The Feasibility of Yoga in the Treatment of Antenatal Depression and Anxiety: A Pilot Study

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The Feasibility of Yoga in the Treatment of Antenatal Depression and Anxiety: A Pilot Study

by

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A thesis submitted to the
Faculty of the Graduate School of the
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This thesis entitled:  
The Feasibility of Yoga in the Treatment of Antenatal Depression and Anxiety: A Pilot Study
written by Kyle J. Davis
has been approved for the Department of Psychology and Neuroscience

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BACKGROUND: The antenatal period is a sensitive time for both mother and the developing fetus. Antenatal depression affects approximately 15% of women and anxiety affects approximately 30%; moreover, the two are frequently comorbid, and studies suggest that they, singly and in combination, can have deleterious consequences for a woman as well as her family and infant. Although psychosocial and alternative treatments for antenatal depression and anxiety have not been studied extensively, they may provide a safe, acceptable, and efficacious option for antenatal women. Yoga interventions may be particularly well suited for depressed and anxious pregnant women given benefits associated with meditation and physical activity, two central components of yoga, and growing interest in yoga across the United States.

METHODS: A randomized controlled clinical trial compared an eight-week yoga intervention to treatment as usual (TAU) among 46 pregnant women with symptoms of depression and/or anxiety recruited through health care providers and community advertisement. Participants were randomly assigned to the yoga or TAU condition and completed brief assessments weekly during the eight-week intervention and at post-intervention.

RESULTS: Participants in the intervention group found yoga to be an acceptable intervention for anxiety and depression and reported high levels of satisfaction with the intervention. Pregnant women’s reports of negative affect suggested significantly greater reductions among women who received yoga compared with TAU. Pregnant women receiving the yoga intervention also
reported significantly lower anxiety and depression over time, but such changes were not significantly greater than those reported by women who received TAU. Analyses of secondary outcome measures suggest that prenatal yoga may increase self-efficacy and factors associated with positive self-regulation skills.

CONCLUSION: Prenatal yoga was found to be a feasible and acceptable intervention for pregnant women with symptoms of anxiety and/or depression. Future research would benefit from more rigorous control conditions and larger sample sizes to gain a greater understanding of how yoga may affect antenatal depression and anxiety.
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CHAPTER 1

INTRODUCTION

Depression and anxiety during pregnancy present a major public health problem. A growing body of research has documented an increased risk of adverse correlates and consequences of depression for women and their offspring. Among women, studies have suggested that, compared with nondepressed pregnant women, depressed pregnant women experience increased risk of postpartum depression, less satisfying relationships with husbands/partners, dissatisfaction with and smaller social support networks, poor social support, and later problems with parenting stress (Goodman & Tully, 2009; Misri et al., 2010; Robertson, Grace, Wallington, & Stewart, 2004). Depression during pregnancy is associated with adverse affective, cognitive, interpersonal and neural correlates for offspring and such problems may persist beyond the conclusion of the mother's symptoms of depression (Field et al., 2004; Goodman, 2007; Kinsella & Monk, 2009). Similarly, children of depressed mothers are more likely to develop depression and other psychiatric disorders throughout their lifetimes relative to children whose mothers did not experience depression (Gelfand & Teti, 1990; Goodman, 2007; Goodman & Gotlib, 1999).

Additionally, antenatal depression often co-occurs with anxiety during pregnancy. Antenatal anxiety is relatively understudied in comparison to the more robust literature concerning depression; however, studies have shown antenatal anxiety affects approximately 30% of pregnant women (Lee et al., 2007) and 6.6% meet criteria for anxiety disorders (Andersson et al., 2003). Antenatal anxiety may have negative implications for both mother and
child, independent of other psychological symptoms the mother may experience. Symptoms of anxiety in the antenatal period may precede the development of antenatal depressive symptoms as well as depression in the postpartum period. Most anxiety disorders occur at a similar rate during pregnancy and the postpartum when compared to the general population, though research is limited (Ross & McLean, 2006). A cross-sectional study indicated the prevalence of state anxiety during pregnancy was the same as for non-pregnant women and these rates were significantly higher than state anxiety in postpartum women (Breitkopf et al., 2006), though other studies have found rates of anxiety to remain stable across the perinatal period (Grant, McMahon, & Austin, 2008; Heron et al., 2004). Others have suggested that anxiety during pregnancy may be a unique syndrome, with “pregnancy anxiety” focused on fear of giving birth, giving birth to a disabled child, and physical appearance during pregnancy (Huizink, Mulder, de Medina, Visser, & Buitelaar, 2004).

Given this context, treatment efforts during pregnancy hold obvious appeal, and alternatives to traditional treatments such as pharmacotherapy may offer particular benefit in the treatment of antenatal depression and anxiety. Alternative interventions, such as yoga, are gaining acceptance in western medicine as viable treatment options for a range of physical and mental health problems, though this is a relatively understudied area (Babbar, Parks-Savage, & Chauhan, 2012; Curtis, Weinrib, & Katz, 2012; Narendran, Nagarathna, Narendran, Gunasheela, & Nagendra, 2005; Uebelacker et al., 2010; Woolery, Myers, Sternlieb, & Zeltzer, 2004). Yoga may offer particular appeal to pregnant women interested in learning skills to cope with stressors, increase relaxation, and reduce or eliminate symptoms of depression and anxiety.

The following section briefly reviews the prevalence, correlates, and consequences of antenatal depression and anxiety. Next, the efficacy and limitations of current treatments are
highlighted to provide a rationale for a randomized clinical trial designed to assess the feasibility of an eight-week yoga class in the treatment of antenatal symptoms of anxiety and depression. Finally, we review potential pathways by which yoga may alleviate symptoms of anxiety and depression to provide a foundation for future assessment of potential mediators in the study of yoga as a treatment for antenatal anxiety and depression.

**Antenatal Depression and Anxiety**

Although depression can affect anyone, regardless of race, socioeconomic status, or gender, women are twice as likely to experience a depressive episode compared to men (American Psychiatric Association, 2000). The peak prevalence among women is from age 18-44, which overlaps with childbearing and parenting among many women. Approximately 10-20% of women will experience a major depressive episode across the perinatal period (Gavin et al., 2005), with similar rates of depression in the antenatal and postpartum periods. Depression during this period may have wide ranging and long term effects for the mother and her family, including the mother child relationship and the developmental trajectories of children (Wisner, Parry, & Piontek, 2002). Antenatal depression has been associated with adverse consequences for mother and infant including: increased rates of obstetric complications (Field et al., 2001), increased visits to physicians (Andersson, Sundstrom-Poromaa, Wulff, Astrom, & Bixo, 2004; Larsson, Sydsjo, & Josefsson, 2004), preeclampsia (Kurki, Hiilesmaa, Raitasalo, Mattila, & Ylikorkala, 2000), spontaneous abortion (Nakano et al., 2004; Sugiura-Ogasawara et al., 2002), preterm labor, preterm birth (Field, et al., 2004; Grote et al., 2010; Jesse, Seaver, & Wallace, 2003; Orr, James, & Prince, 2002), and decreased birth weight (Field, et al., 2004; Grote, et al., 2010).
Approximately 30% of women will endorse clinically significant levels of anxiety during pregnancy (Lee et al., 2007) and antenatal anxiety has been associated with adverse consequences for the infant (Alder, Fink, Bitzer, Hosli, & Holzgreve, 2007) including: postnatal complications (Field et al., 2003), preeclampsia (Kurki, et al., 2000), preterm labor (Bhagwanani, Seagraves, Dierker, & Lax, 1997; Dayan et al., 2002), preterm birth (Rini, Dunkel-Schetter, Wadhwa, & Sandman, 1999), decreased birth weight (Bhagwanani, et al., 1997; Field et al., 2010), lower APGAR scores (Berle et al., 2005), behavioral/emotional problems at four years (O'Connor, Heron, Golding, Beveridge, & Glover, 2002), symptoms of ADHD, externalizing problems, and anxiety at nine years (Van den Bergh & Marcoen, 2004). Antenatal anxiety and anxiety sensitivity have also been correlated with higher rates of self-reported pain during labor (Beebe, Lee, Carrieri-Kohlman, & Humphreys, 2007; Lang, Sorrell, Rodgers, & Lebeck, 2006).

A significant relationship between antenatal anxiety and postpartum depression also exists. One study demonstrated that women who reported high levels of worry in the antenatal period were 2.6 times more likely to develop depression at eight weeks postpartum than women who reported lower levels of antenatal worry (Austin, Tully, & Parker, 2007). Antenatal anxiety has also been demonstrated to be a stronger predictor of postpartum depression than antenatal depression (Heron, et al., 2004), though other studies suggest a bi-directional explanation of this relationship such that depression often precedes anxiety in the antenatal period and that antenatal anxiety often precedes postpartum depression (Skouteris, Wertheim, Railis, Milgrom, & Paxton, 2009). Other studies have demonstrated that anxiety in the antenatal period reflects a U-shape with higher anxiety in the first and third trimesters than the second trimester with rates of depression slowly declining across pregnancy (Teixeira, Figueiredo, Conde, Pacheco, & Costa, 2009).
Antenatal depression and anxiety are frequently comorbid with elevated levels of stress, which can exhibit additive and independent effects on fetal and infant development. Recent reviews suggest that psychological stress during pregnancy may result in dysregulation of the hypothalamus-pituitary-adrenal axis (HPA) and the sympathetic nervous system (SNS), leading to fluctuation in hormonal levels that may have a negative impact on the fetal developmental environment (Kinsella & Monk, 2009; Lazinski, Shea, & Steiner, 2008; Talge, Neal, & Glover, 2007). Hyperactivity of the HPA axis and SNS are commonly observed in those experiencing depression and anxiety (Hughes, Watkins, Blumenthal, Kuhn, & Sherwood, 2004) and may explain the similarity in undesirable birth outcomes seen in pregnant women experiencing excessive symptoms of anxiety and depression. Potential negative effects of antenatal stress, also correlated with anxiety and depression during the antenatal period, include: preterm birth, low birth weight, and intrauterine growth restriction (Copper et al., 1996; Lazinski, et al., 2008; Rondo et al., 2003; Talge, et al., 2007). These factors may predispose infants to develop other cognitive and social developmental problems (Lazinski, et al., 2008).

In summary, the precise relationship between depression and anxiety in the perinatal period is not well understood, but it is clear that the presence of either singly or in combination is associated with an increased risk of adverse outcomes for both mother and offspring. Given this context, interventions that can target simultaneously reductions in depression and anxiety may offer particular benefit.

**Treatment of Depression and Anxiety in the Antenatal Period**

The significant adverse consequences of antenatal depression and anxiety highlight the importance of effective methods to prevent and treat depression among this population. Psychopharmacologic intervention is the most prevalent treatment modality for depression in
antenatal populations, but its use among antenatal women is controversial given potential adverse effects on the fetus and women’s preference for non-pharmacological options. Antidepressant medication (ADM) is widely used during the perinatal period and estimates suggest that use has increased over time. Approximately 13% of women took ADM at least once during pregnancy in 2003 and rates of ADM use increased 7.7% from 1999-2003 (Cooper, Willy, Pont, & Ray, 2007; Sleath et al., 2005), though other studies have found more conservative rates of use, ranging from 2-8.1%, among pregnant women (Alwan, Reefhuis, Rasmussen, & Friedman, 2011; Andrade et al., 2008; Ramos, Oraichi, Rey, Blais, & Berard, 2007; Ververs et al., 2006). Another recent study found that in a population of perinatal women diagnosed with depression, 77.4% used ADM before pregnancy, 67.2% during pregnancy, and 81.5% after delivery (Dietz et al., 2007).

Despite widespread use, significant controversy in the field regarding the potential adverse effects of ADMs on fetal development and obstetric outcome exists. A report from the American Psychiatric Association and the American College of Obstetricians and Gynecologists (Yonkers et al., 2009) listed multiple potential adverse outcomes including: increased rates of miscarriage (Hemels, Einarson, Koren, Lanctot, & Einarson, 2005), low birth weight (Grote, et al., 2010; Kallen, 2004; Oberlander, Warburton, Misri, Aghajanian, & Hertzman, 2006), increased rates of preterm birth (Chambers, Johnson, Dick, Felix, & Jones, 1996; Costei, Kozer, Ho, Ito, & Koren, 2002; Djulus et al., 2006; N.K. Grote, et al., 2010; Kallen, 2004; Simon, Cunningham, & Davis, 2002), neonatal complications when exposed to paroxetine or fluoxetine in the third trimester (Chambers, et al., 1996; Costei, et al., 2002), and increased rates of persistent pulmonary hypertension in newborns (Chambers et al., 2006; Kallen & Olausson, 2008). A recent trial also found increased risk for the development of autism in children of
mothers who used ADM during pregnancy (Croen, Grether, Yoshida, Odouli, & Hendrick, 2011).

On the other hand, it is difficult to differentiate the potentially harmful effects of depression from the possible consequences of pharmacotherapy. A prospective observational study examined birth outcomes in depressed pregnant women using selective serotonin reuptake inhibitors (SSRIs) compared to birth outcomes among untreated depressed pregnant women (Wisner et al., 2009). Both continuous SSRI use ($n = 48$) and untreated continuous depression ($n = 14$) were associated with preterm birth rates. Continuous SSRI use was associated with significantly higher five minute APGAR scores (a measure used to assess the health of a infant immediately after birth) and lower maternal depression scores as compared to continuous untreated depression (Wisner, et al., 2009). A recent trial examined the growth rates of infants born to women with depression that were using antidepressant medication and compared outcomes to women with untreated depression and women without depression. The authors did not find differences in birth outcomes between groups suggesting antidepressant medication use in pregnancy may not impact infant growth (Wisner et al., 2013). Similarly, a large scale population based study did not find a significant relationship between SSRI use and still-birth or neonatal mortality in sample of over 900,000 women (Jimenez-Solem et al., 2013). Furthermore, some large scale studies have reported statistically significant associations between ADM use and negative birth outcomes; however, the clinical significance of such associations has been questioned (Einarson, 2012).

When making decisions regarding the use of ADM for antenatal depression, it is essential for caregivers and their patients to engage in individualized discussions of treatment options, the potential adverse outcomes associated with each treatment, the patient’s thoughts and feelings
concerning treatment options and risks, as well as the opinions of significant others (Price & Bentley, 2013; Wisner et al., 2000). Such guidelines are complex, and should be informed by recent data suggesting women strongly prefer non-pharmacological approaches to treatment. A study of treatment preferences in a sample of pregnant women ($n = 509$), observed that 92% of participants stated they would seek individual therapy if needed, whereas only 35% said they would take medication if recommended (Goodman, 2009). Another study demonstrated that pregnant women ($n = 73$) would prefer to let depression resolve itself naturally (83.6%), receive counseling from a mental health professional (57.6%), go to a support group (49.3%), use herbal medicines (27.3%), or use ADM (23.3%) if they were to become depressed during pregnancy (Sleath, et al., 2005).

The controversy regarding pharmacotherapy during pregnancy has underscored the possible value of non-pharmacological interventions, which may offer the promise of efficacy while avoiding potential negative consequences associated with ADM use. Unfortunately, few rigorous studies have examined the efficacy of non-pharmacological treatments with pregnant women (Brandon & Freeman, 2011; Dimidjian & Goodman, 2009; Goodman & Dimidjian, 2012). Two trials have examined cognitive behavioral therapy in the treatment of antenatal depression. A randomized controlled trial compared the effects of cognitive behavioral therapy in a sample of pregnant women with subclinical levels of stress, anxiety, and depression ($n = 21$) to treatment as usual ($n = 40$) (Richter et al., 2012). The authors found the intervention to be effective in reducing stress response measured by salivary cortisol but did not find differences in self-report measures of stress between the two groups. A randomized trial of a group cognitive behavioral intervention designed for pregnant women in the prevention of postpartum depression and anxiety found that anxiety and depression scores decreased significantly throughout
treatment, but did not differ significantly from the control group, which only received informational materials about perinatal depression (Austin et al., 2008). Additionally, a number of studies have examined the efficacy of Interpersonal Therapy (IPT), a psychotherapeutic intervention addressing interpersonal relationships and role transitions, among pregnant women. Four trials have demonstrated support for IPT as a treatment intervention (Brandon et al., 2012; Grote et al., 2009; Spinelli & Endicott, 2003) and as a preventive intervention for depression among antenatal women (Zlotnick, Miller, Pearlstein, Howard, & Sweeney, 2006).

Few studies have evaluated nonpharmacological interventions for anxiety disorders during pregnancy (Arch, Dimidjian, & Chessick, 2012). The aforementioned review found only one trial of cognitive behavioral therapy in the treatment of anxiety disorders during pregnancy, an exposure-based intervention for blood and injection phobia (Lilliecreutz, Josefsson, & Sydsjo, 2010). Additional studies have examined psychosocial interventions for antenatal stress and anxiety. An open trial stress reduction intervention for pregnant women (n = 41) demonstrated that instructing women to “eliminate things that are stressful and/or participate in things that increase your level of relaxation” was an effective intervention for symptoms of antenatal stress and depression (Urizar et al., 2004). A stress reduction intervention for antenatal women (n = 110) randomized participants to a stress reduction group, which provided psychoeducation about stress and taught applied relaxation training strategies, or treatment as usual. Results indicated the intervention group significantly reduced scores of perceived stress as well as trait and state anxiety (Bastani, Hidarnia, Kazemnejad, Vafaei, & Kashanian, 2006). Weekly phone support (n = 65), compared to waitlist control (n = 66), has also demonstrated the ability to significantly reduce symptoms of stress, trait anxiety, and depression in antenatal women (Bullock, Wells, Duff, & Hornblow, 1995).
Treatment of depression and anxiety during the antenatal period has the potential to improve the quality of the mother’s life and the development of her fetus. Similarly, treatment in the antenatal period may reduce depression in the postpartum period, also having a positive effect on the mother, her family, and the development of her infant. Unfortunately, pharmacotherapy presents women with complex and controversial treatment decisions. Non-pharmacological interventions among this population have been understudied; however, there is emerging evidence that psychosocial interventions can have positive effects on maternal depression and anxiety. The paucity of treatment outcome research in this sensitive time period underscores the need for innovative clinical research evaluating the feasibility of a range of non-pharmacological options.

**Rationale for Yoga in the Treatment of Antenatal Depression and Anxiety**

Yoga may hold particular promise as a non-pharmacological intervention for antenatal depression and anxiety. The emerging literature examining the effects of yoga among general depressed populations provides preliminary evidence demonstrating that yoga practice is an effective adjunctive therapy to ADM in the treatment of depression and is also associated with decreased rates of anxiety (Shapiro et al., 2007). In one small study, in which yoga was compared to a waitlist control in a population of young adults with mild depression ($n = 28$), participants assigned to the yoga condition demonstrated significantly decreased rates of depression and anxiety (Woolery, et al., 2004). Yoga has also been proven to significantly outperform group therapy with hypnosis and psychoeducation alone in a pilot study of participants with long term depressed mood ($n = 46$) (Butler et al., 2008).

Among pregnant women, yoga and other forms of mindful movement have been associated with decreased stress, anxiety, depression, pain and improved birth outcomes (Babbar,
et al., 2012; Beddoe, Yang, Kennedy, Weiss, & Lee, 2009; Curtis, et al., 2012; Ji & Han, 2010; Satyapriya, Nagendra, Nagarathna, & Padmalatha, 2009). Seven studies have examined the relationship between contemplative physical activity and mental health outcomes. A quasi-experimental trial conducted in Korea, utilized a sample of pregnant women ($n = 80$) and compared Qi exercise, similar to yoga in its use of postures, mindful breathing, and meditation, to a waitlist control (Ji & Han, 2010). Participants were assigned to either group based on where they received prenatal care. The authors found that women in the Qi exercise group demonstrated significantly lower symptoms of depression and physical discomfort at the end of the 12-week trial compared to controls (Ji & Han, 2010). A randomized controlled trial conducted in India indicated that participating in yoga and deep relaxation ($n = 45$) was associated with reduced rates of stress and increased adaptive autonomic nervous system response, indicated by increased heart rate variability, when compared to a prenatal exercise control group ($n = 45$) (Satyapriya, et al., 2009). A recently published open trial in the United States found that depression scores decreased and mindfulness scores increased significantly after a 10-week intervention of mindfulness-based yoga in a population of women at risk for prenatal depression ($n = 18$) (Muzik, Hamilton, Rosenblum, Waxler, & Hadi, 2012).

Another recently published trial compared yoga, massage therapy, and a treatment as usual group in a sample of depressed pregnant women (Field et al., 2012). The authors reported the results of the massage therapy and yoga groups together in comparison to the treatment as usual group and did not report sample size of the groups making effects of the yoga intervention alone difficult to interpret. A similar study, from the same research group, compared a combined yoga and Tai Chi class to a waitlist control group in a population of pregnant women with symptoms of depression (Field, Diego, Delgado, & Medina, 2013). The authors reported that
both the treatment \((n = 37)\) and control groups \((n = 38)\) displayed decreases in depression but the treatment group displayed a greater rate of change than the control after the 12-week intervention (Field, et al., 2013). Another trial comparing social support \((n = 39)\) to yoga \((n = 40)\) in a population of antenatal women with symptoms of depression found that participants in both groups reported decreased symptoms of depression at the end of the 12-week intervention and did not find significant differences between treatment groups (Field, Diego, Delgado, & Medina, 2012). Finally, the same research group compared the effects of prenatal yoga \((n = 12)\) to a parenting education control group \((n = 12)\) in a sample of pregnant women with symptoms of depression. At the end of the 12-week trial, the authors reported greater decreases in depression scores in the yoga group compared to the parenting education control group (Mitchell et al., 2012). These findings underscore the potential promise of yoga as an intervention for antenatal depression and anxiety and highlight the need for additional research.

**Potential Pathways for Anxiolytic and Antidepressant Effects of Yoga**

Yoga may benefit women’s mental and physical health and the reciprocal relationship between the two (Uebelacker, et al., 2010). Yoga engages practitioners in mindful movement, that is, physical activity in the context of learning mindfulness (Uebelacker, et al., 2010). From this perspective, yoga may affect symptoms of depression and anxiety through pathways related to physical activity and contemplative practice. Furthermore, yoga may serve as a pathway to promote self-efficacy in coping with symptoms of depression and in the ability to exercise or practice yoga. The following section reviews evidence for potential mediators of the relationship between physical activity, contemplative practice, self-efficacy and the clinical outcomes of depression and anxiety to build a foundation for the exploration of these pathways.
Physical activity has demonstrated encouraging evidence in the ability to reduce symptoms of depression in perinatal populations (Davis & Dimidjian, 2012) and symptoms of depression and anxiety in the general population (Rethorst, Wipfli, & Landers, 2009; Wipfli, Rethorst, & Landers, 2008). One potential mediator of change in the relationship between physical activity and depression and anxiety is the ability of physical activity to promote self-efficacy, or the amount of confidence one feels in dealing with the task at hand (Craft, 2005). Depression and anxiety are often associated with low rates of self-efficacy in the ability to handle stressors (Bandura, 1977). Activities that allow for mastery-oriented experiences may help individuals feel more self-efficacious in that particular task and may translate to other aspects of their lives (Bandura, 1977; Craft, 2005). Aerobic exercise has been associated with increased coping self-efficacy in managing symptoms of depression (Craft, 2005) and increased physical activity self-efficacy (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003). Yoga is a form of physical activity that may increase self-efficacy in the ability to participate in yoga as well as translate more generally to coping with symptoms of depression. Evaluating self-efficacy related to participation in yoga may help explain the relationship between participation in yoga and symptoms of depression and anxiety.

Unlike many forms of physical activity, yoga is traditionally viewed as a form of contemplative practice that integrates specific mental qualities with physical practices (Freeman, 2010). Given evidence for contemplative interventions such as Mindfulness-Based Stress Reduction, Mindfulness-Based Cognitive Therapy, Loving-Kindness Meditation, and Mindful Self-Compassion in the treatment of symptoms of depression and anxiety in general and antenatal populations (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Kabat-Zinn et al., 1992; Neff & Germer, 2013; Teasdale et al., 2000; Vieten & Astin, 2008), it is possible that yoga may
affect clinical outcomes through similar pathways. Contemplative or meditative aspects of yoga may promote positive self-regulation skills such as increased positive emotions, self-compassion, mindfulness, and social support satisfaction (Fredrickson, et al., 2008). Additional research is required, however, to determine if yoga practice is associated with such outcomes, first, and then to examine the degree to which changes in such processes may mediate potential beneficial clinical outcomes. A figure of proposed pathways for the anxiolytic and antidepressant effects of yoga can be seen below in Figure 1.

Figure 1. Proposed Pathways for the Anxiolytic and Antidepressant Effects of Yoga.

In summary, the practice of yoga may have particular relevance for pregnant women with symptoms of antenatal depression or anxiety given promising preliminary data in antenatal and general populations. Moreover, there is no evidence that yoga may have a detrimental impact on
mother or fetus. To the extent that yoga is beneficial, it is important to explore the processes by which yoga promotes such clinical benefit. Like other physical activity- and meditation-based interventions, yoga may be an effective intervention given its potential capacity to increase physical activity, positive self-regulation skills, and self-efficacy.

**Current Study**

The overall aim of the project is to explore the feasibility and preliminary outcomes of a yoga intervention among pregnant women. Using a randomized controlled design comparing an 8-week yoga intervention plus TAU to Treatment as Usual only (TAU) in the local community, we examined the hypothesis that yoga is a feasible intervention for anxiety and depression for pregnant women and that participation in yoga will be associated with decreased symptoms of anxiety and depression. Additionally, we examined the hypothesis that participation in yoga would increase positive self-regulation skills and self-efficacy. We also examined the effect of non-study interventions on primary outcomes and the relationship between attitudes towards complementary and alternative medicine and primary treatment outcomes. Specific study aims are outlines below.

**Specific Aims**

(1) To examine the feasibility of yoga as an intervention for pregnant women exhibiting symptoms of depression and anxiety. We predict that the study will evidence effective rates of recruitment and enrollment, and that within the yoga condition, rates of retention and compliance will be high, satisfaction with and credibility of the yoga class will be high, and self-reported rates of adverse events will be equal to or less than the national prevalence rate of adverse events during pregnancy such as premature birth or spontaneous abortion.
(2) To test the preliminary efficacy of yoga as an intervention for antenatal depression and anxiety. We predict that there will be significantly greater reduction in symptoms of depression, negative affect, and anxiety among women assigned to receive the yoga intervention as compared to those receiving TAU over the 8-week intervention period. We also explore the efficacy of the yoga condition compared to TAU among specific subgroups of patients who completed the yoga intervention and patients who evidenced high baseline depressive severity.

(3) To test whether changes in depression and anxiety are related to use of antidepressant medication, psychotherapeutic treatment, or physical activity participation. We predict that participation in the yoga intervention will demonstrate improvement in clinical outcomes in addition to potential effects of antidepressant medication, psychotherapeutic treatment, or physical activity participation.

(4) To explore potential predictors of symptomatic improvement within the yoga condition. We predict that individual differences in baseline attitudes and expectancies about the yoga intervention will be associated with improvement in primary outcomes. Specifically, we predict that greater acceptance of complementary and alternative (CAM) interventions and positive expectancies about intervention will predict improvement in depressive and anxiety severity within the yoga condition and that group effects will remain significant when these variables are controlled for in predictive models.

(5) To explore the relationship between yoga intervention and positive self-regulation skills. We predict that participants in the yoga condition will demonstrate significantly greater increases in mindfulness, self-compassion, positive emotions, and social support satisfaction over the intervention period in comparison to the TAU group.
(6) To explore the relationship between yoga intervention and self-efficacy. We predict that participants in the yoga group will demonstrate significantly greater increases in depression coping self-efficacy and physical activity self-efficacy than participants in the TAU group over the intervention period.
Participants

Participants included 46 pregnant women with elevated depression or anxiety symptoms. The University of Colorado Institutional Review Board (IRB) approved the protocol. All participants provided written informed consent prior to enrollment in the study. Inclusion criteria were: (1) pregnant up to 28 weeks gestation, (2) 18-45 years of age, (3) a score ≥ 9 on the Edinburgh Postnatal Depression Scale (EPDS), and/or score ≥ 25 on the state subscale of the State-Trait Anxiety Inventory (STAI), and/or ≥ 35 on the trait subscale of the STAI, and (4) engaging in ≤ 60 minutes of contemplative physical activity, such as yoga or martial arts, per week (5) English speaking, and (6) available for classes. Exclusion criteria were: (1) lifetime diagnosis of schizophrenia or schizoaffective disorder, bipolar disorder, current psychosis, organic mental disorder or pervasive developmental delay, or any other axis I or II disorders that necessitated priority treatment not provided by the study protocol, (2) imminent suicide or homicide risk, (3) high risk pregnancy indicated by presence of chronic or acute medical conditions, as determined by approval from the obstetric provider indicating appropriateness for participation.

Procedures

Participants were recruited between July 2011 and March 2012 in the greater Boulder and Denver, Colorado areas through health care provider referral and community advertisement. Of the 97 women who contacted the study, 27% reported finding out about the study from their
midwife or doula, 27% from a friend, 9% through online postings, 6% from a study brochure, 1% from their OBGYN, and 30% through other sources. Participants who passed an initial online screening were scheduled for an on-site clinical evaluation to provide informed consent and to confirm study eligibility. If eligible, participants were required to have their obstetric health care provider sign a document stating they were not at risk for obstetric complications and were physically healthy enough to participate in the study.

Once eligibility requirements were met, participants were randomly assigned to the yoga or TAU condition by an independent statistical consultant based on a computer-generated list. The statistical consultant informed the project coordinator of each group assignment, and the project coordinator contacted each participant to inform the participant of her assigned treatment condition. Participants completed standard comprehensive outcome assessments administered in an online format weekly during the intervention. Clinician administered interviews were conducted at the post-intervention assessment.

Treatment Conditions

**Yoga Intervention Group (Yoga).** Yoga classes were delivered in two cohorts, each of which included up to 15 participants. Each participant was asked to attend eight consecutive 75-minute weekly classes. Participants were told there were no restrictions on seeking care for depression or anxiety outside of the study, but were asked to provide information about any non-study treatment received. All face-to-face assessments and yoga classes took place in the Department of Psychology and Neuroscience at the University of Colorado Boulder and/or the Yoga Workshop in Boulder, Colorado. An expert prenatal yoga instructor, with 18 years of experience teaching yoga generally and 10 years of experience teaching prenatal yoga, delivered classes in a group format.
Yoga instruction was based on the internal forms of the traditional Ashtanga Vinyasa system of yoga in which postures are linked together with the breath, the gaze, and internal awareness of the central axis of the body as a means of focusing the mind while stretching and strengthening the body. This form of yoga was first documented by T.K. Krishnamacharya and K. Pattabhi Jois in Mysore, India in the late 1930’s and has been practiced and refined since that time. Each class included a specific series of postures designed for pregnancy and included 5 minutes of introductory breathing practice, 10 minutes of synchronizing breath, gaze and movement, 20 minutes of synchronized standing postures, 20 minutes of synchronized seated postures, and 20 minutes of cool down and sitting. Participants received an antenatal yoga instructional video to use for home practice and were asked to record their weekly practice in an online “diary.”

Although participants were encouraged to attend all 8 sessions, treatment completion was defined as attending at least five sessions (or 62.5% of available yoga classes). A review of physical activity and yoga interventions did not reveal a standard for defining treatment completion based on number or percentage of available sessions attended; thus, clinical trials of CBT (Jacobson et al., 1996) and MBCT (Teasdale, et al., 2000), defining treatment completion as 60% and 50% respectively, were used to guide the definition of treatment completion.

_Treatment as Usual (TAU) Control Group._ As with the yoga participants, participants in the TAU group were told there were no restrictions on seeking care for depression or anxiety outside of the study, but were asked to provide information about any non-study treatment received. At the conclusion of the study, participants assigned to the TAU group were given a free antenatal yoga instructional video and a pass for a free yoga class.
Measures

Clinician Administered Measures. The baseline interview consisted of a structured clinical interview administered by the participant coordinator prior to randomization, ensuring the participant coordinator’s blindness to study condition. The Structured Clinical Interview for DSM Disorders Research Version SCID-RV (First, Spitzer, Miriam., & Williams, 2002) was used to provide judgments with respect to all five axes of DSM-IV diagnosis. A randomly selected subset of audio-recorded clinical interviews ($n = 5$) was rated by a graduate student trained to use the SCID-RV to assess interrater reliability. For the mood, anxiety, substance use, psychotic, somatoform, and eating disorder diagnostic modules, the kappa coefficient was 0.89.

Self-Report Measures. Self-report measures were completed at baseline, weekly throughout the 8-week intervention phase, and at the conclusion of the study via the Qualtrics online assessment system. Qualtrics has SAS 70 Certification and meets the rigorous privacy standards imposed on health care records by the Health Insurance Portability and Accountability Act (HIPAA). All Qualtrics accounts were password protected and data protected with real-time data replication.

Primary Outcome Measures

Client Satisfaction Questionnaire (CSQ-8). The CSQ-8 (Larsen, Attkisson, Hargreaves, & Nguyen, 1979) is an eight-item measurement designed to measure client satisfaction with services, with higher scores indicating greater satisfaction. Each item is rated on a four point likert scale and the questionnaire has a total possible score of 32 points. The CSQ-8 is unidimensional, yielding a homogeneous estimate of general satisfaction with services.

Credibility Scale. The Credibility Scale (Addis & Carpenter, 1999) is a seven-item scale designed to measure credibility of interventions. The items of the measure are ranked on a seven point likert scale, for a total possible score of 49, with higher scores indicating greater perceived
credibility. These items have demonstrated good internal consistency and are commonly used in treatment studies.

*Group Environment Questionnaire (GEQ-modified for an exercise setting).* The GEQ (Blanchard, Poon, Rodgers, & Pinel, 2000) consists of 18 items rated on a likert scale and addresses four factors of group environment: individual attraction to group–task, individual attraction to group–social, group integration–task, and group integration–social. The subscales have demonstrated good test-retest reliability and internal consistency.

*The Edinburgh Perinatal Depression Scale (EPDS).* The EPDS (Cox, Holden, & Sagovsky, 1987) is the most widely used self-report measure of perinatal depression, contains ten items ranked on a likert scale, and produces scores ranging from 0-30 with higher scores indicating greater severity of depressive symptoms. A score of ≥ 13 was chosen as a cutpoint for depressive severity as scores in this range are consistent with a current depressive episode (Cox, et al., 1987).

*The Positive and Negative Affect Schedule-Negative subscale (PANAS-N).* The PANAS-N (Watson, Clark, & Tellegen, 1988) is a 10-item subscale widely used to measures aspects of negative affect on a likert scale.

*The State-Trait Anxiety Inventory (STAI).* The STAI (Spielberger, Gorsuch, & Lushene, 1970) yields scores indicating levels of both trait (STAI-T) and state (STAI-S) anxiety; scores range from 20 to 80 with higher scores indicating greater anxiety. It has documented concurrent validity and internal consistency and is widely considered the preferred measure to establish baseline anxiety levels in pregnant women (Ayers, 2001).
**Intervention Measures**

*Treatment and Activity Tracking Sheet.* A project-designed measure to monitor medication usage, engagement in non-study interventions, and contemplative physical activity throughout study participation.

*International Physical Activity Questionnaire (IPAQ).* The IPAQ (Craig et al., 2003) assesses duration and intensity of physical activity and expresses physical activity expenditure in terms of Metabolic Equivalent of Task (METs). This measure is one of the most widely used measures of physical activity and has demonstrated acceptable reasonable measurement properties for monitoring population level physical activity.

**Baseline Attitude and Expectancy Measures**

*Expectancy.* Two questions are used to assess treatment expectancies and are rated on a nine point likert scale. Questions include: (1) How much improvement in your ability to function do you think will occur from participating in this intervention? (2) How much do you feel that the intervention will help to reduce your stress level?

*Complementary, Alternative, and Conventional Medicine Attitude Scale (CACMAS).* The CACMAS (McFadden, Hernández, & Ito, 2010) is a 23-item questionnaire used to assess attitudes towards conventional medicine as well as complementary and alternative medicine. Specifically, the CACMAS includes three subscales: Philosophical congruence with CAM, views on holistic balance, and dissatisfaction with conventional medicine. Higher scores are representative of more favorable attitudes towards complementary and alternative medicine.

**Secondary Outcome Measures**

*The Five Facet Mindfulness Questionnaire (FFMQ).* The FFMQ (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) assesses the extent to which individuals engage in mindfulness in
daily life with higher scores indicating increased mindfulness. This measure has demonstrated acceptable psychometric properties and assesses five separate components of mindfulness.

*The Self-Compassion Scale (SCS).* The SCS (Neff, 2003) is a 26-item self-report instrument that measures the degree to which individuals are kind and compassionate to themselves, and to what extent negative thoughts are viewed in mindful awareness as opposed to identifying with these thoughts. This measure has demonstrated to be a reliable and valid measure and has also demonstrated discriminant validity when compared to other measures assessing similar constructs such as self-esteem.

*Positive and Negative Affect Schedule-Positive subscale (PANAS-P).* The PANAS-P (Watson, et al., 1988) is a 10-item subscale widely used to measures aspects of positive affect on a likert scale. Higher scores represent increased positive affect.

*Dispositional Positive Emotions Scale (DPES).* The DPES (Shiota, Keltner, & John, 2006) is a 38-item, self-report instrument with seven 5- or 6-item scales: joy, contentment, pride, love, compassion, amusement, and awe. This scale differentiates aspects of several dispositional positive emotion constructs. Higher scores represent increased dispositional positive emotions.

*The Social Support Questionnaire, short form, Satisfaction Subscale (SSQ-S).* The SSQ-S (Sarason, Sarason, Shearin, & Pierce, 1987) contains six questions that yield measurements of social support. Respondents indicate satisfaction with available supports with scores ranging from 0-6 and lower scores indicating less satisfaction. The SSQ-S has excellent construct and discriminant validity as well as strong internal consistency and test-retest reliability.

*The Physical Activity Self-Efficacy Scale (PASES).* The PASES (Marcus, Selby, Niaura, & Rossi, 1992) rates participant confidence regarding ability to be physically active in challenging
circumstances using a 5-item indicator with higher scores representing increased physical activity self-efficacy. This measure demonstrates an internal consistency of 0.76.

*Depression Coping Self-Efficacy Scale (DCSES).* The DCSES (Perraud, 2000) is a 24-item inventory designed to assess the coping self-efficacy of depressed patients. The inventory asks participants to rate their confidence in their ability to engage in a variety of coping responses with higher scores representing increased depression coping self-efficacy.

*Measurement of instructor adherence to yoga intervention.* Yoga classes were video recorded, evaluated, and coded for adherence to the treatment protocol using a study created measure modeled after the Mindfulness Based Cognitive Therapy adherence scale (Segal, Teasdale, Williams, & Gemar, 2002). The measure consisted of 11 items and each item was rated as 0 (no evidence), 1 (some evidence), or 2 (definite evidence) for a combined possible total score of 22. Adherence items included: (1) instructor was warm and engaging, (2) instructor presented material in an organized manner, (3) instructor led students in a guided 75 minute yoga practice, (4) class included an introduction, more active postures, and a cool down section, (5) instructor guided students to coordinate breathing with movement in postures, (6) instructor included alternative postures and movements for some postures, (7) instructor offered verbal guidance for performing the postures, (8) when demonstrating postures, instructor also described verbally the physical movements and form being demonstrated, (9) instructor encouraged students to participate and try postures, (10) instructor responded to questions raised by students, and (11) the flow of class was smooth and cohesive.

**Statistical Analyses**

Tests of baseline differences in demographic and clinical characteristics were examined using chi-square tests of independence for categorical variables and analysis of variance.
(ANOVA) for continuous variables. Outcome analyses were conducted to examine change over time within and between the treatment conditions. Hierarchical linear modeling (HLM) was used as the primary method to investigate active treatment differences and examine change over time at the individual level (within-subject) and by treatment condition (between-subjects) (Raudenbush & Bryk, 2001). At Level 1 of analysis, HLM allows for the estimation of individual level growth curves over time. At Level 2, the previously calculated estimates of individual level growth are seen as varying randomly across participants and conditional upon group assignment. The proportional reduction in variance statistic was used to calculate local effect size estimates for reduction of variance in level 2 slopes (Peugh, 2010). To determine if models of primary outcomes met assumptions that residual error were normally distributed, hierarchical linear models for each dependent variable were analyzed and the residual error of the model was saved. Next, plots of residual error were examined for normal distribution around zero. All analyses were conducted using SPSS Mixed and/or R and the linear mixed effects model package lme4.

**Statistical Analysis of Feasibility and Acceptance of Yoga Intervention**

Descriptive statistics were used to measure feasibility and acceptance of the intervention. Average percentage of classes attended was calculated as well as the average amount of time spent practicing yoga per week. Averages were calculated for total scores on measures of intervention credibility and satisfaction with the intervention. Paired sample t-tests were used to examine changes in the Group Environment Questionnaire between post-intervention and midpoint time points.

**Statistical Analysis of Primary Treatment Outcomes**

To test our prediction of significantly greater reduction in symptoms of depression, negative affect, and anxiety among women assigned to receive the yoga intervention as
compared to those receiving TAU over the 8-week intervention period, we used hierarchical linear models for each dependent variable to measure effects of time, treatment group, and the interaction between group and time. The intercept and linear slope of time were allowed to vary across individuals. Primary outcome data was collected at 10 time points, including baseline, weekly throughout the intervention, and at post-intervention. Analyses are based on data collected at 10 time points. Given that gestational age was significantly associated with baseline symptoms of depression, negative affect, and anxiety, gestational age at week 1 of the intervention was added as a covariate to evaluate the effect of gestational age on depressive symptoms, negative affect, and anxiety symptoms.

**Statistical Analysis of Exploratory Subgroups**

Two additional analyses were conducted to examine the effect of the intervention on primary treatment outcomes in treatment completers and those with increased symptoms of depression at baseline. Participants in the treatment group who attended five or more of the eight available yoga classes were coded as treatment completers ($n = 19$). Participants with increased baseline depressive severity, defined as having a baseline depression score consistent with a depressive episode (scores $\geq 13$ on the EPDS), were examined separately. Four participants in the yoga group and seven participants in the TAU group met criteria for depressive severity at baseline.

**Statistical Analysis of Outcomes Related to Treatment as Usual**

To test our prediction that participation in the yoga intervention would predict significantly greater reduction in symptoms of anxiety and depression in addition to treatment as usual factors (psychotherapy, antidepressant medication, and physical activity), further analyses were conducted. Psychotherapy and antidepressant medication use were treated as categorical
variables reflecting continued participation in psychotherapy or use of antidepressant medication throughout the course of the study. Physical activity participation was treated as a continuous variable. Hierarchical linear models including the fixed effects of time, TAU condition (psychotherapy, antidepressant use, or physical activity), and the interaction between time and TAU condition were constructed. Treatment as usual data was collected at three time points, including baseline, midpoint and at post-intervention.

**Statistical Analysis of Relationship Between Expectancies and Attitudes for Intervention and Primary Outcomes in Yoga Group**

Hierarchical linear modeling was used to examine the relationship between attitudes towards complementary and alternative medicine at baseline and expectancies for improvement in functioning and levels of stress with change in primary outcomes measures of depression, negative affect, and state and trait anxiety.

**Statistical Analysis of Outcomes Related to Positive Self-Regulation Skills and Self-Efficacy**

To test our prediction that women in the yoga intervention would demonstrate significantly greater improvement in positive self-regulation skills compared to those receiving TAU, we used hierarchical linear models for each dependent variable to measure effects of time, treatment group, and the interaction between group and time. The intercept and linear slope of time were allowed to vary across individuals. Measurements of positive self-regulation skills were collected at three time points, including baseline, midpoint, and post-intervention with the exception of positive affect which was collected weekly throughout the study.

To test our prediction that participants in the yoga group would demonstrate significantly greater increases in self-efficacy compared to those receiving TAU, we used hierarchical linear models for each dependent variable to measure effects of time, treatment group, and the interaction between group and time. The intercept and linear slope of time were allowed to vary
across individuals. Measures of self-efficacy were collected at three time points, including baseline, midpoint and post-intervention.

**Power Analysis**

The effect size used to calculate power was taken from findings by Woolery and colleagues (2004) who reported an effect size of 1.6 for an intervention comparing post-intervention scores of yoga and TAU groups among a sample of young adults with symptoms of depression (n = 28). Based on completion rates in this study, a sample size of (n = 50) was set as a recruitment goal. This sample size provided power of .8 to detect a more moderate effect size of .81 with alpha set at .05 for a two-tailed test.
CHAPTER 3

RESULTS

Participant Enrollment and Retention

Of the 97 women who completed screening measures for eligibility, 46 were randomized to treatment or control (Yoga = 23; TAU = 23). Three participants in the TAU group and one participant in the yoga group dropped out of the study after the baseline assessment and before the first week of the study. During the course of the study, two participants in the yoga and one in the TAU group were lost to follow up. Of the 46 participants randomized, 87% of participants assigned to the yoga group and 82.6% of participants assigned to the TAU group completed the study for a combined completion rate of 84.8%. A CONSORT diagram (Moher et al., 2010; Schulz, Altman, Moher, & Grp, 2010) depicting participant flow throughout the study is included in Figure 2.
Sample Characteristics

Table 1 presents participant baseline demographic and clinical characteristics. Chi-Square tests were used to examine differences between groups on categorical variables and ANOVA was used to test for differences in continuous variables. All participants who met inclusion criteria for depression ($n = 36$), also met criteria for both state and trait anxiety. Five participants
only met eligibility criteria for state anxiety and an additional five participants met eligibility
criteria for both state and trait anxiety. At baseline, five participants reported seeing a mental
health professional. Two participants reported seeing a psychologist specializing in pregnancy
related issues, one weekly and the other biweekly. Another participant reported participating in
weekly therapy with a psychologist for treatment of depression. Five participants reported using
antidepressant medication. Treatment groups did not differ significantly on any measure at
baseline.

Table 1. Participant Baseline Demographic and Clinical Characteristics.

<table>
<thead>
<tr>
<th>Baseline Characteristics</th>
<th>Full Sample (n=46)</th>
<th>TAU (n=23)</th>
<th>Yoga (n=23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years): M (SD)</td>
<td>30.15 (4.92)</td>
<td>30.57 (4.46)</td>
<td>29.74 (5.40)</td>
</tr>
<tr>
<td>Gestational age (weeks) at week 1 (M SD)</td>
<td>20.78 (6.42)</td>
<td>21.26 (7.41)</td>
<td>20.3 (5.37)</td>
</tr>
<tr>
<td>Race n (% White)</td>
<td>36 (78.3%)</td>
<td>20 (87%)</td>
<td>16 (69.6%)</td>
</tr>
<tr>
<td>Currently married n (%)</td>
<td>38 (82.6%)</td>
<td>20 (87%)</td>
<td>18 (78.3%)</td>
</tr>
<tr>
<td>College graduate n (%)</td>
<td>37 (80.5%)</td>
<td>20 (87%)</td>
<td>17 (74.0%)</td>
</tr>
<tr>
<td>Employed n (%)</td>
<td>44 (95.6%)</td>
<td>23 (100%)</td>
<td>21 (91.3%)</td>
</tr>
<tr>
<td>Have children n (%)</td>
<td>19 (41%)</td>
<td>11 (47.8%)</td>
<td>8 (34.8%)</td>
</tr>
<tr>
<td>Met inclusion criteria for EPDS/STAI-T/S</td>
<td>36 (78%)</td>
<td>18 (78.3%)</td>
<td>18 (78.3%)</td>
</tr>
<tr>
<td>Met inclusion criteria for STAI-T/STAI-S</td>
<td>5 (10.9%)</td>
<td>3 (13%)</td>
<td>2 (8.7%)</td>
</tr>
<tr>
<td>Met inclusion criteria for STAI-S only</td>
<td>5 (10.9%)</td>
<td>2 (8.7%)</td>
<td>3 (13.0%)</td>
</tr>
<tr>
<td>Current depressive disorder n (%)</td>
<td>6 (13%)</td>
<td>2 (8.7%)</td>
<td>4 (17.4%)</td>
</tr>
<tr>
<td>Lifetime depressive disorder n (%)</td>
<td>21 (45.7%)</td>
<td>8 (34.8%)</td>
<td>4 (17.4%)</td>
</tr>
<tr>
<td>Current anxiety disorder n (%)</td>
<td>10 (21.7%)</td>
<td>4 (17.4%)</td>
<td>6 (26.1%)</td>
</tr>
<tr>
<td>Lifetime anxiety disorder n (%)</td>
<td>14 (30.4%)</td>
<td>8 (34.8%)</td>
<td>6 (26.1%)</td>
</tr>
<tr>
<td>Seeing a mental health provider n (%)</td>
<td>3 (6.5%)</td>
<td>2 (8.7%)</td>
<td>1 (4.3%)</td>
</tr>
<tr>
<td>Antidepressant medication use n (%)</td>
<td>5 (10.9%)</td>
<td>4 (17.4%)</td>
<td>1 (4.3%)</td>
</tr>
</tbody>
</table>

Note. EPDS = Edinburgh Postnatal Depression Scale; STAI-S = State Trait Anxiety Inventory State Subscale; STAI-T = State Trait Anxiety Inventory Trait Subscale

Feasibility and Acceptance of Yoga Intervention

Consistent with our hypothesis that the yoga intervention would be associated with high
retention and compliance, participants assigned to the yoga treatment condition attended an
average of 5.78 out of 8 or approximately 72% of available classes. Common reasons for missed
classes included traveling out of town and illness. 87% of participants assigned to the yoga treatment condition completed the study. Means for time spent practicing yoga are presented below in Table 2.

Table 2. 
Yoga Participation Means, Standard Deviations, and Ns by Treatment Condition Over Time.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th></th>
<th>Midpoint</th>
<th></th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>TAU</td>
<td>8.26</td>
<td>27.41</td>
<td>23</td>
<td>20.00</td>
<td>64.26</td>
</tr>
<tr>
<td>Yoga</td>
<td>1.30</td>
<td>6.26</td>
<td>23</td>
<td>90.71</td>
<td>44.95</td>
</tr>
</tbody>
</table>

Note. Values are presented in minutes per week.

Adverse events. Consistent with our prediction, rates of adverse events such as premature birth and spontaneous abortion were equal to or lower than the national prevalence rate for adverse events during pregnancy. One participant in the yoga condition reported premature labor and vaginal delivery at 24.5 weeks gestation. The participant reported elevated levels of white blood cells, which may have been indicative of a uterine infection. The national rate of premature birth is 12-13% (Goldenberg, Culhane, Iams, & Romero, 2008). Given the below average rate of premature birth in the treatment condition (4%), the event was not determined to be unexpected. No other adverse events were reported in the study.

Group environment. Consistent with our hypothesis, participants in the yoga condition reported increased satisfaction of integration with other group members over time. Paired sample t-tests were conducted for scores obtained at the midpoint and end of intervention. Analyses of 16 participants who completed measures at both time points revealed that participants reported significantly increased levels on subscales group integration-task ($t(16) = 2.32, p = .03$) and group integration-social ($t(16) = 2.41, p = .03$) at the end of the intervention compared to the midpoint. Individual attraction to group-task ($t(16) = -1.01, p = .33$) and individual attraction to
group-social ($t(16) = 0.18, p = .86$) did not increase significantly from midpoint to post-intervention.

*Credibility of intervention.* Consistent with our prediction, participants in the yoga group found the intervention to be highly credible. The mean post-credibility score of the yoga intervention as a treatment for depression of the treatment group ($n = 20$) was $40.95$ ($SD = 6.42$) and indicative of a high level of credibility.

*Satisfaction with intervention.* Consistent with our hypothesis, participants in the yoga group reported a high level of satisfaction with the intervention. The mean satisfaction score for the treatment group ($n = 20$) at the end of the study was $28.15$ ($SD = 3.48$).

*Yoga instructor adherence to treatment protocol.* Two research assistants rated the yoga classes for treatment adherence. Interrater reliability for total score of the adherence scale was $98\%$ for the four classes that both research assistants evaluated. Overall, the mean treatment adherence score across the $21$ classes taught in the study was $21.88$.

**Primary Treatment Outcomes**

Predictions that participation in the yoga intervention would result in significantly decreased levels of depression, negative affect, and anxiety over time in comparison to the TAU group were partially supported. Means for primary treatment outcome measures at baseline, midpoint, and post-intervention are presented in Table 3 below.
Depression. Our hypothesis that participants in the yoga group would evidence significantly greater change in depression symptoms over time in comparison to the TAU group was not supported. A model including treatment group, time, and the interaction between group and time was analyzed. Although participants in the study evidenced a significant decrease in depressive symptoms over time ($\beta = -0.37, SE = 0.10, p = 0.001$), there was no significant effect for intervention group ($\beta = -0.39, SE = 1.51, p = .80$) or the interaction between group and time ($\beta = -0.09, SE = 0.14, p = .55$). Results showed level-2 slope variance decreased by 2.26% after adding the interaction between group and time to the level-2 slope model. Depression scores within participants decreased across the duration of the study but did not differ by group.

Given that gestational age was significantly associated with baseline symptoms of depression ($\beta = 0.28, SE = 0.09, p = 0.003$) such that, on average, women with a longer gestational age at baseline reported more symptoms of depression than those with shorter
gestational age, gestational age was added as a covariate to the original model. Inclusion of gestational age, however, did not alter the pattern of findings. Results indicated a significant effect of time ($\beta = -0.37, SE = 0.10, p = 0.001$) and nonsignificant effects of group ($\beta = -0.10, SE = 1.45, p = .95$) and the interaction between group and time ($\beta = -0.09, SE = 0.14, p = .53$).

*Negative affect.* Our prediction that participants in the yoga group would demonstrate significantly greater change in negative affect over time in comparison to the TAU group was supported. A model including treatment group, time, and an interaction between treatment group and time was analyzed. Analyses did not reveal a significant effect for group ($\beta = 1.37, SE = 2.02, p = .50$) or time ($\beta = -0.24, SE = 0.15, p = .11$). Analyses revealed a significant interaction between group and time ($\beta = -0.53, SE = 0.20, p = 0.011$) suggesting that participants in the treatment group displayed less negative affect over time than participants in the control group. Results showed level-2 slope variance decreased by 22.88% after adding the interaction between group and time to the level-2 slope model. Differences over time by study group are illustrated in Figure 3.
Figure 3.
Change In Negative Affect by Treatment Group Over Time.

Given that gestational age was significantly associated with baseline negative affect ($\beta = 0.30$, $SE = 0.12$, $p = 0.017$) such that, on average, women with a longer gestational age at baseline reported more negative affect than those with shorter gestational age, gestational age was added as a covariate. Inclusion of gestational age, however, did not alter the pattern of findings. Nonsignificant effects of time ($\beta = -0.24$, $SE = 0.14$, $p = 0.11$) and group ($\beta = 1.68$, $SE$
= 1.94, \( p = .39 \)) and a significant interaction between group and time \((\beta = -0.54, SE = 0.20, p = .009)\) were observed.

**State Anxiety.** Our hypothesis that participants in the yoga group would demonstrate significantly greater change in symptoms of state anxiety over time compared to participants in the TAU group was not supported. A model including treatment group, time, and the interaction between treatment group and time was analyzed. Analyses did not reveal a significant effect for time \((\beta = -0.48, SE = 0.26, p = .07)\), group \((\beta = -2.25, SE = 3.46, p = .52)\), or the interaction between group and time \((\beta = -0.24, SE = 0.36, p = .50)\). Results showed level-2 slope variance decreased by 3.73\% after adding the interaction between group and time to the level-2 slope model. State anxiety demonstrated a nonsignificant trend to decrease over time but did not differ by treatment group. Given that gestational age was significantly associated with baseline state anxiety \((\beta = 0.73, SE = 0.20, p = 0.001)\) such that, on average, women with a longer gestational age at baseline reported more state anxiety than those with a shorter gestational age, gestational age was added as a covariate to the original model. Inclusion of gestational age, however, did not alter the pattern of findings. Nonsignificant effects of time \((\beta = -0.47, SE = 0.25, p = 0.075)\), group \((\beta = -1.50, SE = 3.17, p = .64)\), and the interaction between group and time \((\beta = -0.27, SE = 0.35, p = .45)\) were observed.

**Trait anxiety.** Our prediction that participants in the yoga group would demonstrate significantly greater change in symptoms of trait anxiety over time compared to participants in the TAU was not supported. A model including treatment group, time, and the interaction between treatment group and time was analyzed. Analyses revealed a significant effect for time \((\beta = -0.49, SE = 0.20, p = .019)\). Analyses did not reveal a significant effect for group \((\beta = 0.37, SE = 0.28, p = .91)\) or the interaction between group and time \((\beta = -0.47, SE = 0.28, p = .10)\).
Results showed level-2 slope variance decreased by 11.09% after adding the interaction between group and time to the level-2 slope model. Trait anxiety scores within participants decreased over the duration of the study but did not differ by group. Given that gestational age was significantly associated with baseline trait anxiety ($\beta = 0.73, SE = 0.22, p = 0.001$) such that, on average, women with a longer gestational age at baseline reported more symptoms of trait anxiety than those with a shorter gestational age, gestational age was added as a covariate to the original model. Inclusion of gestational age, however, did not alter the pattern of findings. A significant effect of time ($\beta = -0.49, SE = 0.20, p = 0.019$) and nonsignificant effects of group ($\beta = 1.10, SE = 3.13, p = .73$) and the interaction between group and time ($\beta = -0.47, SE = 0.28, p = .10$) were observed.

**Exploratory Subgroup Outcomes**

Two additional sets of analyses were conducted to examine outcomes on depression, negative affect, and anxiety within and between groups amongst two subgroups: participants who completed five or more yoga classes and participants with high depressive symptom severity at baseline.

*Depressive Severity.* Among the completers, there was a significant effect for time in depressive severity ($\beta = -0.37, SE = 0.10, p = 0.001$); however, treatment completer status ($\beta = -0.54, SE = 1.58, p = .73$) and the interaction between treatment completer status and time ($\beta = -0.08, SE = 0.15, p = .57$) were not significant. Depression scores within the completer subgroup decreased over time but did not differ based on group assignment. An analysis focusing on participants with baseline depression scores $\geq 13$ on the EPDS revealed a significant effect for time ($\beta = -0.55, SE = 0.21, p = 0.023$); however, group ($\beta = 1.25, SE = 2.00, p = .55$) and the interaction between group and time ($\beta = -0.42, SE = 0.33, p = .23$) were not significant.
Depression scores within participants with increased symptoms of depression at baseline decreased over time but did not differ based on group assignment.

Negative affect. An analysis comparing treatment completers to TAU participants revealed nonsignificant effects for time ($\beta = -0.23, SE = 0.14, p = .10$) and treatment completer status ($\beta = 1.31, SE = 2.15, p = .54$). The interaction between treatment completer status and time ($\beta = -0.57, SE = 0.20, p = 0.008$) was significant. Negative affect within participants defined as treatment completers decreased significantly more over time than in participants in the TAU group. An analysis focusing on participants with baseline depression scores $\geq 13$ on the EPDS revealed nonsignificant effects for time ($\beta = -0.38, SE = 0.32, p = 0.26$), group ($\beta = 5.77, SE = 3.96, p = .175$) and the interaction between group and time ($\beta = -1.19, SE = 0.51, p = .051$). Negative affect with participants defined as having increased symptoms of depression at baseline trended towards decreasing significantly more over time than in similar participants in the TAU group.

State anxiety. An analysis comparing treatment completers to TAU participants revealed a nearly significant effect for time ($\beta = -0.48, SE = 0.24, p = .051$). Treatment completer status ($\beta = -2.75, SE = 3.54, p = .44$) and the interaction between treatment completer status and time ($\beta = -0.19, SE = 0.34, p = .58$) were not significant. State anxiety scores within participants defined as treatment completers demonstrated a trend to decrease over time and did not differ based on treatment group. An analysis focusing on participants with baseline depression scores $\geq 13$ on the EPDS revealed nonsignificant effects for time ($\beta = -0.66, SE = 0.42, p = .12$), group ($\beta = 2.14, SE = 5.47, p = .70$) and the interaction between group and time ($\beta = -0.83, SE = 0.66, p = .21$). State anxiety in participants with greater levels of baseline depression did not change significantly over time nor was state anxiety affected by participation in the treatment group.
Trait anxiety. An additional analysis comparing treatment completers to TAU participants revealed a significant effect for time ($\beta = -0.48$, $SE = 0.16$, $p = .004$). Treatment completer status ($\beta = -0.21$, $SE = 3.48$, $p = .95$) and the interaction between treatment completer status and time ($\beta = -0.37$, $SE = 0.22$, $p = .11$) were not significant. Trait anxiety scores within participants defined as treatment completers decreased over time and did not differ based on treatment group. An analysis focusing on participants with baseline depression scores $\geq 13$ on the EPDS revealed nonsignificant effects for time ($\beta = -0.54$, $SE = 0.27$, $p = 0.07$) and group ($\beta = 3.29$, $SE = 4.73$, $p = .50$) and a significant interaction between group and time ($\beta = -0.95$, $SE = 0.42$, $p = .05$). These results suggest that trait anxiety within participants decreased significantly more over time in the yoga group than the TAU group in a subset of participants with elevated symptoms of depression at baseline.

Outcomes Related to Treatment as Usual

Three participants reported engaging in psychotherapy and five participants reported antidepressant medication use during the course of the study. Mean levels of physical activity by treatment group across time are presented below in Table 4. Means did not change significantly over time nor were there significant differences between groups.

Table 4.
Physical Activity Participation Means, Standard Deviations, and Ns by Treatment Condition Over Time.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th></th>
<th>Midpoint</th>
<th></th>
<th>Post-intervention</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$N$</td>
<td>$M$</td>
<td>$SD$</td>
<td>$N$</td>
</tr>
<tr>
<td><strong>IPAQ</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAU</td>
<td>760.63</td>
<td>701.26</td>
<td>23</td>
<td>587.61</td>
<td>602.78</td>
<td>18</td>
</tr>
<tr>
<td>Yoga</td>
<td>684.30</td>
<td>702.30</td>
<td>23</td>
<td>537.34</td>
<td>509.46</td>
<td>19</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. IPAQ = International Physical Activity Questionnaire; Values are presented in MET’s or Metabolic Equivalent Units.*
Given nonsignificant differences between groups in primary outcomes of depression and anxiety, models exploring the relationship between TAU condition and primary outcomes were constructed. Analyses of the interaction between psychotherapy and time and antidepressant medication use and time revealed a nonsignificant relationship between participation in psychotherapy or using antidepressant medication and symptoms of anxiety and depression. Analyses of the interaction between physical activity and time did not find a significant relationship between participation in physical activity and symptoms of anxiety and depression. The model for negative affect included the fixed effect of the interaction between group and time given its significance in previous analysis. Results can be seen in Table 5 below.

<table>
<thead>
<tr>
<th>TAU intervention</th>
<th>Outcome</th>
<th>β</th>
<th>SE</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychotherapy</td>
<td>EPDS</td>
<td>0.20</td>
<td>0.14</td>
<td>p=.17</td>
</tr>
<tr>
<td></td>
<td>PANAS-N</td>
<td>0.27</td>
<td>0.21</td>
<td>p=.21</td>
</tr>
<tr>
<td></td>
<td>STAI-S</td>
<td>0.25</td>
<td>0.35</td>
<td>p=.49</td>
</tr>
<tr>
<td></td>
<td>STAI-T</td>
<td>0.42</td>
<td>0.27</td>
<td>p=.13</td>
</tr>
<tr>
<td>Antidepressant medication</td>
<td>EPDS</td>
<td>-0.18</td>
<td>0.13</td>
<td>p=.18</td>
</tr>
<tr>
<td></td>
<td>PANAS-N</td>
<td>0.09</td>
<td>0.2</td>
<td>p=.64</td>
</tr>
<tr>
<td></td>
<td>STAI-S</td>
<td>-0.14</td>
<td>0.33</td>
<td>p=.67</td>
</tr>
<tr>
<td></td>
<td>STAI-T</td>
<td>-0.24</td>
<td>0.27</td>
<td>p=.37</td>
</tr>
<tr>
<td>Physical activity participation</td>
<td>EPDS</td>
<td>-0.00001</td>
<td>0.0003</td>
<td>p=.37</td>
</tr>
<tr>
<td></td>
<td>PANAS-N</td>
<td>-0.00009</td>
<td>0.0002</td>
<td>p=.60</td>
</tr>
<tr>
<td></td>
<td>STAI-S</td>
<td>-0.0003</td>
<td>0.0003</td>
<td>p=.36</td>
</tr>
<tr>
<td></td>
<td>STAI-T</td>
<td>-0.0001</td>
<td>0.0002</td>
<td>p=.63</td>
</tr>
</tbody>
</table>

Note. EPDS = Edinburgh Postnatal Depression Scale; STAI-S = State Trait Anxiety Inventory State Subscale; STAI-T = State Trait Anxiety Inventory Trait Subscale; PANAS-N = Positive and Negative Affect Scale-Negative Subscale.

Relationship Between Expectancies and Attitudes for Intervention and Primary Outcomes in Yoga Group

Our prediction that response to the yoga intervention would be predicted by expectancies for and attitudes towards the intervention was not supported. As displayed in Table 6, there was
no evidence of significant associations between expectancies for improvements in stress and function or attitudes towards complementary and alternative medicine with symptoms of depression or anxiety.

Table 6.
*Relationship Between Expectancies and Attitudes for Intervention and Primary Outcomes.*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Measure</th>
<th>β</th>
<th>t</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPDS</td>
<td>Stress expectancy</td>
<td>-0.37</td>
<td>-0.62</td>
<td>p=.54</td>
</tr>
<tr>
<td></td>
<td>Functioning expectancy</td>
<td>-0.71</td>
<td>-1.27</td>
<td>p=.22</td>
</tr>
<tr>
<td></td>
<td>CACMAS-P</td>
<td>1.98</td>
<td>1.54</td>
<td>p=.14</td>
</tr>
<tr>
<td></td>
<td>CACMAS-D</td>
<td>.58</td>
<td>0.66</td>
<td>p=.52</td>
</tr>
<tr>
<td></td>
<td>CACMAS-H</td>
<td>.84</td>
<td>1.24</td>
<td>p=.23</td>
</tr>
<tr>
<td>PANAS-N</td>
<td>Stress expectancy</td>
<td>-1.17</td>
<td>-1.62</td>
<td>p=.12</td>
</tr>
<tr>
<td></td>
<td>Functioning expectancy</td>
<td>-1.17</td>
<td>-1.72</td>
<td>p=.10</td>
</tr>
<tr>
<td></td>
<td>CACMAS-P</td>
<td>2.93</td>
<td>1.82</td>
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</tr>
<tr>
<td></td>
<td>CACMAS-D</td>
<td>0.43</td>
<td>0.39</td>
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</tr>
<tr>
<td></td>
<td>CACMAS-H</td>
<td>1.06</td>
<td>1.23</td>
<td>p=.23</td>
</tr>
<tr>
<td>STAI-S</td>
<td>Stress expectancy</td>
<td>-1.39</td>
<td>-0.99</td>
<td>p=.33</td>
</tr>
<tr>
<td></td>
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<td>-0.39</td>
<td>p=.70</td>
</tr>
<tr>
<td></td>
<td>CACMAS-P</td>
<td>4.02</td>
<td>1.28</td>
<td>p=.21</td>
</tr>
<tr>
<td></td>
<td>CACMAS-D</td>
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<td>0.51</td>
<td>p=.61</td>
</tr>
<tr>
<td></td>
<td>CACMAS-H</td>
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<td>0.91</td>
<td>p=.37</td>
</tr>
<tr>
<td>STAI-T</td>
<td>Stress expectancy</td>
<td>-2.38</td>
<td>-1.47</td>
<td>p=.16</td>
</tr>
<tr>
<td></td>
<td>Functioning expectancy</td>
<td>-1.40</td>
<td>-0.93</td>
<td>p=.37</td>
</tr>
<tr>
<td></td>
<td>CACMAS-P</td>
<td>5.94</td>
<td>1.71</td>
<td>p=.10</td>
</tr>
<tr>
<td></td>
<td>CACMAS-D</td>
<td>0.89</td>
<td>0.36</td>
<td>p=.72</td>
</tr>
<tr>
<td></td>
<td>CACMAS-H</td>
<td>-0.95</td>
<td>0.76</td>
<td>p=.46</td>
</tr>
</tbody>
</table>

Note. EPDS = Edinburgh Postnatal Depression Scale; STAI-S = State Trait Anxiety Inventory State Subscale; STAI-T = State Trait Anxiety Inventory Trait Subscale; PANAS-N = Positive and Negative Affect Scale-Negative Subscale; CACMAS-P = Complementary, Alternative, and Conventional Attitudes toward Medicine Scale Philosophical Congruence with Complementary and Alternative Medicine Subscale; CACMAS-D = Complementary, Alternative, and Conventional Attitudes toward Medicine Scale Dissatisfaction with Conventional Medicine Subscale; CACMAS-H = Complementary, Alternative, and Conventional Attitudes toward Medicine Scale Holistic Balance Subscale.

**Outcomes Related to Positive Self-Regulation Skills**

Predictions that participation in the yoga intervention would result in significantly increased positive self-regulation skills over time in comparison to the TAU group were partially
supported. Means for outcomes related to positive self-regulation skills are presented below in Table 7.

Table 7. Positive Self-Regulation Skills Means, Standard Deviations, and Ns by Treatment Condition Over Time.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th></th>
<th></th>
<th>Midpoint</th>
<th></th>
<th></th>
<th>Post-intervention</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>FFMQ</td>
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<tr>
<td>TAU</td>
<td>126.57</td>
<td>15.95</td>
<td>23</td>
<td>126.39</td>
<td>17.02</td>
<td>18</td>
<td>130.42</td>
<td>17.05</td>
<td>19</td>
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<tr>
<td>Yoga</td>
<td>125.00</td>
<td>22.03</td>
<td>23</td>
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<td>137.05</td>
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<td>SCS</td>
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<tr>
<td>TAU</td>
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<td>23</td>
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<td>DPES</td>
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<tr>
<td>TAU</td>
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<td>191.95</td>
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<tr>
<td>Yoga</td>
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<td>23</td>
<td>190.00</td>
<td>38.22</td>
<td>19</td>
<td>203.55</td>
<td>27.00</td>
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<tr>
<td>PANAS-P</td>
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<td></td>
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<tr>
<td>TAU</td>
<td>31.30</td>
<td>5.90</td>
<td>23</td>
<td>30.94</td>
<td>6.58</td>
<td>18</td>
<td>31.42</td>
<td>6.23</td>
<td>19</td>
</tr>
<tr>
<td>Yoga</td>
<td>33.09</td>
<td>7.47</td>
<td>23</td>
<td>32.50</td>
<td>7.88</td>
<td>19</td>
<td>34.20</td>
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<td>SSQ-S</td>
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<tr>
<td>TAU</td>
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<td>0.75</td>
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<td>5.20</td>
<td>0.73</td>
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<td>0.83</td>
<td>23</td>
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<td>1.11</td>
<td>19</td>
<td>5.36</td>
<td>0.70</td>
<td>20</td>
</tr>
</tbody>
</table>

Note. FFMQ = Five Facet Mindfulness Questionnaire; SCS = Self-Compassion Scale; DPES = Dispositional Positive Emotions Scale; PANAS-P = Positive and Negative Affect Scale Positive Subscale; SSQ-S = Social Support Questionnaire Satisfaction Subscale.

Mindfulness. The hypothesis that participants in the yoga group would demonstrate significantly increased mindfulness over time in comparison to the TAU group was not supported. A model including treatment group, time, and an interaction between treatment group and time was analyzed. Results did not reveal significant effects for time ($\beta = 1.84, SE = 1.23, p = .14$), group ($\beta = -3.74, SE = 6.63, p = .58$), or the interaction between group and time ($\beta = 2.61, SE = 1.72, p = .14$). Results showed level-2 slope variance decreased by 6.53% after adding the interaction between group and time to the level-2 slope model. Rates of mindfulness did not differ significantly over time or by treatment group.
Self-compassion. The hypothesis that participants in the yoga group would demonstrate significantly increased self-compassion over time in comparison to the TAU group was not supported. A model including treatment group, time, and an interaction between treatment group and time was analyzed. Results did not reveal significant effects for group ($\beta = -0.12, SE = 0.24, p = .61$), time ($\beta = 0.051, SE = 0.05, p = .35$), or the interaction between group and time ($\beta = 0.12, SE = 0.07, p = .09$). Results showed level-2 slope variance decreased by 11.08% after adding the interaction between group and time to the level-2 slope model. Rate of self-compassion demonstrated a trend to increase more in the yoga group than the TAU group over time but was not statistically significant.

Positive affect. The hypothesis that participants in the yoga group would demonstrate significantly increased positive affect over time in comparison to the TAU group was not supported. A model including treatment group, time, and an interaction between treatment group and time was analyzed. Results did not reveal significant effects for group ($\beta = 1.14, SE = 2.26, p = .62$), time ($\beta = -0.10, SE = 0.51, p = .85$), or the interaction between group and time ($\beta = 0.68, SE = 0.71, p = .35$). Results showed level-2 slope variance decreased by 8.03% after adding the interaction between group and time to the level-2 slope model. Rates of positive affect did not differ over time or by treatment group.

Dispositional positive emotions. Contrary to our hypothesis, dispositional positive emotions in the yoga group did not increase significantly over time in comparison to the TAU group. A model including treatment group, time, and an interaction between treatment group and time was analyzed. Results did not reveal significant effects for group ($\beta = -0.49, SE = 11.42, p = .97$), time ($\beta = 2.80, SE = 1.99, p = .17$), or the interaction between group and time ($\beta = 4.44, SE = 2.78, p = .12$). Results showed level-2 slope variance decreased by 15.06% after adding the
interaction between group and time to the level-2 slope model. Positive emotions did not differ over time or by treatment group.

*Social support satisfaction.* The hypothesis that satisfaction with social support would demonstrate a significant increase over time in the yoga group in comparison to the TAU group was supported. A model including treatment group, time, and the interaction between group and time was analyzed. Consistent with our hypothesis, results revealed a significant interaction between time and group (β = 0.28, SE = 0.11, p = 0.01). Analyses also found a significant effect of group (β = -0.82, SE = 0.31, p = 0.01) and a nonsignificant effect for time (β = -0.04, SE = 0.08, p = .65). Results showed level-2 slope variance decreased by 70.45% after adding the interaction between group and time to the level-2 slope model. This decrease can be explained by sharp differences in the slope of the lines for each treatment group. These findings suggest that social support satisfaction was lower in the treatment group than the control group at baseline but social support satisfaction increased over time in the treatment group and decreased slightly in the control group. Changes in social support satisfaction over time by treatment group are illustrated in Figure 4 below.
Outcomes Related to Self-Efficacy

Predictions that participation in the yoga intervention would result in significantly increased self-efficacy over time in comparison to the TAU group were partially supported. Means for outcomes related to self-efficacy are presented below in Table 8.
Table 8. Self-Efficacy Means, Standard Deviations, and Ns by Treatment Condition Over Time.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th></th>
<th></th>
<th>Midpoint</th>
<th></th>
<th></th>
<th>Post-intervention</th>
</tr>
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Note. DCSES = Depression Coping Self-Efficacy Scale; PASES = Physical Activity Self-Efficacy Scale

Depression coping self-efficacy. Our hypothesis that participants in the yoga group would evidence significantly greater increases in depression coping self-efficacy over time in comparison to the TAU group was not supported. A model including treatment group, time, and an interaction between treatment group and time was analyzed. Analyses revealed a near significant effect for the interaction between group and time ($\beta = 3.07, SE = 1.55, p = 0.054$) and nonsignificant effects for group ($\beta = -6.42, SE = 3.85, p = .10$) and time ($\beta = -0.98, SE = 1.11, p = .38$). Results showed level-2 slope variance decreased by 15.33% after adding the interaction between group and time to the level-2 slope model. Depression coping self-efficacy demonstrated a trend to increase over time in the yoga group in comparison to the TAU group.

Physical activity self-efficacy. Our hypothesis that participants in the yoga group would evidence significantly greater increases in physical activity self-efficacy over time in comparison to the TAU group was supported. A model including treatment group, time, and an interaction between treatment group and time was analyzed. Consistent with our hypothesis, analyses revealed a significant interaction between week and group ($\beta = 1.31, SE =0.56, p = .025$). Analyses also demonstrated a significant effect of group ($\beta = -3.14, SE = 1.38, p = .028$) and time ($\beta = -1.17, SE =0.40, p = .006$). Results showed level-2 slope variance decreased by 50.51% after adding the
interaction between group and time to the level-2 slope model. These findings suggest that physical activity self-efficacy was lower in the treatment group than the control group at baseline. Physical activity self-efficacy decreased over time within participants but decreased significantly more over time in the TAU group than the yoga group. Changes in physical activity self-efficacy over time by treatment group are illustrated in Figure 5 below.

Figure 5.
*Change in Physical Activity Self-Efficacy by Treatment Group Over Time.*
CHAPTER 4

DISCUSSION

Results of the study suggest that yoga is a feasible and acceptable intervention for pregnant women with symptoms of depression and/or anxiety. Rates of retention in the treatment group were high (87%) and participants attended an average of 72% of classes. Only one adverse event was reported during the duration of the study and rates of adverse events in the study sample were lower than in the general population. Participants in the yoga group also reported a high level of credibility and satisfaction with the group. Results suggest that group members perceived that they had a common goal as their peers in the yoga class and they felt socially connected to each other. Compliance with the intervention also was high. Participants in the yoga group reported practicing yoga an average 84 minutes per week during the course of the study, significantly more than participants in the TAU group who reported practicing yoga 18 minutes per week on average.

Although participants in the yoga group reported lower symptom severity of depression and anxiety at the end of the intervention than at the beginning, improvement did not differ significantly from participants in the control group. However, participants in the yoga group evidenced significantly decreased negative affect over time when compared to participants in the control group suggesting that participation in yoga may influence the way practitioners experience emotions. At baseline, participants displayed an average EPDS score of approximately 10 points, scores considered to be clinically significant but below the threshold of 12/13 consistent with a current depressive episode (Cox, et al., 1987). As the study progressed,
depression scores decreased to subclinical levels. According to a recent review of the use of anxiety disorder measures in perinatal populations, state anxiety scores greater than 48 on the STAI are indicative of high levels of anxiety during pregnancy (Grant, et al., 2008; Meades & Ayers, 2011). State anxiety scores of participants in the study remained slightly below 40 through the duration of the study indicating moderate levels of anxiety. Trait anxiety scores at baseline had a mean of approximately 45 points indicating high levels of anxiety. As the study progressed, trait anxiety levels decreased to slightly below 40 indicating a decrease in severity from a level of high to moderate (Barnett & Parker, 1986; Meades & Ayers, 2011). Finally, gestational age was added as a covariate to primary outcome models given its significant association with baseline symptoms of depression, negative affect, and anxiety; however, the pattern of results was unchanged with the inclusion of baseline gestational age. Results from additional exploratory analyses of subgroups of participants, including participants in the yoga group defined as treatment completers (attending five or more yoga classes) and those with increased symptoms of depression at baseline, also were consistent with results with the full sample.

The course of depression and anxiety throughout the antenatal period is not well understood. As with any major life transition, the onset of pregnancy may be associated with symptoms of anxiety and depression. These symptoms may decrease over time as individuals find ways to cope with their symptoms or resolve on their own. The primary outcomes of our study support the idea that symptoms of depression and anxiety may decrease throughout pregnancy, similar to observations reported by other studies conducted in samples of antenatal women with symptoms of depression and anxiety (Austin, et al., 2008; Teixeira, et al., 2009; Whisman, Davila, & Goodman, 2011).
Participants in both groups of the study reported similar levels of participation in TAU. There were no group differences in participating in psychotherapy, using antidepressant medication, or participating in physical activity. Only 6.5% of the sample reported seeing a mental health professional for psychotherapy and 10.9% reported using antidepressant medication during the study. Rates of antidepressant medication use in the study sample are similar to those reported in large scale studies (Cooper, et al., 2007). Studies of psychotherapy use in larger samples with more severely depressed populations have shown that approximately 15% of pregnant women seek some form of psychotherapy treatment (Marcus, Flynn, Blow, & Barry, 2003).

Importantly, participants in the TAU and yoga group participated in much higher rates of physical activity than the general population of pregnant women. According to a recent study, only 10% of pregnant women meet physical activity recommendations of participating in physical activity 30 minutes per day, 5 days per week (Evenson, Moos, Carrier, & Siega-Riz, 2009). This level of physical activity is equivalent to 600 Metabolic Equivalents of Task or MET-minutes/week. Participants in the study achieved greater amounts of physical activity than the recommended level at baseline and gradually decreased physical activity participation through the duration of the study. Physical activity participation by participants in this study was much greater than the national average given the mean levels of physical activity at baseline were 720 METs, 560 METs at midpoint, and 445 METs at post-intervention. Given high levels of physical activity throughout the study, potential effects of the yoga intervention specific to physical activity may be hard to detect.

Self-monitoring, in the form of weekly assessments may have influenced responses among participants. Participants in the TAU group, as well as the yoga group, completed primary
outcome measures weekly throughout the intervention. This form of self-monitoring may have increased participant awareness of symptoms of depression and anxiety and prompted them to take action to reduce these symptoms. Participants in both group were also contacted when their EPDS scores were ≥ 16 or if they endorsed experiencing thoughts of suicide. While this level of contact helped ensure participant safety, it may have also served as an additional form of supportive psychotherapy. While the TAU was designed as a standard control group, participants in the TAU group may have benefitted from self-monitoring and additional contact with the study coordinator.

Contrary to our hypotheses, expectations for improvements in stress and functioning and attitudes towards complementary and alternative medicine did not predict response in primary outcomes measures in the yoga group. The prediction that participants in the yoga group would demonstrate decreased rates of symptoms of depression and anxiety in comparison to the TAU group was also not supported making effects of attitude and expectancy on those outcomes difficult to detect.

Models analyzing factors associated with positive self-regulation skills including mindfulness, self-compassion, dispositional positive emotions, and positive affect did not find significant effects of time, group, or the interaction between time and group. The mean mindfulness score at baseline for all participants was 126. At post-intervention, mindfulness scores increased to 130 in the TAU group and to 137 in the yoga group. In comparison, a validation study of the FFMQ found mean mindfulness scores a community sample to be 117 and 150 in experienced meditators (Baer et al., 2008). This comparison suggests mean mindfulness scores in the yoga group were closer to those of experienced meditators than a community sample at the end of the 8-week yoga intervention. A model analyzing social support
satisfaction revealed significant effects for group and the group by time interaction suggesting that participants in the yoga reported less social support satisfaction than their TAU group peers at baseline but their satisfaction with social support increased over time while it remained constant in the TAU group. These findings are consistent with those found by a study of Loving Kindness Meditation and suggest that contemplative practice may be associated with increased satisfaction with social support (Fredrickson, et al., 2008). While our hypothesis that participation in yoga would lead to increased positive self-regulation skills in comparison to the TAU group was not completely supported, trends for positive self-regulation skills to increase over time in the yoga group in comparison to the TAU condition were observed. The current study was likely underpowered to detect differences in these measures but the results are encouraging and provide insight into how yoga may affect antenatal depression and anxiety. Future research using yoga interventions would benefit from including measures of positive self-regulation skills as potential mediators of change between yoga and depression and anxiety.

Models of physical activity self-efficacy suggested physical activity self-efficacy remained constant in the yoga group over time and declined in the TAU group. These findings suggest participation in yoga during pregnancy may help women maintain a sense of self-efficacy for physical activity throughout pregnancy. Depression coping self-efficacy increased over time in the yoga group and decreased slightly in the TAU group. Findings for depression coping self-efficacy are similar to those reported in an evaluation of the effect of aerobic physical activity on self-efficacy (Craft, 2005). While the finding for depression coping self-efficacy only neared significance, results suggest that participation in yoga may bolster women’s confidence in the ability to cope with stressors throughout pregnancy.
It is important to consider findings from this study in the context of other recent trials. A recently published study by Muzik and colleagues (2012) reported changes in both depressive symptoms and mindfulness nearly identical to results observed among women in the yoga group in our trial. However, these changes were not statistically significant when compared to participants in the TAU group. Thus, it is possible that participation in yoga may yield clinical benefit but such an effect may not be over and above the observed effect of time. Studies conducted by Field and colleagues (2012, 2013) are difficult to compare to our study given the yoga interventions were sometimes combined with other treatments, interventions were sometimes brief (20 minute yoga classes 1-2 times per week), participants typically met criteria for a current major depressive episode, and less stringent methodological and statistical procedures were used. Our results are similar in that participants in the yoga group improved on most clinical outcome measures throughout the intervention.

**Limitations**

This study is limited in six important ways. First, the study made use of a TAU control group, which did not control for specific effects of the yoga condition. Second, the outcome measures possessed a heavy reliance on self-report methodology. A recent study of Mindfulness Based Stress Reduction in comparison to an active control condition found that participants reported significant differences in physiological measures of pain reduction but did not find significant differences in self-report measures (MacCoon et al., 2012). Similar results were found by Richter and colleagues (2012) when they observed changes in salivary cortisol but not in self-report measures of stress in sample of pregnant women in a trial of CBT. Consequently, future studies would benefit from the use of physiological measures related to primary outcomes. Third, it is possible that the location of the study may limit generalizability. Participants in the study
were more physically active in general and potentially more accepting of yoga given the popularity of yoga in the Boulder/Denver area in comparison to the general population. Effects of physical activity specific to yoga are nearly impossible to detect given increased baseline levels of physical activity across participants. Fourth, the relatively low threshold inclusion criteria for symptoms of anxiety and depression may have produced a floor effect such that participants who reported fewer symptoms of depression and anxiety at baseline or early in the study could not continue to improve throughout the study. Fifth, the study lacked a long-term follow up period. Data on birth outcomes and symptoms of psychopathology in the postpartum period would provide valuable information concerning the long-term benefits of yoga during pregnancy. Sixth, the study was limited by a small, relatively homogenous sample.

**Conclusion**

In summary, prenatal yoga is a feasible intervention for pregnant women with symptoms of anxiety and/or depression. Participants demonstrated high levels of compliance with the intervention, responded well to the treatment, and did not report adverse outcomes directly related to participating in yoga. Analyses supported hypotheses that participants in the yoga condition would experience less symptoms of negative affect, increased satisfaction with their social support networks, and increased confidence in their ability to engage in physical activity in comparison to the control group. To our knowledge, this study represents an advance in research on antenatal yoga as an intervention for mood and anxiety symptoms, given the inclusion of a control condition and multiple measurements. Yoga is a promising intervention for depression and anxiety in the antenatal period but closer examination is needed before definitive conclusions can be drawn regarding yoga as a front line intervention for antenatal depression and anxiety.
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