



Narrative Review

A comprehensive review on scientific evidence-based effects (including adverse effects) of yoga for normal and high-risk pregnancy-related health problems

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ABSTRACT

Women undergo distinct physiological changes and stress during pregnancy that are accompanied by various physical and psychological demands. Yoga is a complementary therapy that is commonly used by pregnant women and recommended by healthcare professionals. Thus, it is very important to know its evidence based effects, including adverse effects from all types of research. A comprehensive literature search in PubMed/Medline electronic database from inception to 23 September 2017 was performed using the keywords “yoga for pregnancy”. In total, 137 articles published since 1979 were available. Of the 137 articles, 53 articles were included for the review. This comprehensive review suggests that yoga could be considered as an evidence-based complementary therapy in improving both physical and psychological wellbeing in pregnant women during pregnancy (normal and high-risk), childbirth, and post-partum. However, types, duration, and frequency of yoga practices varied among the studies and the exact mechanisms behind the effects of yoga are less understood and need to be explored.

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1. Background

During pregnancy, women undergo distinct physiological changes and stresses that are accompanied by various physical and psychological demands (Curtis et al., 2012). There is a growing need to manage these demands in order to reduce infant and maternal morbidity and mortality in both developed and developing countries (Jayashree et al., 2013).

Evidence suggests that women are higher adopters of complementary and alternative medicine (CAM) therapies (Cramer et al., 2015). Use of CAM among pregnant women is quite popular and currently increasing (Steel et al., 2014; Cramer et al., 2015; Babbar et al., 2016), with over a third of American women of child-bearing age now using one or more CAM therapies (Holden et al., 2015). A validated survey conducted at the Central Association of Obstetricians and Gynecologists annual meeting in America reported that 62% of the Association had advised their patients to utilize some forms of CAM during pregnancy (Babbar et al., 2016). Similarly, in the United Kingdom (UK), prevalence of CAM use by women during pregnancy was 57.1% (Hall and Jolly, 2014) and in

South Australia, a majority of obstetricians (68%) and midwives (78%) were reported to refer their patients to CAM therapies (Gaffney and Smith, 2004).

Pregnant women seek CAM for a variety of reasons (Cramer et al., 2015), such as to manage stress and depression (Kinser and Masho, 2015); back pain (Holden et al., 2015); to enable choice and control over their childbearing experience; to provide an approach congruent with their holistic health beliefs (Cramer et al., 2015). These alternative therapies can improve general wellness and prevent diseases (Holden et al., 2015) and they are perceived as beneficial for both psychological and physical aspects (Kinser and Masho, 2015).

Among various CAM therapies, yoga is one of the most commonly used and referred therapies by pregnant women (Cramer et al., 2015; Holden et al., 2015) and healthcare professionals respectively in various parts of the world including the USA (Holden et al., 2015; Babbar et al., 2016), the UK (Hall and Jolly, 2014), especially North East Scotland (Stewart et al., 2014), Australia (Gaffney and Smith, 2004), and India (Jayashree et al., 2013) with the objective of reducing pregnancy-related health problems and promoting better pregnancy outcomes. Yoga is a mind-body practice that originated in India as an aspect of ancient Indian philosophy (Kawanishi et al., 2016). It consists of physical postures

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(asana), breathing exercises (pranayama), concentration and meditation (dharana and dhyana), and contemplative practices (Curtis et al., 2012). Evidence suggests that participating in exercise during pregnancy is associated with decreased risk of several birth complications (Peters and Schlaff, 2016).

Yoga is one the most commonly used (Tung et al., 2014) and beneficial forms of exercise to help women keep fit during their pregnancy and prepare them for childbirth (Oakley and Evans, 2014). A survey reported that 65% of pregnant women believed yoga to be beneficial, 40% had attempted yoga even before pregnancy (Babbar and Chauhan, 2015) and those who have practiced yoga had a more positive attitude towards exercise and yoga, after being introduced to it as an intervention (Babbar et al., 2017). Thus, prenatal yoga that involves breathing practices, physical postures, and meditation has increased in popularity as a form of recommended physical activity (Uebelacker et al., 2016; Peters and Schlaff, 2016). It differs in pace, choice of postures, use of modifications, and emphasis on the physical changes of pregnancy (Uebelacker et al., 2016).

Though there are few review articles available on yoga for pregnancy (Babbar et al., 2012; Curtis et al., 2012; Jiang et al., 2015), particularly for women's mental health (Sheffield et al., 2016) (depression) (Gong et al., 2015) and well-being (Sheffield et al., 2016), most of these reviews were performed using only RCTs (Curtis et al., 2012; Gong et al., 2015; Jiang et al., 2015), or RCTs in combination with either observation studies (Babbar et al., 2012, 2016) or controlled trials (Curtis et al., 2012). There is a lack of comprehensive review articles that include all types of research articles including RCTs, controlled trials, observational studies, case reports, health surveys, qualitative studies, and meta-analyses related to yoga and pregnancy. Since yoga is one of the more commonly recommended and practiced therapies for pregnant women (Holden et al., 2015; Stewart et al., 2014), it is essential to report evidence from all types of research for better understanding. A comprehensive review gains more significance as most of the yoga related adverse effects are case studies (El-Khayat, 2017) or non-clinical trials (Steel et al., 2014), which could potentially be excluded if only RCTs were to be considered for the review. Hence, the present review was performed using all type of available literature with the objective of providing an extensive comprehensive review on evidence-based effects (including adverse effects) of yoga on normal and high-risk pregnancy related health problems.

2. Methods

A comprehensive literature search was performed in the PubMed/Medline electronic database from inception to 23 September 2017, to review relevant articles in English, using the key phrase, "yoga for pregnancy". A total of 137 articles published since 1979 were available. Of the 137 articles, 53 articles [RCTs (n = 21); Non RCTs (n = 4); Single-group pre-post trials (n = 9); Meta-analysis (n = 1); Mixed within and between subject study (n = 1); Observational studies including survey; Cross-sectional and descriptive studies (n = 15); Case report (n = 1); and Health updates (n = 1)] that fit into the following inclusion and exclusion criteria were considered for this review. The inclusion criteria consisted of clinical trials, controlled trials, randomized controlled trials, observational studies, health surveys, health updates, qualitative studies, case reports, and meta-analyses dealing with yoga, either alone, or in combination with other therapies. Articles in other languages apart from English were excluded. Articles that were not relevant or specific to the topic, review articles, research protocols, comments, errata, and articles that did not have either an abstract or full text were also excluded.

3. Yoga for normal pregnancy related health problems

3.1. Yoga for prenatal pain

Low back pain is a common musculoskeletal problem associated with pregnancy (Bhardwaj and Nagandla, 2014) that has a significant impact on a pregnant woman's daily activities (Wang, 2003). Despite the pain occurring majorly in either the lumbar or pelvic girdle region, pelvic girdle pain is more prevalent, and results in a greater disability than lumbar pain (Bhardwaj and Nagandla, 2014). Since yoga can be safely used by pregnant women who have lumbo-pelvic pain (Jiang et al., 2015), it has become a commonly chosen CAM therapies (Wang et al., 2005; Martins et al., 2014; Wang, 2003).

Prenatal yoga has shown to be effective in reducing pregnancy-related low back pain (Babbar and Shyken, 2016), particularly in reducing lumbo-pelvic (Martins et al., 2014)/pelvic pain (Kawanishi et al., 2015). The practice of yoga has not only shown to be effective in reducing back pain during pregnancy, but also has shown to be effective in reducing leg pain (Field et al., 2012, 2013; Field, 2017), generalized body pain (Beddoe et al., 2009), pregnancy-related discomforts (Babbar et al., 2012), incidence of prenatal disorders, and small gestational age (Jiang et al., 2015).

3.2. Yoga for preterm birth

Preterm birth is a major contributing factor to perinatal morbidity and mortality. Despite the use of ritodrine hydrochloride as a key drug for preterm labor; it produces adverse effects in the cardiovascular system indicating that it should only be administered when absolutely necessary. In contrast, yoga practice has been shown to significantly lower the need for ritodrine hydrochloride use and the incidences of preterm births, particularly in women who had practiced yoga for more than 900 min over the course of their pregnancy (Kawanishi et al., 2016). Similarly, other studies have also shown yoga practice to significantly lower the rates of preterm labor (Narendran et al., 2005; Babbar et al., 2012; Field et al., 2012; Field, 2017) and low birth weight (Field et al., 2012; Chen et al., 2017; Field, 2017). Moreover, women who participated in a six-week prenatal yoga program during their second and third trimesters of pregnancy were reported to have increased levels of optimism, power, and well-being (Reis et al., 2014).

3.3. Yoga for vital functions and prevention of complications

One study measured the vital signs, pulse oximetry, uterine tocometry, and fetal heart rate during yoga practice, and they were reported to remain normal in pregnant women between 35 and 37 weeks of gestation. There were no falls or injuries during the practice and no subject reported decreased fetal movement, leakage of fluid, vaginal bleeding or contractions in the 24-h follow-up. Thus, yoga postures were suggested as a well-tolerated intervention with no acute adverse maternal or fetal heart rate changes (Polis et al., 2015). In another study, no significant change in fetal blood flow was reported immediately after performing yoga (1-time, 1 h) in uncomplicated pregnancies between 28 and 36 weeks with a non-anomalous singleton fetus. Thus, yoga was recommended for low-risk women during pregnancy (Babbar et al., 2016).

Various other studies have reported that the practice of yoga is effective in reducing pregnancy-related discomforts (Sun et al., 2010), number of awakenings and waking time during sleep (Beddoe et al., 2010), perceived sleep disturbances (Beddoe et al., 2010; Babbar et al., 2012; Field et al., 2013; Babbar and Shyken,

2016), heart rate, blood pressure (Field, 2012), and also in improving autonomic nervous system functioning (Curtis et al., 2012), quality of life (Babbar et al., 2012; Curtis et al., 2012), interpersonal relationships of pregnant women (Rakhshani et al., 2010), and it is suggested to improve various other domains (physical, psychological, social, and environmental domains) of pregnant women. Moreover, the practice of yoga during pregnancy has been reported to be safe (Rakhshani et al., 2010) and helpful in reducing complications like intrauterine growth restriction (IUGR), either in isolation or associated with pregnancy-induced hypertension (PIH) and prematurity (Field, 2012). It also has been correlated with improving birth weight with no significant adverse effects (Narendran et al., 2005; Babbar et al., 2012).

3.4. Yoga for immune functions

20 weeks (70-min yoga sessions twice a week) of yoga practice has shown to significantly enhance immune function in pregnant women by means of higher immunoglobulin-A levels, both immediately after and in long-term yoga practices compared to the control group. Moreover, infants born to women in the yoga group weighed more than the infants in the control group (Chen et al., 2017).

3.5. Yoga for labor pain and delivery outcomes

The practice of yoga (pranayama and meditation) by pregnant women has reported to keep them healthy and relaxed, encourage an optimal fetal position during labor and provide mental focus to aid childbirth (Oakley and Evans, 2014). Complementary methods of pain management are gaining popularity with many pregnant women because they want to avoid pharmacological or invasive methods of pain management during labor (Smith et al., 2011; Oakley and Evans, 2014).

Yoga is a complementary method reported to be effective in reducing labor pain (Chuntharapat et al., 2008; Smith et al., 2011; Curtis et al., 2012; Kawanishi et al., 2015; Jahdi et al., 2017), length of labor (Smith et al., 2011; Curtis et al., 2012; Kawanishi et al., 2015; Jahdi et al., 2017), first stage (Chuntharapat et al., 2008), second and third stages (Jahdi et al., 2017), and the total time of labor (Chuntharapat et al., 2008). Yoga also reduces the rate of assisted vaginal delivery (Smith et al., 2011), while also increasing maternal comfort during (Chuntharapat et al., 2008; Romano and Goer, 2008; Curtis et al., 2012) and after labor (Chuntharapat et al., 2008), satisfaction with pain relief (Smith et al., 2011), and the childbirth experience compared to control groups of pregnant women (Smith et al., 2011; Kawanishi et al., 2015). No differences were found between the groups regarding pethidine usage, labor augmentation, or newborn Appearance, Pulse, Grimace, Activity, and Respiration (APGAR). Scores were recorded at 1 and 5 min (Chuntharapat et al., 2008). Prenatal yoga for a cumulative total of more than 900 min during pregnancy has been reported to counter the onset of uterine contractions that necessitates the use of ritodrine hydrochloride (Kawanishi et al., 2016). Moreover, the subjects who had participated in yoga classes were reported to have a decreased frequency of labor induction and a lower percentage of cesarean section compared to control group (Jahdi et al., 2017).

In one study, subjects who participated in 12–14 weeks of prenatal yoga (30 min per session with a minimum of 3 sessions per week) exhibited higher outcomes and self-efficacy expectancies during the active stage of labor and the second stage of labor compared with the control group. Thus, yoga during pregnancy has reported to contribute to an improvement in childbirth self-efficacy (Sun et al., 2010).

Researchers offer several theories for these effects. 1) Yoga involves synchronization of breathing awareness and muscle relaxation, which decreases tension and the perception of pain. 2) Yoga movements, breathing, and chanting may increase circulating endorphins and serotonin, raising the threshold of mind-body relationship to pain. 3) Practicing yoga postures over time alters pain pathways through the parasympathetic nervous system, decreasing one's need to actively respond to unpleasant physical sensations (Romano and Goer, 2008). Thus, yoga can be considered as one of the therapies for pregnant women to prepare them physically and emotionally for labor. It helps in reducing pain and suffering while optimizing wellbeing in childbirth by improving coping skills, self-confidence, and a sense of mastery (Romano and Goer, 2008). Prenatal yoga may, therefore, be a viable and beneficial option for pregnant women in the selection of alternative therapies (Kawanishi et al., 2016).

3.6. Yoga for mental health

In the gestation period, women undergo significant changes in their biological, social, and psychological aspects. Even though pregnancy is often associated with positive emotions, two different studies reported that 10% and 20–23% (Shi and MacBeth, 2017; Matthews et al., 2017) of pregnant women experience anxiety and depression respectively. Psychological distress (anxiety, depression, and stress) were reported to increase risk for adverse neonatal outcomes (preterm birth, low birth weight, and small fetal head size) (Shi and MacBeth, 2017), and development of chronic diseases in pregnant women (Matthews et al., 2017); this can produce short and long-term negative effects on both mothers and newborns. Thus, reducing these psychological distresses is a crucial public health goal. Non-pharmacological interventions are increasing in pregnancy due to various side effects (low birth weight, preterm birth, low APGAR scores, respiratory distress, neonatal convulsions, and hypoglycemia) of antidepressant medications (Shi and MacBeth, 2017). Hence, pregnant women with psychological distress were reported to be drawn to prenatal yoga for the psychological and physical benefits (Kinser and Masho, 2015).

Yoga for depression: Depression affects 20–23% (Shi and MacBeth, 2017; Matthews et al., 2017) of pregnant women and is associated with adverse health outcomes for both mother (higher rates of pre-eclampsia, spontaneous abortion, pre-birth complications, and postpartum depression) and baby (higher risk of pre-term delivery, low birth weight and cognitive and emotional problems) (Battle et al., 2015; Matthews et al., 2017; Shi and MacBeth, 2017). Prenatal anti-depressants [specifically selective serotonin reuptake inhibitors (SSRIs)] have reported to be associated with negative neonatal outcomes, internalizing problems, and the risk for autism spectrum disorder (Field, 2017). A survey reported that a majority (84%) of depressed pregnant women would consider using a complementary health approach during pregnancy, and more than 50% were interested in yoga (Matthews et al., 2017).

In previous studies, practicing yoga for 12 weeks [one 20 min session per week] was reported to significantly reduce depression, anxiety (Field et al., 2012, 2013), anger (Field et al., 2013), negative affect and somatic/vegetative symptoms scores (Field et al., 2013), cortisol levels (Field et al., 2013), while improving relationship scores in pregnant women with depression (Field et al., 2012, 2013). In another study, the practice of yoga for 10 weeks [75 min per session, one day-time and one evening-time session per week] has reported to be effective in reducing depression in pregnant women (Battle et al., 2015).

Evidence suggests that yoga practice could be considered as a safe (Jiang et al., 2015) (since no yoga-related injuries were

observed) (Uebelacker et al., 2016; Battle et al., 2015), feasible to administer, acceptable (Battle et al., 2015), and effective treatment for pregnant women who are depressed (Jiang et al., 2015; Uebelacker et al., 2016). In a meta-analysis, integrated yoga that includes asana, pranayama, meditation, or deep relaxation has been reported to be more effective in reducing depressive symptom than purely physical exercise-based yoga (asana) in pregnant women (Gong et al., 2015). The improvement in depression by practicing yoga has been reported to be attributed to increasing mindfulness or non-judgmental attention to the present moment rather than ruminating about the past or future (Battle et al., 2015).

Yoga for Anxiety: The practice of yoga has shown to be effective in reducing both subjective and physiological measures of state anxiety (STAI-S and cortisol) toward childbirth and preventing increases in depressive symptomatology (Newham et al., 2014), while another study showed a significant reduction in trait anxiety in pregnant women (Beddoe et al., 2009).

Yoga for both Depression and Anxiety: In a survey, depressed pregnant women were reported to have significantly higher levels of anxiety and stress along with poorer sleep quality, mindfulness, and social support compared to non-depressed pregnant women (Matthews et al., 2017). Eight weeks of yoga practice has reported to be a feasible, acceptable, and effective intervention in reducing symptoms of anxiety, depression, and negative affect as compared to control group (treatment-as-usual) in pregnant women with both depression and anxiety (Davis et al., 2015). Similarly, practice of integrated yoga (one hour daily) from the 20th to 36th week of gestation was reported to be effective in reducing state and trait anxiety along with depression and uncomfortable, pregnancy-related experiences compared to standard antenatal exercises in pregnant women (Satyapriya et al., 2013).

Yoga for Stress: Psychological distress including stress is reported to produce adverse effects to both mother and baby (Shi and MacBeth, 2017). Pregnant urban adolescents were reported to be highly stressed and interested in yoga classes for stress management and relationship building (Kinser and Masho, 2015).

The practice of yoga has been reported to improve perceived stress (Beddoe et al., 2009; Satyapriya et al., 2009; Babbar et al., 2012; Curtis et al., 2012; Jiang et al., 2015), adaptive autonomic response to stress (Satyapriya et al., 2009), and interpersonal relationships in pregnant women (Curtis et al., 2012; Jiang et al., 2015). The activity of the stress-responsive hypothalamic-pituitary-adrenal axis and cortisol is associated with perinatal emotional well-being. Stress is associated with increased basal cortisol levels and poorer cortisol recovery. While increases in cortisol over the course of gestation are normative and adaptive, excessive elevations of maternal stress hormones have been implicated in the development of postpartum depression (Bershadsky et al., 2014). Whereas, the practice of yoga has been reported to be effective in reducing cortisol levels (Bershadsky et al., 2014; Kusaka et al., 2016), salivary alpha-amylase (Kusaka et al., 2016) and negative affect, while also improving positive affect, mood (Bershadsky et al., 2014; Kusaka et al., 2016), and contentment in pregnant women (Bershadsky et al., 2014). Similarly, a study on the practice of yoga for 20 weeks (one 70-min session a day, 2 sessions a week) has reported to significantly reduce stress and salivary cortisol levels in pregnant women (Chen et al., 2017). Thus, yoga might be considered as a promising intervention in reducing psychological distress in pregnancy.

4. Yoga for high-risk pregnancy related health problems

High-risk pregnancy means a pregnancy in which the fetal and/or maternal conditions pose a threat to the life of the fetus or mother. Fetal conditions associated with high-risk pregnancy

include fetal growth restriction and placental insufficiency. Maternal conditions most commonly associated with adverse prenatal outcomes include conditions like diabetes (chronic and gestational), hypertensive disorders (chronic hypertension, and preeclampsia), cardiac, renal, autoimmune, and thrombophilic disorders (Deshpande et al., 2013).

In previous studies, pregnant women with the following conditions were considered as a high-risk pregnancy. Pregnant women with (1) past history of pregnancy complications such as gestational diabetes mellitus (GDM), PIH, IUGR, pre-eclampsia (PE) or eclampsia (E), placental abruption (PA), and fetal death (FD); (2) family history of pregnancy complications; (3) hypertension at the time of/prior to pregnancy; (4) extremes of age, i.e., younger than 20 or older than 35; (5) body mass index above 30; (6) multiple pregnancies (Deshpande et al., 2013); and, (7) abnormal Doppler study of umbilical and uterine arteries (Narendran et al., 2005).

4.1. Yoga for placental circulation and fetal growth

Impaired placentation and inadequate trophoblast invasion are associated with pregnancy-related complications including first-trimester uterine artery resistance (Rakhshani et al., 2015). In one study, standard care plus practice of yoga (1 h a day, 3 times a week) by high-risk pregnant women from the 12th to the 28th week of gestation was reported to produce a significant improvement in head circumference, biparietal diameter, femur length, estimated fetal weight, and heart rate. Also noted was a significant reduction in impedance of the resistance index in the right uterine artery, umbilical artery, and fetal middle cerebral artery. Thus, yoga was suggested as an effective modality that can help to improve the intrauterine fetal growth and utero-fetal-placental circulation in high-risk pregnant women (Rakhshani et al., 2015).

4.2. Yoga for better physiological adaptation and risk reduction

A further study reported that women with hyperuricemia, combined with gestational hypertension, were more prone to have a shorter gestation period, smaller birth weight, and an increased risk of preterm or premature labor. Normally, a small quantity of uric acid (3.0–7.0 mg/dL) is produced, which serves as a strong antioxidant and a strong reducing substance. Although its clinical utility has been actively debated, it is useful to include it in routine screening for high-risk pregnancies. Similarly, platelet count was also reported as another valuable measure in screening for high-risk pregnancies. As pregnancy is basically a hypercoagulable state, benign thrombocytopenia of pregnancy (BTP) with no pathological consequences is a physiological change that helps in preventing placental thrombosis and infarctions. To meet the greater circulatory needs of the placenta and fetus, BTP during normal pregnancy was considered to be due to hemodilution that produces maternal plasma volume expansion (Jayashree et al., 2013).

The practice of antenatal integrated yoga for three months (1 h a day, 3 days a week) from the 12th week of gestation has been reported to be safe, cost-effective, and useful in promoting a better physiological adaptation as reported by the healthy progression of platelets and uric acid levels pointing to healthy hemodilution. More importantly, none of the subjects had abnormal thrombocytopenia or hyperuricemia; and a significantly lesser number of women in the yoga group (n = 3) developed PIH/PE compared to those in the control group (n = 12) (standard care plus walking), with 21% absolute risk reduction in women with high-risk pregnancy (Jayashree et al., 2013).

4.3. Yoga for pregnant women with abnormal umbilical and uterine arteries

In a previous study, practicing yoga for one hour a day from the date of entry into the study until delivery, has shown to produce a reduction in the occurrence of complications of pregnancy such as PIH, IUGR, and pre-term delivery. Moreover, birth weight of the babies was significantly higher in the yoga group compared to the control group (walking) in pregnant women between 18 and 20 weeks of gestation with complications, particularly with abnormal Doppler study of umbilical and uterine arteries (Narendran et al., 2005).

4.4. Yoga for hypertensive related complications of pregnancy and birth outcomes

The practice of yoga (1 h a day, 3 days a week) from the 12th to the 28th week of gestation has reported to produce a significantly lower PIH, PE, GDM and IUGR, Small for Gestational Age (SGA) babies, and newborns with low APGAR scores compared to control group (walking). Thus, yoga was suggested as a safe and effective therapy in reducing hypertensive-related pregnancy complications, while improving fetal outcomes in high-risk pregnancy (Rakhshani et al., 2012).

4.5. Yoga in gestational diabetes

The practice of yoga with mindful eating has been reported to be effective in reducing glycosylated hemoglobin (HbA1c), fasting and postprandial blood glucose levels; and in maintaining glycemic control in pregnant women with gestational diabetes mellitus (Youngwanichsetha et al., 2014).

4.6. Yoga for mental health

Practicing yoga has been reported to produce a significant reduction in perceived stress and significantly fewer pregnancy-related discomforts compared to standard antenatal care in high-risk pregnant women. Thus, yoga was suggested not only as a cost-effective option but also a feasible and safe option to reduce stress levels during high-risk pregnancy complications (Deshpande et al., 2013). In another study, 10 weeks of mindfulness yoga was reported to be feasible and effective in reducing depression, while increasing mindfulness and maternal-fetal attachment in psychiatrically high-risk (those had elevated scores >9 on the Edinburgh Postnatal Depression Scale) pregnant women. Thus, it can be considered as an effective treatment alternative or augmentation to pharmacotherapy for pregnant women at high risk for psychopathology (Muzik et al., 2012).

5. Yoga for in vitro fertilization (IVF) pregnant women

In a 12-week study, a yoga-focused educational program was reported to produce statistically significant improvements in stress, anxiety, labor pain, and labor confidence in the women who were pregnant following in vitro fertilization (Shim and Lee, 2012).

6. Yoga for postnatal health related problems

In one study, three months (60 min a week for 12 weeks) of practicing yoga and pilates was reported to produce significant reductions in bodyweight, body fat percentage, fat mass, basic metabolic rate, and depression while enhancing the quality of life for postpartum women (Ko et al., 2013).

In another study, 4 weeks of Dru yoga (1 h per session per week)

and a 20-min DVD for practice at home were shown to improve psychological well-being as indicated by reductions in stress, negative affect, and dysfunctional coping, along with increases in problem focused coping from 6 week to 1 year postpartum nulliparous mothers (Timlin and Simpson, 2017). Similarly, studies of prenatal yoga were reported to be effective in improving psychological well-being (Bershady et al., 2014) by means of reducing depression (Field et al., 2013; Bershady et al., 2014), reducing anxiety (Field et al., 2013), and improving mood (Bershady et al., 2014) in postpartum women (Field et al., 2013; Bershady et al., 2014).

6.1. Yoga after still birth

Women experiencing stillbirth have a three-fold greater risk of developing depressive symptoms compared to women experiencing a live birth. To cope with stillbirth, they use physical activity including yoga (Huberty et al., 2014). Women who participated in physical activity after stillbirth had significantly lower depressive symptoms compared to women who did not participate in physical activity (Huberty et al., 2014). In a post-intervention satisfaction survey, 75% of women who had stillbirth reported that they were very satisfied or satisfied with the intervention, found it to be very enjoyable or enjoyable, and very helpful or helpful to cope with their grief. Thus, physical activity like yoga could serve as a unique opportunity to help women cope with stillbirth (Huberty et al., 2017).

7. Adverse effects of yoga in pregnancy

In a case study, during yoga practice, sudden onset of painless loss of vision and a large floater in the left eye was reported in a 35-year-old pregnant Caucasian woman (27 weeks gestation). The patient was found to have a dense vitreous hemorrhage with a small pre-retinal hemorrhage. Ultrasound imaging confirmed the hemorrhage and showed no other retinal damage. She was diagnosed with Valsalva hemorrhagic retinopathy and was treated conservatively. After 5 months of follow-up, she had a normal delivery and her hemorrhage and vision loss had resolved (El-Khayat, 2017).

An examination of a nationally representative Australian women reported that the birth outcomes associated with CAM use was emotional distress. It was found to occur more commonly in women who practiced meditation/yoga at home. Moreover, participation in yoga classes was associated with an increased incidence of postpartum/intrapartum hemorrhage (Steel et al., 2014).

It has been suggested that pregnant women should avoid participating in hot yoga due to increased risk of injury (as pregnant women bear extra weight, loose muscles and tendons); excessive heat exposure might also cause various adverse effects start from dizziness or fainting (as blood pressure tends to be lower in the first trimester of pregnancy owing to progesterone relaxing blood vessel walls) to increased risk of neural tube defects and other malformations among fetuses (Chan et al., 2014).

8. Advantages of yoga in pregnancy

A study estimated the average energy expenditure and metabolic equivalent value of a prenatal yoga class as 109 ± 8 kcals and 1.5 ± 0.02 respectively. Thus, time spent in a prenatal yoga class was considered to be primarily a sedentary activity (Peters and Schlaff, 2016). As mentioned in the previous studies, though practice of yoga has been reported to produce very few adverse effects (Chan et al., 2014; Steel et al., 2014; El-Khayat, 2017), and might not be an

appropriate form of moderate or vigorous aerobic physical activity (Peters and Schlaff, 2016), it is considered as an exciting alternative therapy (Uebelacker et al., 2016) in pregnancy. Evidence suggests that the practice of yoga in pregnancy is safe (Romano and Goer, 2008; Jiang et al., 2015; Uebelacker et al., 2016) and recommended by healthcare providers (Stewart et al., 2014) including obstetricians and gynecologists (Babbar et al., 2016). It is feasible to administer (Battle et al., 2015), widely accessible (Uebelacker et al., 2016), and acceptable (Battle et al., 2015; Uebelacker et al., 2016) by pregnant women (Holden et al., 2015) and healthcare providers (Stewart et al., 2014). The ease of practice even by weak individuals is an added advantage (Peters and Schlaff, 2016) and is found to be very enjoyable by pregnant women (Huberty et al., 2017). Yoga holds promise for having a positive impact on both physical and mental health of the pregnant women (Uebelacker et al., 2016). Moreover, it was reported to be a well indicated activity for pregnant women (Curtis et al., 2012), and it is encouraged for interested women to incorporate yoga into their preparations for childbirth (Uebelacker et al., 2016), which leads to improvements in a variety of pregnancy, labor, and birth outcomes (Curtis et al., 2012).

9. Conclusion

The present comprehensive review, suggests that though types, duration, and frequency of yoga practices were varied among the studies, yoga could be considered as an effective evidence-based alternative therapy since it is useful in improving both physical and psychological health-related problems of pregnant women during pregnancy (normal and high-risk), during delivery, and even after the delivery (normal or stillbirth). Thus, it is suggested to incorporate in the antenatal care as a routine practice. However, the specific mechanisms behind the effects of yoga are not clearly understood and need to be explored in the future studies.

Conflict of interest

None Declared.

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Appendix A. Supplementary data

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