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Original Article

Pilot Study Examining Mindfulness Intervention Effects on Perceived and Objective Stress in Adolescent Basketball Players

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Abstract

Stress is a complex factor that significantly affects adolescent athletes, particularly in competitive environments such as basketball. This pilot study examined the effects of an intervention based on mindfulness, acceptance, and commitment on both perceived and objective stress in a group of 31 adolescent basketball players. Participants were divided into a study group (N=17) and a control group (N=14). Only the study group took part in the training program. Both groups completed pre- and post-intervention questionnaires, and salivary cortisol levels were assessed using the ELISA Human Cortisol (Saliva) kit. The results showed a decrease in perceived stress, while cortisol levels remained stable or slightly increased. These findings suggest that adolescent athletes may struggle to accurately identify their actual stress levels, which can impact both performance and psychophysiological health. Therefore, integrating psycho-emotional education and mindfulness-based interventions into athletic training programs is essential for enhancing stress awareness and management among young athletes.

1. Introduction

Stress is an unavoidable part of daily life and plays a crucial role in helping us adapt to various situations. (Cohen, Kessler & Gordon, 1997; Selye, 1975). From protecting the body against physical dangers to fueling the excitement of success, stress helps trigger necessary adaptive responses. (Saini, Arora, Joshi & Gaurav, 2024) However, research indicates that when stress reaches high levels, it can have detrimental effects on health and performance (Davis, Eshelman & McLay, 2000).

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Findings by Natsir at al. (2021) statistically confirm that stress impacts athlete's performance, and Li and Li (2022) further highlight its significant effect on athletic achievements. (Mascret et al., 2016; Luiselli & Reed, 2011).

2. Material and methods

This study investigated the effectiveness of the Mindfulness, Acceptance, and Commitment (MAC) program (Gardner & Moore, 2007), adapted and translated for Romanian athletes, in optimizing psychological interventions for adolescents involved in competitive sports. It explored how this intervention influences both perceived and objective stress levels, emphasizing the cognitive and emotional processes that contribute to athletic performance.

From a theoretical standpoint, the research aimed to explore the relationship between mindfulness and the management of anxiety, the reduction of somatic symptoms, and the enhancement of athletic performance. At the same time, the study tested the reliability of the adapted versions of the psychological instruments used, as well as the applicability of the MAC intervention within the Romanian sports context.

The study *hypothesizes* that participation in the MAC training program would enhance athletic performance, attentional control and psychological flexibility among adolescent athletes. It was further expected that, despite elevated physiological stress markers (salivary cortisol), the MAC intervention would buffer the negative impact of perceived stress, reflecting an adaptive psycho-physiological response, that supports optimal functioning under competitive pressure.

A significant emphasis was also placed on the practical dimension of the intervention, targeting a reduction in adolescent athletes vulnerability to stress and anxiety, strengthening divided attention, and lowering cortisol levels, a physiological marker of stress. Feedback gathered from participants in the pilot study provided valuable insights into which exercises were perceived as relevant and effective, and which were considered less useful or more difficult to apply—crucial aspects for the further refinement of the program. The findings support the importance of integrating psycho-emotional education and mindfulness-based interventions into the training of young athletes, as a means of fostering balanced development and sustainable performance.

The research methods adopted a quasi-experimental design with a pre- and post-test assessment, involving an intervention group that completed the MAC-based psychological program and a control group that continued regular training. Both groups completed a comprehensive psychological questionnaire battery and took part in athletic performance and physiological evaluation before and after the intervention. Statistical analyses were conducted in SPSSv22, using paired-samples t-tests to compare participants pre- and post-intervention scores and to explore potential changes in psychological, physiological and performance measures following the MAC program.

The study was conducted over a period of seven weeks, during which psychological, physiological, and behavioral data were collected using standardized

quantitative methods. Statistical analyses were performed to determine the changes that occurred between the two assessment points. Stress levels were measured both subjectively, through questionnaires, and objectively, via salivary cortisol analysis.

The study involved 31 clinically healthy adolescent basketball players registered with sports clubs in the Transylvania region of Romania. Their ages ranged from 14 to 15 years, with a mean age of 14.76 years (SD = 0.437), as presented in the table 1. Participation in the study was voluntary, and selection was carried out with the support of the athletes coaches. Informed consent was obtained in writing from both the participants and their parents. Of the total number of participants, 17 athletes completed the program.

Table 1. *Demographic characteristics of the participants*

		Minim	**Maxim**	**Mean**	**SD**
Study group	17	14	15	14.76	.437
Control group	14				

To evaluate the effectiveness of the intervention, a series of validated instruments were administered both during the pretest and posttest phases. The psychological dimensions were assessed using the *Acceptance and Action Questionnaire* (AAQ-II) and the *Multidimensional Psychological Flexibility Inventory* (MPFI), which measure psychological flexibility and inflexibility (Szabo, Vargha, Balazsi, Bartalus & Bogdan, 2011; Bond et al., 2011; Rolffs, Rogge & Wilson, 2016). Participants responded to a set of 60 statements using a 6-point Likert scale (ranging from 1 – "never true for me" to 6 – "always true for me"), offering a comprehensive overview of their psychological response repertoire when facing difficult internal experiences.

The *Depression, Anxiety, and Stress Scale* (DASS-21) was also used to provide a quantitative measure of psychological distress, assessing distinct levels of depression, anxiety, and stress. Based on the scores obtained on the three subscales, respondents can be classified into one of five severity categories: normal, mild, moderate, severe, and extremely severe. The questionnaire comprises 21 items, and participants are asked to rate statements referring to their experiences over the past week. Each item is scored on a scale from 0 to 3, where 0 means "did not apply to me at all," and 3 indicates "applied to me very much or most of the time" (Henry & Crawford, 2005).

The *Ghent Multidimensional Somatic Symptoms Scale* (GMSCS) assessed 18 somatic symptoms experienced over the previous four weeks, using a scale from 0 to 7 to capture both the frequency and intensity of the symptoms (Beirens & Fontaine, 2009). Symptom frequency was rated from 0 ("never") to 7 ("constantly"), while intensity was rated from 0 ("not at all") to 7 ("unbearable"). The scale includes five subscales reflecting the main types of somatic discomfort: localized pain in the head, shoulders, and stomach; alternating sensations of cold or heat; unpleasant cardiac sensations; and fatigue. These dimensions allow for a detailed and nuanced

assessment of somatic symptomatology in the context of perceived stress.

The d2 Test of Concentrated Attention is a psychometric tool used to assess the efficiency of concentration and sustained attention processes, as well as the coefficient of variation related to visual stimulation (Siennicka et al., 2019). This test provides relevant information about subject's ability to quickly and accurately process visual stimuli within a limited time frame. Specifically, the test measures the total number of stimuli processed, performance quality, and the relationship between execution speed and response accuracy, offering a detailed profile of selective and sustained attention (Dobrean, 2010).

Physiological stress levels were monitored through salivary cortisol analysis using the *Human Cortisol (Saliva) ELISA kit*, which operates on the principle of competitive ELISA. Samples were collected non-invasively and processed according to the standard protocol, with optical density measured spectrophotometrically at 450 ± 2 nm.

To measure athletic performance, two tools were used: the *T-Drill Test*, which assesses agility and the ability to rapidly change direction—skills that are essential in basketball (Garcia-Gil et al., 2018; Köklü, Alemdaroğlu & Koçak, 2010; Köklü, Alemdaroğlu, Koçak, Erol & Fındıkoğlu, 2011)—and the *Smart Basketball* – SIQ, a FIBA-approved smart ball equipped with sensors. This device records data such as shot success rate, execution type, and player identification based on each individual's unique shooting style.

The experimental intervention consisted of a structured psychological training program, conducted over a period of seven weeks. Each week included a guided session led by a trainer, followed by individual practice carried out by the athletes. The MAC program, developed according to the model proposed by Gardner and Moore (2007), comprised the following stages: (1) psychoeducation; (2) mindfulness training and cognitive defusion; (3) identification of values and value-based behavior; (4) emotional and cognitive acceptance; (5) behavioral commitment; (6) skill consolidation; and (7) long-term maintenance of outcomes. At the end of the program, participants in the intervention group completed a feedback questionnaire, which provided additional qualitative data on their perceptions regarding the relevance and applicability of the exercises included in the program.

3. Results and Discussions

After collecting data from both the study group and the control group, responses to the administered questionnaires were entered, processed, and statistically analyzed. The results were systematically presented, highlighting the most relevant items, and their interpretation was aligned with the objectives of the research. Statistical analysis was conducted using SPSS, version 22, employing the paired samples t-test to compare the values obtained by the study group before and after the intervention. This analysis aimed to identify statistically significant differences between the two measurement points.

According to the data presented in Table 2, which includes the results of the d2 test of focused attention, a reduction in the percentage of relative errors and a

significant increase in overall performance and concentration capacity were observed in the study group. The significant differences recorded between the pre- and post-intervention measurements can be attributed to the implementation of the psychological program.

Table 2. *Comparison of Pre- and Post-Test Results for the Study Group on the d2 Test*

		Mean	SD	t	p	*
Relative errors (d2)	**pretest**	6.5725%	4.30840%	3.302	.005	**
	posttest	4.1638%	3.70575%			
Global performance (d2)	**pretest**	384.63	67.993	-9.869	.000	**
	posttest	478.50	64.518			
Concentration Capacity (d2)	**pretest**	146.81	34.470	-6.171	.000	**
	posttest	199.44	31.106			

*** p<.05, ** p<.01.**

The findings of the present study align with those reported by Strosahl and Robinson (2015), who argue that mindfulness-based training, when applied at a whole-brain level, leads to the strengthening of neural structures involved in attention, emotional regulation, and problem-solving. Additionally, the study conducted by França, Gomes, Gouveia, Ihle, and Coelho-E-Silva (2021) emphasizes that the ability to shift and divide attention is a crucial component of basketball performance. This skill involves the athlete's capacity to efficiently manage two or more tasks simultaneously, as a result of consistent and sustained practice.

Statistical analysis indicated a significant increase in the participants' overall performance (NT-E) between the pretest and posttest evaluations. This improvement highlights a positive development in both cognitive abilities and athletic performance during the intervention period. The comparison of pretest and posttest results, as presented in Table 2, reveals a marked enhancement in concentration capacity among the athletes in the study group. This ability is essential in athletic activities, as it enables athletes to direct their attention toward task-relevant cues during training and competition, helping them to ignore distracting environmental factors and maintain focus on their goals (Kabat-Zinn, as cited in McKay, 2018).

Furthermore, a well-developed capacity for concentration contributes to rapid and effective decision-making in high-demand game situations, as well as to emotional regulation and the reduction of stress impact in tense moments (Tenenbaum & Eklund, 2007; Moran, 2004; Ericsson & Charness, as cited in Luiselli & Reed, 2011; Degroote et al., 2020).

The assessment of somatic symptoms, using the Ghent Multidimensional Somatic Symptoms Scale (GMSCS), revealed a marginal increase in the study group, in contrast to a significant rise in the control group. In a sports context, anxiety

frequently manifests through physiological symptoms such as excessive sweating, elevated heart rate, shallow breathing, and clammy palms (Beirens & Fontaine, 2009)—relevant indicators for assessing distress and its impact on performance (Moran, 2004).

Feelings of restlessness can impair concentration and trigger physical responses such as muscle tension, increased heart rate, and a sensation of weakness (Li & Li, 2022). In the present study, significant differences were observed in the control group on the following GMSCS subscales: "cold–hot sensations – frequency," "heart–chest sensations – frequency and intensity," and "head–shoulders pain – intensity." The statistical details of these findings are presented in Table 3.

Table 3. *Comparison of Pre- and Post-Test Results for the Control Group on GMSCS*

		Mean	SD	t	p	*
Cold–Hot Sensations Subscale – Frequency (GMSCS)	**pretest**	3.2500	2.60494	.749	.032	*
	posttest	5.8750	3.64251			
Heart–Chest Sensations Subscale – Frequency (GMSCS)	**pretest**	.7500	.88641	-2.582	.036	*
	posttest	6.2500	5.57418			
Heart–Chest Sensations Subscale – Intensity (GMSCS)	**pretest**	1.1250	1.55265	-2.400	.047	*
	posttest	6.6250	5.65528			
Head–Shoulders Subscale – Intensity (GMSCS)	**pretest**	1.7500	2.76457	-2.574	.037	*
	posttest	5.6250	3.70087			

*** p<.05, ** p<.01.**

The comparative analysis between the experimental group and the control group was conducted using the independent samples t-test, aiming to evaluate the differences between the two groups' means at the posttest stage. This statistical test helps determine the likelihood that the observed differences are the result of a genuine effect of the intervention rather than random variation (Gratton & Jones, 2010).

Additionally, the independent samples t-test examines whether the mean scores of two distinct groups differ significantly from a statistical standpoint (Williams & Wragg, 2004). This approach was essential in assessing the impact of the MAC intervention by directly comparing outcomes between participants who received the psychological training and those who did not.

Figure 1 highlights significant differences between the study group and the control group at the posttest stage. In the d2 attention test, the study group showed a notable increase in concentration capacity and a reduction in relative errors, indicating improved cognitive focus.

Additionally, in the T-test agility assessment, the execution time decreased significantly in the study group, suggesting enhanced motor efficiency and responsiveness. In contrast, the control group exhibited an opposite trend, with execution time increasing—potentially reflecting the effects of unmitigated stress or fatigue.

Figure 1 also presents a comparative overview of salivary cortisol levels for both groups. The data illustrate a reduction in cortisol in the study group, consistent with lowered physiological stress, while the control group showed either stable or elevated levels, underscoring the potential stress-buffering effects of the psychological intervention.

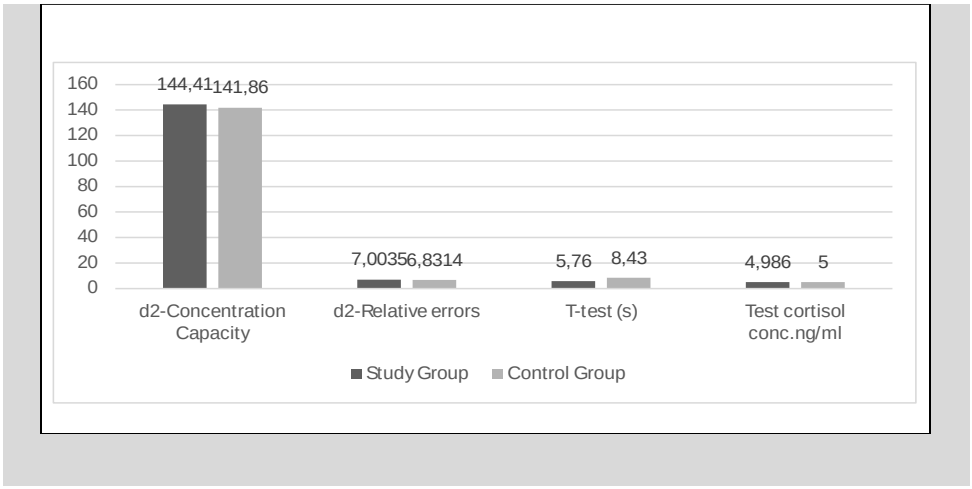

Figure 1. *Posttest Differences Between the Study and Control Groups on the d2 Test, T-Test, and Salivary Cortisol Levels*

The results presented in Figure 2 show significant differences in the MPFI subscale of Acceptance and Present-Moment Awareness. Specifically, the study group demonstrated notable improvements in both acceptance of internal experiences and the ability to remain anchored in the present moment—two core components of psychological flexibility.

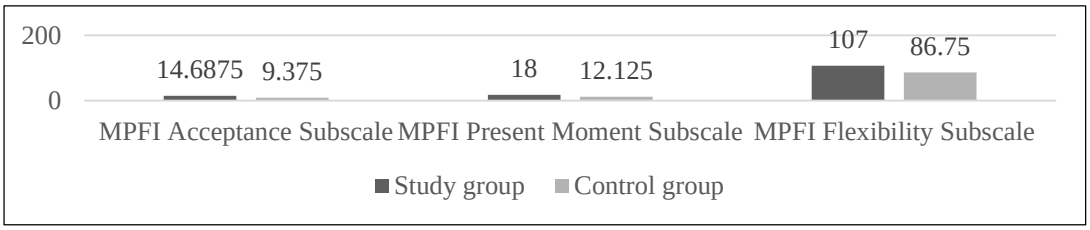

Figure 2. *Posttest Differences Between the Study and Control Groups – MPFI*

Discussions

The results obtained for the control group—who did not receive the mindfulness- and acceptance-based intervention—are consistent with findings from existing research, which confirms that athlete anxiety tends to increase during competitive events (Mohapatra, Panigrahi & Rath, 2012; Padaki et al., 2017; Birrer, Röthlin & Morgan, 2012; Gustafsson, Sagar & Stenling, 2017; Velickovska, Damovska, Anastasovski & Koteva-Mojsovska, 2014).

In their study, Fjorback and colleagues (2013) concluded that mindfulness-based therapies are feasible and well-accepted treatments for reducing both somatic symptoms (Ali et al., 2017; Hazlett-Stevens, 2018; Kahrizi, Taghavi, Ghasemi & Goodarzi, 2017) and psychological distress (Würtzen et al., 2015).

An analysis of research in the field highlights that difficulties in emotional regulation and self-awareness are significantly correlated with increased psychological and somatic symptoms (Mazaheri, 2015). In this study, a significant increase was observed in the control group on the heart–chest subscale, which reflects somatic symptoms originating from this area—further supporting the link between unregulated stress and the amplification of physical discomfort in the absence of psychological intervention.

4. Conclusions

The pilot study conducted on Romanian male adolescent basketball players examined the discrepancy between perceived and objective stress, analyzing the impact of a MAC (mindfulness, acceptance, and commitment) program on athletic performance and concentration capacity. Although salivary cortisol levels remained elevated, participants in the intervention group showed significant improvements in overall performance and focused attention, as reflected by a reduction in errors on the d2 test and higher scores on the T-test, indicating better coordination and reaction speed. Additionally, increases in acceptance, mindful presence, and psychological flexibility were observed, suggesting enhanced mental resilience.

In contrast, the control group, which did not undergo the MAC intervention, exhibited increased vulnerability to anxiety (DASS-21) and a worsening of physical symptoms associated with stress (GMSCS), particularly in the “cold-warm,” “heart-chest,” and “head-shoulders” subscales. A key finding was the rise in salivary cortisol levels in both groups, consistent with the conclusions of Cabarkapa,

Eserhaut, Cabarkapa, Philipp, and Fry (2023) and Madrigal & Wilson (2017), indicating that physiological stress tends to intensify naturally in competitive contexts, regardless of perceived stress or psychological interventions.

The discrepancy between perceived and objective stress did not negatively impact the performance of the study group; on the contrary, the MAC intervention had a protective effect. Thus, the increase in cortisol appears to represent an adaptive physiological response, associated with HPA axis activation, which supports the mobilization of necessary resources in response to competitive demands, even under conditions of emotional balance.

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