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Mindfulness-based stress reduction and athletic performance anxiety among competitive university athletes: A randomized controlled study

Dr. Raghavendra Kulkarni, Dr. Meenal Deshpande
Department of Sports Psychology, Savitribai Phule Pune University, Pune, Maharashtra, India

Abstract
Background: Competitive university athletes frequently experience performance anxiety, which can adversely affect concentration, motor execution, and overall athletic output. Mindfulness-Based Stress Reduction (MBSR) has gained considerable traction in clinical and performance psychology as an evidence-based strategy for managing anxiety; however, its application within competitive collegiate sport settings remains underexplored.
Objective: This study aimed to evaluate the efficacy of an eight-week MBSR intervention programme on reducing performance anxiety and improving self-reported mental readiness among competitive university athletes across team and individual sports disciplines.
Method: A randomized controlled trial (RCT) design was employed. Sixty competitive athletes (n = 60; 34 male, 26 female; Mage = 20.4 ± 1.8 years) from a large public university were randomly assigned to either an MBSR intervention group (n = 30) or a waitlist control group (n = 30). Pre- and post-intervention measures included the Sport Anxiety Scale-2 (SAS-2), the Cognitive Appraisal of Performance Scale (CAPS), and cortisol saliva samples. Data were analyzed using SPSS v.28 with repeated-measures ANCOVA. This study uses a simulated dataset created for academic training purposes.
Key Results: The MBSR group demonstrated a statistically significant reduction in somatic anxiety ($p < 0.001$, $\eta^2 = 0.41$), worry subscale scores ($p = 0.003$), and cortisol levels ($p = 0.012$) compared to controls. Self-confidence indices improved by 27.3% in the intervention group.
Conclusion: MBSR is an effective, scalable, and low-cost adjunct to standard athletic training programmes for managing performance anxiety in competitive university sports environments.

Keywords: Mindfulness, performance anxiety, collegiate athletes, MBSR, sports psychology, cortisol

Introduction

Athletic performance is profoundly influenced by psychological factors, and among these, performance anxiety stands as one of the most pervasive and debilitating challenges encountered by competitive athletes across skill levels [1]. The phenomenon of pre-competition anxiety — encompassing both somatic (physiological arousal) and cognitive (worry, self-doubt) dimensions — has been documented as a significant predictor of suboptimal performance, particularly in high-stakes university-level competition environments [2].

Globally, university sport presents a unique confluence of academic pressure, identity formation, and athletic aspiration. Young athletes between 18 and 24 years of age are simultaneously navigating academic demands, social transitions, and elite performance expectations, creating a fertile environment for anxiety disorders and sport-specific anxiety manifestations [3]. The prevalence of clinically significant anxiety among collegiate athletes has been estimated at between 14% and 25%, with many cases going undetected or unmanaged within sport psychology support services [4].

Mindfulness-Based Stress Reduction (MBSR), originally developed by Jon Kabat-Zinn at the University of Massachusetts Medical School in 1979, represents a structured eight-week programme integrating mindfulness meditation, body scanning, and gentle yoga with cognitive awareness training [5]. While MBSR has demonstrated strong efficacy in reducing anxiety, depression, and chronic pain in clinical populations, its systematic application to sports performance psychology has only recently attracted rigorous empirical attention [6].

Previous research has suggested that mindfulness practices may improve attentional control, emotional regulation, and acceptance of performance-related discomfort — all critical components of athletic resilience [7]. However, most prior studies have relied on non-randomized designs, small convenience samples, or lacked objective physiological markers (e.g., cortisol) to validate self-report findings [8].

The present study addresses these limitations by employing a rigorous randomized controlled trial (RCT) design with a multimodal assessment battery spanning psychological self-report, cognitive appraisal, and neuroendocrine biomarkers. The primary objective is to determine whether an eight-week MBSR intervention, adapted for university athletes, produces significant reductions in performance anxiety relative to a waitlist control condition. Secondary objectives include examining changes in self-confidence and cognitive appraisal of competitive situations [9].

The findings of this study have practical implications for university sport psychologists, athletic directors, and coaches seeking evidence-based, cost-effective mental performance tools that can be integrated into existing training calendars without disrupting physical preparation schedules [10].

Literature Review

The conceptual foundation of this investigation draws upon three interlocking theoretical frameworks: the Multidimensional Anxiety Theory (MAT) [11], the

Mindfulness-to-Meaning Theory (MMT) [12], and the Attention Control Theory of anxiety in sport [13].

Martens *et al* [11]. distinguished somatic from cognitive anxiety and proposed differential relationships with performance — somatic anxiety exhibits an inverted-U relationship with performance, while cognitive anxiety maintains a more linear and consistently negative association. This framework remains widely applied in sports psychology measurement and has directly influenced the design of assessment tools such as the Competitive State Anxiety Inventory-2 (CSAI-2) and its revised Sports Anxiety Scale-2 (SAS-2) iteration [14].

The Mindfulness-to-Meaning Theory, developed by Garland and colleagues [12], proposes that mindfulness practice enables individuals to broaden cognitive appraisals of stressful events, recontextualizing threats as challenges through a process termed 'reappraisal.' This mechanism is particularly germane to sport contexts, where athletes must frequently reframe competitive adversity — injuries, errors, crowd hostility — into motivational stimuli rather than anxiety-inducing threats [15].

Eysenck's Attention Control Theory (ACT) [13] provides a cognitive architecture for understanding how anxiety disrupts performance by impairing the efficiency of inhibition and shifting executive functions. Mindfulness training has been theorized to directly enhance attentional control by strengthening prefrontal regulatory circuits, thereby buffering against the performance-decrements induced by competitive anxiety [16].

Empirically, Birrer *et al* [17]. conducted a systematic review of mindfulness-based interventions in sport and concluded that while evidence was promising, methodological limitations — including lack of active control groups, heterogeneous outcome measures, and short follow-up periods — precluded firm conclusions. Noetel *et al* [18]. subsequently meta-analyzed 28 studies and reported moderate effect sizes (d = 0.55) for mindfulness interventions on sport-specific anxiety, with MBSR producing the largest effects compared to briefer, app-based formats.

Cortisol, a glucocorticoid hormone released by the hypothalamic-pituitary-adrenal (HPA) axis in response to psychosocial stressors, has been increasingly adopted as an objective anxiety biomarker in sports research [19]. Several studies have reported that mindfulness practice attenuates cortisol reactivity in both clinical and non-clinical populations; however, its application in the context of pre-competition anxiety among athletes remains sparse [20].

A critical research gap exists regarding the combined assessment of psychological, cognitive, and neuroendocrine outcomes within a single RCT framework adapted specifically for university-level sports populations. Prior RCTs have either used self-report exclusively or included cortisol without cognitive appraisal measures, limiting the mechanistic interpretations of how MBSR reduces performance anxiety. The present study is designed to address this gap directly.

Methodology

1. Research Design

A pre-test/post-test randomized controlled trial (RCT) design was employed across an eight-week intervention period. Ethical approval was obtained from the Institutional Review Board (IRB) of [University Name] (Reference: [IRB-XXXX-2026]). All participants provided written informed consent prior to enrolment.

2. Participants

Sixty university-level competitive athletes (34 male, 26 female; Mage = 20.4 ± 1.8 years) were recruited from the university athletic department via purposive sampling. Inclusion criteria required active participation in at least one varsity or competitive sport for a minimum of one year, no prior formal mindfulness training, and no current psychiatric medication. Participants were randomly assigned using a computer-generated randomization sequence to either the MBSR intervention group (n = 30) or a waitlist control group (n = 30).

3. Intervention

The MBSR programme followed Kabat-Zinn's standardized eight-week protocol, adapted with sport-specific visualizations and performance-context examples. Sessions ran 90 minutes per week, supplemented by daily 15-minute home practice guided by audio recordings. Control group participants continued with regular athletic training and received no mindfulness instruction until the study's conclusion.

4. Instruments

(i) Sport Anxiety Scale-2 (SAS-2): A 15-item validated instrument measuring somatic anxiety, worry, and concentration disruption on a 4-point Likert scale ($\alpha = 0.89$). (ii) Cognitive Appraisal of Performance Scale (CAPS): A 10-item scale assessing threat-versus-challenge cognitive appraisal of competitive scenarios ($\alpha = 0.82$). (iii) Morning salivary cortisol samples were collected on two consecutive pre-competition days at baseline and post-intervention using Salivette collection tubes and analyzed via ELISA immunoassay.

Statistical analysis

Data were analyzed using IBM SPSS Statistics v.28. Repeated-measures ANCOVA was performed with group (MBSR vs. Control) as the between-subjects factor and time (pre vs. post) as the within-subjects factor, covarying for baseline sport type (individual vs. team). Cohen's η^2 [2] was computed for effect sizes. Significance was set at $\alpha = 0.05$.

Note: This study uses a simulated dataset created for academic training purposes. All statistical outputs below represent plausible, illustrative results consistent with the research design described.

4. Results and discussion

1. Demographic profile

Table 1: Participant Demographic Characteristics by Group

Variable	MBSR Group (n=30)	Control Group (n=30)
Age (Mean ± SD)	20.2 ± 1.7 years	20.6 ± 1.9 years
Male / Female	17 / 13	17 / 13
Individual Sport	14 (46.7%)	15 (50.0%)
Team Sport	16 (53.3%)	15 (50.0%)
Training Yrs (Mean ± SD)	4.8 ± 1.5	4.6 ± 1.7

Source: Simulated dataset created for academic training purposes (2026)

No significant baseline differences were found between groups on any demographic or outcome variable (all $p > 0.05$), confirming successful randomization and comparability of groups at the outset of the trial.

2. Primary outcome sport anxiety scale-2

Table 2: Pre- and Post-Intervention SAS-2 Scores by Group and Subscale

Subscale	MBSR Pre	MBSR Post	Ctrl Pre	Ctrl Post	p-value
Somatic Anxiety	22.4 ± 4.1	14.2 ± 3.6	22.1 ± 3.9	21.7 ± 4.2	< 0.001**
Worry	18.7 ± 3.8	13.5 ± 3.2	19.2 ± 4.0	18.9 ± 3.7	0.003**
Concentration Disruption	14.3 ± 3.5	10.1 ± 2.9	14.6 ± 3.6	14.4 ± 3.5	0.007**

Source: Simulated training dataset (2026). **p < 0.01 (ANCOVA, $\eta^2 = 0.38–0.41$)

The MBSR group exhibited clinically and statistically significant reductions across all three SAS-2 subscales. The somatic anxiety subscale showed the largest effect size ($\eta^2 = 0.41$), consistent with MBSR's primary mechanisms of reducing physiological arousal through parasympathetic activation and diaphragmatic breathing regulation [21]. Control group scores remained essentially stable across the eight-week period, ruling out regression-to-the-mean effects.

3. Salivary cortisol and cognitive appraisal

Table 3: Salivary cortisol and caps scores — pre vs. post comparison

Measure	MBSR Pre	MBSR Post	Ctrl Pre	Ctrl Post
Cortisol (nmol/L)	18.4 ± 5.2	13.1 ± 4.0*	18.9 ± 4.9	18.5 ± 5.1
CAPS Threat Score	26.3 ± 6.1	18.7 ± 4.8**	25.9 ± 5.7	26.0 ± 6.0
CAPS Challenge Score	31.2 ± 5.4	39.6 ± 5.1**	30.8 ± 5.6	31.0 ± 5.4

Source: Simulated training dataset (2026). *p < 0.05; **p < 0.01 (repeated-measures ANCOVA)

Post-intervention cortisol levels in the MBSR group decreased by 28.8% from baseline (18.4 to 13.1 nmol/L), a statistically significant change ($p = 0.012$, $\eta^2 = 0.29$). This finding aligns with meta-analytic evidence[22] demonstrating that eight or more weeks of mindfulness practice consistently reduces HPA-axis reactivity to psychosocial stressors. The control group showed negligible cortisol change (−0.4 nmol/L, $p = 0.71$), confirming the intervention-specific nature of the effect.

Cognitive appraisal patterns shifted favorably in the MBSR group: threat appraisal scores declined significantly ($\Delta = -7.6$ points, $p < 0.01$) while challenge appraisal increased substantially ($\Delta = +8.4$ points, $p < 0.01$), indicating a reorientation from threat to challenge framing of competitive scenarios — a key mechanism proposed by the Mindfulness-to-Meaning Theory [12].

These multi-level findings — spanning subjective anxiety experience, neuroendocrine stress reactivity, and cognitive appraisal collectively provide convergent validity for the efficacy of the MBSR adaptation employed in this trial.

Conclusion

This randomized controlled trial provides robust multi-level evidence that an eight-week MBSR intervention, adapted for the university sport context, significantly reduces performance anxiety across somatic, cognitive, and neuroendocrine domains. The practical implications are considerable: MBSR requires no specialized equipment, integrates naturally into weekly training schedules, and produces lasting shifts in cognitive appraisal that may generalize beyond single competitive events.

These findings support the systematic integration of MBSR components into university athletic programmes, particularly during pre-season training periods characterized by heightened evaluative stress. Sport psychologists should consider employing standardized MBSR protocols alongside conventional psychological skills training to address the full spectrum of performance anxiety symptoms.

Limitations include the single-institution sample, the absence of a three- or six-month follow-up assessment, and the use of a waitlist rather than an active control condition. Future research should examine long-term maintenance of anxiety reductions, explore dose-response relationships (session frequency vs. outcome magnitude), and investigate potential moderating variables including sport type, competition level, and baseline mindfulness trait scores.

Ethical Statement

This article was prepared as an original academic training document. No real participant data, real institutional datasets, or copyrighted instruments were reproduced without permission. The dataset referenced herein is explicitly simulated for educational and formatting practice purposes. All author and institution details are placeholders to be completed by the researcher. This article does not misrepresent any real-world study, identity, or publication.

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