Research Article

EFFECTS OF ANTENATAL YOGA ON MATERNAL ANXIETY AND DEPRESSION: A RANDOMIZED CONTROLLED TRIAL

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Background: *Antenatal depression and anxiety are associated with adverse obstetric and mental health outcomes, yet practicable nonpharmacological therapies, particularly for the latter, are lacking. Yoga incorporates relaxation and breathing techniques with postures that can be customized for pregnant women. This study tested the efficacy of yoga as an intervention for reducing maternal anxiety during pregnancy.* **Methods:** *Fifty-nine primiparous, low-risk pregnant women completed questionnaires assessing state (State Trait Anxiety Inventory; STAI-State), trait (STAI-Trait), and pregnancy-specific anxiety (Wijma Delivery Expectancy Questionnaire; WDEQ) and depression (Edinburgh Postnatal Depression Scale; EPDS) before randomization (baseline) to either an 8-week course of antenatal yoga or treatment-as-usual (TAU); both groups repeated the questionnaires at follow-up. The yoga group also completed pre- and postsession state anxiety and stress hormone assessments at both the first and last session of the 8-week course.* **Results:** *A single session of yoga reduced both subjective and physiological measures of state anxiety (STAI-S and cortisol); and this class-induced reduction in anxiety remained at the final session of the intervention. Multiple linear regression analyses identified allocation to yoga as predictive of greater reduction in WDEQ scores (B = −9.59; BCa 95% CI = −18.25 to −0.43; P = .014; d = −0.57), while allocation to TAU was predictive of significantly increased elevation in EPDS scores (B = −3.06; BCa 95% CI = −5.9 to −0.17; P = .042; d = −0.5). No significant differences were observed in state or trait anxiety scores between baseline and follow-up.* **Conclusion:** *Antenatal yoga seems to be useful for reducing women's anxieties toward childbirth and preventing increases in depressive symptomatology. Depression and Anxiety 31:631–640, 2014.* © 2014 Wiley Periodicals, Inc.

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INTRODUCTION

Research into the incidence of maternal anxiety in pregnancy has been neglected relative to depressive symptomatology,[1,2] despite anxiety being postulated as a requisite for depression.[3,4] The lack of attention to antenatal anxiety is partly due to difficulties raised by broad conceptualizations of what anxiety entails and inappropriate measurement.[5] Many researchers argue that general measures of anxiety do not reliably assess pregnancy-specific anxieties and concerns.[6] There is also uncertainty about the optimal period for assessment as the content of pregnancy-specific anxieties will fluctuate over the course of pregnancy (e.g., anxiety regarding viability of the pregnancy in the first trimester compared to anxiety regarding impending childbirth toward term).[7]

However, a growing body of evidence suggests that maternal antenatal anxiety (measured by both general and pregnancy-specific measures) may increase the risk of preterm delivery and the likelihood of giving birth to a low birth weight infant.[8–11] These infants have increased mortality and morbidity in the neonatal period and an adverse long-term health trajectory.[12] Furthermore, increased anxiety is recognized as a risk factor for (1) poorer obstetric outcomes, including more frequent requests/use of pain relief during labor,[13,14] prolonged labor,[15] increased requests for cesarean section[16,17] and a higher likelihood of delivery by emergency cesarean section[14]; (2) poorer maternal mental health, including suboptimal fetal attachment, postpartum parenting stress, impaired infant bonding; and (3) increased cognitive, behavioral, and emotional problems in the offspring as toddlers and adolescents.[18–21]

Although the mechanism by which increased anxiety causes adverse outcomes is unclear, several studies suggest anxiety-driven stimulation of the maternal hypothalamic–pituitary–adrenal axis, and the consequent elevation in maternal and fetal levels of the stress hormone, cortisol, as a contributing factor.[22–24] Increased cortisol levels may impair fetal growth by inhibiting placental growth[25] and decreasing utero-placental blood flow,[26] and affect the onset and duration of labor by interfering with mechanisms that modulate uterine contraction,[27,28] potentially precipitating the need for interventions such as emergency cesarean delivery.[29]

In response to the growing body of evidence for the effects of maternal anxiety, the National Institute of Clinical Health and Excellence in the United Kingdom has called for randomized controlled trials of interventions that may prevent the escalation of anxiety and improve coping in both the antenatal and postnatal periods.[30]

Psychosocial and psychological interventions that target maternal depression have shown unclear evidence in treating anxiety.[31] Complementary therapies that aid relaxation are an attractive alternative[30–32]; however, studies exploring the effect of such treatments are limited and often suffer from poor methodological quality.[33] Yoga is a form of mind-body medicine that combines physical postures, meditative/relaxation, and breathing techniques.[34] Only a few studies have investigated its effects in pregnancy in cohorts with subclinical anxiety or depression symptoms,[35] and the focus has mostly been on obstetric outcomes rather than the effects on mood or physiology. The aim of this study was to compare maternal anxiety, specifically fear of childbirth, and depression in low-risk, primiparous women randomized to treatment-as-usual (TAU) or an 8-week program of antenatal yoga. It was hypothesized that yoga would have a beneficial effect on both psychological and physiological correlates of maternal anxiety and that it would reduce pregnancy-specific anxiety in a population of low-risk, primiparous women in their late second to third trimester. In contrast women randomized to the TAU group were predicted to show the previously reported escalation in anxiety as pregnancy advanced over the course of the study.

MATERIALS AND METHODS

RECRUITMENT AND ELIGIBILITY CRITERIA

This study focused on healthy women (18+ years old) in the second or early third trimester of an uncomplicated, singleton first pregnancy (that had lasted more than 13 weeks) as primiparous women generally have higher levels of pregnancy-specific anxiety and a similar context to their anxieties (e.g., nervousness about the unknown) in comparison to multiparous pregnant women whose anxiety levels are influenced by previous childbirth experience(s).[36]

Eligible women were identified by sonographers or midwives at their 20-week ultrasound or 24-week routine appointment, respectively, and given an information pack describing the study aims, protocol and the chief investigator's contact details. Women with a medical illness, taking prescription medication, or already practicing antenatal yoga were excluded. Women interested in participating contacted the chief investigator to complete the recruitment process by signing a consent form. Participants were recruited between December 1, 2010 and May 27, 2011.

DESIGN

The study used a 2 (groups) × 2 (time points) factorial design with a 1:1 randomization allocation ratio. At consent, all participants completed a self-report questionnaire pack (AQP1) consisting of five validated questionnaires (described below) and several additional questions, devised for the purposes of this study, about demographic, pregnancy-related and health behavior variables. On receipt of their completed questionnaire forms, participants were randomized (using the sealed envelope system) to receive either an 8-week course of antenatal yoga or TAU. After the 8-week period in which the yoga group took part in the course, both groups completed a second questionnaire pack (AQP2) containing the same validated measures as AQP1 (Fig. 1). The AQP2 was sent, along with a stamped addressed envelope, the day after the Yoga group had completed the intervention. Participants were also asked to indicate whether they were on maternity leave at the point of AQP2 completion as this may also be an influence on mood. In addition, the yoga group completed pre- and postsession assessments at both the first and last session of the 8-week course to assess the immediate effects of yoga. The random allocation sequence and envelope concealment was conducted by a research assistant independent to the study who had no contact with study participants. Participants were informed of their randomization by post by the chief investigator.
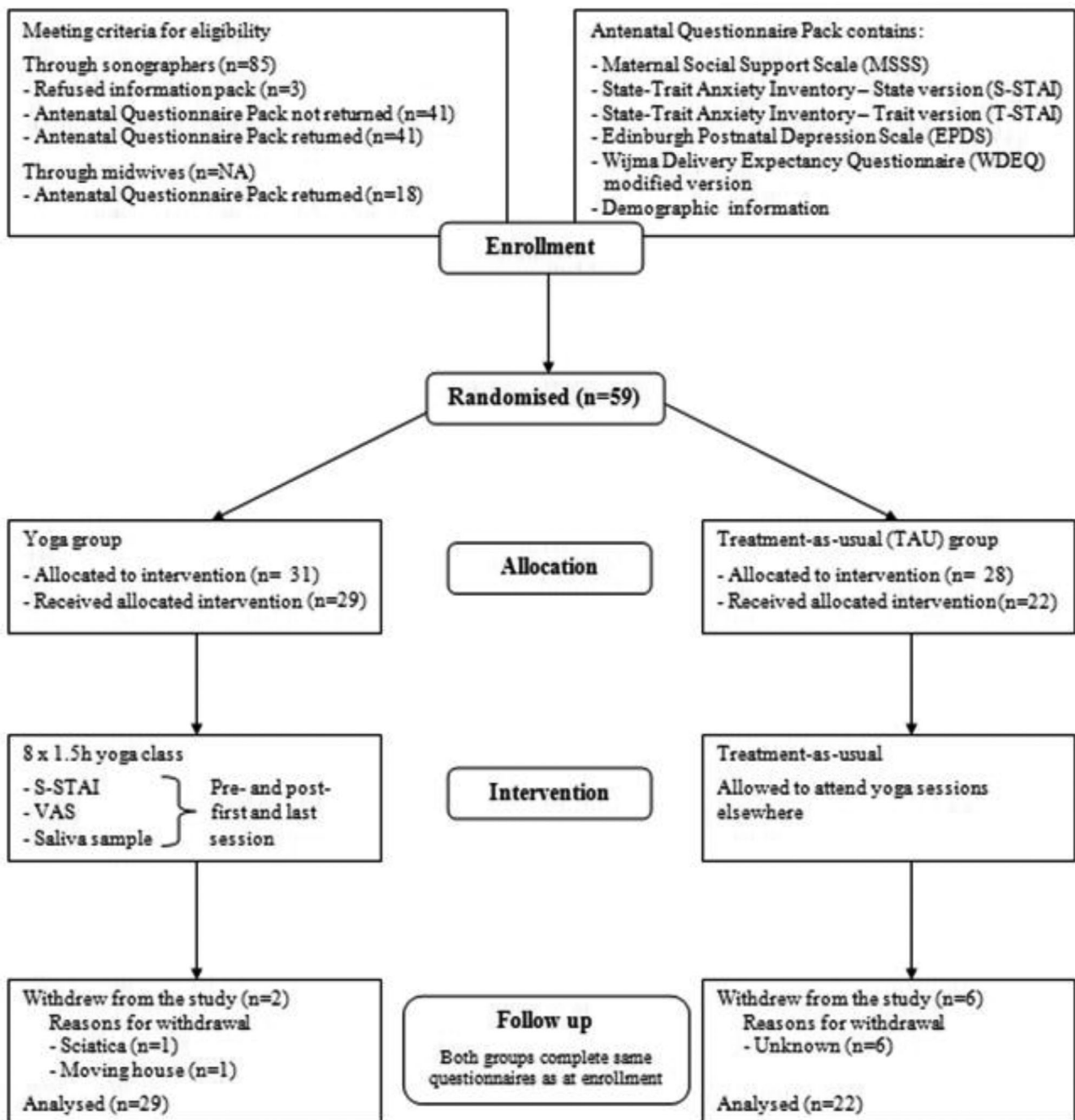
Figure 1. Schematic representation of study protocol.

MEASURES

Currently, there is no generally accepted diagnostic coding of antenatal anxiety. Thus, it was important to utilize a comprehensive battery of questionnaires to determine which aspects of anxiety might be influenced by antenatal yoga.

Trait and state anxiety were measured by the *State Trait Anxiety Inventory-Trait (STAI-T) and State (STAI-S)* versions, respectively.[37,38] In the STAI-T, responders are asked to focus on how they feel *generally* irrespective of current mood. The STAI-T is considered to be a robust measurement that is stable over time and

situation with excellent test–retest reliability (average $r = .88$).[39] The STAI-S accounts for changes in current anxiety due to situational variables and thus responders are instructed to focus on how they *currently feel* rather than how they have *generally* felt. A score >39 on either scale is considered indicative of "high anxiety."[40]

The Edinburgh Postnatal Depression Scale (EPDS)[41] has been validated as a tool that screens for antenatal as well as postnatal depressive symptoms. Participants answer 10 items relating to how they have felt over the past 7 days. Higher scores indicate increased depressive feelings, although a score of 14 or 15 is thought to represent "probable depression" in an antenatal sample.[42]

A modified version of the Wijma Delivery Expectancy Questionnaire (WDEQ)[43] was included to measure fear of childbirth as an indicator of pregnancy-specific anxiety. Higher scores indicate greater fear of delivery. Alpha coefficients for internal consistency were high in both the original validation study and within a subsequent British sample (0.89 and >0.91, respectively).[43,44] However, items (28–33) considered inappropriate for a low-risk population (e.g., 'I have fantasies about the death of my baby') were omitted in the current study following pilot work demonstrating internal reliability estimations for the revised scale that were equal to those reported by Wijma et al.[43] and Johnson and Slade.[44]

The yoga group participants were asked to complete the STAI-S before and after both the first and last yoga session. In addition, participants provided a saliva sample before and after these classes by chewing on a cotton bud for approximately 30 seconds. The saturated buds were transferred to the laboratory and then centrifuged to extract the saliva which was stored at −80°C until analysis of cortisol levels, as a physiological correlate of maternal anxiety/stress, using an ELISA (intra-assay coefficient of variation (CV) – <5%; interassay CV – <10%) in accordance with the manufacturer's instructions (Salimetrics, UK). Salivary cortisol levels are unaffected by salivary flow rate or salivary enzymes and levels are highly correlated with plasma cortisol levels.[45] Basal (nonstress related) cortisol secretion follows a circadian rhythm; peak levels coincide with morning awakening and then gradually decline throughout the day to reach an evening nadir.[46] During pregnancy, the diurnal variation in plasma cortisol is maintained though levels increase threefold by the end of the third trimester.[47,48] Classes were held from 6.30–7.30 pm, when the circadian decline in cortisol production is reported to have reached a plateau,[48] and therefore the diurnal variation in cortisol is unlikely to affect the levels measured at these time points.

INTERVENTION

Participants randomized to yoga (three groups of 10–11 women/group) attended an 8-week course, designed and taught by a trained antenatal yoga teacher (J.H.) with British Wheel of Yoga accreditation, at a SureStart centre near to the hospital where recruitment took place. Antenatal yoga is based on the mild, hatha form of yoga, rather than the more strenuous forms such as Bikram and Iyengar. The same exercises, postures, and relaxation/breathing techniques were taught at each class but sessions were themed to emphasize the application of yoga to aid common ailments of pregnancy (sessions 1–3; postures for alleviating localized aches and pains), optimal positioning of the fetus (sessions 4–5; e.g., relaxing supine positions, back/leg strengthening exercises), the different stages of labor (sessions 6–7; e.g., alternative breathing techniques for first and second stages of labor, postures for improving flexibility of the hips), and in the postnatal period (session 8; e.g., pelvic floor exercises). Group/partner work and massage within the session were omitted to prevent the potential for the group's social dynamic providing a confounding influence. Participants in the TAU group were not permitted to join this class but were allowed to make their own arrangements if so desired and their attendance at alternative yoga classes (or practice at home) was recorded.

STATISTICAL ANALYSIS

All data are presented as medians (interquartile range) because data were not normally distributed. Comparisons of linear data from women in the TAU group versus the yoga group were made using the Mann Whitney U test, whereas the Chi-square test or Fisher's Exact Test (when a cell in cross-tabulation had $n < 5$) was used to analyze categorical data. Within-group (yoga and TAU) comparisons of baseline and follow-up mood outcome scores and of pre- and postclass assessment of STAI-S scores and salivary cortisol levels, were made using

TABLE 1. Demographic characteristics of women recruited to the study ($n = 59$)

	Treatment-as-usual (TAU) ($n = 28$)	Yoga ($n = 31$)
Demographics		
Mean age (SD)	31 (7)	31 (5)
Unemployed	1 (3.6%)	1 (3.2%)
Living with partner	27 (96.4%)	30 (96.4%)
University educated	19 (67.9%)	22 (71.0%)
White British	24 (85.7%)	31 (100%)
Health behaviors		
Alcohol consumption during pregnancy	4 (14.3%)	6 (19.4%)
Caffeine consumption during pregnancy	21 (75.0%)	19 (61.2%)
No other physical activity	2 (7.1%)	5 (16.1%)
Previous yoga experience	3 (10.7%)	7 (22.6%)
Previous anxiety	0	0
Previous depression	1 (3.6%)	3 (9.7%)
Smoking	1 (3.6%)	0 (0%)
Pregnancy-related		
Mean gestational age at study entry (SD)	21 (3)	22 (4)
Previous miscarriage	5 (17.9%)	4 (12.9%)
Infertility problems	1 (3.6%)	4 (12.9%)
Undecided on delivery preference	5 (17.9%)	1 (3.2%)

the Wilcoxon signed rank test. Due to previously recorded fluctuations in maternal mood across the course of pregnancy,[49–51] it was deemed inappropriate to perform intention-to-treat analysis because the questionnaire scores of the women that withdrew from the study were likely to have changed over the course of the study; with analyses using baseline scores carried forward being unlikely to reflect actual scores at follow-up. Thus, only study completers were included in final analyses.

Linear regression with bootstrapping[52] was used to investigate which factors (maternal age, gestational age at baseline, mood questionnaire scores at baseline, maternity leave, group assignment, and attendance of TAU group members at alternative classes) predicted change in mood outcome measures (WDEQ, STAI-T, STAI-S, EPDS) between baseline and follow-up. Effect sizes for bootstrapped means in linear regression analysis were calculated using Cohen's d with values greater than 0.2, 0.5, and 0.8 indicative of a small, medium and large effect respectively.[53] Effect sizes for nonparametric comparisons were calculated using Rosenthal's formula[54] with Cohen's benchmarks of values greater than 0.1, 0.3, and 0.5 indicative of a small, medium, and large effect size. All statistical tests were two-tailed.

A power calculation[55] using data obtained from a pilot study of women attending existing antenatal yoga classes ($n = 22$) revealed that a minimum of 52 women in total (26 per group) would be needed to detect a significant ($P < .05$) clinically meaningful (10-point reduction) between-group difference[56] in our primary outcome measure, pregnancy-specific anxiety (fear of childbirth), with 80% power.

RESULTS

Fifty-nine women were recruited to the study. Their demographic profile is provided in Table 1. Ten of the participants (16.9%) had tried yoga before, but only two women (3.4%) were practicing immediately prior

to becoming pregnant. Four women reported previous depression; however, none of the women reported previous anxiety problems. Thirty-one women were randomized to the yoga group and 28 to the TAU group; the two groups did not significantly differ in any of the baseline parameters recorded (Table 1). Two of the women in the yoga group (6%) withdrew from the 8-week program and the AQP2; the remaining participants attended a minimum of six of eight sessions. Six of the women in the TAU group (21%) did not return the AQP2 at follow-up. Women who withdrew from the study ($n = 8$) did not significantly differ from study completers on any baseline variable and there was no significant difference in the number of withdrawals between the two groups (Fisher's exact test; $P = .13$). The women in the yoga and TAU groups completed the AQP2 at a similar stage of pregnancy (gestation week 31 [SD = 3; Range = 29–38] vs. 31 [SD = 4; Range = 28–38], respectively; $t = -0.75$; $P = .94$). There was no significant difference in the proportion of women in the yoga and TAU groups taking maternity leave at follow-up (5/29 vs. 6/22, respectively; $\chi^2 = 2.25$; $P = .34$). Of the study completers, six women in the TAU group (27%) declared attending alternative pregnancy yoga classes during the study period.

YOGA AND TAU GROUPS HAVE A SIMILAR MOOD PROFILE AT BASELINE

There was no significant difference in STAI-S, STAI-T, EPDS, or WDEQ scores between the yoga and TAU groups at baseline. Similarly, the two groups were comparable in the number of participants meeting the criteria for high trait anxiety (yoga: 10 [32%]; TAU: 6 [21%]; $\chi^2 = 0.87$; $P = .35$), high state anxiety (8 [26%] vs. 6 [21%]; $\chi^2 = 0.69$; $P = .69$), or probable antenatal depression (3 [10%] vs. 0 [0%]; Fisher's exact test; $P = .24$).

YOGA REDUCES BOTH SUBJECTIVE AND PHYSIOLOGICAL MEASURES OF ANXIETY

The yoga sessions were effective in reducing STAI-S scores both at the beginning (37 [IQR = 30–44] presession vs. 25 [IQR = 21–28] postsession; $z = -5.45$; $P < .001$) and the end of the 8-week program (32 [IQR = 25–39] vs. 23 [IQR = 20 to 28]; $z = -5.07$; $P < .001$; Fig. 2A). The STAI-S scores measured before the last session tended to be lower than those recorded before the first session (Fig. 2A; $z = -1.87$; $P = .06$). Scores recorded after the first and last sessions were significantly lower than those obtained when the STAI-S was administered at baseline as part of the AQP1 (28 [IQR = 24 to 42]; $z = -4.12$ and $z = -3.79$, respectively; $P < .001$ in both comparisons).

These changes in subjective measures of maternal anxiety were accompanied by changes in salivary cortisol (Fig. 2B). At the beginning of the intervention period, participation in a yoga class resulted in a significant decrease in cortisol (0.084 [0.07] μg/dL vs. 0.072 [0.05] μg/dL; $P < .001$) and a similar reduction was apparent at the final class (0.15 [0.11] μg/dL vs. 0.13 [0.10] μg/dL;
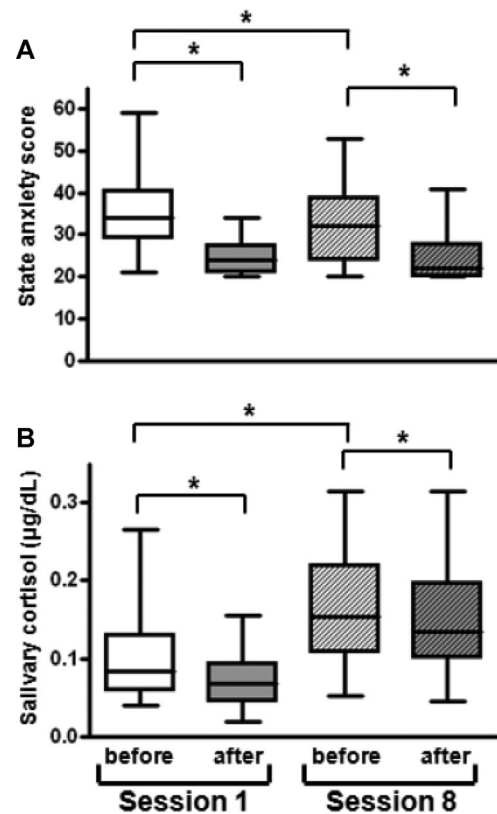
Figure 2. Yoga has an immediate effect on subjective and physiological measures of maternal mood ($n = 29$).

$P = .003$). In accordance with previous findings,[48] maternal cortisol levels increased as gestation advanced, thus preclass cortisol levels were significantly greater at the last session compared to the baseline session ($t = -7.6$; $df = 39$; $P < .001$; Fig. 2B).

AN 8-WEEK COURSE OF YOGA REDUCES PREGNANCY-SPECIFIC ANXIETY

Women in both the TAU and yoga groups completed the questionnaire pack at consent and after the intervention period had finished. There was no significant difference in the STAI-S, STAI-T, or EPDS scores recorded at the two time points in the TAU or yoga group (Table 2). However, pregnancy-specific anxiety, as measured by the WDEQ scale, was significantly lower in both the yoga group ($P < .0001$) and TAU group ($P = 0.04$) after the intervention period as compared to baseline. The change in WDEQ scores tended to be greater in the yoga than the TAU group (−14 [−22 to −7] vs. −6 [−14 to 3], respectively; $P = .06$) with a small effect size ($r = -.26$; Tables 2 and 3). Moreover, once data from women in the TAU group who had independently attended alternative yoga classes ($n = 6$) were excluded, there was no significant change in the WDEQ scores of the TAU group (Table 2) and the change in yoga group scores became significantly greater than that observed in the TAU group (−1 [−9 to 4]; $P < .05$) with a medium

TABLE 2. Within-subject comparison of mood outcome scores for the Yoga and TAU groups (including sub-analysis without TAU yoga attendees)

Measure		Yoga (n = 29)	TAU (n = 22)	TAU exc (n = 16)
T-STAI	Baseline	34 (29–40)	35 (33–39)	35 (33–38)
	Follow-up	34 (29–39)	34 (30–41)	37 (29–41)
	z score	−0.58	−0.5	−0.28
	P value	.56	.62	.69
	r	−.08	−.08	−.05
S-STAI	Baseline	28 (24–42)	32 (24–37)	28 (24–34)
	Follow-up	27 (22–36)	34 (25–38)	37 (29–41)
	z score	−0.93	−0.33	−1.14
	P value	.35	.75	.11
	r	−.11	−.05	−.20
EPDS	Baseline	5 (2–10)	5 (4–8)	5 (3–8)
	Follow-up	4 (2–7)	6 (3–10)	8 (3–10)
	z score	−0.83	−1.17	−1.75
	P value	.41	.24	.09***
	r	−.05	−.18	−.31
WDEQ	Baseline	74 (62–87)	77 (60–85)	72 (57–80)
	Follow-up	61 (42–77)	69 (58–78)	66 (57–78)
	z score	−3.60	−2.09	−0.77
	P value	<.001*	.04**	.19
	r	−.47	−.31	−.14

TAU = Treatment-as-usual; TAU exc = Treatment-as-usual excluding yoga attendees.
*$P < .001$; **$P < .05$; ***$P < .1$; Wilcoxon signed rank test (z score) used for within-group comparisons.
STAI-S, State-Trait Anxiety Inventory–State version; STAI-T, State-Trait Anxiety Inventory–
Trait version; EPDS, Edinburgh Postnatal Depression Scale; WDEQ, Wijma Delivery Expectancy
Questionnaire–modified version.

effect size ($r = −.41$). Subgroup analysis also revealed that the EPDS scores of women in the TAU group who had not participated in external yoga classes were higher at follow-up and the increase was significantly greater than that reported by the yoga group (2 [−1 to 4] vs. 0 [−3 to 2], respectively; $P = .04$) with a medium effect size ($r = −0.31$).

YOGA IS THE PREDOMINANT INFLUENCER OF CHANGE IN PREGNANCY-SPECIFIC ANXIETY

Multiple linear regression analysis revealed that of all the potential influencers investigated, group assignment (0 = TAU group; 1 = yoga group) was the only significant predictor of change in WDEQ score with a greater reduction observed in the yoga group (B = −9.59; BCa 95% CI = −18.25 to −0.43; $P = .014$); with allocation to the yoga group rather than the TAU group showing a medium effect size (mean difference = −3.0 SD = 14.47 vs. 3.95 SD = 9.98; Cohen's $d = −0.57$). Group allocation was also a significant predictor of change in EPDS score (B = −3.06; BCa 95% CI = −5.9 to −0.17; $P = .042$), with allocation to the yoga group showing a medium effect size (mean difference = −0.76 SD = 3.07 vs. 1.0 SD = 4.0; Cohen's $d = −0.5$).

DISCUSSION

MAIN FINDINGS

This study shows that a single session of yoga can reduce both subjective and physiological correlates of

TABLE 3. Between-subject comparisons of change in score for the Yoga and TAU groups (including subanalysis without TAU yoga attendees)

Measure	Yoga (n = 29)	TAU (n = 22)	U	P value	r	TAU excluding yoga attendees (n = 16)	U	P value	r
T-STAI	0 (−3 to −2)	−1 (−4 to 2)	308	.83	−.03	0 (−4 to 4)	235	.83	−.03
S–STAI	4 (−2 to 6)	5 (−6 to 11)	284	.5	−.09	7 (−3 to 14)	177	.15	−.21
EPDS	0 (−3 to 2)	1 (−1 to 2)	242	.14	−.21	2 (−1 to 4)	154	.04**	−.31
WDEQ	−14 (−22 to −7)	−6 (−16 to 2)	221	.06***	−.26	−1 (−9 to 4)	135	<.005*	−.41

TAU = Treatment-as-usual; TAU exc = Treatment-as-usual excluding yoga attendees.
*$P < .01$; **$P < .05$; ***$P < .1$; Mann–Whitney test (U) used for between-group comparisons.
STAI-S, State-Trait Anxiety Inventory–State version; STAI-T, State-Trait Anxiety Inventory–Trait version; EPDS, Edinburgh
Postnatal Depression Scale; WDEQ, Wijma Delivery Expectancy Questionnaire–modified version.

anxiety and that these effects remain after repeated sessions. The STAI-S scores recorded after both the first and last session were significantly lower than when participants completed the STAI-S at baseline, suggesting a genuine reduction in anxiety rather than levels simply reverting to normal over the course of the session. The parallels in the pattern of subjective and physiological responses suggest that women utilizing antenatal yoga techniques can manage elevations in stress hormones, irrespective of the endogenous elevation precipitated by increasing gestation.[47] Moreover, the findings suggest that a course of yoga is more effective than TAU in the reduction of pregnancy-specific anxiety in a population of nulliparous, low-risk UK women. Conversely, women in the TAU group showed elevated depression scores at follow-up.

STRENGTHS AND LIMITATIONS

The study included both subjective (using a variety of questionnaires) and physiological measures to give a multidimensional assessment of anxiety in pregnancy. Aside from the inclusion criteria that controlled for parity, antenatal complications, and physical health, the linear regression model controlled for confounding variables such as baseline mood scores, maternal age, length of gestation, maternity leave, and whether any members of the TAU group attended yoga classes elsewhere.

A recent systematic review of complementary therapies for pregnant women[57] highlighted that while a variety of interventions (e.g., mindfulness, massage) are capable of reducing state anxiety when performed on a single occasion, less is known about the long-term efficacy of such interventions. Any decrease in scores may reflect a return to normal anxiety levels following an initial elevation due to a new experience or situation, but such effects may not persist over time. The design of the current study allowed examination of both the acute effects of a single session and the effect of multiple sessions.

It would be unethical and impracticable to prevent women from participating in yoga classes available in the community and even if this could be enforced, it would bias recruitment toward women who would be unlikely to try yoga in pregnancy. Nonetheless, the fact that some women in the TAU group participated in alternative yoga classes is a limitation of the study, which influences the fidelity of the comparison groups.

It is important to consider whether the program's educational element, provided by the instructor's explanation of the rationale for the yoga postures suitable for pregnancy and childbirth, might influence the mood of the participants in the yoga group. However, in accordance with UK NICE guidelines, midwives give information about labor and birth, for example, preparation of the birth plan, recognizing active labor, and coping with pain, to all pregnant women as part of their routine antenatal care.[58] Thus, it is unlikely that a difference between the two groups level of knowledge could

account for the differences in pregnancy specific anxiety that were observed at follow-up. However, the potential effect of receiving attention from the instructor and also the subject-expectancy effect could, at least in part, contribute to our findings and are a recognized limitation to our study.

It is also possible that the women's prior beliefs, perhaps evidenced by previous participation in yoga classes, could influence mood. Ten of the participants in this study had previously attempted yoga (seven and three in the yoga and TAU groups, respectively); of these, only two women (both in the yoga group) were practicing yoga immediately before their pregnancy and there was no significant difference in the number of previous practitioners between the groups, suggesting that our findings cannot be explained by existing expectations. However we did not record whether any of the women in either of the groups had attended any other sort of class (e.g., Tai chi) that may have affected mindfulness.

The effective component(s) of antenatal yoga (e.g., exercises, relaxation techniques, mindfulness) is unknown. Indeed in our own pilot work, antenatal yoga attendees described physical, mental, and social benefits of attending yoga. Consequently, it is difficult to develop a single comparison group that would control all these elements, for example, a yoga DVD would control the physical and mindfulness components but not the social element, a social "meet and greet" session would control the social element but not physical element, a mindfulness class would control the mental element but not the physical etc. Further research to delineate the mechanisms involved in reducing anxiety is therefore needed in order to design follow-on studies that include an appropriate behavioral placebo or "dismantled" group(s).[59] in addition to the admittedly limited TAU used as the control group in the current study. Nonetheless, the testing of complementary therapies in pregnancy through randomized controlled trials is generally more complex as waitlist controlled groups are often not possible as by the time a participant has fulfilled the initial control period, there is insufficient time to complete the intervention period before giving birth. Furthermore, more studies to determine whether the effects are reproducible with different instructors and locations are required. It will be necessary to also determine the optimal frequency/length of sessions and timing of the intervention within pregnancy. Greater understanding of the fluctuating nature of maternal mood across pregnancy will be useful in this context.[7]

Another potential criticism of the current study is that the women recruited to this study had similar demographic characteristics and health behaviors. Thus the homogeneity of the group does restrict the generalizability of our findings, because the same effects may not be observed in a sample of a lower socioeconomic status, or in those that engage in negative health behaviors to manage anxiety (e.g., alcohol use, smoking). It will be important to determine the effect of yoga in women with clinically diagnosed affective disorders; it is possible that

yoga may be more or less effective due to the woman's enhanced baseline anxiety or reduced ability to engage respectively.

INTERPRETATION

No change in trait anxiety was observed over the course of the study, confirming that the STAI-T measures dispositional anxiety irrespective of situational factors. In contrast, there was no difference between STAI-S scores measured at consent and follow-up in either of the groups although the STAI-S was sensitive to reductions in subjective feelings after the individual sessions. Other studies have shown that STAI-S scores are amenable to change when testing the efficacy of complementary therapies,[57] including antenatal yoga;[60] however, many are not explicit about when and where the STAI-S was completed (e.g., in a hospital, at home) and this might influence scores. The WDEQ and EPDS ask participants to consider how they have felt over recent weeks and so are less influenced by situational variables at the time of assessment, which may explain why differences were observed with only these measures. However, it is important to note that while no statistically significant differences in STAI-S score were observed between baseline and follow-up for either group, the yoga group showed a small effect size for scores *decreasing* at follow-up, whereas the TAU group (after exclusion of yoga attendees) showed a small effect size for scores *increasing* at follow-up.

Cross-sectional studies have shown that maternal anxiety escalates as women progress from the second to third trimester.[49–51] Conversely, participants in the TAU group reported significantly lower fear of childbirth scores at follow-up. However, the change observed in the TAU group was less than that in the yoga group and disappeared altogether once data from women who had attended alternative yoga classes were removed from the analysis. Not attending yoga was associated with a significant increase in depression, suggesting that yoga may be effective at curbing an increase in depression as gestation progresses. The course of depression during pregnancy is unclear as some studies report a decrease in EPDS scores as pregnancy progresses,[50, 61] whereas others have shown that depression increases.[62, 63] These discrepancies may be explained by heterogeneity between the study samples, as depression is reported to escalate in nulliparous women and decrease in multiparous women.[64]

Most previous studies to test yoga as a potential intervention during pregnancy were performed in Asian countries (e.g., India, Thailand), where attitudes toward yoga may differ to that of women in Western cultures,[65–70] and mainly focused on multiparous women who are known to have higher fear of child birth and anxiety if a previous pregnancy resulted in a poor outcome.[36] The study by Field et al.[60] was also the only one to examine anxiety as an outcome measure, albeit after a course of antenatal yoga rather than at the individual sessions and only in a sample with diagnosed depression that combined primiparous and multiparous women. Moreover, a systematic review of these studies[35] noted biased or unclear randomization procedures.

CONCLUSION

This is the first UK study to test the efficacy of antenatal yoga and the first worldwide to report on the effects of both a single and multiple sessions of antenatal yoga on measures of mood. Antenatal yoga lowered state anxiety and cortisol levels after a single session and this effect was consistent over time. Antenatal yoga was associated with significant reductions in fear of childbirth, and is potentially preventative against an increase in depressive symptoms.

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