



## SYSTEMATIC REVIEW AND META-ANALYSIS

# Effect of Acupuncture in the Management of Competitive Anxiety: A Systematic Review and Meta-Analysis

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### Abstract

**Objective:** The aim of this review is to evaluate the effect of acupuncture on competition-induced anxiety in elite athletes to provide an assessment of the overall efficacy of the use of acupuncture in the management of competitive anxiety.

**Method:** A systematic literature search was performed by two reviewers (SB and TE) on electronic databases from their inception to 2022. The risk of bias was assessed using the Cochrane grading system in the RevMan 5.4 software by SB and TE. Acupuncture intervention was assessed using the Standards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA). A total of 36 studies were retrieved and, following further assessment, 5 studies consisting of 219 participants were included in this review.

**Results:** Somatic anxiety was statistically lower in the acupuncture group compared with the control and sham groups with a large effect size (1.92,  $p = 0.05$ , 2.47,  $p = 0.01$  respectively). The acupuncture group presented with a lower level of cognitive anxiety compared with the control and sham groups with a large effect size (2.99,  $p = 0.003$ , 3.26,  $p = 0.001$  respectively). The overall difference between each group was insignificant in the management of self-confidence.

**Conclusion:** Acupuncture has a good effect in the management of competitive somatic and cognitive anxiety; however, more studies are required with a large sample size to determine the effect of acupuncture in the management of competitive self-confidence.

### Introduction

Psychological stress is associated with a host of training outcomes. It has been suggested that stress and anxiety in athletes will cause a physiological increase in peripheral resistance within the body, thereby restricting blood flow to the muscles which will have a

negative impact on performance during high-intensity gross motor activities [1,2]. Several studies have shown that stress and anxiety will affect muscular function and rate of recovery following strenuous exercise. Stults-Kolehmainen and colleagues [3,4] found that following a bout of strenuous leg exercise in 31 active undergraduates, stresses in life affected levels of energy ( $p = 0.038$ ), fatigue ( $p = 0.040$ ), soreness ( $p = 0.027$ ) and the rate of recovery of maximal isometric force ( $p, 0.001$ ). Bartholomew and colleagues [5] found that low-stress participants experienced a significantly greater increase in bench press and squat than their high-stress counterparts following a 12-week training program. Therefore, it can be seen that high levels of stress may reduce a person's ability to adapt to weight training. Generally, athletes will experience higher levels of anxiety just before or during competition. Competitive anxiety and worry are common emotions that athletes at all levels experience to varying degrees before a competition, whether it is anxiety over performing in front of large audiences, worry about not meeting expectations, or simply competing in an unfamiliar environment. Maclean and Lyttleton [6] suggest that anxiety may lead to poor concentration, insomnia and physical and mental fatigue. There has been a growing realization that psychological factors, especially stress and anxiety before and during competition play a major role in determining the frequency, severity, and extent of injuries in sports [7-9]. Furthermore, in competitive athletes, both anxiety and stress are associated with the diminished performance of an athlete and are responsible for the discontinuation of sport participation [10,11]. Anxiety is a multidimensional construct and



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comprises cognitive and somatic components, which influence performance [12,13]. The cognitive is the mental element, which is characterized by negative expectations about success or self-evaluation, negative self-talk, worries about performance, images of failure, inability to concentrate, and disrupted attention [12,14]. The somatic is the physiological element, which relates to autonomic arousals, negative symptoms such as feelings of nervousness, high blood pressure, dry throat, muscular tension, rapid heart rate, sweaty palms, and butterflies in the stomach [12,13]. Acupuncture has been used in the field of sports medicine for several decades; however, its primary use within this field has been in the management of pain and enhancing the healing process following sports injuries [15]. Acupuncture has been shown to be an effective treatment modality for the management of general anxiety disorders. In a systematic review and meta-analysis, Yang, et al. [16] evaluated 20 RCTs to determine the effects of acupuncture on anxiety disorder. They found that acupuncture was more effective than the control condition, with a standard mean effect size of -0.41, and that acupuncture intervention showed good tolerance and safety in the treatment of anxiety disorder. Although acupuncture has been shown to be effective in the management of general anxiety disorder, a review of literature and meta-analysis has not been undertaken that evaluates the effect of acupuncture on competition-induced anxiety in competitive athletes. Thus, the aim of this review is to evaluate the effect of acupuncture on competition-induced anxiety in elite athletes to provide an overall efficacy of the use of acupuncture in the management of competitive anxiety. This review will provide evidence-based information to allow sports psychologists, athletes, coaches, and managers to make an informed decision on the use of acupuncture to reduce anxiety levels and improve muscle function and recovery during training and competition.

## Methods

This review is reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [17].

### Search strategy and study selection

A systematic literature search was performed by SB and TE on the following databases from their inception to 2022: MEDLINE, Embase, SPORTDiscus, CINAHL, AMED, ProQuest nursing journal, PubMed, ScienceDirect, the Cochrane Central Register of Controlled Trials, PEDro, Google Scholar, specialized registry of the Cochrane Musculoskeletal Group and the Cochrane Field of Physical and Related Therapies. The keyword search included: Acupuncture, auricular acupuncture, laser acupuncture, TENS, electroacupuncture, acupressure, or acupoint. These were combined with sports anxiety, competitive anxiety, sports psychology, competition

nervousness, and competition stress. The bibliographies and references of published studies and reviews were scanned for other possible RCTs. The reviewers (SB and TE) determined the studies to be included based on the inclusion and exclusion criteria. To be included in this review, a study had to meet the following criteria: RCTs that had used acupuncture to treat competitive anxiety, stress, self-esteem, or nervousness in competitive athletes. No language restrictions were imposed, and translations were sought where necessary. Only published RCTs in English or translated into English were included.

### Data extraction and quality assessment

The guidelines of the Cochrane Handbook for Systematic Reviews of Interventions [18] were used to assess the methodological quality and to exclude studies with fatal flaws. The risk of bias was assessed using the Cochrane grading system in the RevMan 5.4 software by two reviewers (SB and TE) to evaluate: (a) Sequence generation, (b) Allocation concealment, (c) Blinding of participants and therapists, (d) Blinding of outcome assessor, (e) Incomplete outcome data, and (f) Selective outcome reporting. After evaluation of each domain, the studies were classified as low, unclear, or high risk of bias. Acupuncture intervention was assessed using the Standards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA) [19].

## Results

### Study selection

Figure 1 shows the PRISMA flow diagram outlining the selection of the included studies. A total of 36 studies were located; 22 were excluded either because they were duplicates, a single case study, were in Chinese and could not be obtained in English, or they did not include a control group. Eight full text studies were identified in which 2 were not an RCT and one was a protocol and were therefore removed. Five RCTs were finally included in the systematic review.

### Study characteristics

The characteristics of each study are presented in Table 1. The studies reviewed were published between 2003 and 2021 and included 219 participants aged between 16 and 40-years-old (mean age of 19.04 yrs). The sample size was generally small and ranged from 20 to 103 participants in each study. Two studies [20,21] had fewer than 30 participants. Four studies [21-24] applied one treatment session and one study [20] applied treatment daily for 3 days. Three studies [22-24] applied treatment 3-4 hours before competition and assessed the effect of acupuncture 30 minutes following intervention. One study [21] applied treatment 24 hours before competition and assessed the effect of acupuncture 1 hour following intervention; and one study [20] applied treatment daily during a

**Table 1:** Characteristics of the studies that assessed the effects of acupuncture on competitive anxiety in elite athletes.

Authors	No	Intervention group	Control/sham group	Outcome Measures	Results
Khojastefar, et al. [21]	20 male elite soccer players Crossover design	Received MA on fifteen points related to anxiety. Ear points: Tranquilizer and Shenmen and body points: EX-HN1, Gov-20, PC-6, HT-7, UB-62.  Treatment time = 30 minutes Assessed 30 minutes following intervention	Received MA on fifteen points unrelated to anxiety.  Treatment time = 30 minutes	Measure of resting heart rate, galvanic skin conduction and Competitive State Anxiety Inventory-2 questionnaire	SD on the cognitive anxiety level ( $p = 0.02$ ) but not on somatic anxiety level and sport self-confidence
Shayestehfar, et al. [24]	45 male elite soccer players	Received MA on ear points: Tranquilizer and Shenmen  Treatment time = 30 minutes Assessed 30 minutes following intervention	SA group received needling to same points and the MA group using sham needles  Treatment time = 30 minutes. Control group received no treatment and rested for 30 minutes.	Measure of resting heart rate, galvanic skin conduction and Competitive State Anxiety Inventory-2 questionnaire	MA significantly reduced cognitive anxiety ( $p = 0.001$ ) and somatic anxiety ( $p < 0.001$ ) but did not change self-confidence ( $p > 0.05$ ).  Furthermore, MA significantly decreased the skin conductance compared to SA group ( $p = 0.006$ ) and wait-list control group ( $p < 0.001$ ).
Zarei, et al. [23]	30 male soccer players	Received MA on ear points: Tranquilizer and Shenmen  Treatment time = 30 minutes Assessed 30 minutes following intervention	SA group received needling to same points and the MA group using sham needles  Treatment time = 30 minutes.	Measure of resting heart rate, galvanic skin conduction and Competitive State Anxiety Inventory-2 questionnaire	MA had a significant effect on cognitive anxiety ( $p = 0.001$ ) and somatic anxiety ( $p < 0.001$ ) but not self-confidence ( $p > 0.05$ ). MA significantly decreased the skin conductance in acupuncture group compared to sham group ( $p = 0.006$ ) ( $p < 0.001$ ).
Shu, et al. [22]	103 male and female sprint athletes	All subjects were needled at point 1 at both wrists 3 hours before track session. Treatment time = 30 minutes Assessed 30 minutes following intervention	Sham acupuncture (blunt needle) was performed on point 1 at the wrists 3 h before the track event sessions. The needle was retained for 30 min.	The competitive state anxiety scale was used as the primary outcome measure.  Expectation and treatment credibility scale and participants' feeling of acupuncture questionnaire for secondary outcome measures.	A significant difference was observed in somatic state anxiety and cognitive state anxiety in the WAA group from pre- to post treatment ( $p < 0.001$ , $p = 0.001$ ). No significant change in the score of self-confidence state was found in both the groups. Cognitive state anxiety improved significantly in the post treatment WAA group compared with the sham group.

Akimoto, et al. [20]	21 elite female soccer players	Received EA 2Hz to LI-4, ST- 36, ST-6 for 20 minutes and Lu-6 for 15 minutes 4 hours after the game each night of the competition period (3 days).  Assessed on each day of the competition and 3 days post competition.	Control group received no treatment	Salivary secretory immunoglobulin A level, cortisol level in saliva, subjective rating of physical well-being, and profile of mood states (POMS)	Salivary concentration of cortisol was significantly lower in acupuncture group than in the control group at days 2 and 3 ( $p < 0.05$ ). fatigue" did not change throughout the study in the acupuncture group, whereas it was heavier during the period of competition in the control group.  Mental fatigue and confusion ( $p < 0.05$ ) remained low during the competition for the EA group compared to control.
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SD: Significant Differences; No SD: No Significant Differences; MA: Manual Acupuncture; EA: Electroacupuncture; SA: Sham Acupuncture

three-day soccer tournament and assessed the effect of acupuncture each day and three days following intervention. There were 46 female and 173 male participants reported to take part in the trials. Three studies [20,21,24] used elite soccer players; one study [23] used competitive male and female soccer players; and one study [22] used competitive sprint athletes. One study [21] used auricular and body points, two studies [23,24] used auricular acupuncture, and two studies [20,22] used body points only.

### Study quality

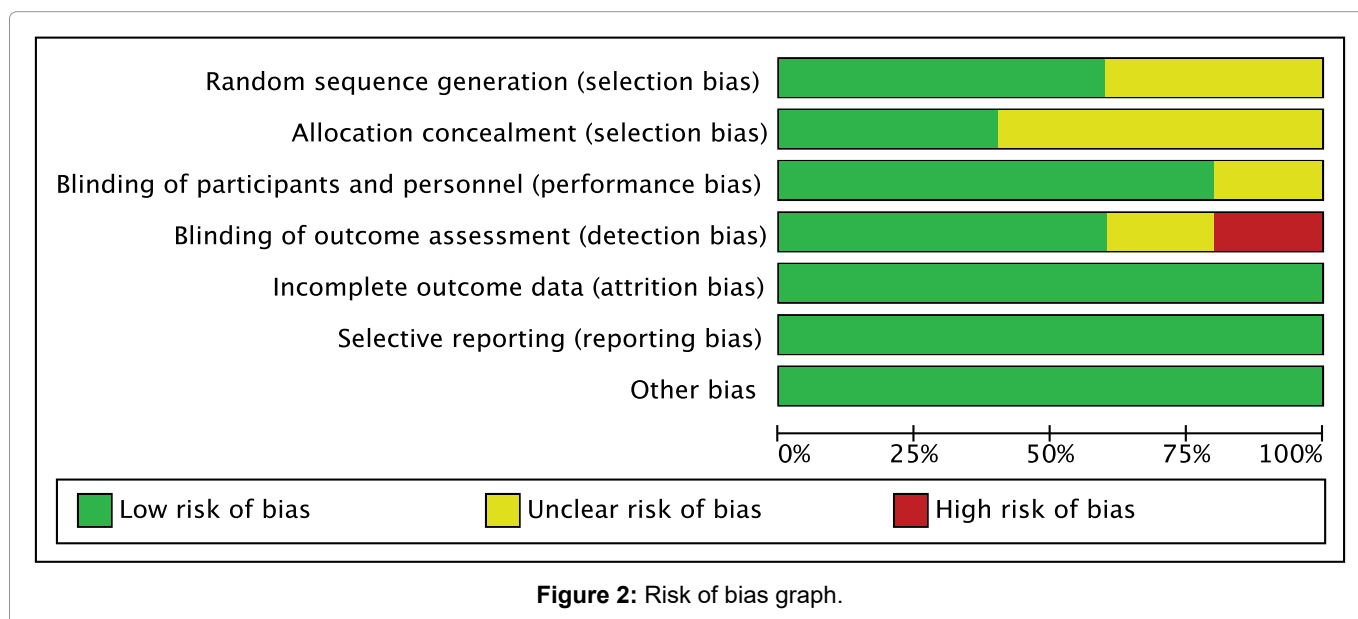
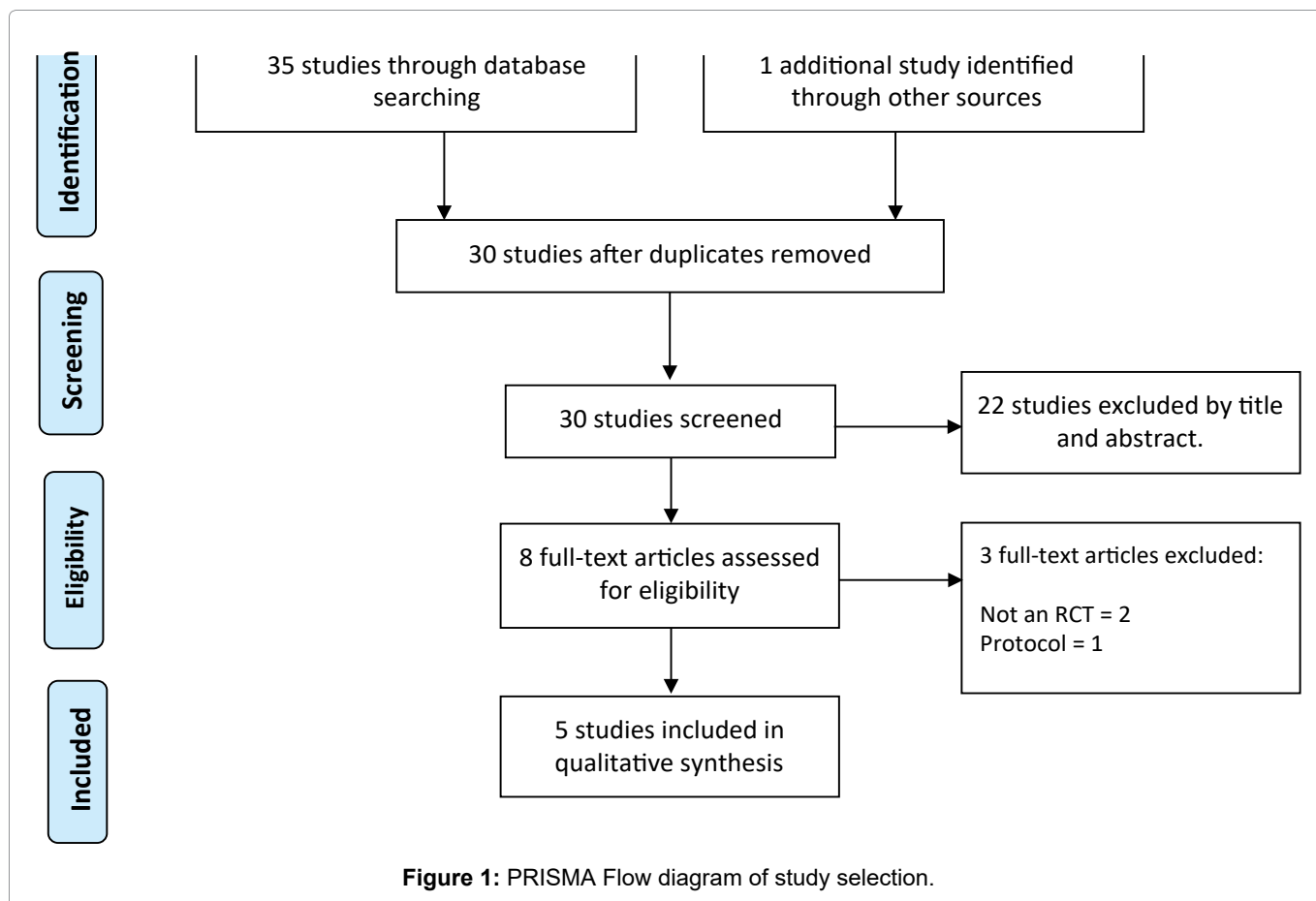
Figure 2 presents the percentage of the risk of bias across all the included RCTs. The risk of bias across all RCTs is summarized in Figure 3. Two studies were rated as unclear (?) for sequence generation and three studies were rated as low risk of bias (+). Three studies gave an unclear description or did not discuss the method of allocation and concealment. Generally, there was a low risk of bias (+) with regards to blinding of participants and personnel and blinding of outcome assessors; otherwise, the studies were unclear in their explanation of blinding of participants and personnel and blinding of outcome assessors. All the studies rated low for incomplete outcome data, selective reporting, and other sources.

### Acupuncture intervention

None of the RCTs assessed in this review stated that they had used the STRICTA checklist as a guide. However, all the recommendations on the checklist were fulfilled by three [20-22] of the RCTs. The methodological bias was low in the study by Shayestehfar and colleagues [24] but the standards of reporting the acupuncture intervention were very poor with no mention of the acupuncture rationale, and very limited information on the needling technique, treatment regimen and the practitioner's background. The study by Zarei, et al. [23] had a high risk of methodological bias and scored low on the STRICTA with limited information on the needling technique, treatment regimen and the practitioner's background and no information on the acupuncture rationale and justification for the choice of acupuncture points.

**Sham acupuncture/control intervention:** Three of the studies [22-24] used sham needles on the same acupoints as the acupuncture intervention group. One study [21] applied Manual Acupuncture (MA) on acupoints unrelated to anxiety, and two studies [20,24] used a control group that received no treatment and rested while the intervention group received acupuncture treatment.

**Delayed effect of acupuncture:** Both human and animal studies have shown that the effects of acupuncture have a delayed onset, with a gradual peak, and a gradual return to baseline [25-27]. Wright, et al.



[28] announced that acupuncture at the Yintang point reported significantly less anxiety 20 minutes post-application of acupuncture in comparison with the control group. Furthermore, several studies [13,29,30] have demonstrated that the intensities of cognitive and somatic anxiety increased between two hours and thirty minutes prior to competition. Most studies in this review appear to have taken into consideration the delayed effect of acupuncture and the increase in the intensity of anxiety prior to competition. Generally, acupuncture was applied at least 3 hours before the competition

and the effect of acupuncture was measured at least 20 minutes following the intervention. Three studies [22-24] applied a single acupuncture treatment session and then carried out an assessment of competitive anxiety 30 minutes after acupuncture treatment had ended. One study [21] used a cross-over design and carried out an assessment immediately following acupuncture treatment. The study by Akimoto, et al. [20] applied acupuncture treatment daily over four days of a three-day soccer competition. Acupuncture treatment was administered between 20:00 hours and 22:00 hours

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Akimoto et al 2003	?	?	?	?	+	+	+
Khojastefar et al 2021	+	+	+	+	+	+	+
Shayestehfar et al 2016	+	?	+	+	+	+	+
Shu et al 2017	+	+	+	+	+	+	+
Zarei et al 2017	?	?	+	-	+	+	+

**Figure 3:** Risk of bias summary.

one day before the competition and continued over the three days of the competition. Assessment of competitive anxiety was taken at 18:00 hours on each day of the competition and finally three days following the competition.

### Effect of acupuncture on competitive state anxiety

Anxiety is a term that is used to describe a group of physiological (somatic) and emotional (cognitive) symptoms and can be classified as somatic anxiety or cognitive anxiety. Somatic symptoms include increased heart rate, butterflies, heavy breathing, sweating, dizziness, nausea, and muscle tension. Cognitive symptoms include negative thoughts, feeling of apprehension, excessive worry, difficulty concentrating, fear, and nervousness. Competitors may suffer from both cognitive and somatic anxiety or may present with one more than the other. A little anxiety before a competition is normal and will allow an athlete to get pumped up and focused before an event to give them a competitive edge. Robinson and Freeston [31] announced that anxiety should not always be perceived as a bad emotion;

rather it could motivate the athlete to be more focused and enhance performance. However, if the anxiety is excessive and is not managed properly this will start to impact their self-confidence and performance. The main tool for measuring competitive state anxiety is the Competitive State Anxiety Inventory-2 (CSAI-2), which was developed by Martens and colleagues in 1990 [32]. It was later revised by Cox, Martens, and Russell in 2003; [33] both versions contain subscales for cognitive anxiety, somatic anxiety, and self-confidence. Several studies [34,35] have shown the Competitive State Anxiety Inventory to be a valid and reliable assessment tool for pre-competition state anxiety. In this review, four studies [21-24] used the Competitive State Anxiety Inventory-2 questionnaire to assess the cognitive and somatic anxiety and self-confidence of athletes prior to competition. One study [20] used the Profile of Mood States (POMS) questionnaire, which is a standard validated psychological test used in research to measure mood.

Out of the four studies that used the CSAI-2 to

assess competitive state anxiety, three [22-24] found a significant ( $p = 0.001$ ) clinical effect in favor of manual acupuncture for the reduction of cognitive and state anxiety. The study by Khojastefar, et al. [21] found a significant reduction ( $p = 0.02$ ) in cognitive anxiety but not in somatic anxiety levels in the acupuncture intervention group. All four studies found no significant change in self-confidence. One study [20] used the POMS questionnaire to measure and assess mood prior to competition. They found that mental fatigue and confusion ( $P < 0.05$ ) remained low during the competition for the electroacupuncture (EA) whereas it remained high in the control group.

### Meta-analysis

A meta-analysis was conducted using the fixed effects model on four studies consisting of 198 participants who completed the Competitive State Anxiety Inventory-2 (CSAI-2) questionnaire to assess the levels of competitive anxiety before a competition. The study by Akimoto, et al. [20] was not included in the pooled data of the meta-analysis because a profile of mood state questionnaire was used to assess competitive anxiety and not a CSAI-2 questionnaire.

### Effect of acupuncture on somatic anxiety

When acupuncture was compared with the control ( $I^2 = 91\%$ ) or sham group ( $I^2 = 81\%$ ) for somatic anxiety, the heterogeneity statistics were substantially high, indicating that there is significant variability in the results. Somatic anxiety was statistically lower in the acupuncture group compared with the control ( $Chi^2 = 10.71$ ,  $df = 1$ ,  $p < 0.001$ ; 95% CI -0.87) with a significantly large effect size (1.92,  $p = 0.05$ ). Somatic anxiety was significantly lower in the acupuncture group when compared with the sham acupuncture group ( $Chi^2 = 10.32$ ,  $df = 2$ ,  $p = 0.006$ ; 95% CI -2.11), with a significantly large effect size (2.47,  $p = 0.01$ ).

### Effect of acupuncture on cognitive anxiety

When acupuncture was compared with the control ( $I^2 = 31\%$ ) or sham group ( $I^2 = 0\%$ ) for cognitive anxiety, the heterogeneity statistics were low. The acupuncture group presented with a lower level of cognitive anxiety compared with the control group ( $Chi^2 = 1.45$ ,  $df = 1$ ,  $p = 0.23$ ; 95% CI -3.62) with a significantly large effect size (2.99,  $p = 0.003$ ). Cognitive anxiety was significantly lower in the acupuncture group when compared with the sham acupuncture group ( $Chi^2 = 1.05$ ,  $df = 2$ ,  $p < 0.59$ ; 95% CI (-4.06, -2.54), with a significantly large effect size (3.26,  $p = 0.001$ ).

### Effect of acupuncture on self-confidence

When acupuncture was compared with the control for self-confidence, the heterogeneity statistics were substantially low ( $I^2 = 0\%$ ) but high when compared with sham ( $I^2 = 76\%$ ). The acupuncture group presented with

a lower level of self-confidence compared with the sham group ( $Chi^2 = 8.47$ ,  $df = 2$ ,  $p = 0.01$ ; 95% CI -1.01, effect size = 1.07,  $p = 0.28$ ) but a higher level of self-confidence compared with the control group ( $Chi^2 = 0.93$ ,  $df = 1$ ,  $p < 0.33$ ; 95% CI -0.29, effect size = 0.52  $p = 0.60$ ). The results indicate that the overall difference between the groups was insignificant in the management of self-confidence.

### Discussion

Elite athletes in competitive sports face significant pressure to perform well which may lead to a heightened level of anxiety. A certain amount of anxiety is considered beneficial as it allows an athlete to be more alert and focused. However, high levels of stress and anxiety may lead to a loss of concentration, increased mental fatigue, reduced ability to adapt to strength training [5], reduced energy levels and reduced rate of recovery between training sessions [3,4]. Hence, the aim of this review was to assess the effect of acupuncture in the management of anxiety in athletes prior to competition. Following a detailed search of several databases, five articles were retrieved in which four used the Competitive State Anxiety Inventory-2 questionnaire to assess competitive anxiety before a competition and one study used the POMS to assess the physical well-being and mood during a competition period. Akimoto and colleagues [20] examined the effect of acupuncture treatment on physical well-being using the POMS on 21 elite female soccer players during a competition period. They found that in the acupuncture group, mental fatigue and confusion remained significantly ( $p < 0.05$ ) lower than in the control group during the period of the competition. Khojastefar, et al. [21] compared the effects of acupuncture against a control group on competitive anxiety using a cross-over design on 20 elite male soccer players under 21 years of age. Unlike the other four studies, Khojastefar and colleagues [21] did not assess athletes during a competition; instead, they created an imaginary process that would arouse competitive anxiety. Before starting the evaluation process, each participant was asked to study a sheet and visualize its content in his mind. The sheet included common events in a competition, such as conflicts with the opposing team athletes, refereeing misjudgments, and the anxiety and stress in the competition field due to the possibility of losing the match. Before and one hour after each treatment session, each participant completed the outcome measurements. The overall results showed a significant treatment effect for the acupuncture intervention ( $p = 0.02$ ) for cognitive state anxiety but no change for somatic anxiety and self-confidence. The data from this study was significantly lower than the data in the other four studies that used real competitive events to assess the athletes. It has been shown [36] that the intensity of anxiety is much greater during competition than during training sessions. Therefore, the data from the study by Khojastefar and colleagues [21] may have

impacted the findings of the heterogeneity of the meta-analysis. Shayestehfar, et al. [24] examined the effect of acupuncture on anxiety on 45 elite adolescent soccer players prior to competition. Participants were equally allocated to either an acupuncture group, sham group, or wait-list control group. Acupuncture was found to have a significant effect on cognitive anxiety ( $p < 0.001$ ) and somatic anxiety ( $p < 0.001$ ) but not on self-confidence ( $p < 0.05$ ) when compared with the control and wait-list control. In agreement with the results of Shayestehfar, et al. [24] the studies by Zarei, et al. [23] and Shu, et al. [22] found a significant effect in the acupuncture group for somatic anxiety and cognitive anxiety compared with the sham acupuncture group but no significant effect on self-confidence. In all the studies, there were no adverse events reported, and the dropout rate of the acupuncture and control groups reported in the study by Shu, et al. [22] was 2.84%. When the data from the four studies that used the CSAI-2 questionnaire was pooled for the meta-analysis, we found a statistical significantly large effect size for cognitive and somatic anxiety in favor of acupuncture intervention. There was a medium (0.52,  $p = 0.60$  in favor of control) and large (1.07,  $p = 0.28$  in favor of acupuncture v sham) effect size for self-confidence. However, the  $p$  values across all studies for self-confidence were above 0.05 indicating that there was no significant difference between groups for self-confidence. Our results agree with the findings of Yang, et al. [16] who undertook a systematic review and meta-analysis on 20 RCTs that used the generalized anxiety disorder questionnaire to explore whether acupuncture has a positive effect on anxiety disorders. They found that acupuncture was more effective than the control condition in the management of anxiety disorders, with a standard mean effect size of - 0.41. Our results indicate that acupuncture has a similar effect to psychological interventions on reducing anxiety levels in competitive athletes. Ong, et al. [37] investigated the effects of psychological interventions (relaxation, multimodal, imaginary, and self-talk) on competitive anxiety in sports. They found a medium to large-sized effect on levels of cognitive anxiety ( $g = -0.54$ ) and self-confidence ( $g = 0.55$ ) and a small to medium-sized effect for somatic anxiety ( $g = -0.36$ ).

## Conclusion

Acupuncture has a good effect on the management of competitive somatic and cognitive anxiety. However, further studies are required with a large sample size to determine the effect of acupuncture in the management of competitive self-confidence.

## Limitations

There were several limitations encountered in this review. Because of the small number of studies in this review, it was not feasible to remove studies that may have influenced a high heterogeneity. A sensitivity analysis was not conducted to see if the results and

conclusions drawn were vastly different when the outlier/influencer studies are excluded because the number of studies in this review was too small. There were a small number of participants in each group, which may have impacted the results of the meta-analysis. The results from two [23,24] separate studies by a group of similar authors present identical data.

## Conflict of Interest

The author declares that they have no conflict of interest, and the author has no financial interest related to the material of this manuscript.

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