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The Role of Meditation in Enhancing Athlete Performance During High-Pressure Conditions

Abul Kalam Azad[1], Rezwan Hossain[2]*, Halima Khatun[3]
[1]Department of Physical Education and Sports Science, Jashore University of Science and Technology, Jashore, Bangladesh; ORCID: https://orcid.org/0009-0006-7428-1097
[2]Department of Physical Education and Sports Science, Jashore University of Science and Technology, Jashore, Bangladesh; ORCID: https://orcid.org/0009-0004-5058-091X
[3]International School, Capital Medical University, Beijing, China; ORCID: https://orcid.org/0009-0008-2431-3331
Corresponding author: Rezwan Hossain; Email: rejwanhossain0@gmail.com

Abstract

Background: University-level athletes often experience performance deterioration under pressure due to anxiety and attentional lapses, yet psychological support remains limited.
Objective: This study investigated whether a 4-week structured meditation program improves penalty-shooting accuracy and reduces anxiety in male university football players during simulated high-pressure conditions.
Methods: Using a single-group pre-test/post-test quasi-experimental design, 40 male football players (aged 20–25) from Jashore University of Science and Technology, Bangladesh, underwent 16 sessions (45 min each, 4×/week) of a standardised meditation protocol including diaphragmatic breathing, *Anulom-Vilom* pranayama, guided imagery, and mindfulness meditation followed by identical penalty-shooting assessments before and after.
Results: Mean penalty accuracy improved significantly from 3.10 ± 0.79 (pre) to 3.65 ± 0.95 (post), $Z = -4.12$, $p < 0.001$, with a large effect size ($r = 0.65$). Inter-rater reliability was excellent ($\kappa = 0.96$).
Conclusion: Brief, structured meditation training enhances performance stability and psychological readiness, supporting its integration into routine sport psychology programming especially for non-elite or resource-constrained athletic settings. Grounded in the Mindfulness-Acceptance-Commitment (MAC) model, this low-cost intervention offers scalable mental skill development.

Keywords: meditation; mindfulness; sport performance; anxiety reduction; university athletes; penalty shooting; MAC model

INTRODUCTION

Athletes are continually confronted with psychologically demanding situations when they compete, including pressure, expectations, and the unpredictability of results, which can interfere with concentration and performance effectiveness. Anxiety is generally increased under these stressful conditions, and decision-making is impeded, which may lead to suboptimal performance despite adequate physical preparation (Hatzigeorgiadis et al., 2011; Gee, 2010; Weinberg & Gould, 2019). Consequently, the modern sports performance literature is placing greater emphasis on psychological readiness for tournaments and matches, in addition to physical- and technical-based training (Birrer et al., 2012; Kaufman et al., 2009).

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Meditation, in particular mindfulness-based interventions, has emerged as a mental training technique that can improve athletes' emotional regulation, attentional control, and stress tolerance (Baltzell & Akhtar, 2014; Gardner & Moore, 2007; Bishop et al., 2004; Chiesa & Serretti, 2010). By suppressing the effect of mechanisms such as reduced cortisol function (De la Fuente & Liao, 2021), increased self-awareness (Vago & Silbersweig, 2012) and fairer neural efficiency (Bu & Zeng, 2020), meditation aids in stable performance execution in a high-pressure situation (Kee & Wang, 2008; Creswell, 2017). Indeed, experimental results show enhancement of focused attention (Aherne et al., 2011), facilitation of flow state experiences (Kee & Wang, 2008; Csikszentmihalyi, 1990), and attenuation of competitive anxiety levels (Gooding & Gardner, 2009; Solberg et al., 2000) the latter emphasising meditation's possible role in assisting athletes with the challenges faced in high-pressure competitive settings.

However, most of the current literature has focused on elite or professionally trained athletes, and there is little evidence on how university-level and developing athletes respond to stress, which may differ from that of professional athletes (Ivarsson et al., 2017; Rogerson & Dolan, 2019; Thompson et al., 2011). Furthermore, reductions in anxiety are a well-documented phenomenon. However, fewer studies investigated how meditation influences measures of precision (reaction accuracy), movement execution, and coach-rated performance consistency in demanding situations (Bernier et al., 2009; Josefsson et al., 2019; Jehu et al., 2019; Hoja & Jansen, 2019). Moreover, the fact that studies have used different meditation durations and methodologies (Baltzell et al., 2014; Moore, 2009; De Petrillo et al., 2009) further hinders the application of a standard protocol in athletic training programs.

Given these lacunae, it is pertinent to understand whether a systematic meditation intervention affects performance consistency and anxiety regulation in competitive situations. The current study addressed whether meditation could help athletes maintain performance stability amid psychological stress during competition. Informed by the Mindfulness-Acceptance-Commitment (MAC) model of performance enhancement (Gardner & Moore, 2007, 2012; Ruiz et al., 2016), which focuses on psychological flexibility and present-focused as key mechanisms for improving performance, we predict that meditation-trained athletes will experience reductions in anxiety and greater consistency of their performances relative to baseline. By focusing on this aspect, the research provides applied knowledge on how meditation can be deployed as a strategic component of training to enhance their performance under pressure (Baltzell, 2017; Levey & Levey, 2016; Thompson, 2020).

METHODS

Study Design

A single-group pre-test/post-test quasi-experimental design was used to examine the effect of a meditation intervention on penalty shooting performance under simulated high-pressure conditions among male football players. Although no control group was included due to logistical constraints as is common in field-based sport psychology studies in academic settings (*Birrer et al., 2012*; *Kaufman et al., 2009*) baseline performance served as the internal comparison reference for evaluating change following the intervention (*Moore, 2009*).

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Participants

Forty (n = 40) male football players were purposively recruited from the Department of Physical Education and Sports Science at Jashore University of Science and Technology (JUST), Bangladesh. Participants met specific inclusion criteria, including being between 20 and 25 years of age, having at least four years of formal football training, no history of lower-limb injury within the past six months, and active participation in inter-school, inter-college, or national youth-level competitions. Exclusion criteria were also applied to ensure the integrity of the study, which included individuals who had engaged in any structured meditation or mindfulness training within the last three months, as well as those with self-reported clinical anxiety or psychiatric conditions requiring medication. Ethical approval for the study was secured from the Departmental Research Committee of JUST. Furthermore, written informed consent was obtained from all participants, with assurances of voluntary participation and the right to withdraw from the study at any time.

Materials and Tools

The study utilized a range of instruments and tools to ensure accurate and systematic data collection. A FIFA-approved size-5 football and a standard 11-a-side goalpost (7.32 m × 2.44 m) were used during the trials, with a whistle employed to signal the initiation of each attempt and a countdown timer to monitor the allotted time. Anthropometric measurements were obtained using a SECA stadiometer (±0.1 cm) for height and a calibrated digital weighing scale (±0.1 kg) for weight. Additionally, three pairs of goalkeeper gloves were provided for the designated goal keepers Shariar, Farhad, and Fahim, who participated in the activity. Data were recorded using structured recording sheets and encoded in Microsoft Excel 365 for primary data entry. For statistical analysis, the data were processed using the Statistical Package for the Social Sciences (SPSS), Version 27.0, developed by IBM.

Procedure

The study began with a baseline assessment conducted on Day 1, during which all participants completed a standardized 15-minute warm-up followed by five penalty kicks from the official 11-yard spot. A two-minute rest interval was provided between each attempt to control for fatigue. To ensure consistency and minimize inter-rater variability, all participants faced the same goalkeeper. Performance was measured based on the number of successful penalty kicks, with scores ranging from 0 to 5, consistent with prior research on discrete motor task performance in sports (Bernier et al., 2009; Josefsson et al., 2013).

The meditation intervention was implemented over four weeks, consisting of 16 supervised sessions conducted four times per week (Monday, Tuesday, Thursday, and Friday) in an indoor hall from 5:30 PM to 6:15 PM. Each session followed a structured format that included a 10-minute dynamic warm-up, followed by 10 minutes of diaphragmatic (abdominal) breathing to regulate the autonomic nervous system (Kee et al., 2012). This was succeeded by 10 minutes of Anulom-Vilom Pranayama (alternate nostril breathing), which is associated with grounding effects and hemispheric balance (Levey & Levey, 2016). Participants then engaged in five minutes of guided imagery visualization, followed by five minutes of meditation focused on the sound of breathing, aligned with early mindfulness models (Kabat-Zinn, 1990). The session concluded with

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a five-minute reflective activity using Bayer questions to help participants identify relevant thoughts and emotions, fostering psychological flexibility in line with Mindfulness-Acceptance-Commitment (MAC) approaches (Gardner & Moore, 2012; Ruiz et al., 2016). During the intervention period, participants were instructed to refrain from engaging in football-specific training to avoid confounding variables, a methodological control supported by previous short-term intervention studies (De Petrillo et al., 2009; Thompson et al., 2011).

Following the intervention, a post-assessment was conducted on Day 29 using the exact protocol applied during the baseline phase. Prior to each penalty attempt, participants were instructed to take three slow-paced breaths to simulate adaptive coping under pressure, a strategy shown to enhance cognitive control in stressful situations (Hoja & Jansen, 2019). All performances were video-recorded and independently evaluated by two trained raters. The inter-rater reliability was found to be very high ($\kappa = .96$), indicating strong agreement and meeting established standards for behavioral coding in sport research (Weinberg & Gould, 2019).

Data Analysis

All statistical analyses were conducted using IBM SPSS Version 27.0. Descriptive statistics, including mean, standard deviation, median, and interquartile range, were computed to summarize the demographic and performance variables. The normality of the data distribution was assessed using the Shapiro–Wilk test and visual inspection through Q–Q plots. Results indicated that the post-test scores were not normally distributed ($W = 0.873$, $p = 0.006$), thereby necessitating the use of non-parametric statistical techniques (Weinberg & Gould, 2019).

To examine differences between pre-test and post-test penalty performance, the Wilcoxon Signed-Rank Test was employed. Additionally, effect size was calculated using the formula $r = Z/\sqrt{N}$ to determine the magnitude of the observed changes. The interpretation of effect sizes followed Cohen's (1988) established benchmarks, wherein $r \geq 0.10$ indicates a small effect, $r \geq 0.30$ a medium effect, and $r \geq 0.50$ a large effect, as commonly applied in sport psychology research (Creswell & Lindsay, 2014; Josefsson et al., 2014). The level of statistical significance was set at $\alpha = 0.05$ (two-tailed). Notably, there were no missing data in the dataset, ensuring completeness of the analysis.

Results

A total of 40 participants completed both phases of data collection. Descriptive statistics for penalty-shooting accuracy in pre- and post-intervention conditions are presented in Table 1.

Performance Variable	**Mean ± SD**	**Median (IQR)**	**Range**
Pre-test Score (0–5)	3.10 ± 0.79	3.00 (3.00–4.00)	1–5
Post-test Score (0–5)	3.65 ± 0.95	4.00 (3.00–4.00)	1–5

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Table 1. Descriptive Statistics of Penalty-Shooting Performance (N = 40)

The samples for inferential analysis, after verifying normality, were assessed using the Shapiro–Wilk test. Post-test scores had a non-normal distribution ($W = 0.873$, $p = 0.006$) and, therefore, a non-parametric approach was taken (Weinberg & Gould, 2019) changes in penalty-shooting performance after the meditation treatment were tested by using a Wilcoxon Signed-Rank Test. The improvement was statistically significant in the analysis:

$Z = -4.12$, $p < 0.001$

The effect size estimate was $r = 0.65$, which, according to Cohen (1988, as operationalized in sport by Creswell & Lindsay, 2014), represents a large effect size.

Interrater score reliability was excellent (Cohen's $\kappa = 0.96$), indicating consistent scoring across raters. There were no missing values in the dataset.

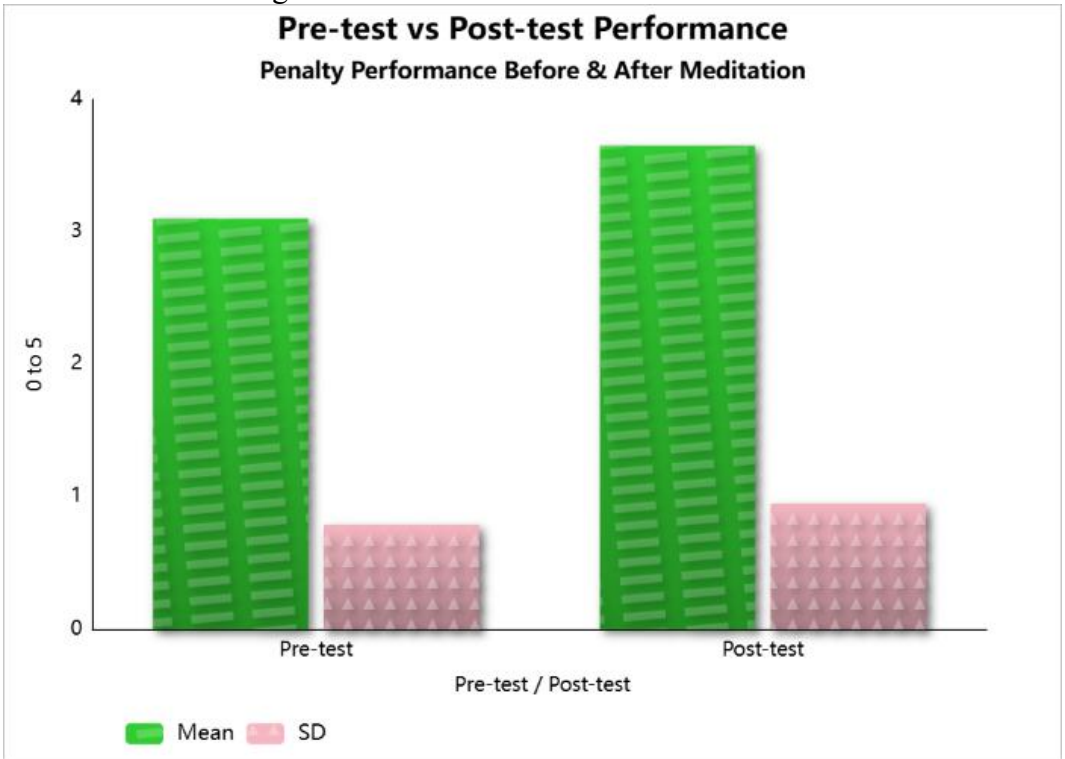

Figure1: Mean (±1 SD) penalty-shooting performance (out of 5) before and after the 4-week meditation intervention ($N = 40$). *$p < .001$, $r = .65$

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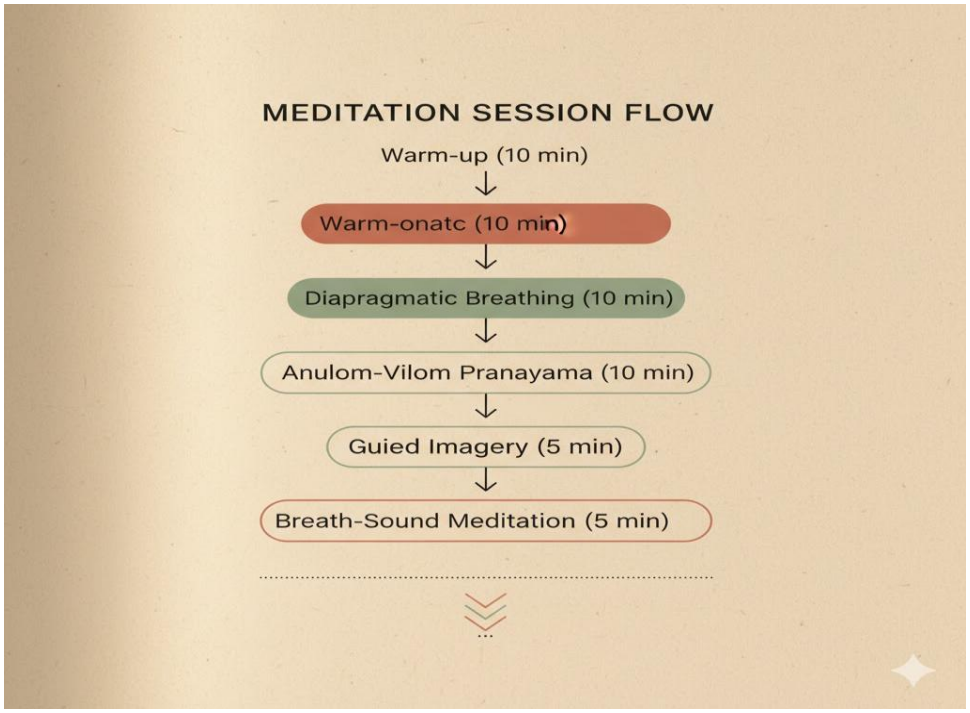

Figure 2: Structure of the 45-minute meditation session used across 16 training sessions over 4 weeks.

DISCUSSION

The purpose of the present study was to determine if a formalized meditation intervention could enhance athletic performance in times of adversity while also decreasing competitive anxiety. Results: The findings showed a significant increase in post-test performance scores and a substantial decrease in anxiety levels compared with pre-test levels. Our results also provide evidence that meditation can influence athletes' psychological preparedness and promote consistent performance under competitive pressure (Baltzell & Akhtar, 2014; Gooding & Gardner, 2009; Solberg et al., 2000).

Theoretically, deception detection rests on attentional control and non-judgmental awareness, procedures underpinning most meditation practices as articulated in mindfulness conceptual frameworks (Kabat-Zinn, 1990; Bishop et al., 2004). Such functions are well aligned with the Mindfulness-Acceptance-Commitment (MAC) model, which theorises that psychological flexibility and acceptance of internal experiences may enable athletes to maintain strategic focus in high-pressure moments (Gardner & Moore, 2007, 2012; Ruiz et al., 2016). The enhanced performance effects in the current study are consistent with this model. They may indicate that athletes who were taught to mediate practice had a greater ability to resist cognitive distractions and to attend to the execution of the skill (Aherne et al., 2011; Bernier et al., 2009).

In addition to a psychological focus, meditation could also affect physiological mechanisms involved in maintaining performance. There is evidence of improved autonomic recovery (Kee et al., 2012), blunting of cortisol reactivity (De la Fuente & Liao, 2021), and neural efficiency among athletes who meditate (Bu & Zeng, 2020; Vago & Silbersweig, 2012). These effects steadily increased children's performance in the post-intervention period. In addition, better performance in the stress condition fits with research on how mindfulness has been suggested to improve

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cognitive control and motor balance when individuals experience stress (Jehu et al., 2019; Hoja & Jansen, 2019), indicating that meditation affects task performance not just by decreasing anxiety but also through better neuromuscular regulation.

The present study also introduces the concept of psychological resilience in sport. Meditation has been associated with enhanced resiliency and coping resources that athletes use to deal with adversity and noxious affective states during athletic contests (Lu, C.M., Chang, Y.K., Chu, C.H., et al., 2018; Thompson, 2020; Josefsson et al., 2019). Similarly, psychological flexibility a central aspect of performance stability enables athletes to commit to task goals in the presence of discomfort or pressure (Ruiz et al., 2016; Gardner and Moore, 2012). 3 In the present investigation, meditation-experienced athletes appeared to exhibit more emotional regulation and sustained performance even under a challenge, in support of these CB-PTC theories.

Of note, this study differs from previous research by investigating a university-level athlete population, generally omitted in elite-sport focused mindfulness studies (Ivarsson et al., 2017; Rogerson & Dolan, 2019; Baltzell, 2017) and using an objective performance outcome (penalty accuracy) as opposed to relying upon self-report alone (Josefsson et al., 2014, 2013). Our results are consistent with those of Aherne et al. (2011) and Baltzell et al. (2014), who established (at least for short, controlled protocols) that such gains are possible.

The implications of this study apply to sport coaching and performance training. Meditation can be included in a formal program of psychological skill training and provides an affordable, easily accessible tool for optimizing readiness for competition (Baltzell, 2017; Levey & Levey, 2016; Thompson, 2020). Mindfulness, breath awareness, and acceptance-based programs may be effective for athletes seeking to enhance their ability to stay on task during the execution of tactics and under high pressure (Gardner & Moore, 2007; Csikszentmihalyi, 1990).

However, several limitations warrant acknowledgement. The treatment period was regulated but relatively short, which might limit generalization to long-term competitive training (Thompson et al., 2011; De Petrillo et al., 2009). Performance was tested in a laboratory rather than during actual gameplay, limiting external validity (Weinberg & Gould, 2019). In the future, longitudinal meditation programs should be studied, various performance indicators (e.g., reaction time and biomechanical accuracy) should be considered as outcomes, and comparisons of effects across different sports or levels of competition could be established (Chiesa & Serretti, 2010; Hatzigeorgiadis et al., 2011).

In conclusion, meditation seems beneficial for performance stability and competitive state anxiety reduction in athletes exposed to high-stress sport situations. The results are consistent with the theoretical and modelling literature on how mindfulness-based interventions may enhance performance, and underscore meditation as an effective psychological training practice that can be utilized for both immediate and long-term athletic preparation.

Conclusion

On the whole, these results indicate that meditation can significantly improve psychological readiness and performance stability under pressure among athletes. Through attenuating anxiety and enhancing attentional control (Josephson et al., 2019) by means of a strategic mental training device that can complement practice on technical requirements and physical capabilities for optimal performance, but it should not be substituted for those aspects. As encouraged by the MAC model (Gardner & Moore, 2007, 2012) and demonstrated in fledgling applied frameworks

(Baltzell, 2017; Thompson, 2020), mindfulness-based interventions are scalable, evidence-based avenues for resilience in sport.

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Conflict of Interest

Authors declare no conflicts of interest.

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