pregnancy (Gavin et al. 2005). Bennett et al. (2004) found prevalence rates of depres-

sion to be 7% in the first trimester, 13% in the second trimester, and 12% in the third trimester. Pregnant women have increased subclinical depressive symptoms, even when potential pregnancy-related confounders such as appetite, somatic symptoms, and sleeping patterns are controlled (Gotlib et al. 1989).

Numerous prospective studies in both animals and humans indicate that high stress and mood disturbance during pregnancy are associated with a variety of negative maternal and infant outcomes (Wadhwa et al. 2001; Bonari et al. 2004) including low birth weight (Altarac and Strobino 2002; Wadhwa et al. 2004), reduced duration of gestation and preterm birth (Dejin-Karlsson et al. 2000; Alvarado et al. 2002), bacterial vaginosis during pregnancy (Culhane et al. 2001), increased risk for chromosomally normal spontaneous abortion (Boyles et al. 2000), lower Apgar scores (Pagel et al. 1990), smaller head circumference (Lou et al. 1994), and neuroendocrine dysregulation (Wadhwa et al. 1996). Stress is a significant predictor of substance use during pregnancy (Nelson et al. 2003), more difficult labor and delivery (Nielsen Forman et al. 2000; Ritter et al. 2000), and postpartum depression (Da Costa et al. 2000). However, pregnant women frequently do not receive screening, prevention or treatment for mood and stress concerns (Marcus et al. 2003; Flynn et al. 2006).

A recent systematic review of 16 trials that examined the effects of providing social and emotional support to women at risk for delivering low-birth-weight babies concluded that providing psychosocial support to at-risk

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women was not associated with improvements in physiological perinatal outcomes, though there was a reduction in rates of caesarean section (Hodnett and Fredericks 2003). However, Lu et al. (2005) have argued that methodological limitations of previous studies make it premature to conclude that psychosocial interventions are ineffective in preventing negative outcomes such as low birth weight.

Some psychosocial interventions have shown promise for improving outcomes. For example, Bullock et al. (1995) found that pregnant women who received weekly telephone support evidenced reduced trait anxiety, less depressed mood, and higher self-esteem. In another trial, pregnant women who received psychosocial support and counseling during pregnancy were more likely to have full-term births (Rothberg and Lits 1991). A couples intervention consisting of didactic sessions, role-playing, and values clarification exercises had a significant positive impact on postpartum anxiety, postpartum marital satisfaction, and postpartum adjustment (Midmer et al. 1995). Receiving stress reduction instructions at a prenatal care visit reduced stress, negative affect, and morning cortisol levels in 42 predominantly low-income Latina women (Urizar et al. 2004).

Mind–body interventions have shown promise for reducing stress and improving mood in many populations, including pregnant women (Astin et al. 2003). Narendran et al. (2005) found that a program incorporating yoga, breathing exercises, and meditation improved birth weight and reduced preterm birth and pregnancy complications in comparison with matched controls. In a randomized controlled trial ($n = 110$), Bastani et al. (2005) found that relaxation training reduced anxiety and perceived stress in pregnant women. They also found that in anxious pregnant women, relaxation training reduced rates of low birth weight, caesarean section, and instrumental extractions, but not preterm birth (Bastani et al. 2006). Massage, while not a mind–body intervention per se, has shown promise for reducing stress, depression, anxiety, pain, and birth complications in pregnant women (Field et al. 1999), as well as increasing dopamine and serotonin and decreasing urinary cortisol and norepinephrine (Field et al. 2004). In lay practice, many mind–body programs have been developed that show anecdotal promise for improving perinatal stress and mood (Peterson 1994; England and Horowitz 1998; Newman and Chamberlain 2005; Bardacke 2006; Sale 2006) but there have been few studies examining their efficacy.

Mindfulness-Based Stress Reduction (MBSR), a program developed by Kabat-Zinn and colleagues (1982), has demonstrated promise with an array of stress-related and chronic medical conditions in diverse populations (Grossman et al. 2004; Roth and Robbins 2004). MBSR is typically taught in the form of an 8- to 10-week, group-based educational program focused on the development of mindfulness. Mindfulness, a set of skills derived from contemplative traditions such as Buddhism, involves the cultivation of moment-to-moment, nonjudgmental awareness of one's present moment experience. While mindfulness practice can induce states of relaxation, it is not a relaxation technique per se as the focus in mindfulness is developing the capacity to simply observe or witness changing mental and physiological states without necessarily trying to alter those states and achieve some desired (e.g., relaxed or calm) state of mind.

Studies in nonclinical populations suggest that participation in MBSR can lessen psychosomatic symptomatology and mood disturbance, increase sense of control, and reduce medical symptoms (Astin 1997; Shapiro et al. 1998; Williams et al. 2001). In clinical populations, participation in MBSR has decreased mood disturbance and stress symptoms (Speca et al. 2000) and improved quality of life and sleep in diverse patient populations (Carlson et al. 2001, 2003).

Recently, MBSR has been modified and studied as a treatment to prevent relapse in clinical depression. Teasdale et al. (2000) reported that for patients who had three or more previous episodes of depression, participation in a program that combined elements of MBSR with cognitive therapy (termed Mindfulness-Based Cognitive Therapy, MBCT) (Segal et al. 2002) reduced the rate of relapse to approximately half that of patients receiving standard treatment. This result was recently replicated (Ma and Teasdale 2004). The positive effects of MBSR on mood disturbance and psychosomatic symptomatology including chronic pain (Kabat-Zinn et al. 1987, 1992) and anxiety and panic disorders (Miller et al. 1995) are also supported by data from several uncontrolled trials (Reibel et al. 2001; Bishop 2002).

The brief and nonpharmaceutical nature of mindfulness-based interventions make them particularly good candidates for intervention during pregnancy. We conducted the current study to develop a mindfulness-based intervention for pregnant women and to test the hypothesis that participation in this intervention would reduce stress, negative affect, and depressive and anxious symptoms during pregnancy and early postpartum. Our theory was that the training would increase mindfulness and

improve ability to regulate negative affect, and that improvement in these variables would be associated with reduced stress and improved mood. In addition, positive affect is a domain that has received increasing attention as a predictor of health outcomes independent of the influence of negative affect on outcomes (Folkman and Moskowitz 2000). We explored the effects of mindfulness training on positive affect, an outcome that seems particularly important in the perinatal period for both maternal psychological health and maternal–infant interactions.

Method

Participants

We included women in the second and third trimesters who were between twelve and thirty weeks gestation at the start of the intervention and were able to speak and read English. Additional inclusion criteria were an affirmative response to the question "Have you had a history of mood concerns for which you sought some form of treatment, such as psychotherapy, counseling, or medication?" This method of selecting for women with "mood concerns" rather than a more formal screening for depression or anxiety was a result of our experience recruiting participants for the initial feasibility group, where we found that pregnant women were reluctant to identify themselves as depressed or anxious, even in the past. We had a very low response when our recruitment materials mentioned "dealing with anxious or depressed mood". However, when we recruited participants with recruitment materials referring to "dealing better with stress and difficult moods", we received an adequate response. This method of inclusion resulted in a sample of participants of whom 35% reported being treated for a psychiatric disorder in the past, 32% had taken psychotropic medications in the past, 52% exceeded a score of 14 on the Perceived Stress Scale upon enrollment, and 31% exceeded a score of 16 on the Center for Epidemiologic Studies Depression Scale (CES-D).

Exclusion criteria were (1) a history of mental disorders that had a psychotic, dissociative, hallucinatory, or delusional component or (2) an inability to attend each of the classes or participate in the assessments.

Women had a mean age of 33.9 (standard deviation [SD], 3.8), all were married, 74% were White, 13% Hispanic, 7% Asian, 3% mixed race, and 3% East Indian. Mean household income was USD 89,677 (SD, USD 17,792) annually, and mean educational level was 17 (SD, 1.4).

Intervention

An intervention was developed to train pregnant women in mindfulness. We began by reviewing and compiling intervention elements of MBSR (Kabat-Zinn 1990) and MBCT (Segal et al. 2002), theoretical and clinical work on working with mood concerns during pregnancy (Peterson 1994), and acceptance-based psychological approaches such as Acceptance and Commitment Therapy (Hayes et al. 2004). From this detailed review, we developed the Mindful Motherhood intervention using a "problem formulation" approach (Teasdale et al. 2003), which calls for tailoring interventions to match the population and problem being addressed. We detailed the symptoms we hoped to alleviate with the intervention, as well as the skills we hoped to enhance, and then selected or developed intervention components that would address each of these areas. Through an iterative process of revision among the investigators and consultants, we developed a provisional treatment manual by group consensus.

The Mindful Motherhood intervention incorporates three approaches to cultivating mindfulness: (1) mindfulness of thoughts and feelings through breath awareness and contemplative practices, (2) mindfulness of the body through guided body awareness meditation and mindful hatha yoga, and (3) presentation of psychological concepts that incorporate mindfulness such as acceptance and cultivation of an observing self. Each of these elements accounted for approximately one-third of the intervention. The intervention contained approximately equal parts education, discussion, and experiential exercises, with more weight on education in the early sessions, and more on discussion and experiential exercises in the later sessions. Adaptations of typical mindfulness-based intervention components included, for example, (1) inclusion of awareness of the developing fetus and belly during the body scan meditation; (2) use of explanatory examples and exercises having to do with pregnancy and early parenting such as mindfulness regarding pain or sleep issues during pregnancy, anxiety about labor, or dealing with a difficult-to-console infant; and (3) greater inclusion of walking and moving mindfulness practices and forms of mindful movement that have been tailored for pregnant women such a prenatal yoga. An intervention manual is available from the authors.

Participants were provided with weekly readings relevant to the material presented in class, as well as a compact disc with three 20 min guided meditations, which they were encouraged to utilize daily. The training was 2 h in duration per week for 8 weeks and was facilitated by a licensed clinical psychologist trained in mindfulness-based interventions, as well as a certified prenatal yoga instructor. Group sizes ranged from 12 to 20 women (and their infants in the postnatal wait-list control group), and groups were held in the multipurpose rooms of a large urban hospital, as well as a local synagogue.

Procedures

Participants were recruited through physicians' offices, childbirth education classes, advertisements, and flyers at other locations pregnant women frequent. The study took place at a large private non-profit hospital in San Francisco, California. All procedures and materials were approved by the Institutional Review Board.

We tested the provisional intervention for feasibility with 12 women and refined it on the basis of (1) participant feedback regarding what they found useful and not useful about the intervention (data collected by written questionnaire at the end of the intervention, during the postintervention measures, as well as informally throughout the course of the group) and (2) group facilitator feedback regarding the order, content, and participant response to intervention components (facilitators kept a journal,

answering a set of questions for each group session). We reviewed this feedback carefully, identified potential changes to the intervention, and then proposed these changes to our investigative and facilitator team who accepted or rejected changes by consensus.

We then conducted a randomized wait-list controlled trial using the refined intervention, recruitment, and measurement strategies. We received 78 phone calls, and 46 women were found to be eligible for the study. The 32 women who called and were not eligible for the study either did not speak or read English (4), were not between 12 and 30 weeks gestation (16), had not had a history of mood concerns for which they sought some form of treatment (9), or had a history of psychosis (3). An additional 9 women did not want to or could not participate in a mindfulness class due to not wanting to be randomized, personal preference, scheduling conflicts, or location of the class. Three women enrolled and dropped out prior to the start of the intervention due to changes in work schedule or difficulty with the location of the class. The remaining 34 women were randomized: 15 to the experimental group from which 2 dropped out, 1 due to a death in the family and 1 due to severe hyperemesis gravidarum. Nineteen women were assigned to a wait-list control group, and one dropped out after the baseline assessment for personal reasons, leaving an overall n of 31 for the pilot study analyses. Those in the experimental group attended the group during their second and/or third trimester. Women were at a mean time of gestation of 25 (SD, 4.0; range, 18–31) weeks at the baseline measurement point.

The baseline assessment occurred for all participants during the two weeks prior to the start of the intervention for the experimental group. Then, women in the experimental group attended the intervention for 2 h per week over eight weeks, for a total of eight groups. Women in the experimental group attended a mean number of 7.2 (SD, 1.1) sessions and reported in weekly diaries engaging for a mean time of 76.9 (SD, 25.6) min per week in formal mindfulness practice. The second assessment for all participants (experimental and control) occurred in the week following the end of the experimental group intervention (eight–ten weeks following the baseline assessment). Follow-up (postnatal) assessments of all participants occurred three months later, and the wait-list control group then received the intervention. Data were collected between September 2004 and May 2006.

Measures

Demographic information was collected at baseline. At each assessment point, measures of perceived stress, depression, anxiety, positive and negative affect, affect regulation, and mindfulness were collected. Perceived stress was measured using the Perceived Stress Scale (PSS), the most widely used psychological instrument for measuring the perception of stress (Cohen et al. 1983). The PSS has demonstrated high alpha reliability in pregnant populations (Lobel et al. 2000), and higher scores on the measure have been associated with lower birth weight babies (Sable and Wilkinson 2000) as well as elevated levels of corticotropin-releasing hormone and preterm birth (Hobel et al. 1999). Depression was measured by CES-D (Radloff 1977; Hann et al. 1999). In pregnant populations, higher scores on the CES-D

have been associated with restricted fetal growth (Hoffman and Hatch 2000) and spontaneous preterm birth (Orr et al. 1996). Anxiety was measured using the State–Trait Anxiety Inventory (STAI) (Spielberger et al. 1970). This measure has been used widely in pregnant populations and shown to be predictive of higher fetal heart rate reactivity (Monk et al. 2004), greater uterine artery resistance (Teixeira et al. 1999), preeclampsia (Kurki et al. 2000), and gestational age at birth (Wadhwa et al. 1993). Positive and negative affect that may not manifest in clinical depression or anxiety symptoms was measured by the Positive and Negative Affect Schedule – Extended (PANAS-X) (Watson and Clark 1994). Internal consistency reliabilities for the PANAS are between 0.83 and 0.90 for positive affect and between 0.85 and 0.90 for negative affect. Affect regulation was measured by the affect regulation measure (ARM) (Vieten et al. unpubl), which assesses impairments in the ability to regulate negative affect across five domains, including affect intolerance, affect lability, cognitive dysregulation, affect preoccupation, and reactivity. Chronbach's alpha coefficients of internal consistency range from 0.81 to 0.90 for the ARM scales, and test–retest reliabilities over 8 weeks ranged from 0.69 to 0.84. Mindfulness was measured by the Mindful Attention Awareness Scale (MAAS), which measures the extent to which individuals are able to maintain awareness of present-moment experience (Brown and Ryan 2003). The MAAS has demonstrated Chronbach's alpha of 0.80–0.87, test–retest reliability intraclass correlation of 0.81, and good convergent, discriminant, incremental, and predictive validity. Adherence to the intervention was assessed by two means: number of sessions attended and weekly diaries of number of minutes spent practicing mindfulness in each day between sessions.

Data analysis

The primary outcome was between-group differences in change from preintervention to postintervention. ANCOVAs with baseline values entered as covariates were performed to assess for between-group differences. It is now recommended by most statisticians and methodologists that investigators report effect sizes, particularly in cases where sample sizes are small and statistical power is likely to be an issue (Cohen 1994). Effect sizes for all outcomes were calculated using Cohen's d, or the difference between two means divided by the pooled standard deviation for those means.

Results

At the postintervention (third trimester) assessment, women participating in the mindfulness group showed statistically significant decreases in state anxiety ($p < 0.05$) and negative affect ($p < 0.04$) compared with wait-list controls. Changes in the expected direction were observed in the intervention group on all other variables (Table 1). Effect sizes (Cohen's d), in order of strength, were as follows: negative affect, 0.90; state anxiety, 0.85; depression, 0.80; positive affect, 0.73; mindful-

Table 1. Changes within groups from baseline to 10 weeks, and differences in changes between groups controlling for baseline values

Measure	Value for group												Between-group ANCOVA		Effect size
	Intervention ($n = 13$)						Control ($n = 18$)								
	Baseline		10 wks		Change		Baseline		10 wks		Change				
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F (2,24)	p	d
Perceived stress	20.1	5.1	15.9	5.7	3.5	5.7	17.1	5.0	16.9	4.6	−0.71	6.2	0.90	0.35	0.39
State anxiety	43.8	12.4	35.4	9.1	6.9	7.6	35.6	10.9	35.6	8.4	−0.35	7.5	4.32	0.04	0.85
Depression	20.4	8.4	16.2	7.3	3.6	5.2	14.2	5.4	17.2	7.4	−4.6	7.3	3.84	0.06	0.80
Negative affect	24.2	5.7	18.2	4.3	5.6	4.5	21.2	5.7	19.9	5.7	0.21	4.5	4.84	0.03	0.90
Positive affect	27.8	7.5	32.4	7.4	2.8	7.9	32.6	6.1	29.5	5.6	−3.0	4.9	3.24	0.08	0.73
Affect regulation	167.1	22.6	152.8	24.0	13.2	16.5	146.3	21.2	143.6	22.2	0.78	13.3	1.51	0.23	0.50
Mindfulness	3.6	0.76	3.8	0.82	0.19	0.45	3.8	0.57	3.6	0.72	−0.23	0.64	2.75	0.11	0.68

Table 2. Improvement on primary outcomes

Variable	% improvement from baseline at:			
	8 weeks		3 months	
	Intervention	Control	Intervention	Control
Anxiety	20	0	7	1
Depression	20	−21	11	0
Perceived stress	20	0	0	0
Positive affect	20	−10	12	7
Negative affect	25	6	13	1
Mindfulness	5	−5	9	0
Affect regulation	9	2	7	1

ness, 0.68; affect regulation, 0.50; and perceived stress, 0.39.

Differences observed between treatment and wait-list controls at 3-month follow-up were not statistically significant. As shown in Table 2, while improvements were still evident for most variables, the percent change among treated subjects decreased for anxiety (20–7%); depression (20–11%), positive affect (20–12%), negative affect (25–13%), affect regulation (9–7%), and perceived stress (20–0%). While changes in mindfulness increased somewhat from 5 to 9% at 3-month follow-up, between-group changes remained nonsignificant ($p = 0.07$).

Discussion

The results suggest that mindfulness training during pregnancy resulted in a significantly greater decline in anxiety and negative affect among participants in the mindfulness intervention when compared with a group that did not receive mindfulness training. The control group showed no improvement in mood at the postintervention assessment (and significant increase in depression and decrease in positive affect), whereas the experimental group showed 20–25% improvement on anxiety, negative affect, positive affect, and stress post intervention. Large effect sizes (as defined by Cohen [1988]) were observed for depression and positive affect despite these changes not reaching statistical significance ($p < 0.05$), leading us to suspect that the small sample size may have afforded inadequate power (Cohen 1994). While these findings are only preliminary given the small sample size, the observed effect sizes may have clinical relevance. For example, in terms of depression, the observed effect size of 0.8 means that the mean of the treated group is better than the scores of 79% of the control group. Taken together, these results indicate that further research with a larger sample is warranted.

In terms of depression, while scores on the CES-D at postintervention remained above the clinical cutoff of 16 in treated subjects, it should be noted that mean baseline values for this group were 20. The mean of the control group on the other hand increased from 14.2 to 17.2 at the postintervention assessment. Furthermore, it should be noted that during pregnancy, CES-D scores are typically inflated due to three somatically oriented questions that are commonly endorsed in pregnancy (item 2: I did not feel like eating; my appetite was poor; item 11: My sleep was restless; and item 20: I could not get going). When used as a screening for pregnant or early postpartum women, these items are often removed as they may confound the depression construct. We opted to leave these questions in for ease of comparison to standard clinical comparisons.

Between-group differences were not significantly different at the three-month postnatal follow-up. However, whereas the control group showed no change from baseline to the three-month follow-up, the experimental group retained 7–10% of their improvements from base-

line on all measures but perceived stress. This trend toward some retention of improvement is worth exploring in a larger sample.

Because mindfulness change scores were not significantly greater in the experimental group than those in the control group, we did not test the extent to which mindfulness mediated improvement in outcomes. However, the moderate effect size ($d = 0.68$, $p = 0.11$) between groups prevents the conclusion that the intervention did not increase mindfulness. In addition, the number of sessions attended and minutes of practice per week were not significantly correlated with improvements (change scores) or outcomes. The small sample size made even relatively large correlations nonsignificant, but more importantly, there was no discernible pattern of correlations between attendance and adherence and outcomes. The mediating effects of mindfulness and attendance and adherence on outcomes should be studied in a larger sample.

Hayes and Muller (2004) suggest that prenatal mood should be treated as a distinct entity, and not only precursory to postnatal mood. The literature indicates prenatal maternal distress has a distinct and direct impact on childbirth and child development outcomes (Wadhwa et al. 2001), and therefore improvements in mood and stress during pregnancy have value in their own right. However, obviously the hope is that the benefit of psychosocial interventions will extend into the postnatal period. Dennis and Creedy (2004) suggest that postpartum interventions have the most promise for influencing postpartum depression. We found that our intervention was feasible in our wait-list control group where women attended mindfulness training with their infants. It is possible that this intervention would be best administered during both the prenatal and postnatal periods to sustain its beneficial effects.

Our study is limited by a small sample size, limited generalizability due to lack of a socioeconomically or ethnically representative sample, reliance on self-report measures, lack of structured interview to assess diagnostic status, and a wait-list control design that does not control for time and attention. While utilizing a wait-list control (in which the control group is receiving only the standard of care) has some benefits for studying psychosocial interventions, lack of an active control group (such as simple group support or education) leaves open the possibility that intervention effects were simply due to the time and attention paid to the experimental group as opposed to mindfulness or other therapeutic aspects of the intervention. Now that within-subjects improve-

ments in stress and mood have been demonstrated in comparison to standard of care, future studies should include an active control group.

Notably, during the course of the study, we learned that when screening potential participants, pregnant women were more willing to admit to having issues with "stress and mood" than "anxiety and depression", even though many of these women did in fact score above cutoff points on both depression and anxiety measures. We speculate that this is partly due to perceived social stigma, and our experience in this regard may have implications not only for how pregnant women are recruited and screened for studies on stress and mood during pregnancy, but also for how pregnant women are screened and assessed for mood problems in clinical settings. It is possible that using more benign language such as "stress", "difficult mood", or "mood concerns" may be more useful in screening than inquiring directly about depression or anxiety.

In summary, our results suggest that a mindfulness-based intervention provided during pregnancy reduced negative affect and anxiety and holds promise for reducing depression and improving positive affect in a pregnant population. A slight trend toward improvements extending into the postpartum period in the group that received mindfulness training warrants further research. Expanding the intervention to bridge between the prenatal and postpartum periods by providing booster sessions postnatally could have value. It remains to be seen what mediates the changes observed, and whether improvements in mood and stress as a result of participating in mindfulness-based interventions will result in improved childbirth and child development outcomes.

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References

Altarac M, Strobino D (2002) Abuse during pregnancy and stress because of abuse during pregnancy and birthweight. J Am Med Womens Assoc 57: 208–214

Alvarado R, Medina E, Aranda W (2002) The effect of psychosocial variables during pregnancy and in birth weight and gestational age of the newborn. Rev Med Chil 130: 561–568 (in Spanish with summary in English)

Astin JA (1997) Stress reduction through mindfulness meditation. Effects on psychological symptomatology, sense of control, and spiritual experiences. Psychother Psychosom 66: 97–106

Astin JA, Shapiro SL, Eisenberg DM, Forys KL (2003) Mind-body medicine: state of the science, implications for practice. J Am Board Fam Pract 16: 131–147

Bardacke N (2006) Mindfulness-Based Childbirth and Parenting Education Program. Available at http://www.mindfulbirthing.org

Bastani F, Hidarnia A, Montgomery KS, Aguilar-Vafaei ME, Kazemnejad A (2006) Does relaxation education in anxious primigravid Iranian women influence adverse pregnancy outcomes?: a randomized controlled trial. J Perinat Neonatal Nurs 20: 138–146

Bastani F, Hidarnia A, Kazemnejad A, Vafaei M, Kashanian M (2005) A randomized controlled trial of the effects of applied relaxation training on reducing anxiety and perceived stress in pregnant women. J Midwifery Womens Health 50: 36–40

Bennett HA, Einarson A, Taddio A, Koren G, Einarson TR (2004) Prevalence of depression during pregnancy: systematic review. Obstet Gynecol 103: 698–709

Bishop SR (2002) What do we really know about mindfulness-based stress reduction? Psychosom Med 64: 71–83

Bonari L, Bennett H, Einarson A, Koren G (2004) Risks of untreated depression during pregnancy. Can Fam Physician 50: 37–39

Boyles SH, Ness RB, Grisso JA, Markovic N, Bromberger J, CiFelli D (2000) Life event stress and the association with spontaneous abortion in gravid women at an urban emergency department. Health Psychol 19: 510–514

Brown KW, Ryan RM (2003) The benefits of being present: mindfulness and its role in psychological well-being. J Pers Soc Psychol 84: 822–848

Bullock LF, Wells JE, Duff GB, Hornblow AR (1995) Telephone support for pregnant women: outcome in late pregnancy. N Z Med J 108: 476–478

Carlson LE, Speca M, Patel KD, Goodey E (2003) Mindfulness-based stress reduction in relation to quality of life, mood, symptoms of stress and immune parameters in breast and prostate cancer outpatients. Psychosom Med 65: 571–581

Carlson LE, Ursuliak Z, Goodey E, Angen M, Speca M (2001) The effects of a mindfulness meditation-based stress reduction program on mood and symptoms of stress in cancer outpatients: 6-month follow-up. Support Care Cancer 9: 112–123

Cohen J (1994) The earth is round ($p < 0.05$). Am Psychol 49: 997–1003

Cohen J (1988) Statistical power analysis for the behavioral sciences, 2nd edn. L Erlbaum Associates, Hillsdale, NJ

Cohen S, Kamarck T, Mermelstein R (1983) A global measure of perceived stress. J Health Soc Behav 24: 385–396

Da Costa D, Dritsa M, Larouche J, Brender W (2000) Psychosocial predictors of labor/delivery complications and infant birth weight: a prospective multivariate study. J Psychosom Obstet Gynaecol 21: 137–148

Dejin-Karlsson E, Hanson BS, Ostergren PO, Lindgren A, Sjoberg NO, Marsal K (2000) Association of a lack of psychosocial resources and the risk of giving birth to small for gestational age infants: a stress hypothesis. BJOG 107: 89–100

Dennis CL, Creedy D (2004) Psychosocial and psychological interventions for preventing postpartum depression. Cochrane Database Syst Rev 2004(4): CD001134

England P, Horowitz R (1998) Birthing from within: an extra-ordinary guide to childbirth. Partera Press, Albequerque, NM

Field T, Diego MA, Hernandez-Reif M, Schanberg S, Kuhn C (2004) Massage therapy effects on depressed pregnant women. J Psychosom Obstet Gynaecol 25: 115–122

Field T, Hernandez-Reif M, Hart S, Theakston H, Schanberg S, Kuhn C (1999) Pregnant women benefit from massage therapy. J Psychosom Obstet Gynaecol 20: 31–38

Flynn HA, Blow FC, Marcus SM (2006) Rates and predictors of depression treatment among pregnant women in hospital-affiliated obstetrics practices. Gen Hosp Psychiatry 28: 289–295

Folkman S, Moskowitz JT (2000) Positive affect and the other side of coping. Am Psychol 55: 647–654

Gavin NI, Gaynes BN, Lohr KN, Meltzer-Brody S, Gartlehner G, Swinson T (2005) Perinatal depression: a systematic review of prevalence and incidence. Obstet Gynecol 106: 1071–1083

Gotlib IH, Whiffen VE, Mount JH, Milne K, Cordy NI (1989) Prevalence rates and demographic characteristics associated with depression in pregnancy and the postpartum. J Consult Clin Psychol 57: 269–274

Grossman P, Niemann L, Schmidt S, Walach H (2004) Mindfulness-based stress reduction and health benefits: a meta-analysis. J Psychosom Res 57: 35–43

Hann D, Winter K, Jacobsen P (1999) Measurement of depressive symptoms in cancer patients: evaluation of the Center for Epidemiological Studies Depression Scale (CES-D). J Psychosom Res 46: 437–443

Hayes BA, Muller R (2004) Prenatal depression: a randomized controlled trial in the emotional health of primiparous women. Res Theory Nurs Pract 18: 165–183

Hayes SC, Follette VM, Linehan MM (eds) (2004) Mindfulness and acceptance: expanding the cognitive-behavioral tradition. Guilford Press, New York

Hobel CJ, Dunkel-Schetter C, Roesch SC, Castro LC, Arora CP (1999) Maternal plasma corticotropin-releasing hormone associated with stress at 20 weeks' gestation in pregnancies ending in preterm delivery. Am J Obstet Gynecol 180: S257–S263

Hodnett ED, Fredericks S (2003) Support during pregnancy for women at increased risk of low birthweight babies. Cochrane Database Syst Rev 2003(3): CD000198

Hoffman S, Hatch MC (2000) Depressive symptomatology during pregnancy: evidence for an association with decreased fetal growth in pregnancies of lower social class women. Health Psychol 19: 535–543

Kabat-Zinn J (1990) Full catastrophe living: using the wisdom of your body and mind to face stress, pain and illness. Dell, New York

Kabat-Zinn J (1982) An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: theoretical considerations and preliminary results. Gen Hosp Psychiatry 4: 33–47

Kabat-Zinn J, Massion AO, Kristeller J, Peterson LG, Fletcher KE, Pbert L, Lenderking WR, Santorelli SF (1992) Effectiveness of a meditation-based stress reduction program in the treatment of anxiety disorders. Am J Psychiatry 149: 936–943

Kabat-Zinn J, Lipworth L, Burney R (1987) Four-year follow-up of a meditation-based program for the self-regulation of chronic pain: treatment outcomes and compliance. Clin J Pain 2: 159–173

Kurki T, Hiilesmaa V, Raitasalo R, Mattila H, Ylikorkala O (2000) Depression and anxiety in early pregnancy and risk for preeclampsia. Obstet Gynecol 95: 487–490

Lobel M, DeVincent CJ, Kaminer A, Meyer BA (2000) The impact of prenatal maternal stress and optimistic disposition on birth outcomes in medically high-risk women. Health Psychol 19: 544–553

Lou HC, Hansen D, Nordentoft M, Pryds O, Jensen F, Nim J, Hemmingsen R (1994) Prenatal stressors of human life affect fetal brain development. Dev Med Child Neurol 36: 826–832

Lu Q, Lu MC, Dunkel-Schetter C (2005) Learning from success and failure in psychosocial intervention: an evaluation of low birth weight prevention trials. J Health Psychol 10: 185–195

Ma SH, Teasdale JD (2004) Mindfulness-based cognitive therapy for depression: replication and exploration of differential relapse prevention effects. J Consult Clin Psychol 72: 31–40

Marcus SM, Flynn HA, Blow FC, Barry KL (2003) Depressive symptoms among pregnant women screened in obstetrics settings. J Womens Health (Larchmt) 12: 373–380

Midmer D, Wilson L, Cummings S (1995) A randomized, controlled trial of the influence of prenatal parenting education on postpartum anxiety and marital adjustment. Fam Med 27: 200–205

Miller JJ, Fletcher K, Kabat-Zinn J (1995) Three-year follow-up and clinical implications of a mindfulness meditation-based stress reduction intervention in the treatment of anxiety disorders. Gen Hosp Psychiatry 17: 192–200

Monk C, Sloan RP, Myers MM, Ellman L, Werner E, Jeon J, et al. (2004) Fetal heart rate reactivity differs by women's psychiatric status: an early marker for developmental risk? J Am Acad Child Adolesc Psychiatry 43: 283–290

Narendran S, Nagarathna R, Narendran V, Gunasheela S, Nagendra HR (2005) Efficacy of yoga on pregnancy outcome. J Altern Complement Med 11: 237–244

Nelson DB, Grisso JA, Joffe MM, Brensinger C, Shaw L, Datner E (2003) Does stress influence early pregnancy loss? Ann Epidemiol 13: 223–229

Newman R, Chamberlain D (2005) Calm birth: new methods for conscious childbirth. North Atlantic Books, Berkeley, Calif

Nielsen Forman D, Videbech P, Hedegaard M, Dalby Salvig J, Secher NJ (2000) Postpartum depression: identification of women at risk. BJOG 107: 1210–1217

Orr ST, James SA, Miller CA, Barakat B, Daikoku N, Pupkin M, Engstrom K, Huggins G (1996) Psychosocial stressors and low birthweight in an urban population. Am J Prev Med 12: 459–466

Pagel MD, Smilkstein G, Regen H, Montano D (1990) Psychosocial influences on new born outcomes: a controlled prospective study. Soc Sci Med 30: 597–604

Peterson GH (1994) An easier childbirth: a mother's guide for birthing normally. Shadow & Light, Berkeley, Calif

Radloff LS (1977) The CES-D scale: a self-report depression scale for research in the general population. Appl Psychol Meas 1: 385–401

Reibel DK, Greeson JM, Brainard GC, Rosenzweig S (2001) Mindfulness-based stress reduction and health-related quality of life in a heterogeneous patient population. Gen Hosp Psychiatry 23: 183–192

Ritter C, Hobfoll SE, Lavin J, Cameron RP, Hulsizer MR (2000) Stress, psychosocial resources, and depressive symptomatology during pregnancy in low-income, inner-city women. Health Psychol 19: 576–585

Roth B, Robbins D (2004) Mindfulness-based stress reduction and health-related quality of life: findings from a bilingual inner-city patient population. Psychosom Med 66: 113–123

Rothberg AD, Lits B (1991) Psychosocial support for maternal stress during pregnancy: effect on birth weight. Am J Obstet Gynecol 165: 403–407

Sable MR, Wilkinson DS (2000) Impact of perceived stress, major life events and pregnancy attitudes on low birth weight. Fam Plann Perspect 32: 288–294

Sale R (2006) Whole birth resources. Available at http://www.wholebirth.com

Segal Z, Williams M, Teasdale JD (2002) Mindfulness-based cognitive therapy for depression: a new approach to preventing relapse. Guilford Press, New York

Shapiro SL, Schwartz GE, Bonner G (1998) Effects of mindfulness-based stress reduction on medical and premedical students. J Behav Med 21: 581–599

Speca M, Carlson LE, Goodey E, Angen M (2000) A randomized, wait-list controlled clinical trial: the effect of a mindfulness meditation-based stress reduction program on mood and symptoms of stress in cancer outpatients. Psychosom Med 62: 613–622

Spielberger CD, Gorsuch I, Lushene RE (1970) Manual for the State-Trait Anxiety Inventory. Consulting Psychologists Press, Palo Alto, Calif

Teasdale JD, Segal Z, Williams M (2003) Mindfulness training and problem formulation. Clin Psychol Sci Pract 10: 157–160

Teasdale JD, Segal ZV, Williams JM, Ridgeway VA, Soulsby JM, Lau MA (2000) Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. J Consult Clin Psychol 68: 615–623

Teixeira JM, Fisk NM, Glover V (1999) Association between maternal anxiety in pregnancy and increased uterine artery resistance index: cohort based study. BMJ 318: 153–157

Urizar GG Jr, Milazzo M, Le HN, Delucchi K, Sotelo R, Munoz RF (2004) Impact of stress reduction instructions on stress and cortisol levels during pregnancy. Biol Psychol 67: 275–282

Wadhwa PD, Garite TJ, Porto M, Glynn L, Chicz-DeMet A, Dunkel-Schetter C, Sandman CA (2004) Placental corticotropin-releasing hormone (CRH), spontaneous preterm birth, and fetal growth restriction: a prospective investigation. Am J Obstet Gynecol 191: 1063–1069

Wadhwa PD, Sandman CA, Garite TJ (2001) The neurobiology of stress in human pregnancy: implications for prematurity and development of the fetal central nervous system. Prog Brain Res 133: 131–142

Wadhwa PD, Dunkel-Schetter C, Chicz-DeMet A, Porto M, Sandman CA (1996) Prenatal psychosocial factors and the neuroendocrine axis in human pregnancy. Psychosom Med 58: 432–446

Wadhwa PD, Sandman CA, Porto M, Dunkel-Schetter C, Garite TJ (1993) The association between prenatal stress and infant birth weight and gestational age at birth: a prospective investigation. Am J Obstet Gynecol 169: 858–865

Watson D, Clark LA (1994) Manual for the Positive and Negative Affect Schedule (Expanded Form). University of Iowa, Iowa City, Iowa

Williams KA, Kolar MM, Reger BE, Pearson JC (2001) Evaluation of a wellness-based mindfulness stress reduction intervention: a controlled trial. Am J Health Promot 15: 422–432