

The Effects of Body Combat and Body Balance Exercises on Mindfulness, Aggression Control and Cognitive Emotion Regulation in Female High-School Students

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Abstract

Background: Mindfulness is defined as the deliberate and non-evaluative awareness of the current moment. This study examined the effects of two training techniques, specifically strength-endurance and balance training, on mindfulness, aggression control, and emotion regulation in female high school students.

Methods: The study employed a quasi-experimental approach with a pretest and posttest design, conducted at a high school located in the 3rd district of Tehran, Iran in 2022. Among the 78 eligible female participants, 45 students were selected using a lottery method and were randomly assigned into three groups including body combat, body balance and control groups (each group including 15 participants). The experimental groups exposed to respected exercises for six weeks, with two weekly sessions lasting 45 to 60 minutes. The participants completed the Children and Adolescent Mindfulness Questionnaire (AAMS), the Aggression Questionnaire (AGQ), and the Cognitive Emotion Regulation Questionnaire (CERQ) in the pretest and posttest. Data analysis was conducted using SPSS version 26, employing ANOVA, paired t-test, ANCOVA, and LSD post hoc test.

Results: BMI of the participants was 19.64 ± 1.67 . Results showed that in the posttest, body balance and body combat groups had significantly better scores than the control group in mindfulness (3.80 ± 0.46 , 3.52 ± 0.68 , and 2.95 ± 0.35 , respectively, $P=0.023$), aggression control (1.10 ± 0.33 , 1.57 ± 0.47 , and 1.77 ± 0.32 , respectively, $P=0.001$) and emotion regulation (5.62 ± 0.52 , 5.07 ± 0.67 , and 4.34 ± 0.55 , respectively, $P<0.001$). Moreover, body balance had significantly higher scores than body combat group in terms of mindfulness ($P=0.041$), aggression control ($P=0.004$) and emotion regulation ($P<0.001$).

Conclusion: Body combat, and body balance training can be assumed as an important intervention for enhancing the mindfulness, aggression, and emotion regulation among female adolescents. These findings may have practical implications for school teachers, exercise psychologists and occupational therapists.

Keywords: Exercise, Mindfulness, Aggression, Emotion regulation, Adolescent

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1. Introduction

The significance of sports and physical activities in enhancing overall well-being, health, and mental development is widely recognized (1-6). Numerous population-based epidemiological studies have definitively established that physical activity is vital in the prevention of various chronic diseases, including cardiovascular disease (1), type 2 diabetes (2), obesity (3), osteoporosis (4), and cancer (5), along with reducing the risk of premature mortality (6). It is essential for youth to participate in sports and recreational activities, as these experiences not only promote physical fitness but also encourage social connections and the development of important life skills. Research has demonstrated that active students experience greater social benefits compared with their inactive

counterparts (4). Moreover, individuals who participate in extracurricular physical activities outside of school exhibit enhanced abilities in goal setting, time management, emotion regulation, leadership, and social intelligence. Adolescents who engage in physical activities tend to be happier, possess higher self-esteem, experience reduced anxiety, exhibit better aggression management, and demonstrate improved emotional control (5). Regular exercise serves as a potential factor for various mental and emotional issues, as it enhances memory and strengthens one's spirit. Studies have revealed that exercise is a valuable tool that can be learned and used to enhance overall well-being, regardless of age (6, 7). The cognitive and psychological advantages of exercise encompass improved memory, clearer thinking, heightened self-esteem, better sleep quality and

increased flexibility. Additionally, exercise aids in aggression management and emotional regulation. It is evident that physical fitness is an essential and necessary aspect of exercise for leading a happy life (8, 9). There are two primary parts of physical fitness factors. The first pertains to health and wellness, encompassing muscular strength, muscular endurance, cardiorespiratory endurance, flexibility, and body composition. The second part relates to skill, including speed, agility, balance, power, reaction time and coordination (10).

Our study focused on the strength-endurance (body combat) and balance (body balance) trainings. This study investigated the impact of these exercises on various psychological components such as aggression control, mindfulness, and cognitive regulation of emotion. The World Health Organization defines physical fitness as the capacity to execute muscular tasks efficiently (11, 12). The American School of Sports Medicine defines physical fitness as the capability to engage in physical activities of moderate to high intensity without experiencing fatigue, maintaining this ability throughout one's life (13, 14). Muscular endurance refers to the capacity of muscles to contract continuously, storing energy within themselves to sustain prolonged activity (15). Strength training targets the anaerobic system, enhancing strength, while endurance training focuses on the aerobic system, improving endurance to prolong training sessions without fatigue, often with the goal of weight loss and muscle mass increase. It is advisable to incorporate both strength training and endurance exercises into your exercise program in order to enhance your physical fitness and make daily activities easier (16, 17). Strength training is particularly beneficial for youth as it promotes bone strength and growth. On the other hand, endurance exercises help improve proper breathing and heart endurance. It is important to design these exercises based on individual physical differences, exercise tolerance, and safety precautions to maximize the benefits and minimize any potential harm (18). Additionally, incorporating balance exercises into the training can further enhance performance and movement in youth, while also improving mental health and overall well-being. It should be noted that muscle strain and damage to growth plates are the most common injuries associated with strength training in youth, which can be caused

by improper movements, lifting heavy weights, or lack of guidance from a trainer (19).

It has been noted that training in strength, endurance, and balance can positively influence the physical attributes of young individuals. Nevertheless, two critical aspects necessitate further investigation. Firstly, the effects of these exercises on the psychological dimensions of youth have not received adequate attention. Secondly, the influence of these exercises on psychological factors in youth remains largely unexplored. Therefore, the present study aimed to examine the effects of strength, endurance, and balance training on the psychological aspects of adolescents. It is essential to acknowledge the psychological ramifications of physical activities and sports, alongside their physical benefits. Specifically, this study intended to explore how strength-endurance (body combat) and balance (body balance) training affect mindfulness, aggression control, and emotional regulation in adolescents. Thus, the focus of this study was to investigate the impact of body combat and body balance training on mindfulness, aggression control, and cognitive emotional regulation among high school students.

2. Methods

This study employed a quasi-experimental approach with a pretest and posttest design. The study sample comprised 45 female high school students from the 3rd district of Tehran, Iran in 2022. The sample size was determined to be sufficient through the use of G*Power software, which indicated a significance level of 0.05, mean values of 95.05 ± 17.65 and 81.50 ± 7.61 , and a power test of 0.95 (20). Participants were selected via a convenience sampling method and subsequently assigned randomly to three equally sized groups. The randomization was conducted by having participants draw numbers from an envelope. The inclusion criteria for the study were: 1) being a female high school student and 2) providing written consent to participate in the research. The exclusion criteria were: 1) incomplete questionnaires, 2) any diagnosed physical or mental disorder, and 3) failure to submit a completed written consent form.

2.1. Procedure

After obtaining a permission from the

Department of Education, District 3 of Tehran, Iran, the selected school was visited and the situation was discussed with the school officials. Then, with the cooperation of the school officials, a list of students who met the inclusion criteria was prepared (initial list included 78 students). Using a lottery method, 45 students were selected and randomly assigned into body combat, body balance, and control groups (each group consisted of 15 participants). Subsequently, in a meeting designed for familiarization, the objectives and protocol of the study were presented to both students and their parents. Afterwards, the parents signed a written consent for their children to participate in the study. During the study, the participants were informed of their right to withdraw at any time without incurring any adverse effects. Additionally, significant emphasis was

placed on the importance of safeguarding personal information and ensuring it remained confidential and undisclosed to others. The following day, the pre-test was administered and all participants filled out the questionnaires. The contact details of the researcher and examiner were provided to all parents and students for any necessary communication. The intervention groups subsequently underwent a series of exercises over six weeks, with two weekly sessions lasting 45 to 60 minutes each. The training sessions for the body combat (strength-endurance) group comprised of a 10-minute warm-up, 30-45 minutes of exercise protocol, and a 5-minute cool down (Table 1). The exercises for the body balance group consisted of various movements performed on both hard and soft surfaces, with participants keeping their eyes open and closed (Table 2).

Table 1: Exercise protocol of body combat (strength-endurance) group

Exercise	Duration (minutes)	Repetitions	Intensity	Notes
Warm-up	5	-	Low	Dynamic stretches and light cardio
Speed squat	2	15	Low	Active rest for 30 seconds
One-leg punch lunge	3	10	Low	Repetition with the opposite leg
Bear walk	3	4	Moderate	4 steps by front squat, 4 steps by back squat
Single-leg punch kick	2	10	Moderate	Repetition with the opposite leg
Squat, punch, jump, forward	3	6	Moderate	Active rest for 30 seconds
Squat, punch, jump, backward	3	6	Moderate	Active rest for 30 seconds
Jab-Cross Combo	3	15	Moderate	Focus on technique and speed
Front Kicks	2	15	Moderate	Engage core and maintain balance
Side Kicks	2	10	Moderate	Emphasize hip rotation and control
Uppercuts	3	10	Moderate	Keep elbows in and use legs for power
Burpees	2	10	High	Full-body engagement; modify as needed
Cool Down	5	-	Low	Static stretching to enhance recovery

Table 2: Exercise protocol of body balance group

Exercise	Duration	Repetition	Description
Single-leg Stand	30 sec.	10	Stand on one leg, maintaining balance; switch legs after each set
Squat	30 sec.	10	With breathing, and hands slowly up and down
Turning the wrist	60 sec.	15	Hands open clockwise and counterclockwise and deep breathing
Single-leg Stand with the hands open	30 sec.	10	The right hand is close to the left hand and back and then vice versa
Kat - Dog	30 sec.	10	Holding the breath in Kat and releasing it in Dog
Cobra	30 sec.	10	With deep breathing
Diamond press	30 sec.	10	Lying on the palm in the form of Naas, make the arms and put the forehead on the hands and move the body along with the breath and lift the head when exhaling
Table position	60 sec.	15	Four hands and feet on the ground, and the position of the pelvis and spine is stable, and one leg is placed behind the back so that it is in line with the pelvis, then the opposite hand goes forward at the same time
Roll your thighs in a resting position	60 sec.	15	Put your legs together and pinch the inner thighs together, open your hands lower than shoulder height and with the palms facing up, rotate the pelvis with deep breathing
Heel-to-Toe Walk	10 meters	2	Walk in a straight line, placing the heel of one foot directly in front of the toes of the other
Tai Chi Movements	20 min	--	Engage in slow, controlled movements to enhance balance and coordination
Balance Board Exercises	5 min	--	Use a balance board to perform gentle shifts in weight, improving stability
Dynamic Balance Training	15 min	--	Incorporate movements like lunges and side steps while maintaining balance

The control group has not engaged in any exercises. However, similar to the other two groups, they completed questionnaires both at the beginning and end of the test. At the end of the intervention, all participants took the post-test.

2.2. Measuring Tools

The Children and Adolescent Mindfulness Questionnaire (AAMS) (21) was used to assess mindfulness. This questionnaire consists of 19 items aimed at evaluating 4 dimensions of mindfulness in both teenagers and adults. These scales are intended for individuals aged 11 years and above. The questionnaire employs a 5-point Likert scale (1=never to 5=always) for responses. In the present study, ten experts were requested to measure the validity of the scale consisting of Content Validity Index (CVI), and Content Validity Ratio (CVR). Results were as follows: CVI=0.90, and CVR=0.88, indicating a good validity of this tool, and a Cronbach's alpha of 0.92.

The Aggression Questionnaire (AGQ) was used for measuring aggression control (22). It is a paper-pencil self-report scale consisting of 30 questions that evaluate anger, aggression, and resentment. The questionnaire comprises 14 questions pertaining to anger, 8 questions concerning aggression, and 8 questions related to resentment. Respondents indicated their answers by choosing from the following options: never, rarely, sometimes, or always, are which assigned scores of 0, 1, 2, or 3, respectively. The cumulative score from the questionnaire can vary from 0 to 90, derived from the total of all individual question scores. A higher cumulative score reflects an elevated level of aggression, whereas a lower score signifies a diminished level of aggression. Herein, ten experts confirmed the validity of this scale, where the results were as follows: CVI=0.88, and CVR=0.90. In addition, we measured the Cronbach's alpha of AGQ to be 0.88.

The Cognitive Emotion Regulation Questionnaire (CERQ) (23) was used to measure cognitive emotion regulation. This questionnaire assesses two emotion regulation strategies for youth: reappraisal and suppression. Reappraisal involves re-evaluating emotions, while suppression is a response strategy. Research suggested that using reappraisal is associated with positive emotions, cognitive well-being, and better social relationships (23). Four items assess the suppression

strategy, while six items evaluate the re-evaluation strategy. Each item is rated on a 7-point Likert scale, ranging from 1 (completely disagree) to 7 (completely agree). In the present study, ten experts confirmed the validity of this scale with the following results: CVI=0.88, and CVR=0.94. In this paper, Cronbach's alpha of CERQ was 0.94.

2.3. Data Analysis

Two analytical techniques, namely descriptive and inferential analysis, were used to examine the data. After data collection, SPSS was employed for data analysis. Descriptive statistics, including mean and standard deviation (SD), were applied to summarize the data. Additionally, analysis of variance (ANOVA) was conducted to compare the descriptive data across different groups. For both intra- and intergroup comparisons of qualitative variables, paired t tests and analysis of covariance (ANCOVA) were implemented. The Tukey's LSD (Least Significant Difference) post hoc test was subsequently applied to determine any significant differences between the mean values of the groups.

3. Results

The demographic characteristics of the participants across the various groups are detailed in Table 3. The mean age and SD for participants in the strength-endurance, body balance, and control groups were 13.41 ± 0.51 , 13.52 ± 0.72 , and 13.17 ± 0.26 years, respectively. No significant differences were observed among the groups ($P=0.587$). The average height and standard deviation for participants in the body combat, body balance, and control groups were 155.16 ± 10.25 , 156.27 ± 9.64 , and 154.92 ± 9.68 cm, respectively, with no significant differences ($P=0.849$). The average weight and standard deviation for participants in the body combat, body balance, and control groups were 45.11 ± 8.97 , 44.97 ± 10.05 , and 44.97 ± 8.66 kg, respectively, again showing no significant differences among the groups ($P=0.475$). Lastly, the average BMI and standard deviation for participants in the body combat, body balance, and control groups were 19.74 ± 1.27 , 19.19 ± 1.39 , and 19.09 ± 1.57 , respectively, with no significant differences ($P=0.329$).

The mean and SD for the pretest and posttest scores of the study variables (mindfulness, aggression, and cognitive regulation) are presented separately for the experimental and control groups in Table 4.

Table 3: Demographic data across groups

Variable	Group	M±SD	P
Age (year)	Body Combat	13.41±0.51	0.587
	Body Balance	13.52±0.72	
	Control	13.17±0.26	
Height (cm)	Body Combat	155.16±10.25	0.849
	Body Balance	156.27±9.64	
	Control	154.92±9.68	
Weight (kg)	Body Combat	45.11±8.97	0.475
	Body Balance	44.97±10.05	
	Control	44.97±8.66	
BMI	Body Combat	19.74±1.27	0.329
	Body Balance	19.19±1.39	
	Control	19.09±1.57	

SD: Standard Deviation

Table 4: Descriptive statistics of research variables in experimental and control groups

Variables	Phase	Control	Body balance	Body Combat	P (Inter-group comparisons)
		M±SD	M±SD	M±SD	
Mindfulness	Pretest	2.81±0.46	3.05±0.44	3.08±0.42	0.120
	Posttest	2.95±0.35	3.80±0.46	3.52±0.68	0.041
	P (intra-group comparisons)	0.547	<0.001	<0.001	
Aggression	Pretest	1.79±0.28	1.88±0.32	1.85±0.31	0.196
	Posttest	1.77±0.32	1.10±0.33	1.57±0.47	0.004
	P (intra-group comparisons)	0.975	<0.001	<0.001	
Emotion regulation	Pretest	4.15±0.68	4.20±0.60	4.32±0.75	0.785
	Posttest	4.34±0.55	5.62±0.52	5.07±0.67	0.001
	P (intra-group comparisons)	0.287	<0.001	<0.001	

Table 5: LSD post-hoc test for paired comparison of the variables in the posttest phase

Variables	Groups	Mean difference	P
Mindfulness	Body Balance – Body Combat	0.28	0.045
	Body Balance – Control	0.95	<0.001
	Body Combat – Control	0.57	0.027
Aggression	Body Balance – Body Combat	0.47	0.009
	Body Balance – Control	0.67	<0.001
	Body Combat – Control	0.20	0.048
Emotion regulation	Body Balance – Body Combat	0.55	0.019
	Body Balance – Control	1.28	<0.001
	Body Combat – Control	0.73	<0.001

LSD: Least Significant Difference

Also, the results of intra-group and inter-group comparisons are shown in Table 4. As shown, there was no significant difference between the body combat, body balance and control groups in the pretest in terms of mindfulness ($P=0.120$), aggression ($P=0.196$), and cognitive regulation ($P=0.785$). Thus, all groups had the same conditions in all variables before the start of sports training. However, the results of the study showed that there is a significant difference between the posttest of the body combat, body balance and control groups

in terms of mindfulness ($P=0.041$), aggression ($P=0.004$), and cognitive regulation ($P=0.001$).

The findings from the LSD post hoc test (Table 5) indicated that participants in the body balance group outperformed those in the body combat group regarding mindfulness ($P=0.045$), aggression ($P=0.009$), and cognitive regulation ($P=0.019$). Furthermore, the body balance group demonstrated better performance compared with the control group in mindfulness ($P<0.001$),

aggression ($P < 0.001$), and cognitive regulation ($P < 0.001$). Additionally, the results revealed that participants in the body combat group had better outcomes than the control group in mindfulness ($P = 0.027$), aggression ($P = 0.048$), and cognitive regulation ($P < 0.001$).

4. Discussion

The findings indicated a significant difference in the post-test scores of mindfulness between the body balance group and the body combat group, with a 95% confidence level. These results demonstrated an enhancement in mindfulness among individuals following a period of body balance exercises and body combat. Body balance is a fitness method that incorporates elements of yoga, Pilates, and Tai Chi, focusing on stretching and strength exercises to improve core muscles, flexibility, and concentration. On the other hand, body combat involves high-intensity aerobic workouts that elevate heart rate by 60 to 80 percent. The outcomes of this study were consistent with previous research (24-27). The findings indicated that mindfulness training had positive effects on physical health, mental health, social relationships, and household environmental health. Mindfulness exercises are specifically designed to impact all dimensions of life, including the physical, psychological, social, and spiritual aspects. The results of this study suggested that body combat programs can also have an effect on mental awareness (28). The presence of mindfulness in one's mind plays a role in regulating attention and ultimately influencing the quality of life. The body combat and body balance trainings focus on mindfulness techniques and being aware of one's current state (29).

The findings indicated that engaging in a period of body balance and body combat exercises has a distinct and significant impact on aggression, suggesting a positive influence on reducing aggression and anger during the body combat training period. These results were consistent with previous studies (30-32). The research also demonstrated that regular physical exercises, including morning exercises, can decrease aggression, violence, anger, and enhance adaptability. The study concluded that an aerobic exercise program, which includes endurance exercises, is an effective strategy in reducing anger and aggressive behaviors in youth. Furthermore,

sports training and physical activities in a sports and social setting have a significant effect on reducing anger management issues and aggressiveness, as well as improving academic performance (33, 34). Recent studies have indicated that engaging in strength training can lead to enhancements in body balance (27, 29, 33). Previous research, along with the physiological processes involved in body balance improvement, highlighted the significance of using tools such as the balance board and stretching band, and Physio Ball (27, 31, 32). These tools, due to their uneven and unconventional surfaces, trigger the balance control mechanisms within the body. Activities like using a stretching band or walking on a balance board challenge an individual's ability to maintain balance while in motion. Moreover, the unique properties of the stretching band and Physio Ball, which induce muscle vibrations, contribute to enhancing muscle condition (30-32). Essentially, these exercises promote muscle flexibility by stimulating the sensory system, while slow movements on the Physio Ball create a gravitational force that pulls the body downwards, resulting in effective muscle vibration and improved muscle condition.

The findings indicated that a single session of body balance exercises demonstrate a positive impact on aggression. These results were consistent with previous studies (34-36). The ability to aggression control through teaching anger management skills helps students recognize warning signs and use muscle relaxation techniques, thereby reducing physical and cognitive arousal during aggressive episodes. The study also found that problem-solving skills training is effective in reducing aggression (35). This suggests that aggressive adolescents tend to offer more aggressive and less constructive solutions to interpersonal problems. Additionally, problem-solving skill training, as part of anger management training, helps individuals approach challenges with a problem-solving mindset (32, 36). This highlights the positive effect of group therapy on reducing aggression and improving academic performance among students.

The findings of the study indicated a significant distinction between the post-test scores of emotion regulation in the body balance exercise group and the body combat group. The emotions experienced by the body balance training group were notably higher compared with the body combat training group. This suggests that balance exercises have a

positive impact on improving students' ability to regulate their emotions. The experiment further demonstrates that moderate-intensity endurance exercise not only increases positive emotions during the activity but also enhances cognitive control of emotions through post-exercise reappraisal. These results aligned with previous research (37-39). The study also revealed that while endurance exercise reduces prefrontal cortex activation, general cognitive control remains unaffected. This suggests that endurance athletes derive emotional advantages from running at moderate intensities, both during and following the activity, without adversely affecting prefrontal-dependent cognitive control. Nonetheless, it remains uncertain whether these benefits continue to hold at elevated exercise intensities, particularly in the context of high-intensity workouts for female students or when faced with more demanding cognitive control challenges. Consequently, further research is warranted to investigate the particular circumstances under which endurance exercise may either bolster or hinder emotional well-being and cognitive control, thereby enriching the current understanding of the intricate interplay between endurance exercise, emotion, and emotional regulation.

Accordingly, adolescents often engage in aggressive behaviors when joining peer groups due to group pressure. Self-expression training is a technique that enables teenagers to handle inappropriate situations without reacting impulsively (35, 38). Moreover, by participating in aggression management programs, teenagers can acquire essential skills through cognitive restructuring, expanding their behavioral repertoire, and learning alternative ways to address problems without resorting to aggression. By adopting adaptive responses, such as replacing arguments with physical or verbal aggression, individuals can effectively navigate various situations. Conversely, in the psychological model, sports activities are believed to serve as a distraction or a means of releasing individuals from internal drives and emotional stressors, ultimately contributing to psychological well-being. It is evident that the persistence of many psychological disorders, including anxiety and mood disorders, stems from a preoccupation with negative thoughts and attitudes (39-41).

4.1. Limitations

This study had several limitations including

the fact that it only involved female participants; specifically, it focused on non-athlete girls. Additionally, the study sample was restricted to high school students, and the exercises incorporated were limited to strength, endurance, and body balance training. Another constraint of this study pertains to the data collection method, which depended on self-reported measures. Furthermore, the execution of the intervention program for the experimental groups encountered difficulties due to the significant school commitments of many participants. It is advisable that future studies include both male and female students across various age groups.

5. Conclusions

Based on our findings, we conclude that body balance training can be assumed as an important intervention for enhancing the mindfulness, aggression, and emotion regulation among female high-school students. Accordingly, regular participation in balance-related sport activities might be suggested as an essential policy for enhancing the mindfulness, aggression, and emotion regulation among female high-school students. These findings might have practical implications for school teachers, exercise psychologists, and occupational therapists. For example, physical educators may have a special focus in physical education lesson on body balance exercises to improve the level of mindfulness and emotional regulation as well as aggression control of girl students. Moreover, occupational therapists may consider balance exercises (e.g., yoga) into their treatment plans for girls experiencing challenges such as aggression.

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Authors' Contribution

Afsaneh Aslinejad: Substantial contributions to the conception, design of the work, acquisition of data for the work, and drafting the work. Maryam Abdoshahi: Design of the work and reviewing the draft critically for important intellectual content. Malihe Naiemikia: Substantial contributions to the conception, design of the work, and reviewing the draft for important intellectual content. All authors

have read and approved the final manuscript and agree to be accountable for all aspects of the work, such as the questions related to the accuracy or integrity of any part of the work.

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Ethical Approval

The current study approved by the Ethics Review Board with the code of IR.SSRC.REC.1401.079. Additionally, written informed consent was obtained from all the participants.

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