

LITERATURE REVIEW

Effect of antenatal yoga on adverse psychological outcomes in pregnancy

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Abstract

Pregnancy is a time when expectant mothers may experience mental health issues for the first time, and stress, anxiety and depression are common. These conditions have been associated with both poor birth outcomes and an increased risk of postnatal depression. Stress levels have also been shown to have a negative impact on musculoskeletal conditions in pregnancy. It has been proposed that the benefits of yoga as a method of stress relief could extend to the ante- and postnatal periods. The aim of this literature review was to explore the available evidence for the use of yoga in the management of stress, anxiety and depression in pregnancy, and to propose suggestions for further research in this field. A literature search was conducted using all the search engines on the Healthcare Databases Advanced Search online resource. Specific inclusion criteria yielded nine papers that were of sufficient quality to be included. The study group sizes ranged from 46 to 122 participants. Interventions were variable with respect to the duration and frequency of yoga practice. Depression, anxiety and stress were measured using validated outcome measures, including the State-Trait Anxiety Inventory assessing state and trait, and the Edinburgh Postnatal Depression Scale. No adverse events were reported, and the outcomes demonstrated decreases in anxiety and depression scores. In conclusion, antenatal yoga may be an effective method of managing stress, anxiety and depression in pregnancy, but there is too much inconsistency within studies to draw any strong conclusions. Therefore, larger-scale, high-quality studies with consistent interventions are needed.

Keywords: adverse psychological outcomes, antenatal, pregnancy, prenatal, yoga.

Introduction

The physical and emotional changes that occur during pregnancy have been well-documented (Wang *et al.* 2004; Vleeming *et al.* 2008; NICE 2014). A combination of hormonal and anatomical changes can lead to musculoskeletal (MSK) complaints such as low back pain (LBP) and pelvic girdle pain (PGP), which affect 50% and 20% of the pregnant population, respectively (Vleeming *et al.* 2008; Katonis *et al.* 2011). On an emotional level, poor perinatal mental health is a significant problem; depression and anxiety are the most common presentations, and have prevalences of 12% and 13%, respectively (NICE 2014). Perinatal anxiety disorders

include generalized anxiety, obsessive–compulsive behaviour, social anxiety and post-traumatic stress disorder (AWHONN 2015). Many people are aware of postnatal depression, but there is less knowledge of depression during pregnancy, and the prevalence of anxiety during and after pregnancy (Mind 2020). It has been established that a history of mental health problems during pregnancy is one of the factors that is associated with postnatal depression (NHS 2018). Research carried out into the effects of depression and anxiety in pregnancy has also demonstrated a link to brain development in the newborn that can extend to child- and adulthood, and this has been associated with anxiety, depression and behavioural problems including attention deficit hyperactivity disorder (Glover 2016).

Mental health problems in pregnancy can be managed by psychological therapy or medication

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(NICE 2014). The need for medication is dealt with on a case-by-case basis, and will depend on the severity of the current symptoms and the patient's past medical history. It is known that medication taken in pregnancy can cross the placenta, and therefore, affect the baby. It has been reported that anticonvulsants increase the risk of spina bifida and learning difficulties, and antidepressants can predispose the baby to heart problems and high blood pressure (NICE 2014). However, the same guideline highlights that doing without medication can run the risk of worsening mental health problems and becoming unwell, which also poses a risk for the baby. There has been a historic lack of integrated physical and mental healthcare in the perinatal period, and also a paucity of specialist services to support women who become unwell during this time (PHE 2019). However, media awareness has increased in recent years, and patient support groups such as APNI (the Association for Post Natal Illness) and the PANDAS (Pre And postNatal Depression Advice and Support) Foundation have also been established to support affected women.

Exercise in pregnancy has numerous physical and psychological benefits for both the mother and her unborn child. Maternal benefits documented by the Department of Health and Social Care (DHSC) include a reduction in hypertensive disorders, improved cardiovascular fitness, less gestational weight gain and a reduction in the risk of gestational diabetes (DHSC 2019). The DHSC also reports low-to-moderate evidence that exercise may reduce the risk of depression in pregnancy, and includes yoga and Pilates within their list of physical activities that are recommended during pregnancy.

The popularity of yoga is evident: studies have reported an increase in the use of complementary and alternative medicine by almost half of all women of reproductive age with hypnosis, relaxation and yoga being the most widely practised examples (Sullivan & McGuinness 2015). With respect to prenatal yoga, there is also a significant media influence, with celebrities promoting the positive physical and mental benefits of regularly practising this form of exercise (Rossi 2014).

One of the six orthodox systems of Indian philosophy, this practice stems from the *Yoga Sutras*, a classical work by a sage known as Patañjali. In his work, he refers to the eight limbs or stages of yoga, four of which include posture, rhythmic control of the breath, concentration and meditation (Iyengar 2001). Hatha Yoga is the umbrella

term under which the majority of yoga practices fall, with the term *hatha* meaning “force or determined effort” (Iyengar 2001, p. 4). More specific styles of yoga include Ashtanga Yoga, Iyengar Yoga, hot yoga, and antenatal or pregnancy yoga.

In the UK, there are a number of pregnancy and postnatal yoga teaching organizations, including Birthlight, Sitaram Partnership and Yoga Mama. These and others have evolved since 2000, leading to the growth of antenatal yoga classes. Such classes have a strong focus on asana (posture) and pranayama (rhythmic control of breath), which can increase energy levels, improve sleep and strengthen the body (Dinsmore-Tuli 2010). Guidelines from the British Wheel of Yoga (BWY) pertaining to the practice of antenatal yoga previously specified that women should wait until week 16 of pregnancy before practising yoga, but these now state that there is no evidence of an increased risk of miscarriage, although women should seek a pregnancy-specific class where possible (BWY 2016). Similarly, the UK National Health Service (NHS) guidelines also do not impose any specific restrictions with respect to the first trimester. In addition, the BWY set out safety guidelines in regard to class content and appropriate asana. Practitioners opting to set up pregnancy-specific classes will generally have antenatal yoga continuing professional development (CPD) qualifications. However, the field is poorly regulated, and many teachers without specialist training will continue to allow pregnant women to join their classes. This can have implications for the safety and well-being of a woman and her unborn child.

Previous systematic reviews have investigated the benefits of yoga with respect to: the mental health of women who have been diagnosed with breast cancer (Cramer *et al.* 2017); mind–body interventions during pregnancy to manage anxiety (Marc *et al.* 2011); and relaxation therapy for preterm labour (Khianman *et al.* 2012). Overall, these reviews have reported positive results in the reduction of stress and anxiety, but highlighted the need for further research. It is possible that yoga could be beneficial for mothers during pregnancy, and thus, have a positive impact on mental health and well-being.

Yoga is thought to influence pathophysiological processes through a number of mechanisms; for example, by reducing sympathetic overactivity and increasing parasympathetic activity (Pilkington *et al.* 2016). These processes could facilitate a reduction in cortisol and, therefore, stress levels, and also boost immune function by

increasing immunoglobulin A (IgA) and salivary α -amylase levels.

The objectives of the present literature review are to explore the evidence to support the claims that antenatal yoga can help in the management of adverse psychological outcomes, especially stress, anxiety and depression in pregnancy. The author also aims to draw these studies together in order to provide a reference point for both health professionals and other researchers who are interested in this area of health.

Materials and methods

A literature search was conducted four times between October and November 2018, and then rerun in October 2019. The keywords used in the title and abstract search criteria were “yoga”, “pregnancy”, “antenatal”, “prenatal”, “depression”, “anxiety” and “stress”. The terms “pregnan*(pregnant)”, “prenatal”, “pre-natal”, “ante-natal” and “antenatal” were linked using “OR” to ensure that no terminology was missed. All Healthcare Databases Advanced Search (HDAS) databases were incorporated in the search. These included AMED, BNI, CINAHL, Embase, HBE, HMIC, MEDLINE and PsycINFO. Because this is a new area of research, only papers written in the past 10 years were included. This also ensured that the present literature review was based on current evidence.

The search criteria were further specified as follows: randomized controlled trials (RCTs) or studies of similar quality, full-text articles written in English, and yoga intervention to include physical postures in addition to meditation/pranayama from peer-reviewed journals. These criteria were especially important in order to ensure rigour, validity and reliability. The initial searches yielded 44 papers, seven of which met the criteria, and the subsequent search yielded eight new papers, but none of these met the inclusion criteria. Secondary referencing from three literature reviews identified four further papers with potential, and two of these were subsequently included. One of these studies (Rakhshani *et al.* 2012) used alternative keywords in line with the high-risk pregnancy bias of the paper, which explains why it was missed in the initial searches. The search also identified papers that provided useful information and possible topics for further research, but did not directly meet the search criteria. These included five systematic reviews, a trial with a single-treatment-group design, a pilot study with a very small study size, conference

abstracts, a study that only examined labour outcomes, and a paper that investigated yoga in the management of pregnancy-related LBP and PGP.

A number of literature review critique methods were considered, including the Consolidated Standards of Reporting Trials (CONSORT 2010) and the Critical Appraisal Skills Programme (CASP) checklists (CASP 2018). Having reviewed the CASP criteria, this checklist was chosen because it met the desired standards. Information extracted from the papers included: the randomization process and patient analysis; blinding of patients and study personnel; analysis of group interventions; treatment effect and local application; and the risk-to-benefit ratio of the intervention. The outcome measures used included: physiological markers, i.e. cortisol, IgA and salivary α -amylase, tested before, during and/or following the yoga intervention; and a number of self-reporting questionnaires (see Table 1). All the selected papers passed the initial screening questions, and therefore, it was deemed appropriate to continue with the CASP checklist and subsequently include these in the literature review.

Figure 1 is a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart (Moher *et al.* 2009; PRISMA 2009) illustrating the search strategy, and the process of selecting and eliminating studies.

Results

Of the nine studies included in the present literature review, three were conducted in the USA, three in India, and one each in Taiwan, Japan and the UK; the sample sizes ranged from 46 (Davis *et al.* 2015) to 122 (Satyapriya *et al.* 2009). Six studies recruited women with no current depressive or anxiety disorders (Satyapriya *et al.* 2009, 2013; Bershadsky *et al.* 2014; Newham *et al.* 2014; Chen *et al.* 2017; Hayase & Shimada 2018). The remainder involved women who were already suffering from anxiety and/or depression (Field *et al.* 2013; Davis *et al.* 2015), or were classified as having high-risk pregnancies (Rakhshani *et al.* 2012). The majority of studies did not recruit women until they were in their second or early third trimester (range = 16–28/40), although one enlisted them at 12–19 weeks’ gestation (Bershadsky *et al.* 2014), and in the case of Rakhshani *et al.*’s (2012) research conducted with high-risk pregnancies, before 12 weeks. The age of the participants

Table 1. Summary of outcome measures

Outcome measure	Abbreviation	Description
State-Trait Anger Expression Inventory	STAXI	Psychological test based on 10 questions that measures the intensity of anger in individuals, and their disposition to experience angry feelings; consists of a four-point Likert scale ranging from (1) “almost never” to (4) “almost always”; based on emotional state at a particular time
State-Trait Anxiety Inventory	STAI	Forty questions based on a four-point Likert scale; measures anxiety about an event (state anxiety) or anxiety level as a personal characteristic (trait anxiety); higher scores correlate with higher anxiety levels up to a maximum score of 30; mothers who score ≥ 13 are likely to be suffering from depressive illness
Positive and Negative Affect Schedule	PANAS	Two, 10-item scales measuring positive and negative affect; each item is measured on a five-point scale from (1) “not at all” to (5) “very much”; results are based on symptoms recorded over the past week
Edinburgh Postnatal Depression Scale	EPDS	Ten-question self-rating scale to identify patients at risk of perinatal depression; results are based on symptoms recorded in the past 7 days
Hospital Anxiety and Depression Scale	HADS	Used to determine the levels of anxiety and depression that an individual is experiencing; the 14-item scale is split between those relating to either anxiety or depression; results are based on symptoms recorded over the past week
Center for Epidemiologic Studies Depression Scale	CES-D	Twenty questions based on a four-point Likert scale ranging from (0) “rarely or none of the time” (< 1 day per week) to (3) “most or all of the time” (6–7 days per week); results are based on feelings and behaviour recorded over the past week
International Physical Activity Questionnaire	IPAQ	Consists of a set of four questionnaires that can be completed by telephone or self-administration; used to obtain data on health-related physical activity over the past 7 days
Pregnancy Experiences Questionnaire	PEQ	Addresses pregnancy-specific stressors and concerns in pregnancy; consists of 41 questions rated on a three-point scale, with higher scores indicating higher stress levels; results based on severity recorded in the past month
Profile of Mood States	POMS	Consisting of 12 items on depression; rated on a five-point scale ranging from (0) “not at all” to (4) “extremely”
Relationship Questionnaire		Consists of 12 items on a four-point Likert scale; measures positive (i.e. sense of support and care) and negative aspects of relationships, including anxiety and irritability
Wijma Delivery Expectancy/ Experience Questionnaire	WDEQ	Measures the feelings and thoughts that women have at the prospect of labour and delivery; rated on a scale from 1 to 6, with higher scores indicating greater fear of childbirth
Structured Clinical Interview for DSM-IV	SCID	Instrument designed to be administered by a mental health professional to diagnose mental health; depending on the type of patient, assessment time ranges from 30 min to 2 h

was variable (range = 18–45 years). However, Rakhshani *et al.* (2012) recruited women who fell within their high-risk criteria specification of < 20 years or > 35 years. A summary of the papers can be found in Table 2.

The interventions researched in the nine papers were all exclusively based on yoga. Experienced teachers led the classes, but a variety of approaches were employed. The styles included: a generic hatha approach, which was followed in five of the studies, including Newham *et al.* (2014) and Bershinsky *et al.* (2014); the integrated approach to yoga therapy (IAYT) (Rakhshani *et al.* 2012; Satyapriya *et al.* 2013); and modified Ashtanga yoga (Davis *et al.* 2015). All authors specified that their chosen style was specifically adapted to the pregnant population, and that informed consent had been obtained from the intervention and control groups.

Randomization was carried out by reliable and tested methods, including block randomization using the Clinstat program (St George’s Hospital Medical School, London, UK) and online random number generators. Control groups were accordingly assigned to either treatment as usual (TAU) (Newham *et al.* 2014; Davis *et al.* 2015; Chen *et al.* 2017; Hayase & Shimada 2018), standard prenatal exercises (Satyapriya *et al.* 2009, 2013; Rakhshani *et al.* 2012) or a leaderless social support group (Field *et al.* 2013), and no intervention (Bershinsky *et al.* 2014). Treatment as usual varied from simple stretches (Satyapriya *et al.* 2013) to standard care and self-reported conventional antenatal exercises, which were described as walking for a 30-min period in both the morning and afternoon (Rakhshani *et al.* 2012).

The intervention periods ranged from an 8-week yoga programme (Newham *et al.* 2014) to

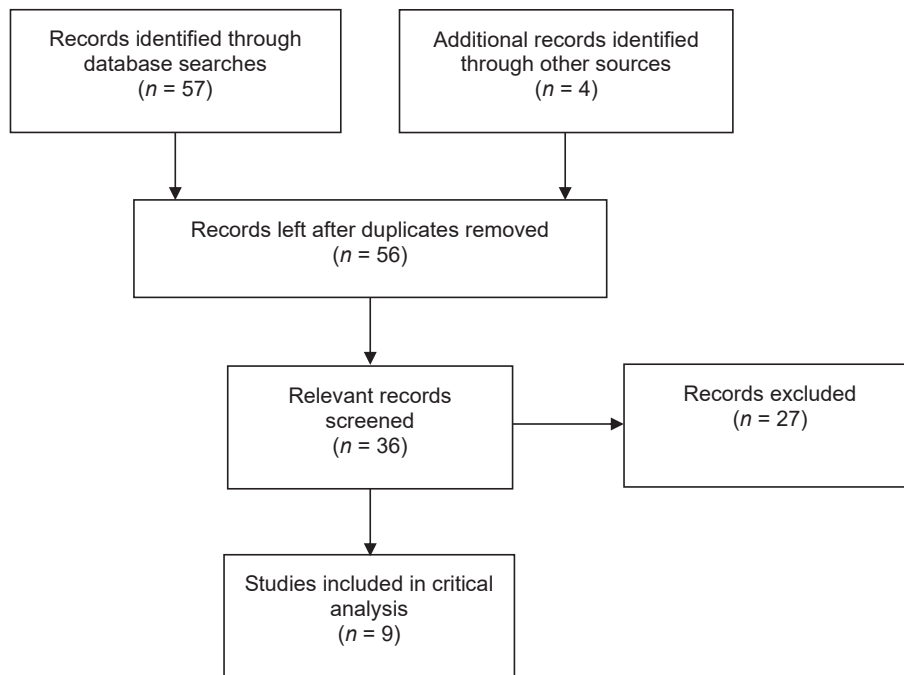


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart demonstrating the literature search strategy (Moher *et al.* 2009; PRISMA 2009).

from 20 weeks' gestation until delivery (Hayase & Shimada 2018). Yoga sessions varied in length from 20 min (Field *et al.* 2013) to 1.5 h (Bershinsky *et al.* 2014). Additional home practice was addressed in three papers (Field *et al.* 2013; Davis *et al.* 2015; Hayase & Shimada 2018). This was consolidated by Davis *et al.* (2015) and Field *et al.* (2013) through the use of a home DVD, although the expectation in the latter study appeared to be for women to engage in home study only after the intervention. Satyapriya *et al.* (2009, 2013) used home practice as part of their intervention, and relied on telephone calls and an activity diary to ensure compliance. Bershinsky *et al.* (2014) were the only authors who used follow-up assessment for up to 2 months into the postnatal period. The remainder of the studies were limited to the pregnancy period only. The locations of the interventions were primarily hospital-based settings, although Newham *et al.* (2014) held their classes in a Sure Start centre, and Bershinsky *et al.* (2014) ran their classes in a yoga studio. Two papers did not specify the location of the intervention (Field *et al.* 2013; Davis *et al.* 2015).

The majority of studies used self-reported psychological outcome measures, including those specific to anxiety [State-Trait Anxiety Inventory (STAI) assessing state (STAI-State) and trait (STAI-Trait)], depression [Edinburgh Postnatal Depression Scale (EPDS)] and relationships

(Relationship Questionnaire). These and the remainder used are described in more detail in Table 1. Four studies measured levels of salivary cortisol, IgA and salivary α -amylase (Bershinsky *et al.* 2014; Newham *et al.* 2014; Chen *et al.* 2017; Hayase & Shimada 2018).

Bershinsky *et al.* (2014) recruited 38 primiparous women (primiparas) who were practising yoga during pregnancy from two yoga studios in California, USA, and a much smaller control group of 11 from an ongoing unrelated study of perinatal depression. These authors acknowledged that this small sample size may have limited the statistical power to establish differences between the two groups. Furthermore, the high attrition rate in this paper, on which the authors did not comment, may have affected the validity of the study. Assessments measuring cortisol levels, affect and depressive symptoms were carried out in early and mid-pregnancy, and <2 months postpartum, before and after a 90-min yoga session. The participants in the control group were younger and less educated, had a lower income and were less likely to be white, but exhibited no difference in their symptoms of depression or affect at the onset of the study. Bershinsky *et al.* (2014) showed lower mean salivary cortisol levels on yoga days ($P < 0.01$), but no change in levels over time. Insufficient saliva samples were available to test differences between the groups. The yoga group also showed a greater immediate

Table 2. Characteristics of the studies included in the literature review: (RCT) randomized controlled trial; (PIH) pregnancy-induced hypertension; (GDM) gestational diabetes mellitus; (IUGR) intrauterine growth restriction; (SGA) small for gestational age; (CES-D) Center for Epidemiologic Studies Depression Scale; (STAI) State-Trait Anxiety Inventory; (STAXI) State-Trait Anger Expression Inventory; (PEQ) Pregnancy Experiences Questionnaire; (HADS) Hospital Anxiety and Depression Scale; (IAYT) integrated approach to yoga therapy; (TAU) treatment as usual; (HCP) healthcare professional; (EPDS) Edinburgh Postnatal Depression Scale; (STAI-State) STAI state subscale; (STAI-Trait) STAI trait subscale; and (IgA) immunoglobulin A

Reference	Location	Study design	Sample	Outcome measures	Results	Conclusion/recommendations
Satyapriya <i>et al.</i> (2009)	Bengaluru, India	RCT Yoga and deep relaxation or standard prenatal exercises for 1 h per day	122 healthy women recruited between weeks 18/40 and 20/40 at prenatal clinics	Parasympathetic and sympathetic tone	Parasympathetic tone and sympathetic tone increased and decreased, respectively, following guided relaxation ($P < 0.001$)	Yoga reduces perceived stress and improves adaptive autonomic response to stress in healthy pregnant women
Rakhshani <i>et al.</i> (2012)	Bengaluru, India	RCT 1 h of yoga three times a week from week 12/40 to 28/40	68 high-risk women	PIH, GDM, IUGR, SGA and newborns with low Apgar scores	Significantly fewer cases of all conditions measured	Yoga can potentially be an effective therapy for reducing the hypertensive-related complications of pregnancy and improving foetal outcomes
Field <i>et al.</i> (2013)	Miami, FL, USA	RCT 12 weeks of 20-min yoga sessions or leaderless social support group	92 women with prenatal depression from two prenatal ultrasound clinics at a large university medical centre	CES-D, STAI, STAXI and relationship scores; cortisol and progesterone levels	Lower CES-D, STAI and STAXI scores, and improved relationship scores; cortisol decreased after each session, oestriol and progesterone levels decreased after the last; anxiety and depression lower for both groups at postpartum follow-up	Yoga may be an effective intervention for reducing depression and anxiety; further research is needed to look at the effect on rates of prematurity and low birthweight, as well as any long-term effects
Satyapriya <i>et al.</i> (2013)	Bengaluru, India	RCT 16 weeks of the IAYT and control group practising simple stretching exercises	96 primiparas or multiparas recruited at week 20/40	PEQ, STAI and HADS	Anxiety and depression significantly reduced following intervention both between and within groups	Yoga reduces anxiety, depression and pregnancy-related uncomfortable experiences
Bershadsky <i>et al.</i> (2014)	CA, USA	Yoga group and control group (not randomized) 90-min yoga session	38 primiparas recruited from two yoga studios	Cortisol levels, affect and depressive symptoms	Greater immediate contentment and negative effect ($P < 0.05$); few signs of postnatal depression a few months postpartum ($P < 0.05$)	Prenatal yoga may improve current mood, and may be effective in reducing postpartum depressive symptoms

Continued/

Table 2. (Continued)

Reference	Location	Study design	Sample	Outcome measures	Results	Conclusion/recommendations
Newham <i>et al.</i> (2014)	Manchester, UK	RCT 8 weeks of prenatal hatha yoga, sessions adopted a themed approach; women in the TAU group could make their own arrangements, if desired	59 primiparas between weeks 20/40 and 24/40	Questionnaire assessing state, trait, pregnancy-specific anxiety and depression; stress hormone assessments	Lowered state anxiety and cortisol levels after a single session	Antenatal yoga seems to be useful for reducing women's anxieties about childbirth, and preventing increases in depressive symptoms
Davis <i>et al.</i> (2015)	CO, USA	RCT 8-week yoga intervention or TAU	46 primiparas and multiparas via HCP referral and community advertisement	EPDS, and STAI-State and STAI-Trait	Antenatal yoga feasible, but the reduction in negative effect was the only significant difference between groups; the reduction in anxiety and depression was less robust	Antenatal yoga is feasible, but the reduction in anxiety and depression is less robust than the reduction in negative effect
Chen <i>et al.</i> (2017)	Taipei, Taiwan	Longitudinal, prospective RCT Two, weekly yoga sessions of 70 min between weeks 16/40 and 36/40, or routine prenatal care	94 primiparas and multiparas from a prenatal clinic at 16 weeks' gestation	Salivary cortisol and IgA levels collected at 16, 20, 24, 28, 32 and 36 weeks	Short-term reductions in salivary cortisol and IgA levels, but long-term effects on IgA only	Prenatal yoga significantly reduced pregnant women's stress and enhanced their immune function
Hayase & Shimada (2018)	Osaka, Japan	Prospective longitudinal study 60-min yoga sessions with advice to perform 15 min of daily yoga practice	38 women in a yoga group and 53 in a control group; the yoga group attended maternity classes between weeks 20/40 and 23/40	Heart rate variability, salivary α -amylase and night-time sleep duration	Positive correlation between the number of classes attended and night-time sleep duration ($P < 0.05$)	Practicing yoga activates the parasympathetic nervous system during the third trimester of pregnancy, consolidating sleep during the night and decreasing α -amylase levels, which indicates a reduction in stress

improvement in contentment and negative effect ($P < 0.05$), and fewer signs of postnatal depression ($P < 0.05$) a few months postpartum.

Chen *et al.* (2017) recruited a larger cohort of 94 primiparous and multiparous women from a prenatal clinic at 16 weeks' gestation. The participants were assigned by block randomization to: a control group (routine prenatal care); or two, 70-min sessions of yoga a week between 16- and 36-weeks' gestation, and had to attend 85% of the total number offered. This study had a low attrition rate, and the authors specified that those who left cited migration or medical reasons. Sessions were taught by a former midwife who had trained as a yoga instructor, and the hatha-style class was designed for women in the second and third trimesters. The outcomes measured were effects on salivary cortisol and IgA levels, which were collected at 16, 20, 24, 28, 32 and 36 weeks' gestation. Participant groups did not differ significantly, but the gestational age was greater and infant birth weight larger in the yoga group ($P < 0.001$). A short-term reduction in salivary cortisol ($P < 0.001$) and increases in IgA levels ($P < 0.001$) were noted after yoga practice, but there were only long-term effects on IgA levels ($P = 0.018$), potentially indicating short-term decreases in stress and long-term improvements in immune function.

The study by Newham *et al.* (2014) involved 59 primiparas who were > 18 years of age. The participants were recruited at their ultrasound scan between weeks 20 and 24 of gestation. They were randomly assigned to 8 weeks of prenatal hatha yoga classes taught by a BWY-accredited antenatal teacher, or TAU. The yoga sessions adopted a themed approach, and included information about the common ailments of pregnancy, optimal foetal positioning, the different stages of labour and pelvic floor muscle exercises. Newham *et al.* (2014) specified that women in the TAU group could make their own arrangement to participate in alternative yoga groups if desired, and 27% did this. Further detail with respect to TAU was not specified. Mood profiles did not differ between the groups at baseline. A questionnaire assessing state, trait and pregnancy-specific anxiety and depression, and stress hormone assessments were completed at the first and last sessions of the course. The outcomes demonstrated lowered state anxiety and cortisol levels after a single session, and a consistent effect over time. Two women dropped out of the yoga group in comparison to six who withdrew from the control group. The reasons for the relatively high control

group attrition were not specified, although it could be speculated that this was a result of their participation in yoga elsewhere.

Satyapriya *et al.* (2013) recruited 96 women aged between 20 and 35 years with at least one living child at 20 weeks of normal pregnancy in order to examine the effect of the IAYT on anxiety, depression and well-being. The intervention period was 16 weeks, and incorporated poses taught in small groups for 2 h a day, 3 days a week for a month, then 1 h a day independent practice consolidated with refresher classes. In contrast, the control group practised simple stretching exercises. Significantly, three women from the control group moved to the antenatal yoga group, leading to dropouts within the study, and this was acknowledged by Satyapriya *et al.* (2013) as a limitation. The assessment tools used were the Pregnancy Experiences Questionnaire (PEQ), the STAI-State, the STAI-Trait and the Hospital Anxiety and Depression Scale (HADS), which demonstrated that anxiety and depression were significantly reduced following intervention both between groups (Mann–Whitney *U*-test $P < 0.001$) and within groups (Wilcoxon signed-rank test $P < 0.001$).

Another paper by Satyapriya *et al.* (2009) with a similar intervention to the above study examined the efficacy of the IAYT on perceived stress and heart rate variability. A combination of physical postures and breathing techniques was specifically developed for healthy pregnant women. The authors concluded that the IAYT reduces perceived stress more than standard prenatal exercises by 18–20 weeks' gestation, and found that parasympathetic and sympathetic tone were increased and decreased, respectively, following guided relaxation ($P < 0.001$). Satyapriya *et al.* (2009) did not appear to address the difference in contact between the two groups, or take into account the fact that an increase in this could have influenced the treatment effect. Furthermore, the study did have a high attrition rate of $> 20\%$ in both the yoga and control groups.

Hayase & Shimada (2018) recruited: 38 primiparas and multiparas, who were attending maternity yoga classes at a Japanese hospital between 20 and 23 weeks' gestation; and a matched control group of 53, who received no intervention. The intervention involved a weekly 60-min yoga session, and advice to perform 15 min of daily yoga practice. The outcomes evaluated at 20–23, 28–31 and 36–40 weeks' gestation were heart rate variability and salivary α -amylase. The authors found significant outcomes with respect

to parasympathetic nervous system activation in the group practising yoga, and a positive correlation between the number of classes attended and night-time sleep ($P < 0.05$). Hayase & Shimada (2018) acknowledged that the small sample size was a limitation of their study. The fact that they did not address attrition is also an issue.

In contrast to the previous studies, which included normal pregnancies among the inclusion criteria, Rakhshani *et al.* (2012) recruited 68 high-risk primiparas and multiparas within the first 12 weeks of gestation, and investigated the effects of yoga in the prevention of pregnancy complications. Their inclusion criteria included a history of poor obstetric outcomes and a body mass index of > 30 . The intervention group attended a total of 28 sessions based on the IAYT used by Satyapriya *et al.* (2009, 2013) between 13 and 28 weeks' gestation, and the control group received standard care plus additional walking in the morning and afternoon. The attrition rate was significant in both groups, but more so in the yoga group (35%), largely because some participants moved away. This could have influenced the outcomes, but was not cited by the authors as a limitation of the study. Rakhshani *et al.* (2012) attributed the lower attrition rate in the control group to the fact that women who had moved out of the area could continue to walk, whereas yoga participants could no longer attend the class. Positive outcomes of the study for mothers and babies included decreased incidences of hypertension ($P = 0.018$), pre-eclampsia ($P = 0.042$), gestational diabetes mellitus ($P = 0.049$) and intrauterine growth restriction ($P = 0.05$).

Field *et al.* (2013) conducted a study that involved 46 women who met the diagnostic criteria for depression on the Structured Clinical Interview for DSM-IV (SCID). On average, the participants were recruited from two ultrasound clinics at 22 weeks' gestation. The authors did not specify whether the population group consisted of primiparas or multiparas. They examined yoga and social support, and found that the yoga group demonstrated decreased depression, anxiety, anger, and back and leg pain after each session, in contrast to those receiving social support. However, both groups showed significant changes with respect to depression, anxiety, anger and relationship outcomes across the period of treatment. The 12-week intervention period consisted of 20-min sessions involving basic poses, which Field *et al.* (2013) employed in order to increase compliance. Although they specified that

the participants should follow the DVD at home at the end of the study, there appeared to be no expectation that they should do this during the course of the study. The authors did not address the possibility that group intervention could also have been a factor in the positive mental health outcomes in the control group. Work commitments were cited as the primary reason for the significant dropout rate in both yoga and social support groups.

The last study to involve women who were already depressed and anxious was Davis *et al.* (2015), who assigned participants to either an 8-week yoga intervention or TAU. These authors used a score of ≥ 9 on the EPDS, ≥ 25 on the STAI-State and ≥ 35 on the STAI-Trait as a diagnosis of depression/anxiety. The authors based their intervention on the traditional Ashtanga vinyasa system, and provided an antenatal yoga instructional video for home practice. The two groups had similar baseline demographic and clinical characteristics, and included primiparas and multiparas. As was the case in the other studies, the TAU group lost four of the 23 participants to follow-up as a result of these women pursuing regular yoga practice. Davis *et al.* (2015) concluded that antenatal yoga was a viable intervention, but acknowledged that the evidence for yoga in the reduction of anxiety and depression was less robust because the only significant difference between the groups was with regard to the reduction in negative affect.

Discussion

The papers identified in the present literature search that met the eligibility criteria were predominantly undertaken in North America and Asia, and only one UK study was included. Although the pool of research was limited, most notably in the UK, it is certain that yoga, including prenatal yoga, has seen a growth in popularity in the Western world in recent years. One study reported that practice in the USA has nearly doubled over a 4-year period (YJYA 2016). Therefore, it is likely that there will be a trend towards further research, which is demonstrated by the fact that all but one of these papers were published after 2011.

As discussed in the introduction, the teachings of Patañjali stress the importance of the eight stages that must be achieved in order to embrace the philosophy and way of life of yoga. Although many Westerners commit to regular yoga practice, they do not necessarily follow or indeed

know much about this philosophy. Because of its strong connections with Hinduism, yoga has been known to alienate some religious groups, including Muslims, Christians and Jews, and demonic inferences have been made by prominent religious figures (Jones 2018). This issue was addressed by Rakhshani *et al.* (2012), who identified some initial reluctance to practising yoga expressed by Muslims and Christians in their study group. Although they reported that this did not influence retention, it may have influenced the level of initial interest in the project. However, the other studies did not discuss this limitation, which may have affected recruitment and retention.

The papers differed significantly with respect to the interventions involved. Overall, those studies carried out in Asia favoured a more labour-intensive approach, and therefore, required more commitment on the part of the students than their Western counterparts. This is probably because the practice has long been embedded in Asian culture. The contrast can be seen when the 20-min yoga sessions taught by Field *et al.* (2013) over a 12-week period are compared to the integrated yoga approach of Satyapriya *et al.* (2009, 2013), who advocated 1 h of daily practice over a 16-week period.

There was some variation in the styles of yoga reported in the papers. The hatha and IAYT styles taught in the majority of studies shared similarities in the outlines of the classes described, and were all adapted for the pregnant population. However, Davis *et al.* (2015) favoured a traditional Ashtanga style that, although modified for pregnancy, is usually a more flowing, energetic practice. This choice of a more vigorous approach is somewhat surprising considering the high-risk population recruited to this study. However, the group did enjoy a reduction in negative effects, although these were not as significant as those seen in other studies. Davis *et al.* (2015) also addressed the possibility of medical complications. However, only one was noted, and this was reported by the participant as being linked to potential infection and not the intervention itself. It should be noted that the themes addressed by Newham *et al.* (2014) in the classes that they taught in addition to yoga practice may have increased the self-efficacy of the women, thereby influencing their results. However, it is likely that elements of these themes may have been addressed in other classes without a specific structure.

The classes described in the studies could be closely monitored. In contrast, the self-reporting

of home practice in the studies by Satyapriya *et al.* (2009, 2013), Davis *et al.* (2015) and Hayase & Shimada (2018) would have been less reliable, and potentially affected both the internal and external validity of associated papers. This also brings into question the ethics of discouraging women from engaging in physical exercise, an activity that can have significant health benefits in pregnancy. This issue was addressed in the study by Newham *et al.* (2014), who allowed women in their control group to practice yoga, but requested that they document their exercise regime. Unfortunately, as these authors acknowledged, this would have influenced the fidelity of the comparison groups, and consequently, the internal validity of their reporting. The control group interventions also varied significantly in other papers. Whereas Bershinsky *et al.* (2014) specifically used a control group who were not practising prenatal yoga or relaxation, Satyapriya *et al.* (2009, 2013) allowed simple stretching exercises and standard prenatal workouts, and Rakhshani *et al.* (2012) included a 30-min walk in the morning and afternoon in their programme. Once again, these interventions may have influenced internal validity. It is also significant that the yoga groups in the Bershinsky *et al.* (2014) and Hayase & Shimada (2018) papers were recruited from women currently practising yoga: these groups may have been biased as a result of existing expectations about the benefits of yoga. Direct comparisons were not possible because of differences in the outcome measures used.

One significant difference between the studies was that six involved women who were experiencing a “normal pregnancy”, and four studied participants with existing depression and anxiety, or high-risk pregnancies. It is interesting that Rakhshani *et al.* (2012) recruited women prior to the 12 weeks’ gestation mark, when risk of miscarriage is still high and anxiety levels may have been especially heightened. This may have influenced the extent to which the participants responded to a yoga intervention. It could be hypothesized that women with no depressive or anxiety symptoms are better placed to commit to regular yoga classes, and therefore, may achieve better outcomes. However, the problems experienced by the participants with existing depressive symptoms, and those who fell into the high-risk category, may have made them more motivated to engage with a potentially beneficial intervention. Alternatively, low mood may have been a factor in dropout rates as a result of

demotivation brought about by depression. Both groups achieved statistically significant outcomes, leading Rakhshani *et al.* (2012) to conclude that yoga is beneficial for both populations.

Financial incentives were paid to participants in three of the studies (Field *et al.* 2013; Bershadsky *et al.* 2014; Davis *et al.* 2015). Women may face significant financial burdens in the ante- and postnatal periods, and this incentive could have contributed to lower stress levels than those who were self-funding. This may have made the participants in these studies not only more motivated, but also likely to respond more favourably to the intervention, which could have affected both the internal and external validity of these papers.

Psychological outcome was the predominant method of assessment used within the papers. The most commonly cited outcomes in five out of nine studies were the STAI-State and STAI-Trait scales. Otherwise, there was significant variation in terms of the outcome measures used including the Positive and Negative Affect Schedule, SCID, PEQ, and HADS. Because the outcome measures employed varied so significantly, it was not possible to make a direct comparison of the results obtained, and this makes the development of a coherent picture of the efficacy of yoga in the studies reviewed challenging.

The four papers that investigated physiological markers with saliva samples had to rely on participants adhering to the rather rigid pre-collection instructions, which included avoiding alcohol for 24 h, and not eating, brushing teeth or consuming caffeine products within 2 h of saliva collection. Adherence to these instructions could certainly potentially affect the internal validity of these studies. All four found that the intervention groups had significantly lower levels of cortisol, the primary stress hormone, and salivary α -amylase after practising yoga. Chen *et al.* (2017) also reported higher levels of the antibody blood protein IgA ($P < 0.001$).

With respect to internal validity, it was not possible to blind either the participants or the therapists because of the nature of the intervention. However, the majority of studies specified that their assessor was blinded. The exceptions were Bershadsky *et al.* (2014) and Davis *et al.* (2015), who did not address this issue. Perhaps influenced by media promoting the positive effects of yoga, intervention expectations may have increased the likelihood of women already feeling more positive at the beginning of a programme. Furthermore, this may also have contributed to

a number of participants dropping out of the control groups in two studies, and commencing a yoga programme (Rakhshani *et al.* 2012; Satyapriya *et al.* 2013). Previous yoga experience would also have influenced participants' motivation and expectations of the intervention.

Rakhshani *et al.* (2012) specifically investigated the feasibility of implementing a yoga intervention in a hospital setting. They determined that this is a suitable environment with regard to the ease with which the research staff carried out the intervention; and the class responded to the exercises taught. Although this issue was not specifically addressed in the other studies, no significant implementation issues were reported. The only shortcoming mentioned was the interaction between groups, which may have contributed to the desire for non-yoga groups to cross over to the intervention group (Rakhshani *et al.* 2012; Satyapriya *et al.* 2013).

One finding that all the studies had in common was that no adverse safety issues came about as a result of the interventions. This is supported by literature reviews by Gong *et al.* (2015) and Sheffield & Woods-Giscombé (2016), and also by Polis *et al.* (2015), who examined foetal responses to 26 yoga postures and reported no negative outcomes.

Limitations

The present literature search was limited to the HDAS and subsequent secondary referencing. It must be acknowledged that a more-comprehensive search that included grey literature (e.g. conference presentations and yoga journals) might have brought to light additional interesting and relevant studies. Since the field of yoga is a developing area, it is also possible that new research could have been published in the time that elapsed since the last search in October 2019.

With respect to the study interventions, differences in the style of yoga, duration of input, intensity of practice and location of the intervention may have influenced the outcomes. Similarly, population groups varied with respect to their obstetric history, demographics and socioeconomic background. However, despite these significant differences, the implementation of the yoga practice itself, as opposed to the specific content, appeared to be the most significant factor since positive outcomes were reported in all the papers reviewed. Baseline levels of anxiety and depression also differed significantly,

ranging from no history or current symptoms of anxiety to having an existing diagnosis, which confounded the results once again. A further limitation within those studies involving women with existing depression was that different diagnostic criteria for depression were used.

Methodological shortcomings were also identified, particularly with respect to the small sample sizes, which meant that the groups may not have been large enough to achieve statistical significance. The recruitment process was biased in several studies, notably those in which the participants were pooled from those already practising yoga (Bershady *et al.* 2014; Hayase & Shimada 2018). Another major limitation was the inability to apply a double-blind design, which is the ideal standard for an experiment (Polgar & Thomas 2013).

The outcome measures used were mainly focused on self-reporting, which very much relies on factors such as honesty, current mood, introspective ability and comprehension. Whereas the STAI-State and STAI-Trait require information based on the subject's present mood, the majority of measures employed involve responses based on the preceding week, and are based on an average score rather than a snapshot representation, which may have given a different perspective. The physiological markers that were reported in a minority of studies had the advantage of providing objective measurements, and it will be important to continue such evaluations in subsequent studies and combine these with self-reported outcomes. However, the disadvantage of the outcome measures, was that these relied on patient compliance with pre-sample collection guidelines.

It is possible that the control group was influenced by the benefits of yoga promoted in media coverage, and governmental and antenatal clinic recommendations. The ethics of restricting access within the pregnant population to such a potentially beneficial mode of exercise should also be considered.

Conclusion and implications for further research

Public awareness of perinatal mental health has increased in recent years, leading to better diagnosis and treatment pathways for women suffering from anxiety and depression in pregnancy and the postpartum period (NICE 2014). The present literature review demonstrates that antenatal yoga may be an effective method of

managing anxiety, stress and depression in pregnancy, but the interventions, population groups and outcome measures used in the nine papers were too variable to allow any strong conclusions to be drawn. This supports the findings of other authors (Marc *et al.* 2011; Gong *et al.* 2015; Sheffield & Woods-Giscombé 2016; Joly 2017), who have concluded that, although the initial results in this area of research are promising, there is a need for further research.

Some additional benefits of yoga have been established by current studies. Joly (2017) reported an increase in optimism and self-efficacy, but acknowledged the need for further research into types of yoga and level of input. Kinser *et al.* (2017) investigated yoga-based approaches for LBP and PGP, and demonstrated positive outcomes in addition to positive effects on depression, stress and anxiety, findings that were also supported by Field *et al.* (2013). Low back pain and PGP are associated with sick days, and impose a financial burden on those affected. Therefore, it can be hypothesized that choosing an activity that can address both these issues might be particularly effective. Future studies should also address the cause-and-effect relationship between stress and anxiety and MSK issues in pregnancy, and subsequent management with a yoga intervention. This type of intervention would also demand that yoga instructors receive specialist training in order that they could modify poses, and give appropriate advice to women with MSK complaints in their classes.

The literature search undertaken for the present study revealed only one RCT undertaken in the UK. The remainder were conducted on different continents, and the consequent cultural differences compromise any attempt at making a direct comparison. The analysis was made more difficult by the lack of homogeneity among the papers critiqued, and factors such as inclusion criteria, sociodemographic status, psychological profile and the intervention itself all affect the internal and external validity of the research.

In order to establish a reliable body of evidence, large multicentre studies are needed that involve highly trained yoga teachers carrying out comparable interventions. These should employ the same outcome measures, and the control groups should have a similar level of contact to the participants who take part in the intervention. This calls for more collaborative working with yoga centres and hospital settings keen to carry out further research. It is also important that yoga governing bodies and teacher training

centres work together in order to standardize the teaching of antenatal yoga.

The settings chosen for the interventions varied between the studies, but the majority were carried out in a hospital environment. This can facilitate recruitment, referral and multidisciplinary team involvement if required. However, some women may feel that this is medicalizing the intervention, and therefore, there is also an argument for conducting classes in community settings, which could include antenatal centres in the community. With the significant financial burden that the NHS is currently facing, it is difficult to implement services that will eat into hospital budgets. However, perinatal mental health problems cost the UK £8.1 billion each year (Bavetta *et al.* 2014), and therefore, effective preventative measures are crucial. Consequently, it is important that we are able to provide sufficient high-quality evidence to justify interventions. Lastly, the postnatal period is a particularly important time for new mothers because this is when they forge lasting bonds with their babies. We should all strive to make this period as stress-free as possible, and thereby, minimize the risk of postnatal depression. Therefore, it is important that studies investigate the effect of antenatal yoga in the postnatal period in order to justify further intervention.

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