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Considerations on the Influence of Mindfulness and Sports Games on the Performance of Taekwondo Athletes

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Abstract: *The research examines the importance of psychological training in preparing taekwondo athletes, proposing innovative methods to enhance their performance through mindfulness techniques and specific training games. The main objective is to improve emotional control, reaction speed, and balance—essential factors for competitive success in contact sports. Given that modern sports involve numerous physical and psychological challenges, the study addresses the need for a holistic training approach that supports both the physical and mental preparation of athletes. To achieve concrete results, a structured six-week program was implemented, with regular training sessions combining mindfulness techniques and games aimed at developing balance and reaction speed, applied to a sample of 30 participants. The mindfulness practices used include the Wheel of Awareness method, which helps athletes enhance focus and reduce anxiety, allowing them to concentrate more effectively under pressure. Additionally, sports-specific games were introduced to increase athlete engagement and motivation, facilitating the development of physical skills in an enjoyable and efficient way. The research' s findings indicate a reduction in stress and anxiety levels and improvements in balance and reaction speed, demonstrating that the integration of psychological components in training can be a key factor in enhancing athletic performance. The conclusions support the application of an integrated approach to sports training that includes both physical and psychological components to optimize athletes' potential in competitive settings.*

Keywords: *taekwondo, mindfulness, stress, anxiety, performance.*

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Introduction

This study examines how psychological training techniques impact the performance of taekwondo athletes, enhancing their understanding of the importance of mental skills in high-performance sports. This study emphasizes an often-overlooked aspect—the psychological component—in contrast to most existing research that mainly concentrates on physical training and tactical strategies. The literature highlights that mental skills, including stress management, concentration, and anxiety control, are important for achieving optimal performance (Birrer & Morgan, 2010).

The study also corresponds with current trends that examine how sports can help reduce tension and anxiety in today's complex daily life. Studies indicate that psychological methods, including mindfulness and progressive relaxation techniques, enhance performance and support the overall well-being of athletes (Høigaard et al., 2008).

However, a significant limitation of the research is the challenge of separating the effects of psychological training from those of physical and tactical preparation. This issue frequently arises in interdisciplinary sports studies, resulting in overlaps between variables and broad interpretations of the findings (Birrer & Morgan, 2010). Another problem with psychological training is that there aren't any standard techniques, and they aren't tailored to the needs of athletes well enough, as shown in new research (Gucciardi et al., 2017).

Although there are limitations, the study makes an important contribution to the incorporation of psychological training in performance sports. It emphasizes the necessity of systematically addressing this aspect, particularly in sports such as taekwondo, where psychological preparation can affect the handling of competitive anxiety and rapid decision-making. Including longitudinal studies and personalizing interventions in the research could enhance our understanding of the psychological effects on sports performance.

The primary aim was to assess the impact of mindfulness and particular sports games on the performance of Taekwondo players. The research concentrated on cortisol levels (a stress indicator), anxiety levels, reaction time, and balance. The primary objective was to ascertain if the incorporation of mindfulness and response games might enhance athletes' performance in competitions, offering coaches a refinement tool in the absence of a psychologist.

Literature review

The concept of performance involves both physiological and psychological factors that influence each other. It describes how individuals or groups behave based on particular skills and the conditions under which they perform. Building up certain adaptation skills to deal with unexpected environmental factors and making good use of these skills during sports competitions can affect performance (Kellmann & Beckmann, 2018). Performance can be affected by physical factors like endurance, strength, speed, or flexibility, as well as psychological factors such as concentration, motivation, and willpower (Beckmann & Elbe, 2015).

The world recognizes Taekwondo as a martial art. It has been part of the Olympic Games since 2000 (Kazemi et al., 2010) and is currently practiced by millions of individuals in more than 200 countries, as reported by the International Olympic Committee (2021). In a competition, athletes utilize powerful and rapid kicks and punches directed at the opponent's torso or head. These activities are intense anaerobic or aerobic exercises that include vigorous movements of the lower limbs (Kim et al., 2015). Furthermore, agility, flexibility, and muscular endurance are essential for sustaining high performance in Taekwondo athletes (Kim & Nam, 2021).

Insufficient research currently exists to show the effects of psychological training on the sports performance of taekwondo practitioners and to determine methods to highlight this aspect. Nam et al. (2022) noted that complete athletic performance requires both mental strength and athletic skills. The researchers found that psychological skills play an important role in reaching peak performance. They observed that elite athletes tend to possess greater self-confidence and experience less anxiety than those with less impressive outcomes.

Methodology

In performing this research, various methods of investigation were employed, including the bibliographic study method, the testing method, the statistical analysis method, and the graphical representation method. We developed the intervention plan by studying specialized literature to ensure it meets the needs of the athletes.

This study involved 60 participants, who are taekwondo practitioners associated with the Romanian Taekwondo Federation WT. They were from three clubs in Iaşi and one in Botoşani. For inclusion in the study, athletes needed to satisfy these criteria: they must be aged between 14 and 18 years and have a minimum performance level, which is determined by at least one

year of practice and participation in at least one competition. Because the subjects were minors, their legal representatives filled out consent forms for both participating in the study and for sample collection.

We allocated the participants into two equal groups: one experimental and one control. We predicated the categorization into these categories on the outcomes from the STAI (Trait Anxiety Questionnaire), which measures an individual's anxiety propensity to maintain equilibrium between the two groups. The analysis of this questionnaire utilized the Independent Samples test, and the p-value ($p=0.0474$) shows that there are no statistically significant differences between the two groups (Table 1).

Table 1. Validation of groups based on the outcomes derived from the STAI Trait Anxiety Questionnaire

	Average	P value
Experimental group	40.43	.474
Control group	40.57	

This research is based on three primary hypotheses and four supplementary hypotheses, as outlined in the bibliographic documentation.

***Main Hypothesis 1*: Implementing a mindfulness program may alleviate stress and anxiety among taekwondo practitioners.**

Secondary Hypothesis 1.1. We anticipate that the implementation of a mindfulness program will reduce stress levels among taekwondo practitioners during training.

Secondary Hypothesis 1.2. We anticipate that the implementation of a mindfulness program will lower the anxiety levels of taekwondo athletes.

***Main Hypothesis 2:* The incorporation of particular sports games into training sessions may affect the reaction speed and balance of taekwondo practitioners.**

Secondary Hypothesis 2.1. Specific sports games utilized during training sessions affect the reaction speed of taekwondo practitioners.

Secondary Hypothesis 2.2: Certain sports games, implemented during training sessions, may affect the static balance of taekwondo practitioners.

***Main Hypothesis 3:* The use of the recommended approaches will enhance the performance of taekwondo athletes, evidenced by improved outcomes in tournaments.**

We implemented the intervention plan twice a week for 6 weeks (one mesocycle) during the final third of the training period. We created the sports games using taekwondo techniques, with a focus on improving reaction speed

and balance. In the initial two weeks, the emphasis was on improving balance. The following two weeks concentrated on enhancing reaction speed, and the final phase involved activities that integrated both reaction speed and balance. We utilized the mindfulness technique known as "The Wheel of Awareness" during the final 10 minutes of each training session.

Wielgosz et al. (2019), Foster & Chow (2020), and Sappington & Longshore (2015) have emphasized the advantages of mindfulness meditation in alleviating stress and anxiety, along with its versatility across various domains. Their findings emphasized its importance in athletic training and performance, with research indicating a decrease in anxiety, better relaxation, and improved motor control.

Siegel's Wheel of Awareness demonstrates how the mind perceives and interacts with reality, improving self-awareness and promoting open awareness through focused attention and the management of distractions (Forman, 2013).

Research shows that incorporating sports activities into training enhances motivation among participants, leading to greater enthusiasm and enjoyment while also supporting their development in a dynamic and indirect way (Yu et al., 2018).

This research analyzed factors such as reaction speed, balance, anxiety, and stress in taekwondo practitioners. A preliminary test was done to check the stress hormone cortisol levels in the saliva, the subjects' trait anxiety (to see how prone they were to anxiety), their current state anxiety, their reaction time using the Tre-action app, and their balance using the posturograph's stabilometric plate.

Saliva contains various biomarkers that indicate health status and body response to stimuli, such as cortisol, testosterone, immunoglobulins, alpha-amylase, and melatonin. This information is supported by studies conducted by Gatti & De Palo (2011) and Hayes et al. (2015). These biomarkers are crucial for comprehending the body's response to the physical and psychological stress elicited by rigorous athletic activity. Sports research is increasingly using this to assess stress and adaptability to training, as it enables sample collection in various settings without requiring sophisticated equipment or skilled medical professionals.

This investigation noted intermittent anxiety among the subjects; none of them received a clinical diagnosis of anxiety disorders from a specialist. The STAI anxiety inventory is a commonly utilized psychometric instrument for evaluating anxiety levels, consistently revised and validated in clinical and sports psychology contexts. STAI comprises two separate subscales that measure anxiety in terms of state and trait. Recent studies

confirm the validity and reliability of the STAI across various contexts, particularly in evaluating anxiety associated with sports and academic performance (Balsamo et al., 2013; Marteau & Bekker, 2020).

In taekwondo bouts, which consist of alternating high-intensity efforts and low-intensity phases, the significance of the response time and execution speed of techniques is paramount. In non-Olympic disciplines like poomsae (forms), referees evaluate the speed of execution and the consistency of technique execution times by competitors (Avramov & Grigorova, 2022).

Even though there have been other studies using standard tests to measure reaction time in taekwondo athletes (Asia & Warkar, 2013), this study used the TReactionCo program and a modified keyboard to measure the athletes' reactions. At the end of each test, the program shows the results and finds the average, as well as the lowest and highest values for both upper limbs. This study utilized the application's feature that measures athletes' simple reaction time via eye-hand coordination.

The central nervous system regulates the perception, regulation, and execution of musculoskeletal movements by integrating input from three primary subsystems: somatosensory, vestibular, and visual. The optimal functioning of these three subsystems substantially influences a positive balance (Coughlan et al., 2012). The change in competition regulations, which now award extra points for head-level blows, especially those executed from jumps and spins, has led competitors to focus more on these tactics (Lee et al., 2020). In taekwondo, most landings occur on one foot, which, depending on the jump's height, applies pressure approximately tenfold the body weight on the ankle, hence generating significant shock at the joint level. Consequently, the equilibrium of practitioners is crucial for these landings to occur under optimal conditions, thereby averting injuries and mishaps that could jeopardize their athletic careers (Doherty et al., 2015; Smith et al., 2015).

The Faculty of Physical Education and Sports in Iaşi provided the posturograph for assessing balance. The posturograph's functions included the utilization of a stabilometric platform for balance and dynamic analysis in conjunction with GPS software. This shows how the weight is distributed on the three support points of the foot (metatarsophalangeal joint 1, metatarsophalangeal joint 5, and the calcaneus), as well as the forward and backward, left and right, curve length, angular deviation, and ellipsoid area.

The study faced limitations, including the absence of a club psychologist, travel requirements for posturograph testing, injury occurrences during the competitive season, and conflicting training schedules. The study suggests increasing the participant sample size and

extending the duration of the intervention to enhance data representativeness and variability. These modifications would improve the validity and generalizability of the research findings.

Data Analysis

The analysis of the data was performed using SPSS version 20.0, with a significance level established for all statistical tests at $p < 0.05$. The Shapiro-Wilk test and visual methods, such as histograms and QQ-Plots, were used to check the distribution of the data. Because the initial and final levels of salivary cortisol did not have a normal distribution ($p < 0.05$), the Wilcoxon test was applied to compare them within each group.

An analysis of covariance (ANCOVA) was done with the initial cortisol level as a covariate to see how being in a group affected the final cortisol level while keeping the initial values in mind. We used Pearson correlation to look at the link between state anxiety levels and cortisol, and linear regression analysis to see how well they could predict changes in cortisol levels. The study used both parametric and non-parametric tests to carefully look at the intervention's effects and get a clear picture of how physiological and psychological factors are connected.

Findings

Due to the absence of a normal distribution in the groups, we used the Wilcoxon test to evaluate the athletes' salivary cortisol results (figure 1). Both groups demonstrated statistically significant differences, albeit in opposing directions. The experimental group exhibited a reduction in stress following the intervention ($p = 0.039$, initial-final mean difference = 2.71), while the athletes in the control group attained values nearly double those of the initial assessment ($p = 0.001$, initial-final mean difference = -1.99).

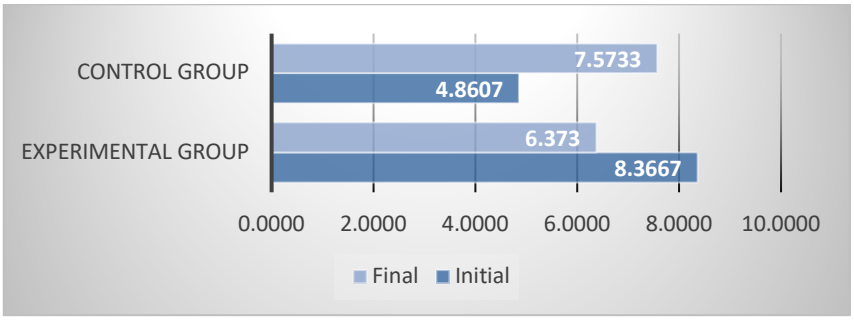


Figure 1. The means achieved by the two groups in the salivary cortisol assessment (initial-final)

The experimental group exhibited a significant reduction in anxiety levels (p=0.000, initial-final mean difference=5) compared to the control group (p=0.361, initial-final mean difference=-1.37), as illustrated in figure 2.

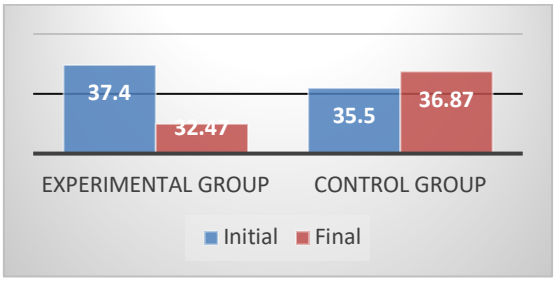


Figure 2. Initial and final means of the two groups on STAI-state

Table 2. The Wilcoxon test for the results obtained in the reaction speed evaluation

	Experimental group	Std. Deviation	Control group	Std. Deviation
Speed reaction-Left	Z= -3.281 **P= .001**	Initial=±35.545 Final = ±28.809	Z= -.761 P= .447	Initial=±46.236 Final = ±66.676
Speed reaction-Right	Z= -3.086 **P= .002**	Initial=±34.877 Final =±44.007	Z= -1.790 P= .073	Initial=±43.091 Final =±67.784
Errors-Left	Z= -1.000 P= .317	Initial=±1.03335 Final =±1.04166	Z= -.320 P= .763	Initial= ±0.53498 Final =±0.63968
Errors-Right	Z= -.312 P= .755	Initial=±0.69149 Final =±1.38298	Z= -1.897 P=.058	Initial=±0.46609 Final =±0.30513

We employed the Wilcoxon Signed Ranks test to assess the disparities between the first and final assessments of reaction speed. The experimental group exhibited significant differences between starting and final measures for both the left hand (Z = -3.281, p = 0.001) and the right hand (Z = -3.086, p = 0.002). The results indicate that particular sports games utilized during training sessions significantly enhanced reaction speed in athletes from the experimental group. Conversely, the Wilcoxon tests for the control group (Table 2) showed no significant differences between the baseline and final assessments (Z = -0.761, p = 0.447 for the left hand; Z= -1.790, p = 0.073 for the right hand).

The specific games implemented for the patients did not yield statistically significant differences in static balance, nor did the control group exhibit any notable changes.

The results of the athletes at the national championships in 2023/2024 indicated an enhancement in performance for the experimental group, achieving higher rankings than the previous year or maintaining the same level, in contrast to the control group, where most participants exhibited regression.

Discussions

Taekwondo practitioners show significant reductions in stress levels, with the mindfulness intervention being effective. However, addressing social, academic, and age-related stressors is crucial for optimal effectiveness. A comprehensive strategy that addresses both sport-specific and external stressors may lead to a more lasting decrease in stress levels among taekwondo practitioners.

Studies have demonstrated that mindfulness techniques reduce cortisol levels, a biomarker of stress, leading to a reduction in perceived stress. Gardner & Moore (2017) highlighted that mindfulness can enhance emotional reactions, particularly in reducing stress, among athletes.

Sukys et al. (2019) research suggests that athletes' baseline stress levels significantly influence the effectiveness of mindfulness therapies, emphasizing the need for tailored interventions. Wang et al. (2024b) study also highlights the impact of group affiliation and application setting. Lilja et al. (2015) propose that the effectiveness of mindfulness therapy may differ according to individual characteristics and environmental contexts.

The research demonstrated that a mindfulness program significantly decreased anxiety levels in taekwondo players, thereby supporting the hypothesis that it alleviates anxiety in athletes. This aligns with the findings of Sipe & Eisendrath (2012), which indicate that mindfulness therapies reduce anxiety symptoms, particularly in clinical populations, while also providing notable advantages for healthy individuals, especially athletes.

Gardner & Moore (2017) examined the correlation between mindfulness and athletic performance, suggesting that mindfulness's stress alleviation enhances emotional responses, notably diminishing anxiety, which is crucial for peak performance.

The study suggests that athletes' anxiety levels remain stable without mindfulness interventions, highlighting the importance of these interventions in enhancing their psychological well-being (Beauchemin et al., 2008).

The confirmation of Hypothesis 2.1 highlights the importance of psychological training and mindfulness in sports, emphasizing the need to strike a balance between speed and accuracy to reduce errors. The study by Shaabani et al. (2020) and Birrer et al. (2012) provides evidence that targeted sports training enhances reaction speed, a critical factor in athletic performance.

The correlation between speed and errors highlights the imperative of incorporating psychological strategies into sports training to assist players in sustaining attention and managing competitive stress without sacrificing accuracy for speed (Shaabani et al., 2020). Birrer et al. (2012) research emphasizes the importance of personalizing interventions for the specific demands of athletes, suggesting that coaches must refine training regimens to align with both physical and psychological needs.

The results demonstrated that for the majority of variables, there were no significant differences between the beginning and final measures, indicating that the intervention did not substantially affect the athletes' balance. Nonetheless, prior studies have demonstrated that particular exercises can enhance dynamic balance in contact sports (Hwang et al., 2013; Brachman et al., 2017). Exercises enhance dynamic balance in contact sports, influenced by initial factors such as baseline stability and prior sports experience, which affect outcomes following intervention (Remaud et al., 2013).

The study does not confirm the impact of specific sports games on the balance of taekwondo practitioners, despite some isolated advancements, on a global scale. Recent studies highlight the intricate nature of equilibrium, emphasizing the need for more targeted actions and the influence of various external and internal factors (Pereira et al., 2022; Hammami et al., 2016).

The study found that the participants' lower limb injuries limited their ability to fully utilize training interventions for enhancing balance, indicating that the ineffectiveness of the training and compromised physical condition were significant factors. Elite athletes require rest and rehabilitation strategies for injury avoidance, balance enhancement, and performance improvement. This is because physical condition significantly impacts balance training, and post-injury rehabilitation is crucial for the recovery of motor capabilities (Dai et al., 2015; Butler et al., 2013).

The study partially supports main hypothesis 2, suggesting that sports games during training enhance the reaction speed of taekwondo practitioners; however, it does not affect balance, and secondary hypothesis 2.2 remains unvalidated.

Specialized literature underscores that response time is crucial for contact sports, and training using targeted workouts can yield substantial

enhancements in this domain (Wang et al., 2024b). Consequently, while balance did not exhibit a substantial improvement, the increase in reaction speed signifies a considerable achievement of the implemented training regimen.

Conclusions

The research showed that mindfulness training and certain sports games positively affected the performance of taekwondo practitioners, leading to a notable decrease in stress and anxiety levels. In comparison to the control group, athletes who took part in the mindfulness program indicated a decrease in stress and anxiety, which supports the primary hypothesis 1. The results are in line with other research that shows that mindfulness improves focus and emotional stability during competitions, leading to better performance under pressure (Baltzell & Summers, 2017).

The analysis also confirmed that adding certain sports games to the training sessions had a positive effect on reaction speed, which supports secondary hypothesis 2.1. Still, the improvements in balance were not statistically significant, which means that the games did not have a big effect on this area. This could be because each person is different or because the intervention lasted too long. This result does not support secondary hypothesis 2.2 and suggests that changes in the training methodology are necessary to improve the development of static balance. Therefore, the intervention plan partially confirmed the second main hypothesis by altering only one of the two studied parameters.

This supports Hypothesis 3 because the athletes in the experimental group did much better in competition, showing that using psychological techniques and specific training plans can improve sports performance. Recent studies support this aspect by highlighting the positive effects of psychological training on competitive capacity (Gardner & Moore, 2017; Rice et al., 2016). Thus, the primary suggestion from this study is that mindfulness techniques and specific sports games should be regularly included in the training routine of taekwondo practitioners.

The results highlight the need for careful monitoring of athletes' health, especially for preventing injuries and ensuring effective rehabilitation (Rice et al., 2016). The findings support the view that excelling in contact sports like taekwondo necessitates a comprehensive strategy that merges physical and mental training in a balanced and tailored way, focusing more on the specific needs of each athlete.

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