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COMPARATIVE EFFECTS OF HIGH-INTENSITY INTERVAL TRAINING AND STEP AEROBIC TRAINING ON MOTOR ABILITIES AND BODY COMPOSITION AMONG RECREATIONAL WOMEN

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(Original scientific paper)

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Abstract

Introduction: This comparative study analyses the effectiveness of High-Intensity Interval Training (HIIT) and step aerobic training on improving motor abilities and body composition in woman participating in recreational physical activities. The goal is to identify which training program offers more substantial benefits in terms of muscle strength, body fat reduction, and overall physical fitness. Methods: The study included 23 females, distributed into two groups according to their designated training protocols: HIIT and step aerobics. Over six weeks, participants underwent pre, control and post-intervention assessments that included body composition analysis using the OMRON BF511 and standardized physical fitness tests for assessing the motor abilities. Basic statistical parameters have been calculated and a repeated measures ANOVA was conducted to determine the within-group significance over the intervention period. Results and Discussion: The analysis revealed statistically significant improvements within both groups for most of the measured parameters for the tests assessing the motor abilities ($p<0.05$) and some of the variables assessing the body composition, favoring the HIIT group. Notably, the HIIT group exhibited more substantial increases in muscle mass and a larger decrease in fat mass compared to the step aerobics group. Conclusion: Both HIIT and step aerobics are effective in improving motor abilities and body composition among woman participating recreational activities. However, HIIT offers a more pronounced improvement in muscular strength and body fat reduction, suggesting its suitability for women involved in recreational activities, targeting faster fitness gains and potential health improvements. This study supports the integration of both training protocols into fitness regimens for women looking to optimize physical fitness and body composition outcomes effectively.

Keywords: *HIIT, Step Aerobics, Motor Abilities, Body Composition*

Introduction

Recent trends in physical fitness have increasingly focused on the efficacy of varied training programs to optimize health outcomes and enhance motor abilities among health enthusiasts and women practicing recreational physical activities. This study specifically examines High-Intensity Interval Training (HIIT) and step aerobic training, two popular fitness protocols, to determine their respective impacts on motor abilities and body composition in female practicing recreational physical activities.

Non-communicable diseases are the leading cause of death globally, accounting for over 73% of all deaths, with cardiovascular diseases being the most prevalent. The main risk factors associated with these diseases include high blood pressure, poor physical activity, obesity, high blood sugar, inappropriate diet, smoking, and environmental factors like air pollution and access to clean water (Hannah Ritchie, Fiona Spooner, Max Roser, 2018 and 2019). In Macedonia, data from the Global Burden of Disease (2019) also shows that cardiovascular diseases cause the majority of deaths, followed by cancer, diabetes, and respiratory diseases. The leading risk factors in the country are high blood pressure, high blood sugar, smoking, and obesity.

Physical activity significantly reduces the risk of diseases such as breast cancer, where women who are active have a 30% lower risk compared to inactive ones (Janneke Verloop et al., 2000). It also helps in

maintaining mental health and preventing anxiety and depression (Ströhle, A et al., 2009; Dinas, P. C et al., 2011), besides aiding in weight management and improving pregnancy outcomes (Evenson et al., 2016). Regular physical activity during pregnancy is associated with babies having normal weight and better motor skills (Hatch et al., 1993; Melzer, K et al., 2010). HIIT, characterized by short bursts of intense exercise followed by recovery periods, has been widely documented for its effectiveness in improving cardiovascular health and metabolic rate.

Research has shown that HIIT can significantly increase aerobic and anaerobic fitness, reduce insulin resistance, and lead to skeletal muscle adaptations that are beneficial for muscle fat oxidation and improved glucose tolerance (Boutcher, S. H. 2011; Gibala et al., 2012). These attributes make HIIT particularly attractive for individuals seeking to improve fitness in a time-efficient manner.

On the other hand, step aerobic training, which involves choreographed routines on a raised platform, is praised for its ability to enhance cardiovascular health, coordination, and agility. It promotes fat loss and muscle endurance without the extreme intensity of HIIT, potentially appealing to those who prefer moderate-intensity, rhythmic exercise that can be sustained over longer periods (Thompson et al., 2018). The comparative effectiveness of these training methods in improving body composition and motor abilities has not been thoroughly explored, particularly among females practicing recreational physical activities. This study aims to fill this gap by employing a methodological framework to evaluate changes in muscle mass and body fat percentage, utilizing standardized fitness tests and body composition analysis. Furthermore, understanding the specific benefits of each training program can help fitness professionals and people practicing recreational activities make informed decisions about their training choices. It aligns with broader fitness goals that include not only enhancing physical appearance and performance but also improving overall health markers and quality of life (Smith & Thomas, 2020). By integrating empirical data from various studies and systematically assessing the outcomes of HIIT versus step aerobics, this research contributes to understanding of how different training intensities and modalities influence key fitness and health outcomes in a target population of female recreational athletes. This approach is grounded in the perspective that personalized exercise programs, tailored to individual preferences and physiological responses, are crucial for sustainable engagement in physical activities and long-term health benefits.

Training load is a crucial concept in sports science, representing the volume and intensity of exercise performed. It provides a quantitative measure of the stress imposed on an athlete during training sessions (Borresen & Lambert, 2009). Accurately assessing training load helps in optimizing the training plan to improve performance and prevent over training. The Training Impulse (TRIMP) model is an innovative method to quantify training load. Developed by Eric Banister, TRIMP integrates exercise duration, intensity and the athlete's physiological response to create a complex score that reflects the overall training load (Banister & Clavert, 1980). TRIMP is calculated by multiplying the duration of the exercise session by the intensity, adjusted by an individual's heart rate response to the exercise.

Materials and Methods

This study involved a randomized controlled trial design to compare the effects of High-Intensity Interval Training (HIIT) and step aerobic training on motor abilities and body composition. A total of 23 females practicing recreational activities aged 25 to 45 years were selected through local fitness center. Participants were randomly assigned to one of two groups: the HIIT group (n=12) or the step aerobic group (n=11) and the groups were previously homogenized. Inclusion criteria required participants to be active but not currently engaged in any other form of physical activity. Exclusion criteria included any cardiovascular, metabolic, or orthopedic conditions that could interfere with training. Due to incomplete testing procedure one of the participants from the step aerobic training group was excluded from the experiment.

Training Interventions: The HIIT protocol consisted of 50-minute sessions three times per week, involving 2 full sets of 3 high-intensity exercises followed by of low-intensity recovery exercises. The workouts included a 5-minute warm-up and 5-minute cool-down. The main focus was on improving the strength of the muscles of the core and the lower extremities.

The step aerobic group participated in 50-60 minute sessions three times per week, which included a combination of choreographed step movements using a raised platform and the intensity of the trainings was adjusted at a rhythm from 120-150 bpm (beats per minute). The intensity was adjusted by the instructor based on standard aerobic exercise guidelines, with sessions including a warm-up and cool-down period similar to the HIIT group. Training load data was collected in every session through continuous heart rate

measurements. After each training session participants stated their rate of perceived exertion (RPE). In both groups the intensity of the training was assessed and monitored individually using a heart rate monitor POLAR H9 and the max heart-rate and heart rate zones were predicted and adjusted using the formula (208-0.7 x age) developed by Tanaka (2001). To assess motor abilities, all participants underwent individual testing using a modified battery of standardized tests adapted from Robert Wood (2008, 2010). The study applied the following 7 tests: YMCA 3-Minute Step Test (YMCA), Standing Long Jump (SLJ), Sit ups for 30 seconds (SU30S), Sit ups till failure (SU), Plank Hold to failure (PLANK), Wall Sit Hold (WALL), and Push-ups to failure (PUSH). In the experiment, anthropometric measurements followed the recommendations of the International Biological Program (Lohman, Roche & Martorell, 1988). Anthropometric measures in this study included the following: Body Height (BH), Total body mass (TBM), Percentage of Muscle Mass (PMM), Percentage of Subcutaneous Fat Tissue (PSFT), Total body mass Index (BMI), Percentage of Visceral Fat (PVF), Waist Circumference (WC), Hip Circumference (HC), and Thigh Circumference (TC).

Statistical analysis

To address the research problem, objectives, and subjects, the data were processed using statistical procedures with the SPSS for Windows Statistics 22 software package. For all variables on the interval and ratio scales, basic statistical parameters were calculated, including the mean (Mean-$\bar{X}$), standard deviation (S-d), skewness of the distribution of results (Skew), kurtosis of the distribution of results (Kurt), Kolmogorov-Smirnov test for normality (K-S), and Shapiro-Wilk test for normality (Shapiro-Wilk). Descriptive statistics was performed along with an assessment of the normal distribution. A repeated measures ANOVA was conducted for statistical analysis to determine the significance of within-group differences (Weir, J. P., & Vincent, W. J. 2020).

Ethical Considerations:

The study was approved by the institutional review board of the Faculty of Physical Education, Sport and Health- Skopje, and all participants provided written informed consent before participation. The study adhered to the ethical standards of the Declaration of Helsinki.

Results and Discussion

The Kolmogorov-Smirnov and Shapiro-Wilk tests for normality (Table 1, 2, 3, 4) show that all variables follow normal distribution ($p > 0.05$).

Table 1. Descriptive statistics and results from ANOVA of the tests assessing the motor abilities for the HIIT group

Test	Control Point	Mean	S.d	Percentage difference (%)	P value	Partial Eta Squared	K-S	Shapiro-Wilk
YMCA	1	123.82	12.96	15.57	0.01*	0.61	0.2	0.22
	2	104.55	15.96	-3.83			0.2	0.24
	3	100.55	14	-18.8			0.2	0.44
SLJ	1	139.64	25.83	6.51	0.50	0.14	0.15	0.07
	2	148.73	19.3	0.06			0.05	0.35
	3	148.82	19.83	6.58			0.2	0.86
SU	1	29.55	10.57	41.5	0.00**	0.79	0.2	0.1
	2	41.82	11.95	47.4			0.2	0.96
	3	61.64	21.61	108.6			0.01	0.01
SU30S	1	14.64	1.86	15.53	0.01*	0.68	0.08	0.47
	2	16.91	2.3	6.45			0.2	0.33
	3	18.00	3.13	22.98			0.2	0.86
WALL	1	80.00	24.54	46.48	0.00**	0.74	0.12	0.25
	2	117.18	38.1	28.16			0.2	0.63
	3	150.18	74.76	87.73			0.1	0.13
PUSH	1	21.00	5.29	-1.73	0.00**	0.77	0.11	0.08
	2	20.64	6.09	33.48			0.2	0.18
	3	27.55	5.57	31.17			0.16	0.48
PLANK	1	123.82	53.11	-6.24	0.01*	0.66	0.2	0.12
	2	116.09	27.31	50.43			0.01	0.12
	3	174.64	55.08	41.04			0.2	0.38

Statistically significant differences from the initial to the final testing ($p<0.05$) can be observed in all except one of the tests assessing the motor abilities in the HIIT group with SLJ having increased 108% between initial-final testing (table 1). Also Changes (or improvement) can be observed in the results for most of the variables determining the body composition, although not statistically significant except for the percentage of the visceral fat with a decrease of -9.26% between initial-final testing (table 2) and the waist

circumference (-15.21%) initial-final witch are closely related to one another, and the other variable that is statistically significant is the thigh circumference.

Figure 1. Changes in motor abilities- initial, control and final testing for the HIIT group

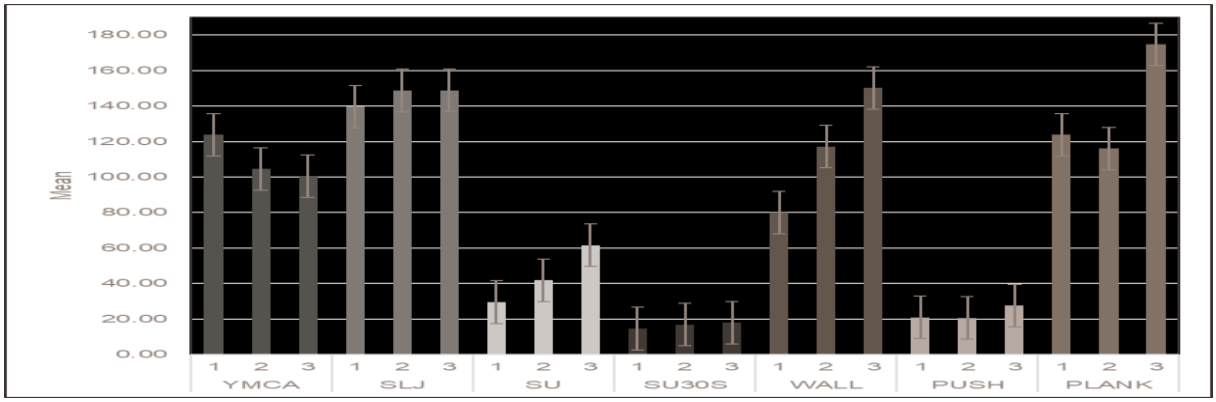
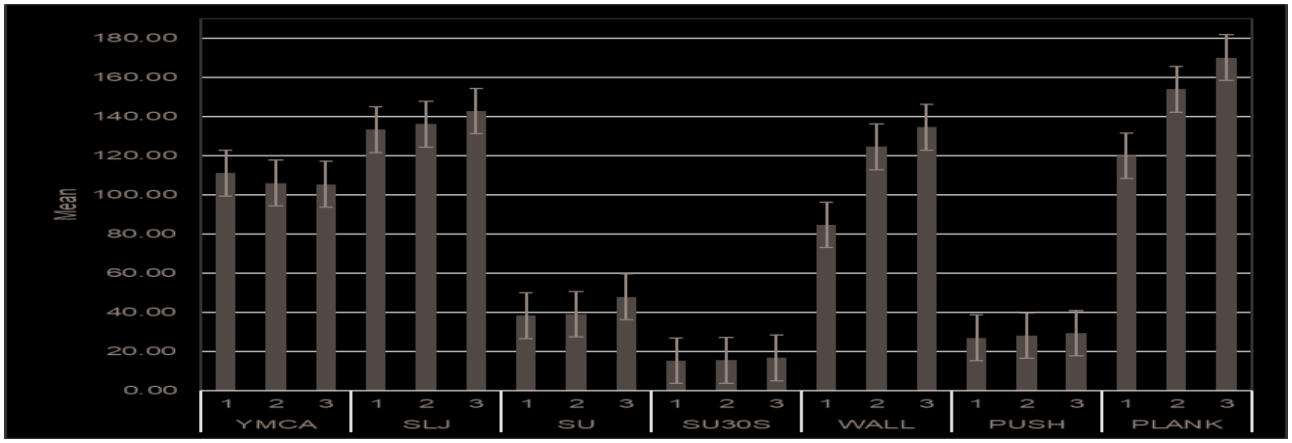


Table 2. Descriptive statistics and results from ANOVA of the tests assessing the motor abilities for the SA group

Test	Control Point	Mean	S.d	Percentage difference (%)	P value	Partial Eta Squared	K-S	Shapiro-Wilk
YMCA	1	111.1	12.6	-4.59	0.13	0.41	0.2	0.22
	2	106	8.77	-0.57			0.2	0.55
	3	105.4	7.92	-5.13			0.19	0.71
SLJ	1	133.3	14.43	2.1	0.00**	0.74	0.09	0.35
	2	136.1	15.47	4.92			0.2	0.78
	3	142.8	16.29	7.13			0.2	0.47
SU	1	38.3	24.19	1.83	0.00**	0.83	0.01	0
	2	39	24.56	22.82			0.1	0.01
	3	47.9	24.12	25.07			0.14	0.01
SU30S	1	15.3	2.45	1.31	0.1	0.44	0.08	0.04
	2	15.5	2.27	7.74			0.2	0.44
	3	16.7	1.95	9.15			0.11	0.25
WALL	1	84.6	36.49	47.16	0.01*	0.72	0.2	0.1
	2	124.5	51.24	8.03			0.2	0.66
	3	134.5	54.15	58.98			0.2	0.74
PUSH	1	27	10.98	4.07	0.29	0.27	0.12	0.38
	2	28.1	10.65	4.63			0.15	0.38
	3	29.4	10.06	8.89			0.2	0.25
PLANK	1	119.9	70.47	28.36	0.01*	0.67	0.02	0.2
	2	153.9	87.8	10.53			0.2	0.71
	3	170.1	82.83	41.87			0.17	0.18

Figure 2. Changes in motor abilities- initial, control and final testing for the SA training group



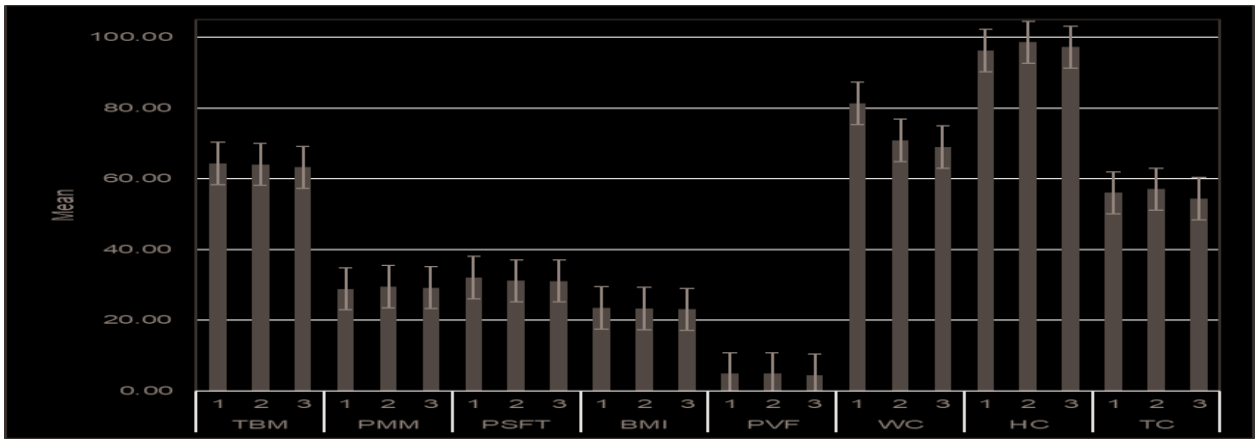
The step aerobic training group demonstrated significant improvements in most of the test assessing the motor abilities. Specifically, participants showed progress in the SLJ, SU, WALL and PLANK tests

with a statistically significant increase ($p < 0.01$), indicating enhanced lower body strength, core strength and muscular endurance (table 2). Despite these improvements, the overall percentage changes in motor abilities were less substantial compared to the HIIT group, suggesting that while step aerobics is effective, it may not provide as rapid or pronounced results in motor skills as high-intensity training.

Table 3. Descriptive statistics and results from ANOVA of the body composition measurements for the HIIT group

Test	Control Point	Mean	S.d	Percentage difference (%)	P value	Partial Eta Squared	K-S	Shapiro-Wilk
TBM	1	48.9	9.92	-0.45	0.57	0.13	0.2	0.66
	2	49.5	9.42	-1.32			0.2	0.62
	3	48.5	9.27	-1.77			0.2	0.66
PMM	1	24.7	2.86	2.17	0.65	0.1	0.2	0.89
	2	25.8	2.84	-0.99			0.2	0.52
	3	25.8	2.4	1.17			0.2	0.6
PSFT	1	20.8	7.21	-2.87	0.53	0.15	0.2	0.69
	2	20.1	6.82	-0.06			0.2	0.29
	3	20.3	6.48	-2.92			0.2	0.16
BMI	1	17.1	3.29	-0.93	0.58	0.13	0.2	0.74
	2	17.3	3.02	-0.98			0.2	0.67
	3	17	3.11	-1.89			0.2	0.68
PVF	1	2	1.51	0.00	0.13	0.4	0.15	0.36
	2	2	1.64	-9.26			0.2	0.82
	3	2	1.57	-9.26			0.05	0.2
WC	1	83.2	81.27	-12.86	0.07	0.49	0.2	0.28
	2	78.2	70.82	-2.7			0.2	0.66
	3	75.8	68.91	-15.21			0.2	0.89
HC	1	95.75	96.24	2.4	0.59	0.12	0.2	0.89
	2	96.6	98.55	-1.38			0.2	0.57
	3	96.2	97.18	0.98			0.2	0.76
TC	1	56.95	56	1.87	0	0.71	0.2	0.89
	2	55.25	57.05	-4.75			0.2	0.57
	3	56.3	54.34	-2.97			0.2	0.76

Figure 3. Changes in the body composition- initial, control and final testing for the HIIT training group



The HIIT group showed more substantial improvements in body composition, with a significant decrease in fat mass and a notable increase in muscle mass. Specifically, participants in the HIIT group experienced an average fat mass decrease of 1.7% and a muscle mass increase of 2.5%, highlighting the effectiveness of high-intensity training in promoting rapid changes in body composition. Additionally, there were significant reductions in waist circumference and visceral fat percentage, further emphasizing the superior impact of HIIT on body composition compared to moderate-intensity exercise.

The SA group has shown modest improvements in body composition, with a decrease in fat percentage and a slight increase in muscle mass, although these changes were not statistically significant. Participants experienced a small reduction in waist circumference and visceral fat percentage, indicating some positive effects on body composition despite the moderate intensity of the training. These results suggest that while step aerobics is beneficial for overall fitness, more pronounced changes in body composition may require a longer intervention period.

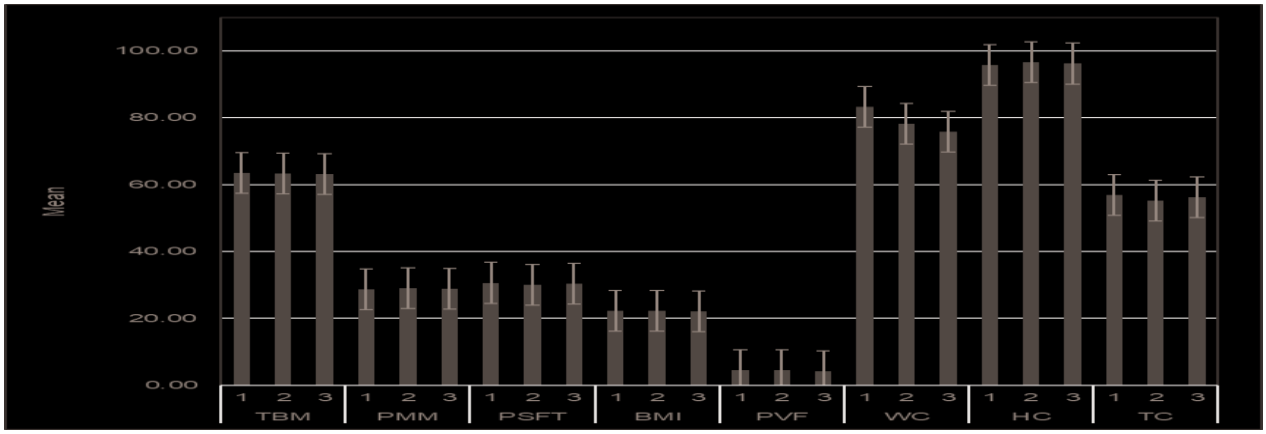
Both the HIIT and step aerobic training protocols led to statistically significant improvements in motor abilities ($p<0.05$). The HIIT protocol demonstrated more pronounced changes compared to the step aerobic group, indicating its greater efficacy in enhancing motor skills such as strength, agility, and overall power.

Despite the improvements in motor abilities, no statistically significant differences were observed in body composition and anthropometric measures between the two groups. This result suggests that the exercise interventions were equally effective in maintaining or marginally improving body composition.

Table 4. Descriptive statistics and results from ANOVA of the body composition measurements for the SA group

Test	Control Point	Mean	S.d	Percentage difference (%)	P value	Partial Eta Squared	K-S	Shapiro-Wilk
TBM	1	63.53	14.44	-0.25	0.57	0.13	0.2	0.14
	2	63.37	14.61	-0.57			0.2	0.18
	3	63.22	14.16	-0.49			0.2	0.21
PMM	1	28.70	3.2	1.25	0.65	0.1	0.2	0.05
	2	29.06	3.03	-0.41			0.2	0.61
	3	28.94	2.67	0.84			0.2	0.13
PSFT	1	30.64	8.75	-1.93	0.53	0.15	0.2	0.28
	2	30.05	8.45	0.93			0.2	0.3
	3	30.33	7.83	-1.01			0.2	0.5
BMI	1	22.28	4.35	-0.18	0.58	0.13	0.2	0.1
	2	22.24	4.37	-0.27			0.2	0.14
	3	22.18	4.3	-0.45			0.2	0.15
PVF	1	4.60	2.22	0.00	0.13	0.4	0.2	0.34
	2	4.60	2.12	**-8.70**			0.2	0.47
	3	4.20	1.87	**-8.70**			0.2	0.49
WC	1	83.2	13.57	**-6.01**	0.07	0.49	0.12	0.02
	2	78.2	14.3	**-3.07**			0.28	0
	3	75.8	16.12	**-8.89**			0.33	0.11
HC	1	95.75	10.94	0.89	0.59	0.12	0.11	0.02
	2	96.6	9.03	-0.41			0.23	0.2
	3	96.2	8.15	0.47			0.52	0.17
TC	1	56.95	7.25	-2.99	0.27	0.28	0.2	0.11
	2	55.25	4.53	1.9			0.78	0.04
	3	56.3	4.37	-1.14			0.15	0.68

Figure 4. Changes in body composition- initial, control and final testing for the SA training group



The superior performance of the HIIT group aligns with research suggesting that high-intensity training significantly enhances metabolic adaptations and improves aerobic and anaerobic fitness levels more effectively than moderate-intensity training (Gibala et al., 2012; Boutcher, 2011). The lack of significant differences in body composition might indicate that the duration of the intervention was not sufficient to cause significant changes in muscle mass or fat percentage, which is supported by findings from Weir et al. (2020) that longer training periods may be required to see substantial transformations.

The step aerobic training, while less impactful in enhancing rapid motor abilities, still significantly improved participants' fitness, supporting the findings of Thompson et al. (2018) that moderate-intensity continuous training effectively enhances cardiovascular health and endurance.

Both training protocols can lead to a reduction in body fat percentage overall, especially in abdominal and visceral fat (Nunes, P. R. et al., 2019). However, it is important to note that other factors such as the age of the participants, previous training experience, the programming of the training sessions, and their dosing also influence the results.

This study underscores the effectiveness of both HIIT and step aerobic training in improving motor abilities in woman participating in recreational physical activities. HIIT, in particular, shows potential for rapid and significant enhancements in performance attributes. Future research should consider longer

duration studies to fully assess the impact of these training modalities on body composition and to explore the potential cumulative benefits of continued practice.

Conclusion

The study supports the effectiveness of both HIIT and step aerobics in improving motor abilities and body composition among woman practicing recreational physical activities. However, HIIT appears to be more effective in rapid improvement of muscle strength and body composition. These insights could guide women practicing recreational activities in choosing training regimes that align more closely with their fitness goals. Studies have been conducted worldwide on the impact of aerobic training on body composition and the level of physical fitness of middle-aged women (Bryner, R. W, et al., 1997; Keating, S. E, et al., 2014; Clark, A, et al., 2019), but in Macedonia, there is very little research in this area focusing on the impact of fitness on the female population. It is believed that this research will contribute to this field.

Furthermore, as a result of the findings and conclusions presented, the research may encourage the female population to engage more in physical activity, which in turn is expected to result in the improvement of their health and well-being.

A recommendation can be made that the data from this research be applied to another sample, similar to the one used in this study, over a longer period, with the aim of confirming changes in body composition and motor abilities as a result of applying a specific exercise program.

The results from the research can also be used by relevant health institutions, fitness centers, fitness trainers and health enthusiasts whose primary activity is the care and improvement of people's health.

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