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EFFECTS OF 12 WEEKS OF MODERATE-INTENSITY AEROBIC EXERCISE ON CARDIAC FUNCTIONS OF UNIVERSITY-LEVEL FEMALE ATHLETES

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Abstract

Cardiovascular health is essential for athletic performance and long-term well-being, particularly among female athletes. This study investigated the effects of a 12-week moderate-intensity aerobic exercise program on cardiac functions—specifically stroke volume, cardiac input, and cardiac output—among university-level female athletes. A pretest–posttest experimental design was used, involving ten female athletes aged 20–24 years from the University of Lakki Marwat. Participants were divided into experimental and control groups. The experimental group completed a 12-week aerobic training program (65% of maximum heart rate), five sessions per week, including activities such as brisk walking, rope jumping, and burpees. Cardiac parameters were measured using echocardiography before and after the intervention. Statistical analyses (paired and independent t-tests) revealed significant improvements ($p < 0.01$) in all cardiac variables among the experimental group, whereas the control group showed no significant changes. Stroke volume increased by 14.95%, cardiac input by 13.55%, and cardiac output by 16.57%, indicating enhanced cardiac contractility, diastolic filling, and overall circulatory efficiency. These findings align with previous research suggesting that moderate-intensity aerobic exercise promotes left ventricular adaptations and improved autonomic regulation. The study concludes that consistent aerobic conditioning substantially enhances cardiac efficiency and endurance in university-level female athletes. It is recommended that such training programs be incorporated into university sports curricula to optimize cardiovascular health and athletic performance. Further research with larger samples and extended durations is suggested to explore the long-term sustainability of these cardiac adaptations.

Keywords: Aerobic Exercise, Cardiac Function, Female Athletes, Stroke Volume, Cardiac Output, Cardiovascular Health

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INTRODUCTION

Cardiovascular health is a critical aspect of overall well-being, particularly for athletes and physically active individuals (Lavie et al., 2019). Aerobic exercise, known for its benefits on heart function, metabolic health, and physical fitness, has been widely studied (Swift et al., 2013). However, the specific effects of moderate-intensity aerobic exercise on cardiac functions in young, university-level female athletes remain underexplored. This study aims to fill this gap by investigating how an 8-week moderate-intensity aerobic exercise program impacts cardiac functions, metabolic adaptations, and overall cardiovascular performance in this demographic.

Aerobic exercise is a cornerstone of cardiovascular health, improving heart rate variability, stroke volume, and diastolic filling time, all of which are critical for optimal cardiac function (Hottenrott et al., 2012). For female athletes, who often face unique physiological challenges, such as hormonal fluctuations and varying body composition, aerobic exercise can enhance insulin sensitivity, lipid profile, and metabolic flexibility (Oosthuyse & Bosch, 2010). These adaptations are particularly relevant for university-level players, who require both endurance and strength for peak performance (Joyner & Coyle, 2008).

University-level female athletes represent a unique population due to their high physical activity level and the demands of competitive sports (Mountjoy et al., 2018). However, they may also experience stress, irregular training schedules, and nutritional imbalances, which can impact cardiac health (Nattiv et al., 2007). An 8-week moderate-intensity aerobic exercise program offers a structured approach to improving cardiovascular function, potentially enhancing athletic performance and reducing the risk of long-term cardiovascular diseases (Shiroma & Lee, 2010).

While numerous studies have explored the effects of aerobic exercise on cardiac functions, most have focused on older adults, sedentary individuals, or mixed-gender populations. Limited research has specifically addressed young, active female athletes, particularly at the university level. Additionally, the optimal duration and intensity of aerobic exercise for this demographic remain unclear. This study seeks to address these gaps by providing targeted benefits of a 12-week moderate-intensity aerobic exercise program.

PROBLEM STATEMENT

Despite being physically active, many university-level female athletes may experience suboptimal cardiac performance due to inconsistent aerobic conditioning. Existing literature predominantly focuses on older or mixed-gender populations, leaving a gap regarding young, active women. Therefore, this study aims to examine how moderate-intensity aerobic training affects cardiac functions—specifically stroke volume, cardiac input, and cardiac output—among university-level female players.

OBJECTIVES OF THE STUDY

1. To assess the effect of 12 weeks of moderate-intensity aerobic exercise on stroke volume among university-level female athletes.
2. To evaluate the effect of 12 weeks of moderate-intensity aerobic exercise on cardiac input.
3. To determine the effect of 12 weeks of moderate-intensity aerobic exercise on cardiac output.

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LITERATURE REVIEW

Moderate-intensity aerobic exercise (50–70% VO_2 max) produces cardiovascular adaptations that improve ventricular efficiency, diastolic filling, and overall cardiac function (Garber et al., 2011; Pluim et al., 2000). Warburton et al. (2005) demonstrated significant improvements in stroke volume and ejection fraction after 8 weeks of aerobic training. Similarly, Sandercock et al. (2005) found that heart rate variability increased by up to 25% in female athletes following consistent aerobic exercise.

Female athletes exhibit distinct cardiovascular adaptations due to hormonal influences, including enhanced diastolic function and vascular elasticity driven by estrogen (Fu & Levine, 2013; Mendelsohn & Karas, 2005). Studies also confirm that consistent moderate-intensity training can reduce systolic and diastolic blood pressure while improving arterial compliance (Cornelissen & Fagard, 2005; Green et al., 2017). In trained female athletes, 8–12 weeks of moderate aerobic exercise can produce up to a 10% increase in left ventricular volume and a 12–15% improvement in myocardial contractility (Hellsten & Nyberg, 2015). These changes enhance endurance performance and long-term heart health, emphasizing the value of structured, moderate-intensity aerobic exercise programs for young female athletes.

HYPOTHESES OF THE STUDY

HA1 There is a significant effect of 12 weeks moderate intensity aerobic exercise on stroke volume of university level female athletes.

HA2 There is a significant effect of 12 weeks moderate intensity aerobic exercise on cardiac input of university level female athletes.

HA3 There is a significant effect of 12 weeks moderate intensity aerobic exercise on cardiac output of university level female athletes.

METHODOLOGY

The study employed a pretest-posttest experimental design. The sample consisted of 10 female athletes aged 20–24 from the University of Lakki Marwat, divided into equal experimental and control groups. The independent variable was a 12-week moderate-intensity aerobic training program (65% of MHR), and dependent variables were stroke volume, cardiac input, and cardiac output measured via echocardiogram. The program consisted of five sessions per week (40 minutes per session) including brisk walking, rope jumping, jumping jacks, burpees, and rest intervals. Statistical analysis involved mean, standard deviation, and variance.

RESULTS AND ANALYSIS

TABLE 1. DESCRIPTIVE STATISTICS OF CARDIAC PARAMETERS (MEAN ± SD)

Variable	Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	% Change
Stroke Volume (mL/beat)	Experimental	68.20 ± 4.25	78.40 ± 5.12	+14.95%
	Control	67.80 ± 3.97	68.10 ± 4.10	+0.44%
Cardiac Input (L/min)	Experimental	4.65 ± 0.48	5.28 ± 0.52	+13.55%
	Control	4.60 ± 0.46	4.62 ± 0.44	+0.43%
Cardiac Output (L/min)	Experimental	5.25 ± 0.61	6.12 ± 0.58	+16.57%
	Control	5.18 ± 0.59	5.20 ± 0.60	+0.39%

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Table 1 shows that the 12-week moderate-intensity aerobic exercise program produced marked improvements in all cardiac parameters among the experimental group, while the control group showed negligible changes. Stroke volume increased from 68.20 ± 4.25 to 78.40 ± 5.12 mL/beat (+14.95%), indicating enhanced cardiac contractility and left ventricular efficiency. Similarly, cardiac input rose from 4.65 ± 0.48 to 5.28 ± 0.52 L/min (+13.55%), reflecting improved venous return and diastolic function. Cardiac output also improved significantly from 5.25 ± 0.61 to 6.12 ± 0.58 L/min (+16.57%), demonstrating a greater capacity of the heart to deliver oxygenated blood during physical activity. In contrast, the control group exhibited only marginal percentage increases across all parameters, suggesting that the observed improvements were primarily due to the aerobic training intervention. Overall, the findings highlight that consistent moderate-intensity aerobic exercise effectively enhances cardiac efficiency and overall cardiovascular performance among university-level female athletes.

TABLE 2. COMPARISON OF PRE- AND POST-TEST RESULTS

Variable	Test	Group	t-value	p-value	Interpretation
Stroke Volume	Paired t-test	Experimental	5.72	0.001**	Significant improvement after training
		Control	0.38	0.712	Not significant
Cardiac Input	Paired t-test	Experimental	4.89	0.002**	Significant improvement after training
		Control	0.42	0.680	Not significant
Cardiac Output	Paired t-test	Experimental	6.03	0.001**	Significant improvement after training
		Control	0.33	0.748	Not significant
Post-test Comparison	Independent t-test	Exp. vs Control	3.98	0.003**	Significant group difference

Table 2 indicates that the 12-week moderate-intensity aerobic exercise program led to statistically significant improvements in all cardiac function parameters among the experimental group, while no significant changes were observed in the control group. The paired t-test results revealed significant increases in stroke volume ($t = 5.72$, $p = 0.001$), cardiac input ($t = 4.89$, $p = 0.002$), and cardiac output ($t = 6.03$, $p = 0.001$) for the experimental group, confirming that the training intervention effectively enhanced cardiac performance. Conversely, the control group's results for the same variables showed non-significant changes ($p > 0.05$), indicating that improvements did not occur without exercise. Furthermore, the independent t-test comparing post-test results between the experimental and control groups ($t = 3.98$, $p = 0.003$) demonstrated a statistically significant difference, confirming that the observed improvements were directly attributable to the aerobic training program rather than random variation. Overall, these findings validate the effectiveness of moderate-intensity aerobic exercise in significantly improving cardiovascular efficiency and functional capacity among university-level female athletes.

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DISCUSSION

The 12-week moderate-intensity aerobic training significantly improved cardiac performance in female athletes. The increase in stroke volume and cardiac output aligns with findings by Warburton et al. (2005) and Baggish & Wood (2011). The improvement in cardiac input suggests enhanced circulatory efficiency, contributing to greater endurance. Physiological mechanisms likely include improved ventricular filling, increased plasma volume, and enhanced autonomic regulation (Convertino, 1991; Hautala et al., 2009).

CONCLUSION

A 12-week moderate-intensity aerobic exercise program significantly enhances cardiac functions—particularly stroke volume, cardiac input, and cardiac output—among university-level female athletes. These findings demonstrate that consistent aerobic conditioning yields measurable cardiovascular benefits, improving both athletic endurance and heart efficiency.

RECOMMENDATIONS

- Integrate 12-week moderate-intensity aerobic training into university sports programs.
- Use stroke volume as a reliable measure of cardiac adaptation.
- Tailor training intensity based on individual cardiovascular responses.
- Conduct larger-scale studies to generalize results.
- Explore the long-term sustainability of cardiac improvements.

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