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“Grow Wiser at the Water Tower”
“የዕውቀት አውጅማ ከጮቂ ማማ”

C J S T

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Effects of Eight Weeks of Moderate versus High-Intensity Aerobic Exercise on Body Composition and Selected Physiological Variables among Male Secondary School Students

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Abstract

The increasing prevalence of obesity, cardiovascular disease, and poor physical fitness among adolescents are closely associated with physical inactivity, a developing community well-being issue. Aerobic exercise is known to improve cardiovascular endurance, respiratory efficiency, and metabolic health; however, its effectiveness depends largely on training intensity and duration. This study investigates the effect of an eight-week moderate- and high-intensity aerobic exercise on body composition and selected physiological variables in preparatory school students. This study employed a pretest–posttest randomized experimental design. The participants were 115 male Grade 11 and 12 students from Ethio-Japan Preparatory School who met the inclusion criteria. From these, 90 students were randomly assigned to three equal groups (30 each): Experimental Group One (EG1) received moderate-intensity aerobic training, Experimental Group Two (EG2) received high-intensity aerobic training, and the remaining 30 students regarded as the control group. Both moderate- and high-intensity aerobic exercises significantly improved body composition and cardiovascular health ($p < 0.05$). Body weight decreased from 59.70 ± 4.53 to 53.30 ± 3.88 kg in the moderate-intensity aerobic training group (MIATG) and from 59.50 ± 5.86 to 55.20 ± 4.30 kg in the high-intensity aerobic training group (HIATG), while body fat percentage declined from $27.45 \pm 3.73\%$ to $23.10 \pm 3.66\%$ in the MIATG and from $29.49 \pm 3.22\%$ to $26.35 \pm 3.36\%$ in the HIATG. Similarly, Heart rate was reduced from 71.62 ± 7.28 to 65.83 ± 5.35 bpm in the MIATG and from 70.85 ± 5.73 to 69.36 ± 4.28 bpm in the HIATG ($p = 0.000$), while, systolic/diastolic blood pressure decreased from $122.85 \pm 2.10/91.85 \pm 0.98$ mmHg to $115.95 \pm 1.01/85.15 \pm 0.75$ mmHg in the MIATG and from $122.25 \pm 1.98/90.52 \pm 0.75$ mmHg to $119.65 \pm 0.75/88.95 \pm 0.83$ mmHg in the HIATG. In contrast, no significant changes were observed in the control group. Both medium- and high-intensity aerobic training significantly decreased body weight, body fat percentage, and heart rate, systolic and diastolic blood pressure among male preparatory school students in Debre Markos Town.

Introduction

Body composition refers to the distribution of muscle, bone, and fat that constitutes total body

mass; it is a chemical characterization of the body [1] and is usually categorized into fat mass (FM) and fat-free mass (FFM) [2]. The body composition reflects

the health status and physical capacity of individuals and is a concern of exercise scientists, who emphasize that an individual can be obese in the presence of excess BF even without appearing to be overweight [1]. ACSM [3] defines body composition as the percentage of body water, FM, and lean mass. Body composition is not only relevant to athletes whose performance is based on the relationship between FFM and FM, but it is also relevant for individuals of all ages, genders, and ethnicities in terms of health and physical fitness.

Khan et al. [4] showed the consequences of six weeks of continuous training and interval training on aerobic exercise (VO_2Max) and other physiological variables, comprising heart rate (HR), blood pressure (BP), and respiratory rate (RR), in young healthy adults. Former sedentary individuals were arbitrarily assigned to either continuous or interval treadmill training for six weeks. The study found that aerobic exercise (VO_2Max) improved significantly in both groups. In addition, cardiovascular and respiratory parameters, such as BP, HR, and RR, also indicated significant increases following the training programs.

Beyond routine daily activities, exercise strengthens the body's systems, which leads to morphological and physiological changes [5]. By activating the heart, lungs, and all working muscle groups, aerobic exercise produces positive changes in the body and mind. Aerobic exercise on a daily basis can determine several physiological changes. Aerobic exercise promotes the development of new blood vessels,

improves the supply of oxygen and nutrients to active muscles, facilitates the elimination of metabolic waste, and improves the ability to maintain physiological activity for longer periods of time without becoming overly exhausted [6].

Physical education in schools serves a vital role in supporting children in acquiring abilities and confidence essential to engaging in a range of physical activities, which can build permanent habits both during and beyond their school years. A properly planned physical education program enables all children to engage in and enjoy an extensive range of physical activities. Hillman et al. [7] reported that many schools have curtailed physical education time in favor of focusing on other academic areas. Laval [8] indicated that many institutions of higher education have hampered their physical education departments so as to focus more on academic accomplishment, which may lead to a reduction in students' physical fitness and overall well-being, eventually affecting their academic performance and mental health as well.

The increasing prevalence of obesity among male preparatory school students has become a major public health concern. Insufficient physical activity contributes to poor body composition and related health problems, including cardiovascular disease, reduced muscle strength, and metabolic disorders [9, 10]. This problem is particularly important because school-age children and young adults are in a vital step of growth and development. Since physical fitness is invaluable for overall health and well-

being, generating effective strategies and approaches to stimulate physical activity in this category is critical for facilitating both their physical growth and scholarly achievement. Aerobic exercise is widely recognized for its favorable impacts on body composition, facilitating a lower BFP while promoting an increment in lean muscle mass. Several researchers point out that high-intensity training contributes to a considerable increment in body composition [11], cardiovascular fitness [12], and cognitive function [13] among school students. Koyuncuoglu et al. [14] stress that, although evidence reveals the benefits of HIAT over MIAT for body composition and physiological outcomes, the intensity that provides the best results is still uncertain, and further inquiry is required to decide the optimal intensity levels for maximizing these benefits.

Despite the known benefits of aerobic exercise, research comparing MIAT with HIAT in male preparatory school students is still insufficient. This study undertakings to bridge this research gap by evaluating the consequences of these two exercise intensities on body composition, specifically BW and BFP, as well as significant physiological variables, such as BP and resting heart rate (RHR). The goal of Ethiopia's physical education curriculum is to support students' total growth, including their social, mental, and physical health. The present forty-minute weekly teaching period allotment per section for physical education in secondary schools,

however, is probably insufficient to meet these objectives. A minimum of 30 minutes of moderate-intensity physical exercise three times every week offers significant health advantages, according to ACSM [15] recommendations. In a similar vein, Thomas et al. [16] advise people to do aerobic exercise 3–5 times per week for 20 to 60 minutes, depending on intensity. The World Health Organization [17] recommends striving for at least 10,000 steps every day to maintain health.

Male students at Ethio-Japan Preparatory School have a high degree of motivation to participate in PE classes. However, the present weekly allotment of just one 42-minute session might make it more difficult for them to reach adequate levels of exercise intensity and advancement. This limitation could be a factor in their physical fitness levels being below grade-level expectations. Our goal is to investigate how a moderate and high intensity aerobic exercises can affect students' fitness outcomes to address this problem. The researcher particularly believes that after the intervention, the experimental group will show significant improvements in body composition and cardiorespiratory fitness compared to the control group.

Therefore, this study aimed to investigate the effects of eight weeks of moderate- and high-intensity aerobic exercise on body composition and selected physiological variables among students of Ethio-Japan Secondary School in Debre Markos City

Material and Methods

Study Area

This study was carried out at Ethio-Japan Preparatory School, located in Debre Markos City in the East Gojjam Zone Amhara Region, approximately 300 km northwest of Addis Ababa and 265 km southwest of Bahir Dar (Central Statistical Agency of Ethiopia, 2018).

Study Design

This study implemented an experimental design, specifically a pretest–posttest randomized category design. This approach was selected based on the nature of the pre- and post-test data and enabled the measurement and analysis of the effects of an eight-week MIAT and HIAT program (independent variables) on body composition, namely BW and BFP, as well as key physiological variables, such as HR and BP (dependent variables).

Variable Selection

In this study, both independent and dependent variables were examined. The independent variables consisted of moderate- and high-intensity aerobic exercise, while the dependent variables included body weight (BW), body fat percentage (BFP), heart rate (HR), and blood pressure (BP). These dependent variables were used to assess the participants' training outcomes.

Study Population

The research focused exclusively on male students in the 11th and 12th grades at Ethio-Japan Preparatory School, within a total number of 115 male students

in those grades. Participants were chosen based on specific inclusion and exclusion criteria.

Inclusion Criteria Vs Exclusion Criteria

Students enrolled at Ethio-Japan Preparatory School who had been sedentary for at least one month, had completed the PAR-Q+, were free from medication, and had no history of injury or other health complications were included in this study. Furthermore, male students who did not require the above inclusion criteria were excluded from this study.

Sample Size Determination and Sampling Techniques

Because this study employed an experimental design, participants were selected using a simple random selection method. The sample size was calculated using Yamane's formula, $[n = \frac{N}{1+Ne^2}]$, where n denotes the required sample size, N represents the total number of participants under consideration, and e represents the marginal error ($e = 0.05$) as recently revised by Slovin [18]. Accordingly, with the total population of 115 students, the required sample size was calculated as:

$$n = \frac{115}{1 + 115(0.05)^2} = \frac{115}{2.8} \approx 90$$

Thus, 90 participants were chosen using simple random sampling, and each subject of the study group had an equal chance of being selected; 30 participants were designated to Experimental Group One (EG1) and underwent moderate-intensity aerobic training, while another 30 participants were designated to Experimental Group Two (EG2) and

underwent high-intensity aerobic training. The remaining 30 subjects were assigned to Control Group (CG).

Sources of Data

In this research, primary sources of information were employed. The researcher used primary sources of data to gather available information by measuring the subjects' body subcutaneous fat, height, weight, heart rate, and blood pressure.

Data collection tools/instruments

To collect essential data for investigating the effect of an eight-week MIAT and HIAT program on body composition and physiological variables among preparatory school students at the Ethio-Japan Preparatory School in Debre Markos City, a pre-test and post-test design was employed. The researcher collected data on body composition, including body fat percentage, height, and weight, using standard measurement tools such as a skin fold caliper, a measuring tape, and a digital weight scale.

Heart rate data were obtained using a heart rate monitor, while blood pressure was measured using a sphygmomanometer administered by professionally trained personnel. All collected data were recorded using pen, paper, and standardized score sheets during both the pretest and posttest sessions.

Data Collection Procedures

The researcher followed a series of systematic procedures to collect the required data. These procedures included obtaining informed consent from all relevant stakeholders, particularly the

students selected for the intervention. A logical and standardized sequence was followed in administering the measurements, including body fat, weight, height, HR, and BP of the participants. In addition to outlining the data collection procedures, this section also describes the administration of the tests in detail to ensure consistency, accuracy, and reliability of the measurements.

Height Measurement Procedure

As adapted from ACSM [19], the researcher measured the height of research participants by following the procedures below;

- Ensure the subject removes their shoes.
- Instruct the subject to stand upright with a straight posture.
- Instruct the subject to breath deep and keep it momentarily.
- Ensure the subject is looking up straight ahead.
- Record the participants' height in centimeters or inches.

Body Weight Measurement

Body weight was measured in accordance with the guidelines of ACSM [19]. Participants of under consideration were instructed to get rid of their shoes and weighty dressing before measurement, and their weight was then recorded using a standardized, calibrated scale.

Procedures for skin fold caliper measurement

According to ACSM [19], the subsequent procedures might assist standardize the measure: Skinfold thickness was measured using standard

anthropometric techniques to estimate body fat percentage. A fold of skin and subcutaneous fat was firmly pinched between the thumb and index finger of the left hand and carefully lifted away from the underlying tissue. Care was taken to avoid including any muscle in the fold. Participants were instructed to relax the measured area before the reading was taken.

The skinfold was held with the fingers positioned approximately 8 cm apart along a line perpendicular to the fold, forming parallel sides. For individuals with larger skinfolds, a wider finger spacing was applied. A calibrated skinfold caliper was held in the right hand, with the measurement scale facing upward for easy reading. The caliper jaws were placed about 1 cm below the fingers at the exact measurement site, ensuring proper alignment with the skinfold.

After proper positioning, the caliper was gently released while supported, and measurements were recorded within 1–2 seconds to the nearest 0.5 mm, ensuring no jaw slippage. Each site was measured at least twice, rotating systematically to allow the skin to recover between assessments. Mean skinfold values were summed to estimate BFP using the appropriate equation.

Skinfold Measurement Sites and Procedures

Skinfold thickness was measured at three standardized places on the right side of the body using approved procedures. The triceps measurement was taken vertically along the back of the upper arm at the midpoint between the acromion and olecranon processes, with the arm relaxed at the side; the chest (pectoral) measurement was obtained diagonally between the anterior axillary line and the nipple; and the subscapular measurement was recorded diagonally at roughly a 45° angle, 1–2 cm below the inferior angle of the scapula. In each case, the skinfold was firmly pinched, and the caliper was positioned perpendicular to the fold about 1 cm beneath the fingers. Readings were taken within 1–2 seconds while maintaining the pinch. Each site was assessed at least twice, with additional trials conducted if differences between measurements exceeded 1–2 mm. To enhance reliability, measurements were alternated across sites, allowing adequate time for the skin to recover between readings. This approach was adapted from ACSM's Health-Related Physical Fitness Assessment Manual (2nd edition). [19]

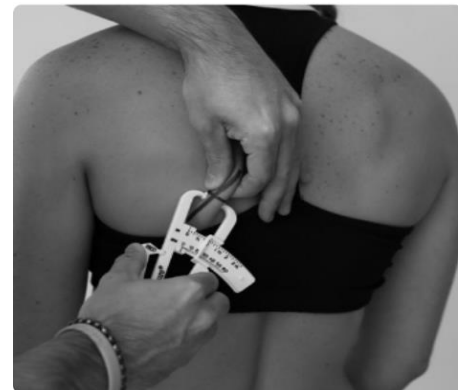
The three Site Skinfold Measurements



Chest



Triceps



Subscapular

In accordance with Jackson and Pollock, as cited in ACSM [19], the researcher applied the three-site formulas for men to assess body density, which was subsequently used to calculate the participants' body fat percentage.

Estimation of Body Density and Percent Body Fat

Body density (BD) for male participants was estimated using the three-site skinfold equation (chest, triceps, and subscapular) as follows:

$$BD = 1.1125025 - (0.0013125 \times \text{sum of 3 skinfolds}) + (0.0000055 \times [\text{sum of three skinfolds}]^2) - (0.0002440 \times \text{age}).$$

According to ACSM (2010), PBF can be derived from BD using either the Siri or Brozek equations. In this study, the Siri equation was selected due to its simplicity and widespread use in the literature:

$$\% \text{ Body Fat} = 495/BD - 450$$

This method was applied to estimate body fat percentage among the participants.

Methods of data analysis

After collecting the data, appropriate statistical analyses were applied using SPSS version 24. Both

descriptive statistics (mean and standard deviation) and inferential tests (paired and independent t-tests) were employed to assess the effects of eight weeks of MIAT and HIAT on body composition and physiological variables among students at Ethio-Japan Secondary School. The paired t-test was specifically used to compare measurements taken before and after exercise. A significance level $p \leq 0.05$ was set, and any results meeting this criterion were considered statistically significant.

Training protocol

Since the training program was based on aerobic exercise, it consisted of structured aerobic activities. According to ACSM [3] and CDC [24], the program for school students was designed to run for eight weeks, with a frequency of three times per week, each lasting 60 minutes at moderate intensity for the moderate-intensity group and at high intensity for the high-intensity group. Participants in both the moderate-and high-intensity aerobic exercise groups performed their activities immediately after proper warm-up sessions guided by the researcher.

The interventions were conducted for eight weeks, three times per week, each session lasting approximately 45–60 minutes. During this period, participants did not engage in any additional structured exercise programs and refrained from any exercise routines similar to the intervention, ensuring consistency across all participants.

The experiment included two testing sessions (pre-test and post-test) and two interventions (moderate- and high-intensity aerobic exercise). The pre-tests were administered two days before the start of the aerobic exercise program, and the post-tests were conducted two days after the completion of the intervention to minimize the acute effects of exercise, reduce fatigue-related influences, and obtain more accurate measurements that reflected the participants' actual fitness and health status as well as the chronic adaptations resulting from the training program. All testing sessions began with dynamic stretching and warm-up exercises and concluded with static stretching and cool-down activities.

Ethical consideration

In health care research, ethical principles require respect for participants' privacy, the prevention of harm, and the assurance of confidentiality and data protection. As these principles are fundamental to both human and animal research, this study adhered to all relevant ethical standards. Participant confidentiality was strictly maintained, and potential risks associated with participation were carefully considered and minimized. All procedures were

conducted in line with established ethical guidelines, codes of conduct, and institutional research ethics policies. Ethical approval was obtained prior to data collection, and written informed consent was secured from both the relevant authorities and all participants.

Validity and Reliability of Instruments

Here, the researcher highlighted the validity and reliability of the instruments applied in this study and demonstrated how to verify the data collection tools and the methods for guaranteeing data confidentiality when applicable. Pilot testing and calibration are used to assess validity and reliability.

To standardize testing procedures and ensure the validity and reliability of the results, all measurements were administered consistently. Standardized instruments were used to accurately assess the study variables and ensure the validity of the data collected. The tools employed to assess the dependent variables were of high quality and appropriate for the study.

To ensure uniformity and reliability, each measurement was taken three times for every variable, approximately, the same time of day and under similar environmental conditions. The testing schedule was carefully organized to maintain consistent timing, and all equipment was properly calibrated before each testing session. Additionally, all measurements were conducted by the same examiner to maintain consistency.

Results

Demographic characteristics: Descriptive Data of male students at Ethio-Japan Secondary school

Table 1: Descriptive Data on the Age and Height the three Groups.

No.	Training group	N	Age		Height		Remark
			Mean	Standard deviation	Mean	Standard deviation	
1	ModerateIntensity Aerobic Training	30	17.90	1.502	1.6170	0.07973	
2	High Intensity Aerobic Training	30	17.60	0.958	1.6060	0.06947	
3	Control Group Participants	30	17.80	1.341	1.6130	0.10425	
Total		90	17.77	1.393	1.6123	0.08266	

The data presented in the above table indicate that the mean and standard deviation (SD) of the research participants' ages were 17.9 ± 1.502 for the moderate-intensity aerobic training group (MIATG), 17.6 ± 0.958 for the high-intensity aerobic training group (HIATG), and 17.8 ± 1.341 for the control group (CG), respectively. Furthermore, the table

shows that the average height of participants in the MIAT, HIAT, and control groups were 1.6170 ± 0.07973 , 1.6060 ± 0.06947 , and 1.6130 ± 0.10425 meters (mean $\pm$ SD), respectively. In general, the mean $\pm$ SD for the age and height of the participants in this investigation was, respectively, 17.77 ± 1.393 years and 1.6123 ± 0.08266 meters.

Pretest and Posttest Data on Body Composition Variables of Experimental Group

Table 2 Significant of Mean Differences (MDs) between Pretest and Posttest on Body Composition Variables

Research Participant	N		Pretest BW of Research Participants	Posttest BW of Research Participants	Pretest BFP of Research Participants	Posttest BFP of Research Participants
Moderate Intensity Aerobic Training	30	Mean	59.70	53.30	27.4524	23.0969
		S D	4.533	3.875	3.72500	3.65911
		Sig.		.000		.000
High Intensity Aerobic Training	30	Mean	59.50	55.20	29.4868	26.3453
		SD	5.860	4.295	3.21695	3.35923
		Sig.		.000		.000
Control Group Participants	30	Mean	57.60	59.80	28.3490	29.9149
		SD	4.371	3.189	4.45494	4.19772
		Sig.		.725		.275

*. The MD is significant at the 0.05 level.

$df = 29$

As presented in Table 2, the mean and SD (Mean $\pm$ SD) body weight values for MIATG were 59.70 ± 4.533 at pre-test and 53.30 ± 3.875 at post-test. The mean and SD body weight values for HIATG participants were also 59.50 ± 5.860 and 55.20 ± 4.295 at pre-test and post-test, respectively. Similarly, these values for CG participants were 57.60 ± 4.371 and 59.80 ± 3.189 at pre-test and post-test, respectively.

On the other hand, the mean and SD BFP values for MIAT experimental group were 27.452 ± 3.725 ; for the HIAT experimental group, 29.4868 ± 3.21695 ; and for the CG participants, 28.3490 ± 4.45494 ,

respectively at the pretest, while in the posttest, the values were 23.0969 ± 3.659 for the MIAT experimental group, 26.3453 ± 3.35923 for the HIAT experimental group, and 29.9149 ± 4.19772 for the CG participants, respectively.

The findings of the study revealed that MIAT and HIAT were significantly improved in BW and BFP ($P < 0.05$; $p = .000$), whereas CG participants BW and BFP were not significantly improved ($P > 0.05$; $p = .725$ and $p = .275$). Therefore, there is a significant difference between pretest and posttest in terms of both BW and BFP in both experimental groups.

Pretest and Posttest Data of Physiological Variables of Experimental Groups

Table 3. Significant of Mean Differences between Pretest and Posttest results of Physiological Variables

Research Participant	N		Pretest Heart Rate of Research Participants	Posttest Heart Rate of Research Participants	Pretest Blood Pressure (PrTBP-RP) of Research Participant		Posttest Blood Pressure (PTBP-RP) of Research Participant	
					Systolic	Diastolic	Systolic	Diastolic
Moderate Intensity Aerobic Training	30	Mean	71.62	65.83	122.85	91.85	115.95	85.15
		SD	.7275	.5345	2.0975	.9825	1.0125	.7525
		Sig.		.000			.000	.000
High Intensity Aerobic Training	30	Mean	70.85	69.36	122.25	90.52	119.65	88.95
		SD	.5725	.4275	1.9785	.7515	.7535	.8325
		Sig.		.000			.000	.000
Control Group Participants	30	Mean	71.25	72.83	121.75	91.75	123.45	92.75
		SD	.5375	.8275	1.5425	.7985	.8675	.6875
		Sig.		.625			.152	.750

*. The mean difference is significant at the 0.05 level.

$df = 29$

As indicated in Table 3, the mean and SD heart rate values for MIATG were 71.62 ± 0.73 at pre-test and 65.83 ± 0.53 at post-test, whereas the mean and SD

heart rate values at pre-test and post-test for HIATG participants were 70.85 ± 0.57 and $69.36 \pm .43$, respectively. These values for the CG participants

were also 71.25 ± 0.54 and $72.83 \pm .83$, respectively. The mean and SD systolic blood pressure for MIATG participants were 122.85 ± 2.10 and 115.95 ± 1.01 at pre-test and post-test, respectively, while the mean diastolic blood pressures were 91.85 ± 0.98 and 85.15 ± 0.75 in respective order. Similarly, the mean and SD systolic blood pressure at pre-test and post-test for MIATG participants were 122.25 ± 1.98 and 119.65 ± 0.75 , while the mean diastolic blood pressures were 90.52 ± 0.75 and 88.95 ± 0.83 , respectively. The significance values for heart rate, systolic blood pressure, and diastolic blood pressure in both MIATG and HIATG were $p < 0.05$. Similarly, the mean systolic blood pressures were 121.75 ± 1.54 and 123.45 ± 0.87 , and the mean diastolic blood pressure 91.75 ± 0.80 and 92.75 ± 0.69 , respectively, for CG participants. The significance values were $p = 0.625$ for heart rate, $p = 0.152$ for systolic blood pressure, and $p = 0.750$ for diastolic blood pressure.

The findings of the study showed that MIAT and HIAT were significantly improved in both HR and BP. On the contrary, there was no significant improvement in the HR or BP of the control group participants (as $P > 0.05$; $p = .625$, $p = .152$, and $p = .750$). As a result, both experimental groups' HR and blood pressure significantly differed between the pretest and posttest.

Discussion

This research aimed to examine the effects of eight weeks of MIAT and HIAT on body composition and selected physiological variables among male students at Ethio-Japan Preparatory School in Debre Markos City. The pretest and posttest results indicated that eight weeks of MIAT and HIAT

significantly improved both body composition (BW and BFP) and physiological variables (HR and BP) ($p < 0.05$; $p = 0.000$). In this study, MIAT produced significantly greater improvements than both HIAT. When papers in the literature were carefully reviewed, it was observed that some results support the findings of this recent paper, while others argue with its results. The results of the paired sample t-test demonstrated that MIAT significantly improved BW and BFP ($p < 0.05$; $p = .000$). The outcomes of the independent t-test showed that MIAT led to more significant improvements in both BW and BFP among the subjects.

In this regard, the results of the present study are consistent with those of earlier investigations. For example, Evrim Cakmakci et al. [20] demonstrated that the effects of MIAT on body composition have been investigated in several studies. In particular, it has been observed that regular and controlled exercise decreases body fat and increases lean body weight, and the number of studies reporting these findings has increased day by day. Similarly, the results of Rinsa Raj and D. Sultana's [21] study indicate that both MIAT and HIAT improved body composition in sedentary individuals. To assess the effects of HIAT on physiological variables among secondary school students, paired-sample and independent-sample t-tests were employed for data analysis.

The outcomes of the paired sample t-tests revealed that HIAT considerably improved HR and BP ($p < 0.05$; $p = .000$). However, the posttest results from

the independent t-test indicated that the HIATG exhibited smaller improvements in both HR and BP compared to the MIAT group. In this regard, the findings of the present study are consistent with previous research, such as that of Hellsten and Nyberg [22], who demonstrated that HIAT promotes improvement in cardiovascular adaptation, including increased cardiac output, enhanced blood flow capacity, and improved arterial compliance. These physiological changes enhance the cardiovascular system's ability to transport oxygen more efficiently. These physiological changes enhance the cardiovascular system's ability to transport oxygen more effectively. These physiological adjustments enhance the efficiency of oxygen transport within the cardiovascular system. As a result, they improve both muscular and pulmonary VO_2 kinetics, as well as increase VO_2 max. Consequently, a greater proportion of energy can be supplied through aerobic metabolism, enabling players to withstand higher levels of performance.

To assess the effects of MIAE on physiological variables among preparatory school students paired sample t-tests and independent t-tests were conducted. The paired sample t-test results revealed that MIAT significantly improved HR and BP ($P < 0.05$; $p = .000$). Furthermore, the independent t-test indicated that MIAT produced greater improvements in both heart rate and BP among the subjects. In relation to this, the findings of the present study are consistent with previous research, such as the study by Rinsa Raj and D. Sultana [21], which indicated

that both MIAT and HIAT improved body composition in sedentary individuals.

The last objective of this study was to examine the effect of HIAE on body composition among preparatory school students. To assess this, paired sample t-tests and independent t-tests were computed. The results of the paired sample t-test demonstrated that HIAT significantly improved both BW and BFP ($P < 0.05$; $p = .000$). However, the post-test results of the independent t-test indicated that the HIATG exhibited smaller improvements in BW and BFP compared to the MIATG.

In this regard, the findings of the current study are consistent with previous research. For instance, Evrim Cakmakci et al. [20] stated that medium-intensity aerobic exercise contributes to reductions in central obesity and overall body weight, thereby improving health and lowering the risk of overweight and obesity. Likewise, Janssen et al. [25] found that higher levels of physical exercises are associated with better body composition among youth, which helps reduce related health risks.

Moreover, Zahara K. Polen and Snehal Joshi [23] indicated that high-intensity aerobic training can help individuals' burn calories more quickly than some other forms of aerobic exercise. The extended and more intensely a person performs high-intensity interval training (HIIT), the more calories they burn, making it easier to lose weight.

Conclusions

The study investigated the effects of MIAT and HIAT on body composition and physiological variables among secondary school students. An experimental pretest-posttest randomized group design was used, involving 90 randomly designated subjects assigned to MIAT, HIAT, and control groups. The study focused on body weight (BW), body fat percentage (BFP), heart rate (HR), and blood pressure (BP). The findings showed that both MIAT and HIAT significantly influenced body composition and physiological variables.

Based on the analyzed data, the researcher drew the following conclusions:

- The primary findings from the experimental analysis are that there is a significant difference between the pretest and posttest results for both body composition and physiological variables within the experimental group, i.e., both MIAT and HIAT.
- There is also a significant difference between the two groups, with MIAT showing greater improvements than HIAT.
- Therefore, according to the results of this study, both MIAT and HIAT significantly reduced BW, BFP, HR, and both systolic and diastolic BP among male students at Ethio-Japan Preparatory School in Debre Markos town.

Based on the findings of the study, the following practical recommendations are suggested:

- School fitness center trainers should use moderate-intensity aerobic training methods based on scientific training principles, as they are

effective in reducing certain body composition variables (BW and BFP) and physiological variables (HR and BP) among Ethio-Japan preparatory school male students.

- To be successful, medium-intensity aerobic exercise should be done at least three days a week.
- When applying moderate and high-intensity aerobic training methods, the training loads should be adjusted according to the individual's physical fitness level, training experience, age, and gender—particularly for overweight and obese participants.
- Awareness should be raised among trainers, trainees (students), fitness center owners, private and governmental sports organizations, healthcare professionals, and the broader community about the benefits of MIAT and HIAT in improving body composition (reducing BW and BFP) and physiological health (lowering HR and BP) in preparatory school male students.

In our future work we will conduct this study by increasing the duration of the training period and incorporating additional body composition and physiological variables beyond BW, BFP, HR, and BP of preparatory school male students. We will also investigate alternative training methods, taking into account the diet and economic status of preparatory school male students.

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