

## Acute Effects of Yin Yoga and Aerobic Exercise on Anxiety

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### Abstract

Yoga and aerobic exercise have several health benefits. These include improved mood and well-being, and reduced symptoms of depression and stress. Research further suggests that the two modes of exercise have an anxiolytic effect, although these findings are not consistent across the literature. The current study measured the acute effects of yin yoga and aerobic exercise on state anxiety, trait anxiety and trait mindfulness. Thirty participants completed a one-hour yin yoga session, and fourteen returned one week later to complete a one-hour aerobic exercise session. Immediately before and after the sessions, participants completed the State-Trait Anxiety Inventory (STAI) and the Mindfulness Attention Awareness Scale (MAAS). No differences in scores on the STAI and MAAS were detected after the aerobic exercise, however there was a significant reduction found in state anxiety and trait anxiety after the yin yoga, with no changes in trait mindfulness. The results indicate that yin yoga has an anxiolytic effect, although the uneven number of participants made comparison difficult. Yin yoga should be considered as a potential treatment option for anxiety.

**Keywords:** Anxiety state; Trait; Mindfulness; Yin yoga; Aerobic exercise

### Introduction

Anxiety has been defined as an emotional state of excessive and irrational worry [1], and is one of the most common psychological disorders, alongside depression [1,2]. In Australia alone, approximately 11.2% of the population (2.6 million) suffers from an anxiety-related condition and is the most frequently reported mental health concern nationwide [3]. Hence, mental health problems such as anxiety make up a large proportion of disability in Australia, and is a great burden for the public health system and the individual [4].

Anxiety is a complex response to an internal or external stimulus [1], where symptoms include feelings of apprehensiveness, nervousness, and pessimism [5]. Two different types of anxiety have been defined in the model of state-trait anxiety [6]. State anxiety is defined as a response to a specific situation or threat [1], and is a momentary, and occasionally expected emotional state [1,6]. In contrast, trait anxiety refers to a chronic and stable personality trait, which increases the risk of developing an anxiety disorder [1]. The state-trait model suggests that anxiety is a consequence of an interaction between the appraisal of stimuli and the activation of the nervous system [6,7].

Anxiety is frequently treated with antidepressant medication [5]. Medication such as selective serotonin reuptake inhibitors and serotonin-norepinephrine reuptake inhibitors treat anxiety on a neurochemical level [2]. These antidepressant medications inhibit the physiological response of anxiety, by targeting hormones and neurotransmitters (noradrenaline and serotonin) involved in anxiety [8]. Although medications may suppress the physiological response, there are potential side-effects such as fatigue, nausea, dizziness, and altered sexual behavior [8]. Therefore, it is important to investigate non-pharmaceutical and therapeutic interventions that could offer

complementary treatment alongside medication, or an alternative option without the side-effects of pharmaceutical medication [1]. Alternative treatment options for anxiety range from self-help interventions to cognitive behavioral therapy, talk therapy, and relaxation and mindfulness-based therapies [1,5,9]. However, research suggests that exercise can act as a 'natural' antidepressant with similar effects [5,10].

Individuals with anxiety do not always seek help or get the treatment needed, with males less likely recipients of treatment than females [2]. Therefore, having an accessible and affordable alternative or adjunct to traditional treatments, such as exercise, without the involvement of the mental health system could potentially target those who may otherwise go untreated [11]. Research has previously demonstrated that physical exercise can significantly reduce symptoms of anxiety [5,12]. Several studies suggest that relaxation-based exercise, such as yoga, results in greater reductions in anxiety, and greater improvements in mood and well-being than other types of exercise such as walking, swimming and dancing [13-16]. In studies that specifically compared yoga and aerobic exercise in the same cohort, yoga was also demonstrated to be more effective than aerobic exercise [13] and walking, in reducing anxiety [10,16]. However, studies have been mixed, as one investigation found that yoga and aerobic exercise were equally effective in reducing symptoms of anxiety [17]. Conversely, in another scenario, yoga was effective in increasing well-being [14], and decreasing depression [9,18] but not anxiety per se.

Yoga has become a popular type of exercise in the Western world [19]. This relaxation-based exercise originated as a spiritual practice in India, approximately 5000 years ago [1,20]. Yoga integrates movement of asanas (postures) into a bodily and mental meditation through relaxation and breath awareness [1,9,20]. Besides flexibility, yoga enhances memory, strength and vigour [10], and has also been found to reduce pain, fatigue, and stress [20]. Positive effects of yoga on well-being, mood and quality of life have also been described in the literature [10,14,16,21,22]. Although, yoga has been shown to reduce

symptoms of depression, there are ambiguous findings on its anxiolytic effect; its ability to target and reduce symptoms of anxiety [10,14,16].

In contrast to the relaxing nature of yoga, aerobic exercise is a cardiorespiratory type of exercise, which commonly consists of rapid and intense movements [23,24]. Consequently, aerobic exercise may result in greater physiological arousal, like increased respiration and heart rate [24]. The benefits of aerobic exercise described in the literature include improvements in mood and well-being, stress reduction, and decreased depressive symptoms [13,17,25]. Moreover, aerobic exercise is the leading mode of exercise evident in the research of anxiety treatments [23]. Nonetheless, the findings on the anxiolytic effect of aerobic exercise remain inconclusive [23]. Hence, aerobic exercise and yoga appear to have similar health benefits, although, the anxiolytic effect of the two modes of exercise, remains unclear.

Several facets of yoga appear to contribute to its beneficial physiological and psychological effect, however, to our knowledge, only one study has previously investigated the effect of yin yoga on stress and pathological worry [11]. The study described herein aims to examine the acute effect of yin yoga and aerobic exercise on state anxiety, with trait anxiety and trait mindfulness as additional measures. Since yin yoga is a slow, meditative and relaxing form of exercise [11], it was expected that levels of state anxiety would be reduced, where no change in trait anxiety or trait mindfulness would occur. Due to the nature of yin yoga, we predicted that heart rate and perceived exertion would be relatively low, in accordance with previous research [26]. In contrast, aerobic exercise is a more intense mode of exercise, and it was therefore expected that heart rate and perceived exertion would be high. Based on previous studies, it was hypothesised

that there would be no effect evident on state anxiety [13] following aerobic exercise, with no changes in trait anxiety or trait mindfulness.

## Methods

### Participants

A statistical power analysis was conducted using G\*Power, which yielded an estimated sample size of 36 participants. Although, the targeted sample size was not met, 30 adults, aged 18-49 years (M=24.1, SD=6.0), completed a one-hour yin yoga session. Fourteen of these participants (M=24.1, SD=4.8) returned one week later to complete a one-hour aerobic exercise session. Demographic data of participants are summarized in Table 1. The participants satisfied the inclusion criteria of being above the age of 18 years, in addition to having no contraindications to exercise as per the Exercise & Sports Science Australia (ESSA) Pre-exercise Screening Tool. The ESSA Pre-exercise Screening Tool was used to assess any risk factors associated with the participation of physical exercise. The participants did not practice yoga or aerobic exercise more than once a week. Most of the participants reported having more experience with aerobic exercise. However, a higher number of participants reported a preference for yoga as a mode of exercise (Table 1). The participants who reported yoga as a preference explained that “it seems easy” and “it is good for my mind”. Those participants who preferred aerobic exercise described that “I like the energy release” and “feels more active”. This study was approved by the Southern Cross University Human Research Ethics Committee (ECN-17-065).

Variables		Yin Yoga (N = 30)	Aerobic Exercise (N = 14)
Gender	Female	21	9
	Male	9	5
Age M(SD)		24.1 (6.0)	24.1 (4.8)
Ethnicity (%)		White/Caucasian (70.0)	White/Caucasian (71.4)
		Asian/Pacific Islander (20.0)	Asian/Pacific Islander (21.40)
		Other (10.0)	Other (7.14)
Occupation (%)		Student (86.7)	Student (64.3)
Previous experience (months)	Yoga	10.8	15.5
	Aerobics	25	24
Preference (%)	Yoga	73.3	64.3
	Aerobics	16.7	28.6

**Table 1:** Demographics of participants by exercise group.

## Design

This study used a cross-over design, however, due to the small number of participants returning to the aerobic exercise session, comparisons were only made within conditions (i.e., from pre to post for yoga and aerobics, separately). The dependent variables were state anxiety, trait anxiety, trait mindfulness, perceived exertion and heart rate.

## Materials

**Demographics:** The demographics questionnaire was used to provide information about the sample regarding age, gender, ethnicity, and occupation. Questions about previous experience, regular practice, and preference of exercise were also included.

**State and trait anxiety:** To measure state and trait anxiety, the State-Trait Anxiety Inventory [27] was used. The STAI consists of 40 items

rated on a 4-point Likert-type scale. The form measuring state anxiety (Y-1: 20 items) includes items such as “I am worried” and “I am relaxed” as indicators of what is felt in the present, where scores range from 1 (not at all) to 4 (very much so). The form measuring trait anxiety (Y-2: 20 items) includes items such as “I have disturbing thoughts” and “I am content” as indicators of what is generally felt and is scored from 1 (almost never) to 4 (almost always). Total scores were calculated by summing up the items in each respective form of anxiety (ranging from 20 to 80), where higher scores reflected greater levels of anxiety. Cronbach’s alpha ( $\alpha$ ) was calculated for internal consistency, to assess the reliability of the scale. Internal consistency in this study was good to excellent in the yoga session (state anxiety; pre  $\alpha=0.92$ , post  $\alpha=0.88$ , trait anxiety; pre  $\alpha=0.89$ , post  $\alpha=0.85$ ) and in the aerobic exercise session (state anxiety; pre  $\alpha=0.86$ , post  $\alpha=0.89$ , trait anxiety; pre  $\alpha=0.86$ , post  $\alpha=0.84$ ). The STAI has previously demonstrated adequate internal consistency, test-retest reliability, and validity [28,29].

**Mindfulness:** To measure trait mindfulness, the Mindfulness Attention Awareness Scale was used. The MAAS comprises of 15 items rated on a 6-point Likert-type scale ranging from 1 (almost always) to 6 (almost never), including items such as “I rush through activities without being really attentive to them” and “I snack without being aware that I’m eating” as indicators of trait mindfulness. A total score was calculated by averaging a mean of the items, where higher scores represented greater levels of dispositional mindfulness. Internal consistency in this study was excellent in the yoga session (pre  $\alpha=0.90$ , post  $\alpha=0.91$ ) and in the aerobic exercise session (pre  $\alpha=0.92$ , post  $\alpha=0.87$ ). The MAAS has previously demonstrated high reliability and is suggested to be the most empirically valid mindfulness measure [30]. Exertion. Borg’s Rating of Perceived Exertion Scale [31] was used to measure participant’s perceived levels of physical exertion. The RPE is a 15-point scale that ranges from 6 (no exertion at all) to 20 (maximal exertion). The RPE is commonly used to measure subjective effort during physical exercise and have previously demonstrated adequate reliability and validity [32-34]. Heart rate. Polar heart rate monitors were worn continuously to measure heart rates in each of the different modes of exercise.

**Procedure**

Participants completed the State-Trait Anxiety Inventory (STAI) and the Mindfulness Attention Awareness Scale (MAAS) before and after each session. These questionnaires were compiled into an online survey (Qualtrics, Provo, Utah, and Seattle, Washington, United States) and sent to participants via text message. A subset of the participants also had heart rate monitors fitted before each session. The restriction was due to the limited number of heart rate monitors available.

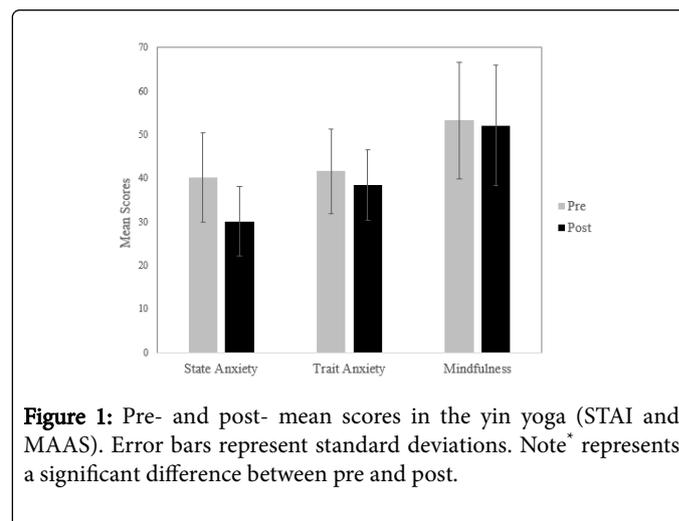
Professional instructors were used to lead both exercise sessions. Prior to the yin yoga session, the instructor introduced the concept of yin yoga and its slow and meditative nature. Meditation music was played to complement the yin yoga practice. Prior to the aerobics exercise session, the instructor briefly explained the class, and played upbeat music during the session.

**Statistical Analysis**

**Yin yoga**

A paired samples t-test with an  $\alpha$  of 0.05 was conducted to compare pre- and post- scores in state anxiety, trait anxiety, and trait

mindfulness (N=30). There was a significant difference (12.6%) found between pre- and post- scores in state anxiety,  $t(29)=5.64$ ,  $p<0.001$ , and in trait anxiety (3.9%),  $t(29)=2.94$ ,  $p=0.006$ . There was no significant difference detected between the pre- and post- scores in trait mindfulness,  $t(29)=0.568$ ,  $p=0.574$  (Figure 1). Cohen’s effect size value for state anxiety ( $d=1.1$ ), suggested a large difference. However, Cohen’s effect size value for trait anxiety ( $d=0.35$ ), and trait mindfulness ( $d=0.09$ ), indicated a respectively small and trivial difference.

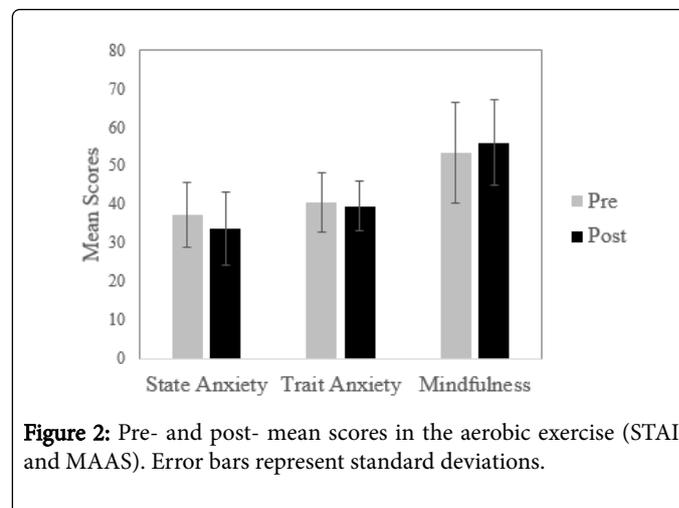


**Figure 1:** Pre- and post- mean scores in the yin yoga (STAI and MAAS). Error bars represent standard deviations. Note \* represents a significant difference between pre and post.

During the session, the average heart rate ( $M=76.3$ ,  $SD=11.6$ ) and maximum heart rate ( $M=115.7$ ,  $SD=20.6$ ) was recorded from the subset of 10 participants ( $n=10$ ). The average score on perceived exertion ( $M=8.7$ ,  $SD=3.0$ ) from the sample size of 30 participants, was low ( $N=30$ ).

**Aerobic exercise**

There was no significant difference found in either state anxiety,  $t(13)=1.38$ ,  $p=0.190$ , trait anxiety,  $t(13)=1.06$ ,  $p=0.310$ , or trait mindfulness  $t(13)=-1.80$ ,  $p=0.096$  (Figure 2) following the aerobic exercise session. Cohen’s effect size value for state anxiety ( $d=0.37$ ), trait anxiety ( $d=0.12$ ), and trait mindfulness ( $d=0.21$ ), indicated trivial to small differences.



**Figure 2:** Pre- and post- mean scores in the aerobic exercise (STAI and MAAS). Error bars represent standard deviations.

The average heart rate ( $M=141.0$ ,  $SD=26.8$ ) and maximum heart rate ( $M=178.8$ ,  $SD=12.4$ ) was recorded during the session from a subset of 4 participants ( $n=4$ ). The average score of perceived exertion after the session, was somewhat high ( $M=17.0$ ,  $SD=1.8$ ), from the sample size of 14 participants ( $N=14$ ).

## Results and Discussion

The current study examined the acute effects of yin yoga and aerobic exercise on state anxiety, trait anxiety and trait mindfulness. Participants completed a yin yoga session and returned the following week to complete a session of aerobic exercise. However, due to the small number of returning participants, the design of this study was revised. The results were therefore analyzed and interpreted separately. The results provided support in favor of all hypotheses, excluding the reported reduction in trait anxiety, which was contrary to the author's expectations.

In accordance with the main hypothesis, there was a significant change in state anxiety following yin yoga, while no significant difference was detected after aerobic exercise. This finding is in agreement with previous research where yoga also reduced state anxiety, while no effect was evident from aerobic exercise [13]. Although in the current study, the findings from the two modes of exercise could not be compared directly. The effect of the yin yoga on state anxiety could be explained by the slow, relaxing and meditative practice, which has previously been demonstrated to reduce pathological worry [11]. The findings are further supported by several other studies [10,11,16], but contradict other research that have found yoga to either have no effect, or equal effect on state anxiety when compared to aerobic exercise [9,17]. The participants recruited in this study however, were healthy participants, whereas the aforementioned studies included individuals using a clinical diagnostic criteria of schizophrenia, depression and anxiety disorders [9,17].

The ambiguous findings in the literature indicate an inconclusive effect on state anxiety and could be due to several different factors. A possible explanation is the discrepancy in interventions used. One study that initially did not find an effect on state anxiety, used an individualized yoga intervention [9]. Contrastingly, our study and those with similar findings, employed group-based yoga [13,16], that removed the individual focus, which is a potential stressor for individuals high in anxiety. Moreover, most studies have used either Hatha or Iyengar yoga, both with moderate intensity and a faster pace than yin yoga, whereas other studies have no mention of the type of yoga used [11,18,22]. Whether there are differential effects between types of yoga on anxiety is not known [11], but it may potentially explain the anxiolytic effect found in the yin yoga condition. Moreover, the meditative music played during the session may have also contributed to the effect demonstrated in the yin yoga condition.

Secondary findings revealed a significant difference in trait anxiety after yin yoga, unsupportive of the second hypothesis, although no significant difference was found after aerobic exercise. Trait anxiety was used as a relative measure for spontaneous changes and was therefore not expected to change in either modes of exercise. The reduction in trait anxiety was not as great as in state anxiety, although still unforeseen as the STAI (Y-2) measures a supposedly, stable dispositional trait [1]. Previous research that has used the STAI to measure differences in trait anxiety after a yoga intervention, found no significant changes [28]. A possible explanation is that yin yoga has not altered trait anxiety directly, but the perceived experience of trait

anxiety, which could have been minimized by feelings of relaxation. However, the STAI is a well-established and reliable measure [28]. An alternative explanation is that the change in trait anxiety was due to spontaneous responses, as many of the participants were aware of what was being measured in the study,

The third finding was that yin yoga and aerobic exercise had no significant effect on trait mindfulness, in line with the third hypothesis. Like trait anxiety, the mindfulness scale was used as an additional measure, and thus no effect was expected. Mindfulness is an otherwise desired and expected outcome of yoga [1]. Although, research suggests that mindfulness takes considerable practice, and would usually be expected to increase over time [11,35] Interestingly, the study by [35], found that an aerobic exercise intervention enhanced dispositional mindfulness over a twelve week period, whereas a comparative relaxation-based exercise intervention yielded no change[35]. Commonly though, mindfulness has been used as a comparative measure with yoga, but not as an outcome measure [11,36]. Thus, future research could focus on investigating the acute effects of yin yoga and aerobic exercise on state mindfulness, and alternatively, over time on trait mindfulness.

In the current study, there was no anxiolytic effect evident in the aerobic exercise condition. Previous research present mixed findings on the effect of aerobic exercise on state anxiety [17,24,37], although additional research propose that the effect on state anxiety is, in fact, delayed, but not acute [23]. Potentially, both modes of exercise target anxiety, but through different underlying mechanisms. Yoga (decrease in gamma-aminobutyric acid) and aerobic exercise (increase in atrial natriuretic peptide) appear to target different hormones, both with anxiolytic properties [1,38]. Moreover, yoga stimulates the parasympathetic nervous system, which slows down breathing, heart rate and relaxes the body [11], which some argue increases the likelihood of reducing anxiety [10,26,39]. In contrast, it is suggested that interoceptive exposure through aerobic exercise, activates the sympathetic nervous system, and thus reduces anxiety via desensitization [24,37].

The results of the current study further showed that heart rates were low during the yin yoga condition, and consequently ratings of perceived exertion were reported to be low. In the aerobic exercise condition, heart rates were high, which was also reflective of the high ratings of perceived exertion. No comparison, nor conclusive causality can be made between the modes of exercise in terms of its anxiolytic effect, although it gives an indication of the physiological responses of the different modes of exercise. However, in this study, findings suggest that yin yoga has an anxiolytic effect, particularly in targeting state anxiety. These findings have implications in remediating alternative interventions for anxiety, especially as a form of therapeutic self-help. These results also support previous studies [13,16,17], although the limitations require consideration.

## Limitations

The limitations of this study were first, a significant change found in trait anxiety, which was not anticipated due to it being a stable construct. Thus, the unexpected result in trait anxiety, may be indicative of spontaneous or biased responses. Whether this applied to the change in state anxiety was concerning, although its effect size was large and therefore indicated otherwise. Secondly, the failure to compare directly between the different modes of exercise further limited the depth of analysis and thus, the findings. Thirdly, the sample

sizes in the current study was partially a strength, and partly limiting due to the uneven number of participants. Moreover, most of the sample consisted of Caucasian, female students, hence restricting generalizability.

Above the limitations, the inclusion criteria were used to minimize regular practitioners of both yoga and aerobic exercise, as greater experience potentially differentiates the effect of exercise [40]. It is possible then, that the limited experience of yin yoga, influenced the results. Compared to other studies, self-selection bias was also accounted for [13,17]. Nevertheless, the preference of exercise may have impacted the results as most participants preferred yoga over aerobic exercise, which potentially enhanced the expectations of the benefits of the yin yoga [13,41]. Further investigation is therefore suggested, using follow up testing, long-term interventions and mixed design [42-46].

## Conclusion

Yoga and aerobic exercise are suggested to yield several different health benefits, although there are mixed findings on their anxiolytic effect. The present study found yin yoga to significantly reduce levels of reported state anxiety, which has implications to how general anxiety is treated. A reduction was further detected in trait anxiety following yin yoga, although this could be due to spontaneous responses. In contrast, aerobic exercise had no significant effect on state anxiety, trait anxiety or trait mindfulness. Yoga should be considered further as a treatment for anxiety.

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