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The Impact of the Type of Sport on the Adolescents' Self-Control

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ABSTRACT

Background: Self-control refers to the self-initiated ability to regulate one's thoughts, emotions, and actions. It plays a crucial role in predicting real-life outcomes. Existing literature highlights self-control as an essential skill that can help individuals achieve their goals and enhance various aspects of their lives.

Objectives: The present study aimed to determine the impact of three different sports—middle-distance running, chess, and kata—on the self-control of adolescents.

Methods and Materials: The study employed a quasi-experimental method with a pretest-posttest control group design. The statistical population consisted of male adolescents aged 13 to 18 in Kermanshah. 48 participants were selected by a purposive sampling method. Subsequently, the sample members were randomly assigned to three intervention groups (middle-distance running, kata, and chess), along with a control group. Before the intervention, a pre-test was conducted. The experimental groups followed specific protocols for each sport over a two-month period, with training sessions held three times a week, each lasting one hour. Post-tests were administered at the end of the intervention, and a follow-up assessment occurred after two weeks. Tthe Tangney, Baumeister, and Boone Self-Control Scale (2004) and a demographic consent form were the research tools.

Findings: The study findings indicated significant differences in self-control scores across pre, post, and follow-up time intervals (Wilks' lambda = 0.311, $F(2,43) = 47.65$, $p < 0.00123$). Additionally, there were significant differences in mean self-control scores among the four groups (middle-distance running, chess, kata, and control) (Wilks' lambda = 0.199, $F(9,102.37) = 10.70$, $p < 0.00000148$). Specifically, middle-distance running demonstrated a significant improvement in self-control among adolescents compared to chess and kata ($p \leq 0.05$).

Conclusion: Incorporating sports with specific demands, especially middle-distance running, can be an effective intervention for enhancing self-control among adolescents. Engaging in middle-distance running positively impacts self-control, offering young individuals an avenue to develop this essential skill.

Keywords: Adolescent, Executive function, psychology, Self-Control, sports.

1. Introduction

When thoughts, emotions, and behaviors are unwelcome or inappropriate for the ongoing task or situation, it becomes necessary to exert control in order to prevent or override such incompatible thoughts, emotions, and behaviors. (1).

The ability to exert control or self-control entails the ability to regulate emotions, motivations, and actions that an individual engages in to attain certain rewards or avoid certain punishments. In essence, self-control is an internal control process that determines which behaviors to enact and allows internal controls to gradually substitute external behavioral controls (2).

When enduringly valued goals come into conflict with quickly more gratifying goals, self-control emerges as the self-initiated regulation of thoughts, emotions, and actions. According to this definition, firstly, self-control is self-initiated, meaning that individuals intentionally and spontaneously engage in controlling themselves rather than being compelled to do so. Secondly, self-control pertains only to choices where one option holds greater long-term value compared to others. However, the less valuable option may be more attractive at the moment. (3).

There is not a unanimous agreement on the definition and measurement approach of self-control. In the literature of cognitive neuroscience, the term "executive function" is sometimes used interchangeably with self-control. Executive functions refer to cognitive capacities, including inhibitory control, working memory, and cognitive flexibility. Self-control can be considered as the behavioral aspect of inhibitory control. However, meta-analyses have shown a weak correlation between task measures of executive function and questionnaire measures of self-control (4).

Self-control is a significant determinant in predicting real-life outcomes (5). It plays a crucial role in personal and social well-being, indicating financial management, physical health, safety, and success in various life domains (6, 7). Furthermore, the role of self-control has been emphasized in reducing aggression (6), occurrence of deviant behaviors (8), increasing attitudes and tendencies towards doping in athletes (9), and academic success (2). Self-control ability significantly influences individual's mental health. It is consistently observed that individuals with higher indicators of mental health exhibit greater levels of self-control (2). Additionally, lower levels of self-control have been associated with decreased individual performance (10).

Based on the review of the literature, it can be said that self-control is an important skill and can help individuals achieve their goals and improve their lives in various ways. Therefore, the most important question is whether this skill can be improved, considering its significance in different areas of life. Longitudinal research suggests that self-control assessed in early childhood predicts various important real-life outcomes in adolescence and adulthood (11).

Thus, according to such studies, it can be argued that self-control is a stable trait that develops early in life and is challenging to enhance and improve! However, other research perspectives do not confirm such a explanation and acknowledge the possibility of changing self-control through targeted interventions (12). Furthermore, according to the Strength Model of self-control, self-control is a general resource of Strength. In fact, according to this model, all acts of self-control are based on a specific energy resource (capacity), namely self-control strength, which individuals have different capacities for (13). Therefore, just as a muscle becomes stronger with regular exercise, self-control may also be strengthened with regular and repeated practice. Additionally, among various types of self-control training protocols, studies have highlighted sport and exercise as an effective intervention for improving self-control abilities among individuals (14, 15).

As studies indicate, the role of self-control in the occurrence of health-related behaviors is crucial. On the other hand, considering the aforementioned points, exercise and physical activity have been proposed as a potential effective intervention in enhancing self-control (16, 17). Furthermore, according to research, the role of sport and exercise in obtaining cognitive benefits and mental health is significant (18-20). On the other hand, different cognitive demands in various types of sports are likely to result in differences in cognitive benefits. Therefore, it seems that the cognitive benefits derived from exercise or physical activity depend on the dose of physical exercise and the cognitive engagement required to cope with the motor and cognitive complexity of the exercise task (15). Some studies have focused on the cognitive benefits of open-skill sports and closed-skill sports. In open-skill sports, athletes must constantly respond to changing conditions and a fast-paced external environment, which may require higher cognitive demands compared to closed-skill sports, where environmental conditions are stable and predictable (21). As previously mentioned, the cognitive engagement required to deal with the motor and cognitive complexity of the sports

task is one of the influential components in order to gain cognitive benefits in sports (15).

The cognitive demands of different sports are not uniform. The classification of sports based on their required components and skills is not absolute, and in each classification, there may be components from other categories. In certain sports, high cognitive skills may be necessary, but this does not negate the importance of motor skills. For example, some sports like chess involve high cognitive engagement where cognitive skills dominate over motor skills. Conversely, in other sports like middle-distance running, cognitive skills are less crucial. Instead, motor skills are the determining factor. In certain sports like kata, both motor and cognitive skills are equally important. Since adolescence, due to rapid growth changes, likely plays a vital role in improving mental health, and sports interventions may be one way to achieve such advancements (22). Additionally, considering the importance of self-control during this period and its development, this study aims to determine the impact of three types of sports (middle-distance running, chess, and kata) with different demands (in terms of cognitive and motor skills) on adolescents' self-control.

2.   Methods and Materials

2.1   Study Design and participant

The present study employed a quasi-experimental method with a pretest-posttest control group design. The statistical population consisted of male adolescents aged 13 to 18 in Kermanshah. The sample was selected purposefully (48 participants). In the next stage, the sample members were randomly assigned to three intervention groups and one control group. 48 adolescent boys aged 13 to 18, whose self-control scores were below average, were purposively selected as the sample. Subsequently, in the next stage, the sample members were randomly assigned to three experimental groups (middle-distance running, kata, and chess) and one control group. The inclusion criteria for participation in the study included: obtaining informed consent from participants, no history of illness and psychiatric disorders, no history of regular physical activity in the last year, non-participation in walking programs,

obtaining a score lower than the average in the self-control test, and being aged between 13 and 18 years. Additionally, the exclusion criteria consisted of: unwillingness to participate in the study, and absence from more than 2 sessions. Prior to the intervention, a pre-test was conducted on the participants, followed by the experimental groups undergoing training in kata, middle-distance running, and chess under experienced sports coaches (according to specified protocols) for a period of two months. Training sessions were held three times a week, with each session lasting 1 hour. At the end, post-tests were administered to the participants, and a follow-up period was measured after 2 weeks.

2.2   Measures

2.2.1   Self-Control

Tangney, Baumeister, and Boone Self-Control Scale (2004): The Self-Control Scale (2004) was developed by Tangney and colleagues in 2004 to measure self-control tendencies. It comprises a response range from "not at all" (1) to "very much" (5), where higher scores indicate greater self-control. In their research conducted in 2004, Tangney and colleagues reported Cronbach's alpha coefficient of 85% for the short-form 13-item Self-Control Scale. The responses to the items in this scale are measured on a 5-point Likert scale. To calculate the overall score of the questionnaire, the scores of each question are summed together. Additionally, the validity and reliability of this questionnaire were confirmed in the study conducted by Mousavi Moghadam and colleagues in 2015. They utilized the Cronbach's alpha coefficient method and obtained a coefficient of 84 (23, 24).

2.3   Intervention

2.3.1   Middle-distance Running

The middle-distance running protocol was developed based on input from three experienced coaches. It spans a two-month period, with training sessions held three times a week, each lasting one hour. The protocol details is provided in Table 1.

Table 1. Middle-Distance Running Protocol

Week 1 -2	Week 3-4	Week 5-6	Week 7-8
1-Warming up and stretching/ interval training intensity 50% of	1-Warming up and stretching/ interval training intensity 70% of	1-Warming up and stretching/ interval training intensity 60% of	1-Warming up and stretching/ interval training intensity 70% of

vo2max, 1 minute duration (10 time repeat) / active recovery (1 minute) /Cooling down 2-Warming up and stretching/ interval training intensity 60% of vo2max, 2 minute duration (7 time repeat) / active recovery (1 minute) /Cooling down 3- Warming up and stretching/ interval training intensity 60% of vo2max, 1 minute duration (6 time repeat) / active recovery (30 second) /Cooling down	vo2max, 2 minute duration- / interval training intensity 50% of vo2max, 3 minute duration (4 time repeat) / active recovery (1 minute) /Cooling down 2-Warming up and stretching/ interval training intensity 70% of vo2max, 3 minute duration- / interval training intensity 50% of vo2max, 3 minute duration (3 time repeat) / active recovery (1 minute) /Cooling down	vo2max, 10 minute duration- / interval training intensity 50% of vo2max, 3 minute duration (1 time repeat) / {or interval training intensity 60% of vo2max, 10 minute duration / interval training intensity 30% of vo2max, 4 minute duration(1 time repeat)} /Cooling down 2. Warming up and stretching/ interval training intensity 50% of vo2max, 5 minute duration- / interval training intensity 60% of vo2max, 20 minute duration (1 time repeat)	vo2max, 15 minute duration- / interval training intensity 50% of vo2max, 3 minute duration (1 time repeat) 2- Running 1600 meters according to time

2.3.2 Chess

The chess protocol was devised based on input from three experienced coaches. It covers a two-month duration, with training sessions occurring three times a week, each lasting one hour. The protocol details are available in Table 2.

Table 2. Chess Exercise Protocol

Week 1 -2	Week 3-4	Week 5-6	Week 7-8
1- Getting to know the history of chess, the chess board and pieces and the movement of the pieces 2- Continuing the movement of pieces and playing with pieces / the relative value of pieces and defense and attack	1- Game and explain the purpose of the game- Concept of Check and checkmate 2- Reviewing /value of the pieces / Promotion/ attack and defense/counting the number of checks and Getting out of check.	1- Checkmate in one move/ Pin/ Discovered check, Double check, Cross-check. 2- Checkmate with different pieces/ playing the game and review.	1- Idioms/ playing the game and review. 2- En passant/ playing the game and review

2.3.3 Kata

The Kata protocol was developed with input from three experienced coaches. It spans a two-month duration, with training sessions held three times a week, each lasting one hour. The protocol details is provided in Table 3.

Table 3. Kata Exercise Protocol

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Teaching arms and legs techniques (zuki, Shuto Uke, yoko uke, 2 dachi techniques)	The combination of the first week's training (kihon)	Elementary junino kata	New dachi techniques and heian nidan kata	Review the techniques of the previous session and heian nidan kata	Review the techniques tips	Elementary neuromuscular training	Shuto uke and uchi uke techniques

2.4 Data Analysis:

The data was analyzed using IBM SPSS Statistics software, version 26. In order to determine the effectiveness of each sport, a mixed repeated-measures analysis of variance was conducted. Time (pre-intervention, post-intervention, and 2 weeks follow-up) served as the within-subjects factor while group (Middle-distance runing, Kata, Chess and control group) acted as the between-subjects factor. Assumptions of the sphericity were assessed using Mauchly's test, and the Greenhouse-Geisser corrections were applied when necessary. Additionally, Bonferroni-adjusted post-hoc tests were conducted to identify pairwise differences between the groups at each time point. Significance was set to $p < 0.05$ for all tests. Additional

analysis comprised of effect size calculations were performed to determine the magnitude of significance of the findings.

3. Findings and Results

According to the data presented in Table 4, it is evident that there was a noticeable increase in the mean self-control scores within the running group over the pre-test, post-test, and follow-up periods when compared to the other groups. Specifically, the average self-control scores for the running group were recorded as 32.25 (SD=4.39), 41.67 (SD=2.96), and 39.83 (SD=2.79) during the pre-test, post-test, and follow-up stages, respectively. In contrast, the average scores for the chess and kata groups were documented as 34.33 (SD=1.50), 35.42 (SD=1.78), and 34.5 (SD=2.68), as well as 33.5 (SD=2.39), 35.92 (SD=1.73) and 35 (SD=1.41) in their respective stages.

This study involved 48 non-athletic adolescents with a mean age of 16.40 (SD=1.047) years, a mean height of 1.75 (SD=0.54) cm and a mean weight of 75.92 (SD=5.79) kg. Table 4 shows the mean and standard deviation of the dependent variable (self-control) at various measurement stages and in different groups.

Table 4. Descriptive Statistic for Self Control

Group	Variable	Mean	Standard Deviation
Running	Self-Control Pretest	32.250	4.39266
	Self-Control Posttest	41.667	2.96444
	Self-Control Follow up	39.833	2.79068
Chess	Self-Control Pretest	34.333	1.49747
	Self-Control Posttest	35.417	1.78164
	Self-Control Follow up	34.500	2.67989
Kata	Self-Control Pretest	33.500	2.39317
	Self-Control Posttest	35.917	1.72986
	Self-Control Follow up	35.000	1.41421
Control	Self-Control Pretest	32.417	2.67848
	Self-Control Posttest	33.250	2.52713
	Self-Control Follow up	32.583	2.06522

To conduct inferential analysis in this study, the normal distribution of self-control scores at three distinct stages was checked and verified through the Shapiro-Wilk test. The findings confirmed that the scores exhibited normal distribution across all three stages. Consequently, a mixed repeated measure analysis (4 groups * 3 measurement stages) was applied for data analysis. Box's Test for Equivalence of Covariance Matrices indicated that observed covariance matrices for the self-control scores are not equal across groups $F(18, 6841.32)= 3.355$, $p= .000002$. So, the wilks lambda test was reported as a result of a multivariate test for Self-Control.

Table 5. Multivariate Test for Self-Control

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Time	Wilks' Lambda	.311	47.648b	2.000	43.000	.00000123	.689
Group	Wilks' Lambda	.199	10.701	9.000	102.368	.00000148	.416
Time * Group	Wilks' Lambda	.303	47.648b	6.000	86.000	.00000146	.450

The data presented in Table 5 demonstrates statistically significant variations in the mean scores of self-control across the pre, post, and follow-up time intervals. wilks lambda=.311, $F(2,43)=47.65$, $P=.00000123$.

Furthermore, there are notable variances in the mean scores of self-control among the four groups (middle-distance running, chess, kata, and control). wilks lambda=.199, $F(9,102.37)=10.70$, $P=.00000148$.

The results also reveal that the interaction between time and group is statistically significant, indicating that the enhancement in self-control scores at each time point measurement varies across the different groups. wilks lambda=.303, $F(6,86)=47.65$, $P=.00000146$.
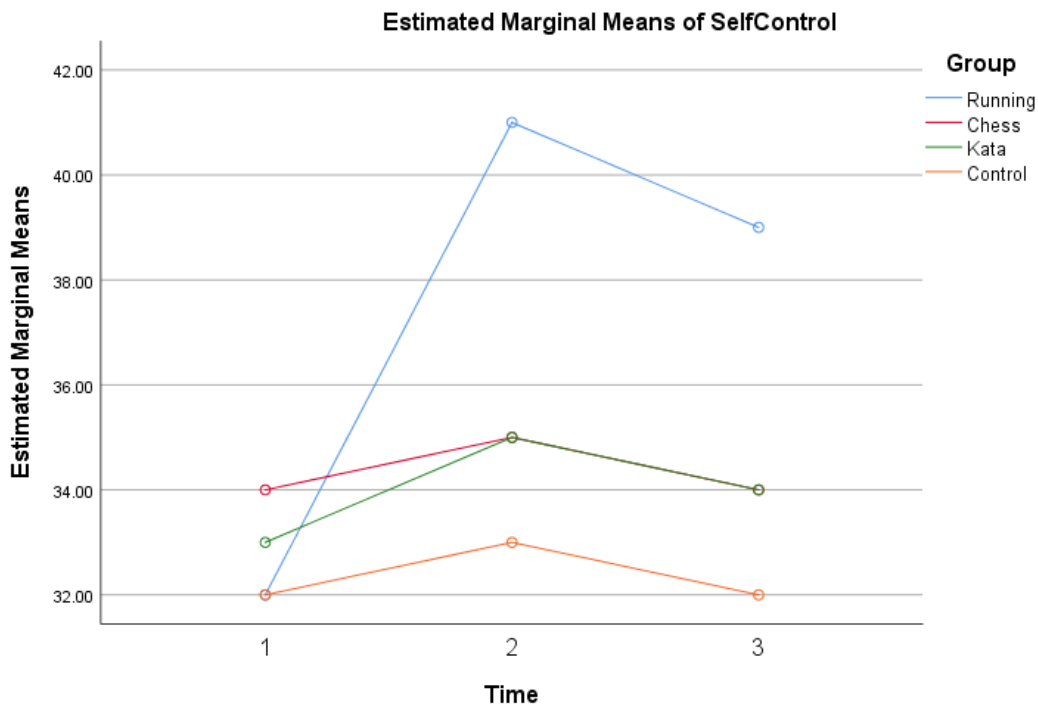
Table 6. Bonferroni Post-hoc Test for Self-Control Based on estimated marginal means

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Running	Chess	3.167*	.895	.006
	Kata	3.111*	.895	.007
	Control	5.167*	.895	.000004
Chess	Running	-3.167*	.895	.006
	Kata	-.056	.895	1.000
	Control	2.000	.895	.183
Kata	Running	-3.111*	.895	.007
	Chess	.056	.895	1.000
	Control	2.056	.895	.158
Control	Running	-5.167*	.895	.000004
	Chess	-2.000	.895	.183
	Kata	-2.056	.895	.158

Table 6 presents the results of the Bonferroni post-hoc analysis, demonstrating comparisons of self-control scores using estimated marginal means at different evaluation timeframes for all groups. The post-hoc analysis, using the Bonferroni criterion for significance, showed that there were significant differences in self-control scores between the running and chess groups (ME=3.167, SE=.895, P=.006), between the running and kata groups (ME=3.11, SE=.895, P=.007), and between the running and control groups (ME=5.167, SE=.859, P=.000004).

Figure 1. Bonferroni Post-hoc Test for Self-Control Based on estimated marginal means

Figure 1 demonstrates that running led to a significant improvement in self-control compared to chess, kata, and the control group in both the post-test and follow-up stages. The self-control scores of the chess and kata group increased in the post-test stage and follow-up stage compared to the control group, but this increase was not found to be significant.

4.   Discussion and Conclusion

Self-control is an essential skill that can help individuals achieve their goals and improve their lives in various ways. It is associated with many positive outcomes in life. Given the importance of the adolescent period and the cognitive benefits of exercise, this study was designed to determine the impact of three types of sports (middle-distance runing, chess, and kata) with different demands on the self-control of adolescents. The study revealed notable variations in self-control scores across pre, post, and follow-up time intervals (Wilks' lambda = 0.311, F(2,43) = 47.65, p < 0.00123). Additionally, significant differences existed in mean self-control scores among the four groups: middle-distance running, chess, kata, and control (Wilks' lambda = 0.199, F(9,102.37) = 10.70, p < 0.00000148). Specifically, middle-distance running significantly improved self-control in adolescents compared to chess and kata (p ≤ 0.05). This study provides two dimensions of interpretation. The first dimension suggests that different sports with different demands create different psychological advantages. This finding is consistent with studies by Kerrn and colleagues and Wang and colleagues (21,25). Wang and colleagues (2013) reported that open-skill sports, such as tennis, compared to closed-skill sports, such as swimming, are more effective in enhancing inhibitory control (25).

Furthermore, Krenn and colleagues (2018) reported that the cognitive advantages of sports vary based on their specific characteristics. They found that cognitive benefits differ between static sports (which involve activities in consistent circumstances, such as swimming), interceptive sports (which involve activities requiring dynamic coordination between the athlete's body and the environment, such as tennis), and strategic sports (involving adapting to diverse situations, considering factors like teammates, opponents, positions, and objects, like volleyball). In this study, we found that middle-distance running, where motor skills predominate over cognitive skills, has created different advantages compared to chess and kata. According to this study, the cognitive benefits of different sports are distinct (21).

However, the second dimension of this study reveals that mid-distance running, compared to kata and chess, significantly improves self-control in adolescents. Few studies have measured the impact of different types of exercise on behavioral self-control. In the studies by Wan and colleagues and Krenn and colleagues, the cognitive aspect of inhibitory control (one of the main components of executive functions) was examined, while the behavioral aspect of inhibitory control, which includes self-control, was not adequately addressed. However, studies have shown a weak correlation between task measures of executive function and questionnaire measures of self-control (3). Previous research, including studies by Boat and Cooper (2019) and Ghorbanzadeh and Lotfi (2017), has demonstrated that engaging in aerobic activities contributes to enhanced self-control. This finding aligns with the significant impact of mid-distance running on improving self-control, as observed in the current study. In summary, aerobic exercise has been associated with better self-control, and mid-distance running specifically appears to have a positive effect in this regard (26, 27). Additionally, Pesce and colleagues (2021) stated that for the enhancement of cognitive aspects of self-control (in executive functions), a specialized physical activity program should be designed (15). However, in the mentioned study, behavioral self-control was not specifically addressed.

In explaining the findings of this study, it can be said that according to the definitions provided, self-control has three distinct components: a desire, a higher-order goal, and desire–goal conflict (28). Therefore, it seems that if a task or sport can create such conditions in individuals, it will likely be effective in enhancing their self-control. It seems that in chess and kata, there is no conflict between desire and goal. However, in middle-distance running, this conflict is more pronounced for the individual. Running in a non-athlete individual creates a sense of discomfort that the individual constantly seeks to relieve by discontinuing the activity (desire to quit). However, maintaining optimal performance in running is considered a valuable goal, and the runner is constantly faced with the conflict between desire and goal during training. In the chess group, adolescents learn a set of principles through a specific protocol, and in kata, learning elementary techniques does not create such pressure on the individual to induce conditions of conflict between goal and desire. Therefore, it seems that the act of running, due to the conflict it creates in the individual, invokes self-control. If the individual cannot control themselves, the desire to reduce effort and ultimately stop prevails, and the person cannot continue with the running training. Therefore, running training in each session serves as an exercise where the individual is inevitably required to use their self-control capacity, leading to a significant improvement in self-control in adolescent running groups.

Furthermore, in classical psychology, self-control has been defined as the effortful suppression of impulses (2, 29). Therefore, according to this definition, it seems that exercise or any activity that can strengthen willpower and effort in individuals likely enhances their capacity for self-control. Chess involves high cognitive engagement, whereas in middle-distance running, cognitive engagement or cognitive skill is not predominant; rather, motor skill is determinative. Similarly, in kata, both motor skills and cognitive skills are important. Given that motor skill is more important in running, it is evident that middle-distance running requires more effort compared to kata and chess in this study. In the middle-distance running group, adolescents are required to expend more energy and effort to achieve the standard performance of 1600 meters in each training session, thereby enhancing their willpower to some extent. Consequently, these individuals have access to a greater source of effort during the sessions, making it easier for them to suppress impulses. From a classical psychological perspective, the significant improvement of self-control among adolescents in the middle-distance running group is understandable. Based on the findings of this study, middle-distance running, where motor skills dominate over cognitive skills, leads to significant improvements in self-control for young individuals. It seems that sports activities that simulate self-control actions and create a conflict between goals and desires can effectively enhance self-control. As a result, using sports with specific demands, particularly middle-distance running, is generally recommended as an effective intervention to improve self-control among adolescents. In summary, engaging in middle-distance running can positively have an impact on self-control, providing a valuable avenue for adolescents to develop this essential skill.

Authors' Contributions

M.A.S.S., the corresponding author, conceptualized the study, designed the research methodology, and supervised the overall project implementation. He also played a central role in drafting and revising the manuscript. M.R. was responsible for conducting the training sessions, assisting in the recruitment of participants, and contributing to the data collection process. H.S. supported the physiological measurements, helped with data analysis, and contributed to the literature review. All authors participated in discussing the findings, critically reviewed the manuscript for important intellectual content, and approved the final version for publication.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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