

A Critical Assessment of the Acute Effects of Yoga and Cardiovascular Exercise on Markers of Mood and Stress

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Abstract

Both yoga and exercise have been suggested as an effective method of alleviating depressive disorders, along with being shown to uplift mood and increase positivity, even when not clinically depressed.

Objectives: The aim of this trial was to examine the efficaciousness of yoga and exercise in acutely improving mood in non-depressed participants.

Methods: This study involved female participants of a yoga group (n=8) and an exercise group (n=7). Participants completed a Profile of Mood States (POMS) questionnaire before undertaking a sixty minute class. An identical POMS questionnaire was then completed immediately after the class had ended.

Results: There was a main effect of trial ($p=0.049$) on anger; participants of the exercise class displayed higher levels of anger than participants of yoga. There was no main effect on fatigue for trial or time ($p=0.244$ and $p=0.270$ respectively). There was a main effect of time on tension/anxiety ($p<0.001$), depression/dejection ($p=0.009$), anger/hostility ($p=0.011$), vigour/activity ($p<0.001$) and confusion/bewilderment ($p=0.001$). Both yoga and exercise improved these mood states.

Conclusion: Exercise and yoga significantly increase vigour, and reduce depression, tension, confusion, anxiety and anger. Both are invigorating to participants and provide an uplifting effect and increase in feelings of positivity; they would be a viable method of self-treatment for people experiencing low mood. With further research, exercise and yoga would be a viable option of an alternative or adjunct to medication.

Introduction

The World Health Organisation estimates that 5-10% of the population suffers from identifiable depression at any one time [35]. Depressive disorders are common and are stated to be increasing in prevalence [12], proven by [17], 118 studies consisting of a total of 50,371 subjects were meta-analysed, and 14% of those were diagnosed as depressed. This leads us to question the reasoning, as it cannot be explained purely through genetics; there are only a specific number of candidate genes for depression [9], there must be other attributing factors for the increase in diagnosed depression disorders in our population. Some studies have suggested a correlation between the increased rates of depressive disorders and an unhealthy lifestyle [25]. There are many forms of depression and, in fact, many people may experience feelings of low mood on a regular basis without being clinically depressed. For these people, the situation precipitates the mood, for example, a social loss, such as the death of a loved one, will cause the person to experience a period of feeling 'low' [11]. In these incidences, medication is not always necessary, and it may be left to the person themselves to try and uplift their mood.

Incidences of certain types of depression or low mood are also increasing. Seasonal Affective Disorder (SAD) diagnoses, where depression is prominent during winter months, with spontaneous remission in spring or summer [19,5] are growing in frequency. For these cyclic disorders, medication is often unnecessary, but for the few months that symptoms occur, lethargy and lack of energy are prominent (NHS). Exercise or yoga could be very efficient in helping to treat symptoms where medication is not an option. The use of exercise and yoga to increase vigour, specifically with seasonal affective disorder may be especially prominent due to the recent research into increased incidence of seasonal affective disorder and its correlation with climate change [2], where longer winters experienced by the UK are increasing incidence of SAD.

For depressed patients, along with psychotherapy and anti-depressants, exercise is commonly recommended either alongside medical treatment [26], or as an alternative method of treatment [15]. Studies have shown 20-59% of primary-care patients stop taking prescribed anti-depressants within three weeks [13]. It is only in the last decade that research into the psychological benefits of exercise has really started to increase pace. Research is being published frequently showing the positive effects exercise can have on mood. A study conducted by [4], assigned eighty participants to exercise groups, varying in energy expenditure and frequency, over twelve weeks. The effect of energy expenditure at twelve weeks was significant, suggesting the determining factor for reduction and remission of depressive disorders to be energy expenditure. Aerobic exercise at a dose of 17.5Kcal/kg was deemed an effective treatment for depression. This research is progressing strongly, but a divide is occurring between the forms of exercise examined. A review was published to determine the effects of exercise as an intervention in treatment of depression, the terms 'jogging', 'cycling', 'swimming' and 'walking' were all examined alongside terms of depression; there was no analysis into the effectiveness of exercises that would reduce heart rate, such as yoga. The

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review concluded that there was no association between the variation in results and the type of aerobic exercise, provided that the heart rate was increased [13].

In contrast, many reviews have also been published into the benefits of yoga as an effective intervention [30], clearly relaying the therapeutic actions in the treatment of depressive disorders; such as that published by [23], where five randomised control trials were analysed, each utilising a different form of yoga with varying severities of depression. All trials reported positive findings. As previously suggested, a division is occurring between the forms of exercise that are being undertaken and researched. Yoga, as a slow and methodical exercise, should by definition cause physiologically opposite results to cardiovascular exercise; yet both can be used effectively in helping to combat symptoms of depression, and indeed improve mood [34,8].

Morbidity risk and incidence of depressive disorders are higher in females than in males, and they are more likely to report problems and seek advice [22]. Trial variables are minimised using females, as physiological changes due to exercise can be significantly different to males [20], in this experiment only female subjects were used. Age is also a crucial factor in depression, as commonly it is onset in mid-puberty, and continues through adult life [1]. Using a medical questionnaire can help to establish age, and any previous disposition or occurrence of depressive disorders.

Yoga causes augmentation of positive mood through synchronous musculoskeletal patterning, with minimal strain. It has been said that the lifting of the chest and increase in muscular tone increases oxygen and blood supply to the brain, and the asanas (positions/alignment of the body) held counteract the generalised 'slumped' position of depression [34]. The pressure gradient in the muscle contractions causes a physical cleansing of the lymphatic system. Another theory behind the benefits of yoga are based on the assumption of reductionism; that complex phenomena is explained by the simplest principles possible [6], the mood benefits of yoga are related to the modulation of the autonomic nervous system, activation of underused neuromuscular systems, reduction in sympathetic tone, and stimulation of the limbic system [21]. A report by [28], also demonstrated an association between the control of asanas and increased GABA levels, which are allied with anxiety disorders and depression. Using mind concentration in yoga whilst holding the position allows the participant to "flow energy to the areas of their body that feel 'blocked'" [33], and this psychological feeling may also be of relevance to the subsequent feelings of positivity. Hatha yoga is the most common form of yoga in western society; it focuses the body on emotional, physical, and spiritual health [32].

High intensity cardiovascular exercise reduces parasympathetic vagal tone, causing acute effects on blood lipids, blood pressure, blood glucose and levels of triglycerides, along with increasing levels of high density lipoproteins. The social support and engagement of undertaking exercise, particularly within a class, is deemed of equal importance as the biological changes in explaining the improvement of mood [8]. In fact, the improvement of mood through exercise is not fully understood. It may be due to complex neurobiological or psychology mechanisms [29]. A study by [20], used ten participants to determine the physiological effects of strenuous exercise. They found that exercise significantly increases peak oxygen consumption, which may subsequently improve the oxygen supply to the brain. Low oxygen supply to the brain can be associated with vascular depression. People with vascular depression are more resistant to anti-depressant drugs, and so targeting vascular problems could be essential in treatment of such depression [28]. High intensity exercise induces

analgesia and sedation, evidence by [27], reports moderate exercise (70% of max. heart rate) activates the endocannabinoid system, and increases endocannabinoid serum levels, aiding anxiolysis and a sense of wellbeing [3]. Physical activity is hugely beneficial to health; lack of exercise can lead to obesity, cardiovascular disease, and diabetes. The effects exercise has on mood and stress may be linked to the improvement of self-image [29].

The 'Profile of Mood States' (POMS) is a self-administered questionnaire, based on scoring sixty five mood adjectives in relation to how the participant is feeling. It takes under ten minutes to complete, and measures six theorised mood states; 'tension/anxiety', 'depression/dejection', 'anger/hostility', 'vigour/activity', 'fatigue/inertia' and 'confusion/bewilderment' [7]. The profile of mood states questionnaire is commonly used in sport with athletes. It is an economic way to measure transient and fluctuating moods. It is accurate due to its sensitivity to change, and is rapid in response due to it being marked by hand. It provides detailed information and can be used frequently, allowing repeat experiments within short periods of time [14].

Previous studies have shown that mind-based, low-exertion exercises show greater improvement of mood than aerobic exercises [18]. The purpose of this experiment was to prove that yoga is more efficacious than high-intensity exercise in improving mood and reducing stress.

Method

Participants

Fifteen females between 18 and 25 years old volunteered to be the subjects of this experiment. Permission was requested and granted from a local gym to attend exercise classes in order to recruit volunteers. Participants were informed of the purpose and methodology of the experiment. If written informed consent was provided, they then took part in the experiment. None of the volunteers were clinically depressed. The information given to the participants was of importance to both the experimenters, and the participants themselves; the medical questionnaire ensured they did not have any previous illnesses or dispositions of which would cause concern. They were also asked about any current medication, which would be taken into account when analysing the results.

Measures

A paper copy of the POMS questionnaire was given to participants and POMS items were completed by hand, without scrutiny by the experimenters, before being returned confidentially and the data being computer processed.

Procedures

A one hour beginner's hatha yoga class was attended, from which eight participants were recruited. They read and signed a consent form, and a medical screening questionnaire, and then completed a POMS questionnaire before the class commenced. The yoga class consisted of gentle stretching and breathing exercises to warm up the body. Slow and methodical asanas were then retained, whilst the participant concentrated their mind. Asanas that open and lift the chest, such as back bends and inversions were of particular importance and prominence in the class. A relaxation cool-down was then undertaken, using stretches and deep breathing whilst supine. After the class had finished, an identical POMS questionnaire was completed.

The experimental procedure was repeated in a beginner's circuits

exercise class, again, of an hour's duration, from which seven participants were recruited. In this class, after a warm up, high intensity exercises were completed for three minutes, before moving on to the next exercise. Exercises such as sprinting, plyometric push-ups and high bench step-ups with jumps were performed. The exercises were highly anaerobic. A cool-down was then undertaken, after which the POMS questionnaire was immediately completed. Both exercise classes were attended at the same time for five consecutive weeks, to gain repeat readings to enable accurate analysis of both the acute and long term effects the exercise had on the participants. Exercise sessions were composed of similar activities each week.

Over the period of five weeks some participants did not attend all classes, and for that reason, their results were not beneficial and were discarded.

Data analysis

Two factor repeated measures analysis was performed. Significance was accepted where $p < 0.05$

Using the 'p' values of the time trial, all significant POMS states were analysed further, using unpaired t-tests to compare the quantitative data of each individual trial.

One way ANOVA was performed, allowing for differences between trials to be investigated and any significance established where $p < 0.05$.

SPSS18 computer software was used to analyse data.

Results

Multivariate analysis based on the mean results of the six theorised mood states of the POMS questionnaire was performed (Table 1).

Two-factor repeated ANOVA reported that there was no effect of trial, excluding the mood state of anger/hostility; that the participants in both trials experienced the theorised mood states to the same degree. There was a main effect of trial on anger/hostility ($p = 0.049$), which shows that the participants in the exercise trial experienced and displayed more elevated levels of 'anger' than the participants of the yoga trial, further unpaired t-test analysis was used to show this (Table 2), significance was assumed where $p < 0.05$.

Unpaired t-tests reported significance of equality of means for week two of the yoga trial ($p < 0.001$), and week five of the exercise trial ($p = 0.02$)

Two-factor repeated ANOVA (Table 1) on fatigue/inertia reported that there was no significance on both time and trial ($p = 0.244$ and $p = 0.270$ respectively), and there is no interaction between the two factors ($p = 0.064$); fatigue does not differ between participants of either trial, and does not change significantly during either exercise. Following this, no more statistical analysis was performed on fatigue/inertia.

The two factor repeated ANOVA stated a main effect of time on tension/anxiety ($p < 0.001$), depression/dejection ($p = 0.009$), anger/hostility ($p = 0.011$), vigour/activity ($p < 0.001$) and confusion/bewilderment ($p = 0.001$) mood states. As with fatigue/inertia, two factor repeated ANOVA reported no significant interaction between time and trial.

Graphs were produced of all the individual mood states data in order to analyse them fully, the results are shown below.

One way ANOVA (using Tukey's post-hoc) reported that there was a main effect of time on the trials during weeks one and four ($p = 0.032$ and $p = 0.006$ respectively, Figure 1). As stated by the multivariate analysis, there is no significance between the trials, however there is significance between factors of time ($p < 0.001$, Table 1), and this is visually clear in the figure; all theorised mood state mean values decrease after the exercise has been undertaken.

One way ANOVA reported that there was a main effect of time on the trials during week four ($p = 0.044$, Figure 2). As stated by the multivariate analysis, there is no significance between the trials, however there is significance between factors of time ($p = 0.009$, Table 1).

One way ANOVA reported that there was no main effect of time on the trials (Figure 3). The multivariate analysis reported significance between the trials ($p = 0.049$, table 1), and there is significance between factors of time ($p = 0.011$, Table 1), but no significant interaction between trial and time ($p = 0.573$, Table 1).

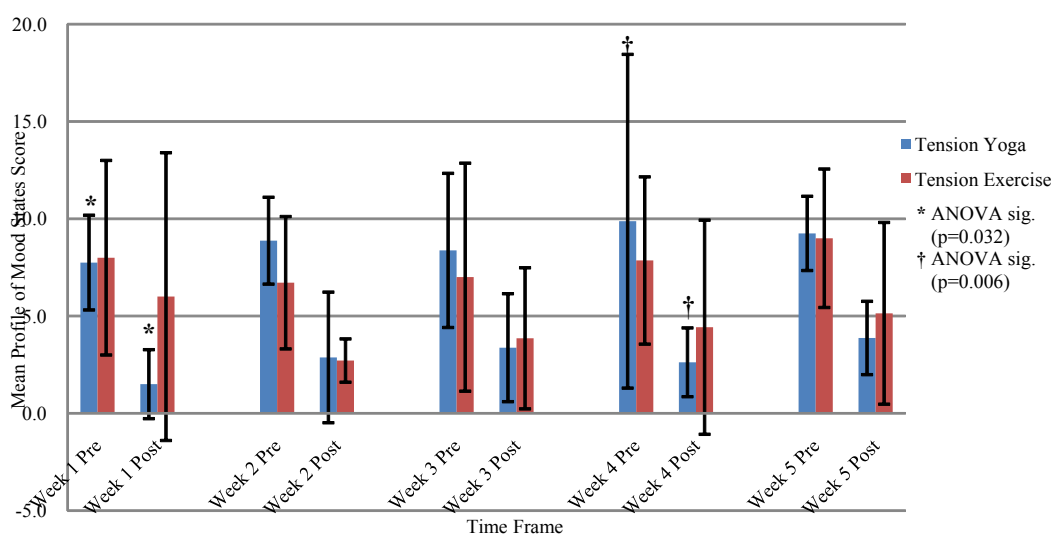


Figure 1: The effects of yoga and exercise on tension over a 5-week period.

Mood State	Trial p-Value	Time p-Value	Trial*time p-Value
Tension/Anxiety	0.600	<0.001	0.433
Depression/Dejection	0.217	0.009	0.666
Anger/Hostility	0.049	0.011	0.573
Vigour/Activity	0.126	<0.001	0.530
Fatigue/Inertia	0.270	0.244	0.064
Confusion/Bewilderment	0.123	0.001	0.470

Table1: Multivariate tests of within-subject effects: Greenhouse-Geisser established p-values.

	Yoga p-Value	Exercise p-Value
Week 1	0.2	<1
Week 2	<0.001	0.13
Week 3	<1	<1
Week 4	<1	<1
Week 5	<1	0.02

Table 2: Unpaired t-tests of anger/hostility: p-values.

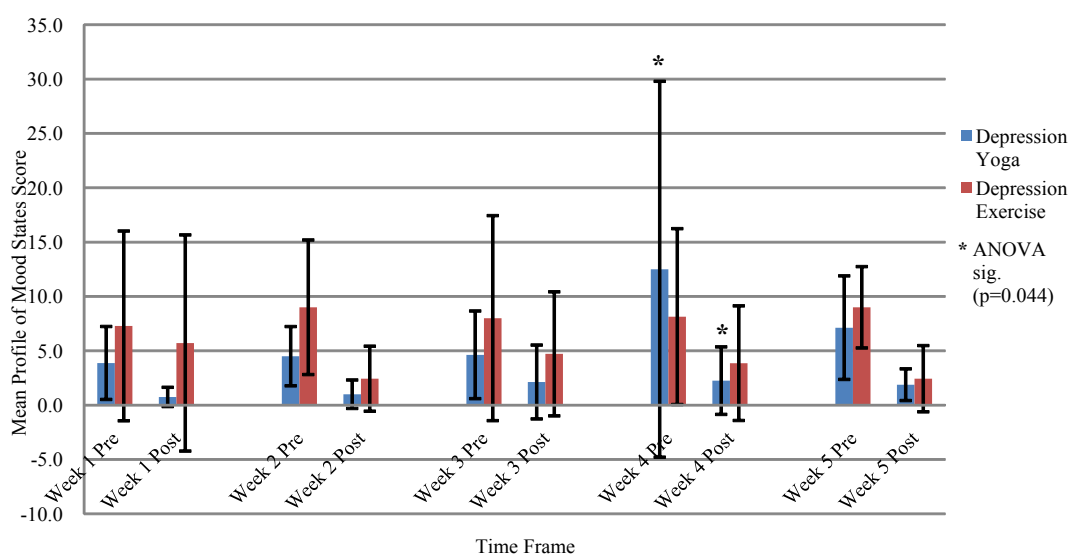


Figure 2: The effects of yoga and exercise on depression over a 5-week period.

One way ANOVA reported that there was a main effect of time on the trials during weeks two, four and five ($p=0.004$, $p=0.01$ and $p<0.001$ respectively, Figure 4). As stated by the multivariate analysis, there is no significance between the trials, however there is significance between factors of time ($p<0.001$, Table 1).

One way ANOVA reported that there was no main effect of time on the trials (Figure 5). The multivariate analysis reported no significance between the trials ($p=0.123$, Table 1), significance between factors of time ($p=0.001$, Table 1), and no significant interaction between trial and time ($p=0.470$, Table 1).

Discussion

Feelings of low mood could be improved through the undertaking of yoga; however there is no evidence from this trial to suggest that it

could be used as a long term solution to prevent or reduce stress or low mood, only acute benefits have been seen. The evidence suggests that long term effects may in fact be restrained due to lack of significance over trials. Yoga should be used to acutely improve mood, it may be most beneficial when personal situations are reducing feelings of positivity, rather than being used primarily in the treatment for depression. The findings of this trial are similar to those in many other trials, and would correspond with a recent meta-analysis by Mehta and Sharma [16], in which of the eighteen studies analysed, it was found the majority of the yoga trials were able to reduce symptoms in depressed patients. Mehta and Sharma did state limitations to the methodology, such as overestimation of treatment effects, and a lack of data regarding long term benefits, which again may be similar to this trial.

The trial has proven that exercise is equal to yoga in its ability to

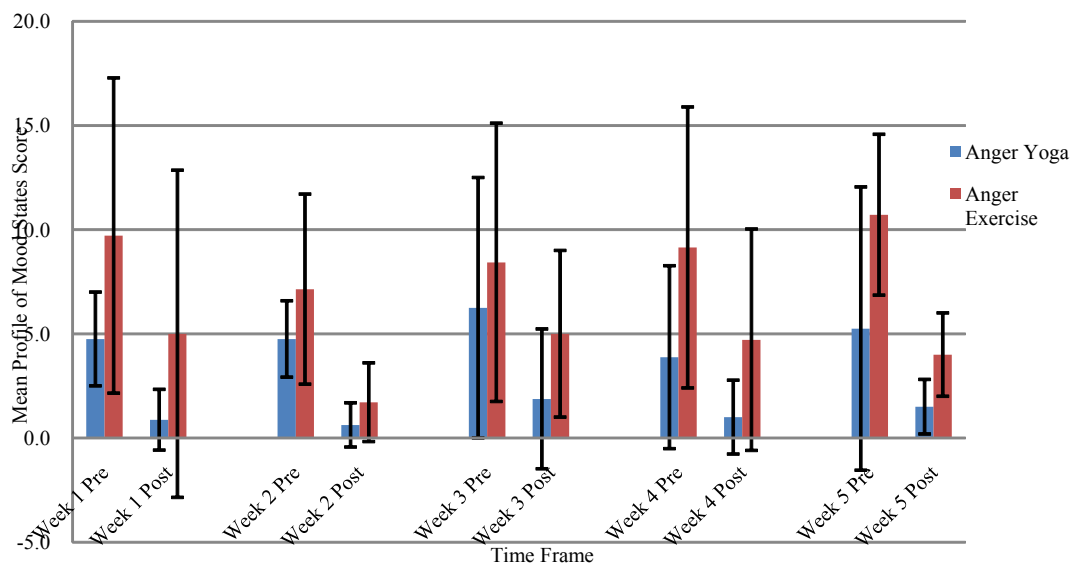


Figure 3: The effects of yoga and exercise on anger over a 5-week period.

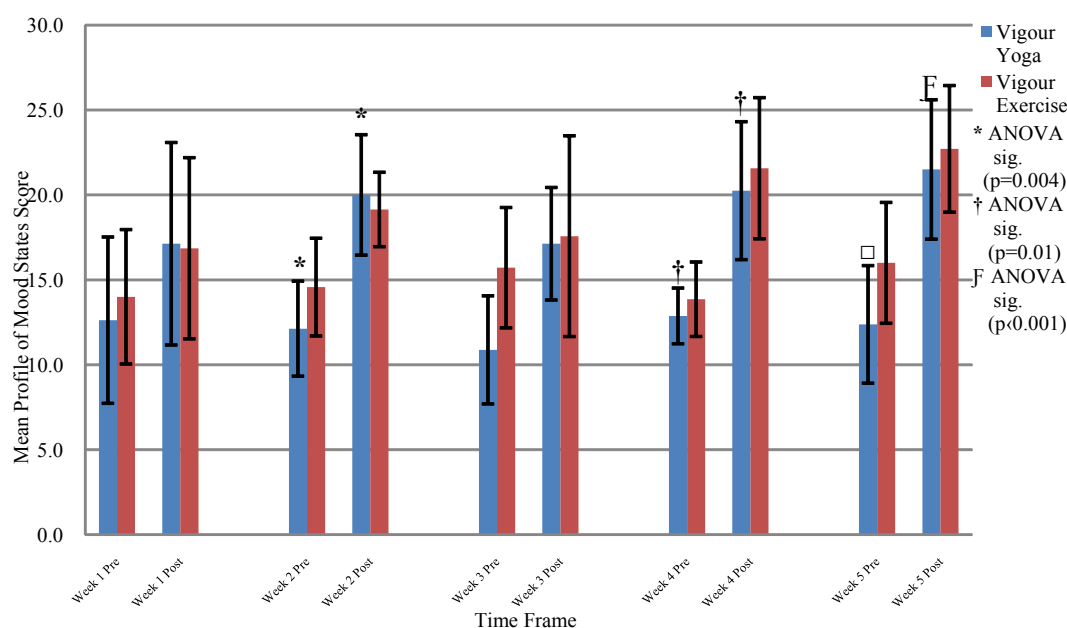


Figure 4: The effects of yoga and exercise on vigour over a 5-week period.

acutely improve mood and reduce stress. This evidence could again be used by those suffering from mood or stress disorders as a method of increasing positivity. The trial did not examine the effect of either exercise or yoga after a period of time. If the POMS questionnaire was repeated at hourly intervals after exercise for a period of time, it would be possible to gauge how long the mood improvement lasts for. If the trial was repeated, including the measure of mood after an interlude, then evidence may show that although exercise or yoga only acutely affects mood, training every day may help improve mood substantially. This would correlate with the findings of [4], as previously mentioned, where they found that moderate cardiovascular exercise training 3-5 times per week was enough to improve mood. Dunn et al found that

the UK government recommended level of exercise (17.5Kcal/kg for 30 minutes, 5 times/week) was the minimum level of exercise needed to produce a significant effect on mood, stress, and depressive disorders. If this information was more widely circulated, and the population as a whole undertook the recommended levels of exercise per week, then it would be a fair assumption to make that rates of depressive disorder may decline. Currently, only 29% of the population undertake the recommended amount of physical activity every week [10]. Physical activity may stimulate a complex system within the body, resulting in a greater resilience to stress related or depressive mood disorders.

The collected data within the trial is not substantial enough to

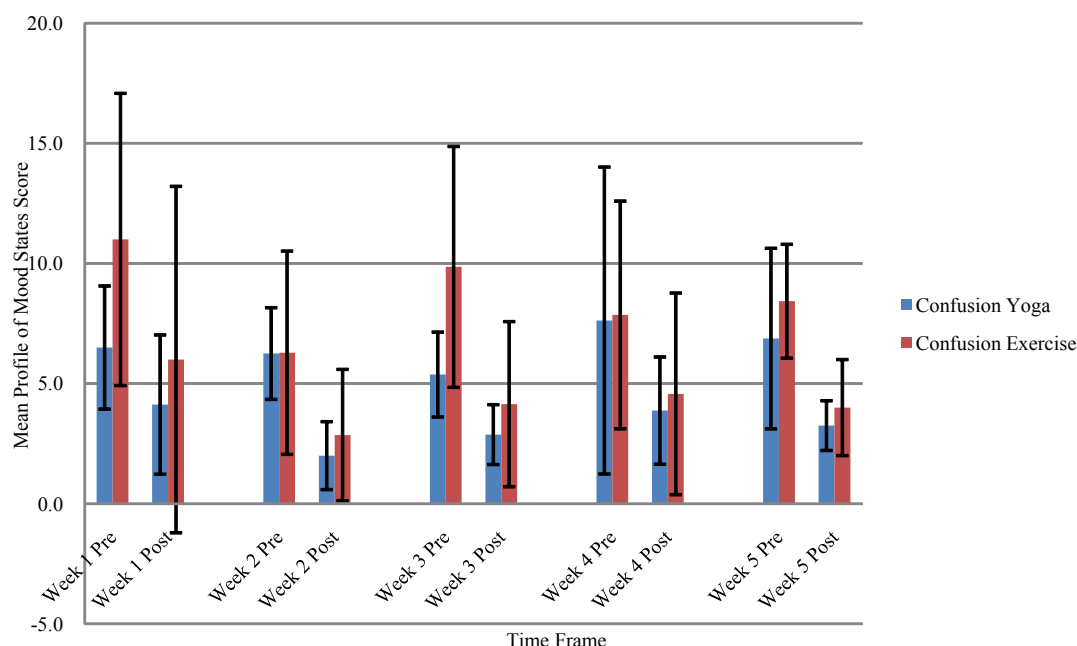


Figure 5: The effects of yoga and exercise on confusion over a 5-week period.

state that exercise is effective in reducing the likelihood of depression; it is, however, significant enough to say that exercise can acutely improve mood and reduce stress. The analysis of this trial produces findings similar to a meta-analysis by [31], where evidence from 27 observational studies and 40 intervention studies suggested that even low doses of physical activity may be protective against depression and low mood.

Neither yoga nor exercise has any effect on fatigue. Although not synonymous, both yoga and exercise are activating and invigorating; lethargy is reduced as vigour is increased; people who experience depression, or low mood often feeling lacking in energy. In these incidences, yoga or exercise could be recommended to increase vigour. This may be of use in certain instances of depression; for example, people who suffer seasonal affective disorder often have little energy, and find they sleep more (NHS). The cyclical changes of mood may be moderated with exercise or yoga, as shown by the results of this trial.

The effectiveness of the experiment could have been improved and advanced through the use of a larger sample size. The experiment was limited in participant numbers due to the restricted sizes of the exercise classes at the local gym. Exercise classes held a maximum of thirty participants, and of these, not all attended every week, and some were unwilling to participate in the study. The time frame of the study could have been increased or altered. If a longer time frame was used, such as twelve weeks, more analysis could have been undertaken, and more significance could have been established. All female participants were assumed to have achieved menarche; changes in hormone levels during the menstrual cycle cause analogous fluctuating patterns in mood, these fluctuations were not taken into account. If repeat readings were analysed in four weekly intervals, the change in mood state may have been apparent, and have produced interesting results. The time frame was limited due to the specificity of the gym, it was only open during term time of the local universities, and therefore the repeat readings were gained in the largest time frame possible. Different time frames of each exercise could have been examined in order to establish

minimum 'doses' of the exercises necessary. The profile of mood states questionnaire was found to be effective in analysing the mood states of the participants, particularly considering the small time frame.

Another interesting factor to take into account when considering the methods of the experiment is the participants. If the same participants were used in the exercise and yoga class, a direct comparison between the effects of the activities could have been made. For this to be possible, a far larger time frame must be used so the results do not become interspersed. Another consideration that needs to be considered is the personal situation of the volunteers at the time of the experiment; as previously discussed, situations can influence the mood of the participant and the situations of the volunteers were not requested. A diary could be requested of the participants; both of emotion and activity, and this would help in further trial analysis. All participants were healthy, and non-depressed, and due to this, significant improvement may not have been demonstrated over the time frame of the trial.

Yoga and exercise are also cost-effective in the treatment of low mood. Results from this trial show the effectiveness of both interventions, and with publicity, could help to reduce health care costs. Anti-depressant medication costs the NHS around three hundred million pounds a year, and doctors have said that anti-depressants are over-prescribed [24]. In a meta-analysis study by Bellani et al. [8], the effects of anti-depressants on the brain were examined on both depressed patients and non-depressed patients. Results were inconclusive, but elevated levels of GABA serum concentration were seen in both depressed and non-depressed participants. This increase is similar to the results produced by [28], where GABA serum levels were increased through the undertaking of exercise. The improvement of mood through exercise or yoga, shown by the results of this trial could be due to GABA serum levels increasing, although further trials would need to be carried out. This would suggest that exercise and yoga act in a physiologically similar way on the body as anti-depressants – improving mood.

Conclusion

It was found that participants of the exercise class experienced significantly higher levels of anger/hostility initially ($p=0.049$), with the mood state reduction being relative to yoga; exercise and yoga both have a significant effect on reducing anger. The same can be said about tension, confusion and depression; exercise and yoga both significantly alter the markers of mood state. Vigour is increased significantly with both exercise and yoga. This analysis and observation can permit rejection of the initial hypothesis; yoga is no more efficacious than high-intensity exercise in improving mood and reducing stress.

Although not synonymous, both yoga and exercise are activating and invigorating. Given the prevalence of depressive disorders within modern populations, it is worthwhile to continue research into high-intensity cardiovascular exercise and yoga for the improvement of mood and reduction of stress. In cases of depressed patients, exercise or yoga would be beneficial for the option of an alternative or adjunct to antidepressant medication. Either exercise or yoga would be a viable method of self treatment for people experiencing feelings of low mood.

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