Yoga in Pregnancy

SHILPA BABBAR, MD, and JAYE SHYKEN, MD
St. Louis University, St. Louis, Missouri

Abstract: Yoga is a mind-body practice that encompasses a system of postures (asana), deep breathing (pranayama), and meditation. Over 36 million Americans practice yoga of which the majority are reproductive-aged women. Literature to support this practice is limited, albeit on the rise. A prenatal yoga practice has been shown to benefit women who suffer from anxiety, depression, stress, low back pain, and sleep disturbances. A small number of studies have been performed in high-risk pregnancies that also demonstrate an improvement in outcomes. The safety of performing yoga for the first time in pregnancy and fetal tolerance has been demonstrated.

Key words: yoga, pregnancy, prenatal, exercise

Introduction

Yoga is a term derived from the Sanskrit term “yuj,” which means to merge or to unite. It is a mind and body practice that encompasses a system of stretching exercises and postures (asana) combined with deep breathing (pranayama) and meditation. Yoga requires a mindful coordination of body movement and breath with a focus on self-awareness. The yoga concepts are said to be thousands of years old, originally disseminated in an oral tradition but allegedly assembled by Patanjali in the Yoga Sutras some 2000 years ago. Yoga as we know it originated in India in the 1820s as a mystical practice performed solely by men in secluded forests. In the early 1920s, a scientific researcher, Jagannath Gune, transformed the practice of yoga into an exercise for health and fitness by establishing the Kaivalyadhama health and yoga research center in India. It was not until the late 1930s that yoga became a worldwide phenomenon and women were allowed to learn yoga and participate. Today, yoga is a widely recognized form of exercise and is practiced by over 36 million adults in the United States. This figure has nearly doubled in the decade from 2002 to 2012 and grown by over 50% in the last 4 years. Over 70% of yoga practitioners are women of which the majority are in the reproductive age group.

Hatha yoga or the physical practice of yoga is what is most commonly understood in the West. There are many styles practiced in the United States and Europe, including Anusara, Ananda, Ashtanga, Bikram, Iyengar, Kundalini, Power, vinyasa flow, Viniyoga, and Yin among others. Although each style has its own expression, the underlying principles are the same with emphasis on breath work and meditation. It is unclear when yoga was first introduced as a prenatal practice or the current prevalence of yoga practice among pregnant women.

According to the National Health and Nutrition Examination Survey, which was conducted between 1999 and 2006, about
<table>
<thead>
<tr>
<th>Reference (Country)</th>
<th>Sample Size, Population</th>
<th>Yoga Intervention, Comparison Intervention, Duration</th>
<th>Outcomes Measured</th>
<th>Results and Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narendran et al(^7) (India)</td>
<td>335 (169: yoga group, 166: control) 18-20 wk pregnant</td>
<td>Yoga exercises, breathing techniques and meditation Control—walked ½ hour twice a day 1 h daily, from time of recruitment to delivery</td>
<td>Gestational age at delivery, Mean birth weight, Mode of delivery, IUGR, Obstetrical complications—PIH, IUFD</td>
<td>Yoga group had significantly higher likelihood of newborns with birth weight ≥ 2500 g ((P &lt; 0.01)) and lower rates of preterm labor ((P &lt; 0.0006), isolated intrauterine growth restriction ((P &lt; 0.003), and PIH with associated IUGR ((P &lt; 0.025))</td>
</tr>
<tr>
<td>Narendran et al(^8) (India)</td>
<td>121 (68: yoga group, 53: control) 18-20 wk pregnant with abnormal Doppler velocimetry scores of umbilical and uterine arteries</td>
<td>Yoga exercises, breathing techniques and meditation Control—walked ½ hour twice a day 1 h daily, from time of recruitment to delivery</td>
<td>Birth outcomes measured by: Blood pressure, IUGR, Doppler velocimetry scores of umbilical and uterine arteries Mode and gestational age of delivery Birth weight</td>
<td>A significant increase in birth weight ≥ 2.5 kg ((P &lt; 0.018)) in the yoga group</td>
</tr>
<tr>
<td>Beddoe et al(^9) (USA)</td>
<td>16 Nulliparous, singleton pregnancies between 12 and 32 wk gestation</td>
<td>Iyengar yoga and mindful based stress reduction curriculum 75 min, once weekly, 7 wk</td>
<td>Perceived Stress Scale, Prenatal Psychosocial Profile stressor subscale State Trait Anxiety Inventory Brief Pain Inventory Salivary cortisol General Sleep Disturbance Scale Wrist actigraphy</td>
<td>For second trimester women, pain was significantly decreased ((P = 0.02)) after intervention Trait anxiety ((P = 0.03)) were significantly lower in the third trimester No significant difference in pre and post morning salivary cortisol Significantly fewer awakenings, less wake time during the night, and less perceived sleep disturbances in the 2nd trimester yoga group ((P = 0.03))</td>
</tr>
<tr>
<td>Beddoe et al(^10) (USA)</td>
<td>15 Nulliparous, singleton pregnancy in 2nd or 3rd trimester</td>
<td>Iyengar yoga Once weekly, 7 wk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun et al(^11) (Taiwan)</td>
<td>88 (45: yoga group, 43: control) Primigravid healthy women at 26-28 wk who had not engaged in regular exercise or yoga for at least 1 y</td>
<td>Yoga exercises and meditation Control—no intervention 30 min, 3 x /</td>
<td>Discomforts of pregnancy questionnaire at 38-40 wk Childbirth self-efficacy inventory in the</td>
<td>Yoga group reported significantly fewer pregnancy discomforts than the control group at 38-40 wk of gestation ((P = 0.01)). They exhibited higher</td>
</tr>
<tr>
<td>Reference (Country)</td>
<td>Sample Size, Population</td>
<td>Yoga Intervention, Comparison Intervention, Duration</td>
<td>Outcomes Measured</td>
<td>Results and Conclusions</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------</td>
<td>------------------------------------------------------</td>
<td>-------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Muzik et al(^{12}) (USA)</td>
<td>18 primiparous Psychiatrically high risk for depression 12-26 wk pregnant</td>
<td>Mindfulness yoga—90 min, once weekly, 10 wk</td>
<td>Structured Clinical Interview for DSM Disorders (N-P) EPDS BDI-II The Five Facet Mindfulness Questionnaire-Revised FFMQ MFAS</td>
<td>Significant reduction in depressive symptoms on BDI-II and EPDS ((P = 0.025)) FFMQ scores significantly improved ((P = 0.007)) MFAS significantly increased ((P = 0.000))</td>
</tr>
<tr>
<td>Ko et al(^{13}) (Taiwan)</td>
<td>23 postpartum women</td>
<td>Yoga and Pilates group—1 h, once/week, 12 wk</td>
<td>Fatigue Symptoms Checklist CES-D Body composition analyzer</td>
<td>Significant decrease in depression scores after exercise ((P = 0.21)) No significant difference in fatigue levels ((P &gt; 0.05)) Significant reduction in body weight, body fat percentage, fat mass, and basic metabolic rate ((P &lt; 0.001))</td>
</tr>
<tr>
<td>Bershadsky et al(^{14}) (USA)</td>
<td>51 (38 yoga, 13 control) 12-19 wk pregnant</td>
<td>Hatha yoga-1, 90 min class—usual activity Control—usual activity</td>
<td>Salivary cortisol Derogatis Affects Balance Scale CES-D Antenatal and postnatal assessment</td>
<td>Cortisol was significantly low ((P &lt; 0.01)) and positive affect was higher ((P &lt; 0.001)) in the yoga group Negative affect and contentment improved more in the yoga group ((P &lt; 0.05)) Significantly fewer postpartum depressive symptoms ((P &lt; 0.05)) in the yoga group No change in maternal heart rate, temperature, or pulse oximetry</td>
</tr>
<tr>
<td>Polis et al(^{15}) (USA)</td>
<td>25 Healthy, uncomplicated pregnancies between 35 0/7 and 37 6/7 wk</td>
<td>One time, 1 h class of 26 yoga poses</td>
<td>Fetal nonstress test Maternal vital signs and pulse oximetry</td>
<td>No change in fetal heart rate during those poses</td>
</tr>
</tbody>
</table>

BDI indicates Beck Depression Inventory; CES-D, Center for Epidemiologic Studies Depression Scale; DSM, Diagnostic and Statistical Manual of Mental Disorders; EPDS, Edinburgh Postnatal Depression Scale; FFMQ, Five Facet Mindfulness Questionnaire-Revised; IUFD, intrauterine fetal demise; IUGR, intrauterine growth restriction; MFAS, Maternal Fetal Attachment Scale; PIH, pregnancy-induced hypertension.
7% of women reported practicing yoga and stretching during pregnancy.\textsuperscript{3} Because of the recent increase in popularity of the practice, it is plausible that the prevalence is higher than reported previously. Yoga is a low impact, intentional, and readily modifiable exercise making it a suitable exercise for pregnant women. Some women, particularly those with a preexisting practice, attend general yoga classes or participate in yoga classes specific for pregnant women, whereas others have exclusively a home exercise experience.

**Physiological Effects**

The health benefits from yoga are said to be myriad and include reduction in perceived stress, anxiety, depression, chronic back pain, migraines, and may have a benefit in conditions such as hypertension and diabetes.\textsuperscript{4} But how does yoga actually work? Several theories have been proposed.

Pranayamic breathing, also known as deep breathing, is defined as a voluntary manipulation of breath movement and serves as the cornerstone of any yoga practice. Slow, deliberate, deep breathing activates the parasympathetic nervous system mainly by stretching of lung tissue and the vagal nerves. This leads to a physiological response characterized by a decrease in heart rate, blood pressure, metabolic rate, and oxygen consumption.\textsuperscript{5} Deep breathing also increases neuroplasticity, defined as the reorganization of neural pathways as an adaptive response. Studies reveal an increase in neuroplasticity in those who perform yoga, thereby improving concentration, intelligence quotient scores, and motor control.\textsuperscript{5}

On the basis of these physiological responses, yoga may serve to benefit women in pregnancy. The natural physiological adaptations that occur in pregnancy such as an increase in cardiac output, heart rate, and plasma volume could possibly be counteracted by intentional parasympathetic activation during yoga. Satyapriya et al\textsuperscript{6} were able to demonstrate an improvement in autonomic response to stress in healthy pregnant women who performed yoga during their pregnancy.

**Clinical Application**

The first peer-reviewed publications on prenatal yoga were in 2005 by Narendran et al\textsuperscript{7,8} demonstrating a significant increase in fetal birth weight and significant decrease in preterm labor and fetal growth restriction in those who performed yoga during their pregnancy. Since then, a limited number of prospective and randomized trials have been published revealing evidence on the maternal benefits of yoga in pregnancy. A PubMed search in January 2016 using the terms “yoga” and “pregnancy,” “prenatal,” “postpartum,” revealed over 100 results. Upon review of each abstract, currently there are 17 randomized controlled trials and 9 prospective studies on the effects of yoga in pregnancy and postpartum. These studies have been summarized in Tables 1 and 2. A review of this literature will be discussed.

**PREGNANCY**

The evidence suggesting benefits of yoga in pregnancy continues to rise. The most commonly assessed pregnancy-related factors include stress, anxiety, depression, pregnancy and labor pain, sleep, and pregnancy outcomes.

**Anxiety, Depression, and Stress**

Depression is a common occurrence in pregnancy and occurs in anywhere between 14% and 23% and up to approximately 50% of women during pregnancy.\textsuperscript{23,32} The majority of the prenatal yoga studies revolve around the assessment of depression and anxiety during and after pregnancy. Five studies assessed the effects of yoga in a prenatal population at high risk for depression. Field et al\textsuperscript{23} randomized prenatally depressed women into those receiving yoga for 20 minutes per session, twice a week for 12 weeks
### Table 2. Randomized Controlled Trials of Yoga During Pregnancy

<table>
<thead>
<tr>
<th>Reference (Country)</th>
<th>Sample Size, Population</th>
<th>Yoga Intervention, Comparison Intervention, Duration</th>
<th>Outcomes Measured</th>
<th>Results and Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuntharapat et al (Thailand)</td>
<td>74 (37: yoga, 37: control) Primigravida women at 26-28 wk</td>
<td>Yoga exercises and breathing techniques Control—standard prenatal care Six, 1 h sessions at prescribed weeks of gestation with home practice at least 3 times/wk for 10-12 wk</td>
<td>Visual analog scale to total comfort Maternal comfort questionnaire Visual analog sensation of pain scale Pain behavioral observation scale Birth Outcomes—Apgar scores and length of labor</td>
<td>Yoga group was found to have higher levels of maternal comfort during labor and 2 h post labor, shorter duration of 1st stage of labor and total time of labor, and less subject evaluated labor pain ($P &lt; 0.05$). No differences in labor augmentation or newborn Apgar scores at 1 and 5 min.</td>
</tr>
<tr>
<td>Satyapriya et al (India)</td>
<td>122 recruited (45 yoga, 45 control completed the study) 18-20 wk pregnant</td>
<td>Integrated yoga Control—standard prenatal exercises 1 h daily, from the time of recruitment to delivery</td>
<td>PSS Heart rate variability via an ambulatory electrocardiogram</td>
<td>Perceived stress decreased by 31% in the yoga group and increased by 7% in the control group ($P = 0.001$). Yoga reduces perceived stress and improves adaptive autonomic response to stress in healthy pregnant women.</td>
</tr>
<tr>
<td>Rakhshani et al (India)</td>
<td>102 (51 yoga, 51 control) 18-20 wk pregnant</td>
<td>Integrated yoga Standard antenatal exercises For 1 h, 3x/week, 16 wk</td>
<td>QOL measured by: WHOQOL-100 domains* FIRO-B domains*</td>
<td>Yoga group showed a significant improvement in physical ($P = 0.001$), psychological ($P &lt; 0.001$), social ($P = 0.003$) and environmental domains ($P = 0.001$). Yoga improved the WHOQOL in pregnant women.</td>
</tr>
<tr>
<td>Field et al (USA)</td>
<td>84 prenatally depressed (breakdown per group is not stated)</td>
<td>Yoga 20 min, twice a week, 12 wk Massage—20 min, twice a week, 12 wk Control—standard prenatal care</td>
<td>CES-D STAI POMS STAXI The Relationship questionnaire Neonatal outcomes</td>
<td>Significantly decreased depression, anxiety, anger, back and leg pain scores ($P &lt; 0.001$) and increased relationship scores ($P &lt; 0.001$) in the yoga and massage group.</td>
</tr>
<tr>
<td>Reference (Country)</td>
<td>Sample Size, Population</td>
<td>Yoga Intervention, Comparison Intervention, Duration</td>
<td>Outcomes Measured</td>
<td>Results and Conclusions</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------</td>
<td>------------------------------------------------------</td>
<td>----------------------------</td>
<td>-------------------------------------------------------------------</td>
</tr>
<tr>
<td>Rakhshani et al&lt;sup&gt;19&lt;/sup&gt; (India)</td>
<td>68 (30 yoga, 38 control) High risk pregnancies 12-28 wk pregnant</td>
<td>Simple meditative yoga, 3 d/wk × 16 wk Control—standard care plus walking twice daily for 30 min</td>
<td>Development of high-risk complications such as preeclampsia, gestational diabetes, growth restriction Birth weight Maternal blood pressure</td>
<td>No significant difference on neonatal outcomes Significantly fewer hypertensive disorders in the yoga group ( (P = 0.028) ) Significantly fewer SGA and growth restriction in the yoga group ( (P = 0.006 \text{ and } 0.05) )</td>
</tr>
<tr>
<td>Jayashree et al&lt;sup&gt;20&lt;/sup&gt; (India)</td>
<td>68 (30 yoga, 38 control) High-risk pregnancies 12-28 wk pregnant</td>
<td>Simple meditative yoga, 3 d/wk × 16 wk Control—standard care plus walking twice daily for 30 min</td>
<td>Development of pregnancy-induced hypertension/preeclampsia</td>
<td>Uric acid and platelet counts remained within normal limits in both groups Significantly less women developed preeclampsia in the yoga group ( (P = 0.018) )</td>
</tr>
<tr>
<td>Satyapriya et al&lt;sup&gt;21&lt;/sup&gt; (India)</td>
<td>96 (51 yoga, 45 control) 20-36 wk pregnant</td>
<td>Integrated yoga, 1 h daily Control—simple stretching exercises</td>
<td>PEQ STAI Hospital anxiety depression scale</td>
<td>PEQ scores, anxiety and depression significantly decreased in the yoga group ( (P &lt; 0.001) )</td>
</tr>
<tr>
<td>Deshpande et al&lt;sup&gt;22&lt;/sup&gt; (India)</td>
<td>68 (30 yoga, 38 control) High-risk pregnancies 12-28 wk pregnant</td>
<td>Simple meditative yoga, 3 d/wk × 16 wk Control—simple prenatal stretching exercises</td>
<td>PSS</td>
<td>Significantly lower stress in the yoga group ( (P = 0.02) ) Significantly fewer pregnancy discomforts in the yoga group ( (P = 0.02) )</td>
</tr>
<tr>
<td>Field et al&lt;sup&gt;23&lt;/sup&gt; (USA)</td>
<td>92 (46 yoga, 46 control) Prenatally depressed</td>
<td>Yoga 20 min/wk, 12 wk Control—social support group</td>
<td>CES-D STAI EDPS POMS STAXI The Relationship questionnaire Salivary cortisol, estriol, and progesterone</td>
<td>Less depression, anxiety, anger, and pain in the yoga group Cortisol decreased for both groups Estriol and progesterone decreased in both groups</td>
</tr>
<tr>
<td>Youngwanichsetha et al&lt;sup&gt;24&lt;/sup&gt; (Thailand)</td>
<td>180 (85 yoga, 85 control) A1 Gestational diabetes mellitus 24-30 wk pregnant</td>
<td>Yoga and mindfulness eating—two, 50 min sessions, encouraged to practice at home 5x/week for 8 wk</td>
<td>Capillary fasting plasma glucose 2 h postprandial glucose HbA1c</td>
<td>Significant reduction in fasting plasma glucose ( (P = 0.012) ), 2 h postprandial glucose ( (P = 0.001) ) and HbA1c in the</td>
</tr>
<tr>
<td>Reference (Country)</td>
<td>Sample Size, Population</td>
<td>Yoga Intervention, Comparison Intervention, Duration</td>
<td>Outcomes Measured</td>
<td>Results and Conclusions</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------</td>
<td>-------------------------------------------------------</td>
<td>-------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Martins et al&lt;sup&gt;25&lt;/sup&gt; (Brazil)</td>
<td>60 (30 yoga, 30 control) Lumbopelvic pain 12-32 wk</td>
<td>Control—standard diabetic care Hatha yoga, 1 h / week, 10 wk Control postural orientation—encouraged to exercise</td>
<td>LPP Posterior pelvic pain provocation test Pain intensity via Visual Analog Scale</td>
<td>Significantly lower pain scores in the yoga group ($P &lt; 0.0058$) Decrease response in LPP with gradual reduction in pain intensity ($P &lt; 0.024$)</td>
</tr>
<tr>
<td>Newham et al&lt;sup&gt;26&lt;/sup&gt; (UK)</td>
<td>59 (31 yoga, 28 control) Primiparous</td>
<td>Yoga, 1.5 h/wk, 8 wk Control—treatment as usual</td>
<td>EDPS STAI WDEQ Stress hormone assessment (yoga group only)</td>
<td>A significant reduction in cortisol levels in the yoga group ($P = 0.003$) Pregnancy specific anxiety (WDEQ) was significantly lower in the yoga group ($P &lt; 0.0001$) No significant difference in STAI or EDPS scores</td>
</tr>
<tr>
<td>Rakhshani et al&lt;sup&gt;27&lt;/sup&gt; (India)</td>
<td>59 (27 yoga, 32 control) High risk pregnancies 12-28 wk pregnant</td>
<td>Yoga, 1 h daily, 3 × / week, 16 wk Control—walking twice daily, 30 min each, 16 wk</td>
<td>Fetal growth parameters (BPD, HC, AC, FL), fetal heart rate, estimated fetal weight Uterine artery Dopplers Umbilical artery Dopplers Middle cerebral artery Dopplers</td>
<td>Significantly higher BPD ($P = 0.001$), HC ($P = 0.002$), FL ($P = 0.005$), estimated fetal weight ($P = 0.19$) in the yoga group Lower impedance in the right uterine RI ($P = 0.01$), umbilical artery ($P = 0.011$) and middle cerebral artery ($P = 0.048$) in the yoga group</td>
</tr>
<tr>
<td>Davis et al&lt;sup&gt;28&lt;/sup&gt; (USA)</td>
<td>46 (23 yoga, 23 control) &lt;28 wk pregnant with depression or anxiety symptoms</td>
<td>Yoga—75 min/wk, 8 wk Control—treatment as usual</td>
<td>EDPS STAI Positive and negative affect schedule-negative subscale</td>
<td>No difference in improvement of depression/anxiety symptoms between groups Yoga was associated with a significantly greater reduction in negative affect</td>
</tr>
<tr>
<td>Buttner et al&lt;sup&gt;29&lt;/sup&gt; (USA)</td>
<td>57 (28 yoga, 29 control) Postpartum women with depression</td>
<td>Gentle vinyasa flow yoga 1 h, twice/wk, 8 wk Control—wait list group</td>
<td>Hamilton Depression Rating Scale Inventory of Depression and Anxiety Symptoms Panic, Social</td>
<td>Significantly lower depressive symptoms in the yoga group ($P &lt; 0.001$) Improvement at a significantly faster rate</td>
</tr>
</tbody>
</table>
versus those receiving standard care with social support. They demonstrated a significant reduction in depression and anxiety after the intervention during pregnancy, which also persisted into the postpartum period.\textsuperscript{18} This conclusion was supported by a nonrandomized study by Muzik et al.\textsuperscript{12} However, in 2015, 2 randomized trials had different conclusions. Davis et al\textsuperscript{28} randomized 46 women into an 8-week yoga (75 min/wk) intervention versus a “treatment as usual” group. Participants in both groups reported significant improvement in their symptoms; however, the yoga group had a significant reduction in negative affect when assessed by multiple survey scales. Uebelacker et al\textsuperscript{30} conducted a pilot study to assess the benefits of prenatal yoga versus perinatal health education for antenatally depressed women. On the basis of their study, yoga remains a feasible alternative option in the management of depression in pregnancy. They did not demonstrate a significant reduction in symptoms, possibly because of their small sample size of 20 randomized women. Although promising, a large scale trial is needed to provide

\begin{table}
\centering
\begin{tabular}{|l|l|l|l|l|}
\hline
Reference (Country) & Sample Size, Population & Yoga Intervention, Comparison Intervention, Duration & Outcomes Measured & Results and Conclusions \\
\hline
Uebelacker et al\textsuperscript{30} (USA) & 20 (12 yoga, 8 control) 12-26 wk pregnant with depression & Gentle yoga—75 min/wk, 9 wk Control—75 min workshops on mom-baby wellness & Treatment credibility and expectations Depression severity & Feasible and acceptable intervention procedures Depression improved in both arms with a trend towards yoga group \\
Babbar et al\textsuperscript{31} (USA) & 46 women (23 yoga, 23 control) Uncomplicated, singleton, low-risk women with no previous yoga experience 28 0/7 to 36 6/7 wk pregnant & Yoga—1 h only Control—1 h educational experience only & Umbilical artery Doppler Fetal heart rate, nonstress test and biophysical profile Maternal heart rate and blood pressure & No significant change in umbilical artery Doppler indices No significant change in other maternal or fetal parameters \\
\hline
\end{tabular}
\end{table}

\textsuperscript{*WHOQOL-100, is an assessment instrument containing 100 questions, which evaluates an individual’s perception of their position in life and health taking culture and value systems into consideration; \textsuperscript{9}FIRO-B assesses interpersonal relations with regard to affection, control, and inclusion in social situations.

\begin{itemize}
\item AC indicates abdominal circumference; BPD, Biparietal diameter; CES-D, Center for Epidemiologic Studies Depression Scale; EDPS, Edinburg Postnatal Depression Scale; FIRO, Fundamental Interpersonal Relations Orientation; FL, Femur length; HC, Head circumference; HbA1c, hemoglobin A1c; HRQOL, Health Related Quality of Life; LPP, lumbar pain provocation test; PEQ, Pregnancy experiences Questionnaire; OMS, Profile of Mood States; PSS, Perceived Stress Scale; QOL, quality of life; RI, Resistance index; SGA, Small for Gestational Age; STAI, state-trait anxiety inventory; STAXI, State Anger Inventory; WDEQ, Wijma Delivery Expectancy Questionnaire; WHOQOL-100, World Health Organization Quality of Life.
\end{itemize}
compelling evidence for the benefits on depression in pregnancy. Women with a known history of anxiety or depression are at a high risk for symptoms during and after delivery; however, women without a significant history are also at risk. Anxiety scores significantly improved in women who practiced yoga during their pregnancy from once a week for 7 weeks to daily until delivery. Elevated cortisol levels correlate with depression and anxiety. Several studies reveal an improvement in cortisol, whereas others reveal no change; therefore, the evidence on the effects of prenatal yoga on cortisol levels is inconclusive.

**Pregnancy and Labor Pain**

One of the most common complaints in pregnancy is progressive low back pain, especially in the lumbosacral area. Exercises focusing on stretching and strengthening of the back and abdominal muscles are frequently recommended to relieve pregnancy-related pain. Martins et al concluded that a 1 hour a week Hatha yoga practice for 10 weeks can significantly lower lumbopelvic pain during pregnancy. A more frequent practice of yoga 3 times per week for 30 minutes each over a 12- to 14-week period was also shown to have similar findings in pain reduction during gestation.

Chuntharapat et al from Thailand was the only group to study pain during labor. Seventy-four women were randomized into those performing yoga for 10 to 12 weeks versus those receiving standard prenatal care. Women who were in the yoga intervention group were found to have significantly more comfort during labor and was also associated with a shorter duration of the first stage of labor. They also assessed birth outcomes that were not significantly different. Further studies are needed to demonstrate the efficacy of a yoga practice on labor patterns and outcomes.

**Sleep**

Sleep disturbances in pregnancy are common and often overlooked, but can be associated with adverse pregnancy outcomes such as preterm birth and preeclampsia. Sleep changes may be influenced not only by physiological changes in pregnancy but anxiety created in anticipation for childbirth and parenthood. Beddoe et al conducted a pilot study in California utilizing 15 healthy, low-risk pregnant women. Each woman participated in a weekly mindful meditation and Hatha yoga class for 7 weeks. Sleep parameters were evaluated subjectively through validated surveys and objectively by a wrist actigraph. When starting yoga in the second trimester, there was a significant improvement in sleep parameters from baseline. This study provides promising evidence on the benefits of yoga on sleep; however, a randomized trial is warranted to evaluate the potential effects of improving pregnancy outcomes.

**POSTPARTUM**

The postpartum period serves as a time where hemostasis is being restored and a mother is adjusting to her new life. Stress encountered during this time can be mitigated by utilizing meditation, yoga breathing techniques, and exercises. To date, there are 2 publications assessing the effects of yoga in the postpartum period. In 2012, Ko et al engaged a convenience sample of 23 women to assess the effects of a community-based postpartum yoga program. A 60-minute, once a week exercise session for 3 months revealed a significant reduction in depression scores in those who were at a high risk for depression ($P = 0.021$). Three years later, Buttner et al performed a small randomized trial that supported Ko’s findings. Twenty-eight of 57 women at high risk for postpartum depression participated in yoga classes twice a week for 8 weeks. This group experienced significantly greater rates of
improvement in depression, anxiety, and health-related quality of life compared with their control counterparts ($P \leq 0.05$). \textsuperscript{29}

**SPECIAL POPULATIONS**

**Multifetal Gestations**

To date, there are no specific studies that have assessed the effects of yoga on multiple fetal gestations. Most studies either excluded multiple gestations or made no mention in their inclusion criteria. As women with certain types of multiple gestations are at a higher risk for pregnancy complications, it is unclear at this time if yoga is recommended for this population. A discussion on physical activity in pregnancy with an obstetrician is warranted.

**High-risk Populations**

High-risk pregnancies account for approximately 6% to 8% of all gestations in the United States. \textsuperscript{34} Specific medical conditions such as gestational diabetes and hypertension could potentially benefit from a yoga practice in pregnancy. In 2012, a team of clinicians from India published a series of articles from a randomized controlled trial conducted in high-risk women. \textsuperscript{19} This high-risk cohort was defined as those with any of the following: a history of previous pregnancy-induced hypertension, preeclampsia, growth restriction; extremes of age; obesity; twin pregnancies; or a family history of poor obstetric outcomes. A simple meditative yoga practice 3 days a week for 16 weeks of pregnancy lead to significant benefits when compared with controls. Significantly fewer women in the yoga group developed a hypertensive disorder in the index pregnancy and had a lower rate of fetal growth restriction and Doppler changes. \textsuperscript{19,27} The women in the yoga group also maintained normal uric acid and platelet levels throughout their pregnancy, thereby reducing the risk of developing hemolysis, elevated liver enzymes, low platelet count syndrome. \textsuperscript{20} They also experienced a significantly lower degree of stress and pregnancy discomforts in pregnancy. \textsuperscript{22}

Mindfulness eating has become a widely recognized and recommended practice in which eating is performed with intention and attention to reduce the amount of food consumed. \textsuperscript{24} A study from Thailand assessed the utility of mindfulness eating and yoga on the control of blood glucose levels in women with gestational diabetes. Women were included if they had diet-controlled gestational diabetes diagnosed between 24 and 30 weeks. Mindfulness eating in this study included setting a goal for blood glucose control, integrating medical nutrition therapy including carbohydrate choices and low glycemic index foods, considering portion size, being aware while consuming diabetogenic food, and eating slowly for 30 to 45 minutes. Yoga was practiced for 15 to 20 minutes a day for 5 days of the week over an 8-week period. This study demonstrated a statistically significant lowering of fasting glucose (yoga = 83.39, control = 85.85, $P = 0.012$), postprandial glucose (yoga = 105.67, control = 112.36, $P = 0.001$), and hemoglobin A1C (yoga = 5.23%, control = 5.68%, $P = 0.038$) in the yoga group versus the control. \textsuperscript{24} Although these results seem promising, perinatal outcomes were not assessed in this study; therefore, the clinical significance of yoga in diabetes management remains unknown.

**Hot Yoga**

Bikram yoga consists of a specific series of 26 postures including 2 breathing exercises performed for 90 minutes in a room heated to 104°F with a humidity of 40%. \textsuperscript{35} “Hot yoga” is commonly used synonymously but differs in the degree of heat attained in the room and the sequence of postures performed. The hypothetical benefits of the addition of external heat to a yoga practice include increased joint lubrication and flexibility leading to deeper stretching, and increased sweating leading to continuous flushing of toxins from the body.
However, a theoretical risk for overheating the body and exhaustion raise concern with this practice during pregnancy. Hot yoga is specifically to be avoided, as increasing core temperature is associated with an increased risk for birth defects. Although this relationship has not been studied specifically for human pregnancy, the literature gives us examples of dangers of other forms of heat in early pregnancy, such as hot tubs, saunas, and maternal fever. For example, women who use a hot tub for >30 minutes more than once in pregnancy have an increased risk for certain birth defects, particularly those of the neural tube and spine and also abdominal wall defects.36

The scientific evidence to support the overall health benefits of Bikram yoga is sparse. A short-term Bikram yoga practice may improve balance, flexibility, glucose tolerance, and rate of bone loss in a non-pregnant cohort.37–39 Physiological response to this type of yoga in novice and experienced practitioners was recently assessed in San Diego, California.40 Utilizing 24 yoga students, of which 79% were women, Pate and Buono40 demonstrated the overall Bikram yoga sequence to be of light intensity (METS = 2.73), and the maximum mean heart rate achieved was in the 160s, particularly in the standing poses. Oral temperature significantly increased by a mean of 1.0 ± 1.2°F in novice versus 1.8 ± 1.4°F in experienced practitioners. Although none of these women were known to be pregnant during the study, it serves as a supportive evidence for the possible use of Bikram yoga in pregnancy.

Currently, there are no studies assessing the effects of hot or Bikram yoga in pregnancy. Despite the lack of evidence to support the practice of hot yoga in pregnancy, it is imperative for obstetricians to know that women are engaging in this activity while pregnant. When surveyed, approximately 25% of hot yoga practitioners were currently pregnant, 77% would practice prenatal yoga if they became pregnant, and 88% who practiced prenatal hot yoga before would do it again in a subsequent pregnancy.41 Hot prenatal yoga practitioners trusted themselves, a friend, or acquaintance who practiced hot/hot prenatal yoga or a yoga studio employee over their obstetrician to provide knowledge on the safety of hot yoga in pregnancy.41

**Risks**

Adverse events with yoga and pregnancy are not well reported in the literature. Yoga is a low-impact and easily modifiable exercise that makes it more likely to be a safe endeavor with minimal injury. Previous studies have not reported any maternal injuries during their study period in those who practiced yoga.30,31 Risks to the fetus are also unknown and not well documented. A randomized controlled trial conducted by Babbar et al31 assessed the acute fetal response to prenatal yoga. Women who were new to yoga underwent standard antenatal fetal testing before and after a 1 hour yoga class. Acute fetal behavior as assessed by umbilical artery Dopplers, nonstress testing and biophysical profile parameters, were compared with a stationary control group. There was no significant difference in fetal parameters or delivery outcomes in this cohort. Another study assessing the acute fetal response to controversial yoga poses in the third trimester concluded similar findings.15 Short-term fetal tolerance to yoga exercises in pregnancy has been demonstrated.15,31

The long-term effects of yoga on the fetus or neonate are unknown because of the paucity of reports in the literature. Fetal growth and birth weight serve as measurable outcomes that reflect the health status of a pregnancy. Several studies demonstrate higher birth weights and lower rates of fetal growth restriction in those who practice yoga in pregnancy.8,27 It is conceivable to deduce a positive impact of yoga on the fetus...
Summary
Yoga is an easily modifiable exercise that can provide maternal and fetal benefits when practiced regularly during pregnancy. It is likely that the increase in strength and fitness as well as the perception of stress reduction underlies all the benefits of yoga for pregnant women. When practiced wisely, there is no reason to believe that yoga is harmful in pregnancy and the scientific data are accumulating to support the benefits. Further studies aimed to determine the physiological changes, applicability to specific high-risk populations, and appropriate duration and frequency to practice to improve maternal and neonatal outcomes are warranted.

References


