

Aerobic Exercise Intervention to Increase VO₂ Max Capacity of Higher Students in College Environment

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ABSTRACT

Low physical activity among higher students impacts those with less than optimal cardiorespiratory capacity. One important indicator of physical fitness is VO₂ max. This study aims to evaluate the impact of aerobic exercise on higher students. The research method used a quasi-experimental design with a pre-test and post-test approach without a control group. The subjects of the study were 96 students from the Faculty of Sport Science and the Faculty of Public Health, Makassar State University, aged 19–22 years, who participated in an aerobic exercise program for eight weeks with a frequency of four times a week and a duration of 60 minutes per session. VO₂ max measurements were carried out using the Modified Cooper Test. The findings of the analysis revealed that the average VO₂ max increased from 32.1 ml/kg/minute to 38.7 ml/kg/minute ($p < 0.001$), representing a 20.5% increase. This study proves that aerobic exercise is an effective and applicable form of intervention to improve the cardiorespiratory fitness of higher students. Aerobic exercise programs should be incorporated into the campus health agenda to promote a sustainable, active, and healthy lifestyle.

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1. INTRODUCTION

Higher students as a productive age group are in a transition period full of academic, social, and emotional demands (Wong & Cheung, 2024). Amidst the busy lecture schedule and academic pressure, physical activity is often neglected. The sedentary lifestyle common among higher students causes a decline in physical fitness, including the ability of the cardiovascular and respiratory systems to meet the body's metabolic needs (Ozemek et al., 2018; Ozkan et al., 2018). One of the main indicators of physical fitness is the maximum oxygen capacity (VO₂ max), which shows the body's efficiency in supplying and using oxygen during intense physical activity. Low VO₂ max values are associated with low cardiorespiratory capacity, which ultimately has a negative impact on endurance, academic performance, and overall quality of life. Based on a

report by the [World Health Organisation \(2024\)](#), the decline in physical fitness among adolescents and young adults contributes to the increasing incidence of non-communicable diseases, such as coronary heart disease, hypertension, obesity, and type 2 diabetes. This situation presents a serious challenge in higher education, as it overlooks the importance of promotive and preventive interventions that encourage physical activity.

In the context of higher education, students face a higher risk of declining physical fitness due to a lifestyle that tends to be passive ([Ringin et al., 2023](#)). Students spend more time sitting in class, in front of a computer screen, or engaging in other static activities. Lack of awareness and education about the importance of physical fitness exacerbates the situation. Optimal VO₂ max is essential for students, not only to support physical health but also to improve cognitive function, concentration, and resilience to academic stress ([Hasibuan et al., 2021](#)). Research by [Muhyi et al. \(2024\)](#) shows a positive correlation between high VO₂ max levels and the academic performance and psychological well-being of students. Aerobic exercise is a form of physical exercise that combines rhythmic and repetitive movements with moderate to high intensity, which aims to improve cardiovascular fitness and respiratory capacity ([Arfanda et al., 2025](#)). This exercise involves repetitive and rhythmic movements for a certain duration that aim to gradually increase heart rate and respiratory rate. The main benefits include increased cardiovascular and pulmonary endurance, burning calories, strengthening muscles, and increasing flexibility and body balance ([Nurulita et al., 2024](#)). Aerobic exercise is very effective in increasing VO₂ max capacity because it involves almost all the large muscle groups in the body.

Aerobic exercise is also easy to implement in a campus environment. Compared to other competitive sports, aerobic exercise does not require special facilities or equipment and can be done en masse. This advantage makes aerobic exercise an efficient and economical intervention to improve students' physical fitness ([Wu et al., 2023](#); [Yin et al., 2025](#)). Participants typically engage in this exercise in groups while listening to energetic music, which enhances their motivation and comfort. Various previous studies have indicated that aerobic exercise can significantly increase VO₂ max. For example, studies conducted by [Candrawati et al. \(2016\)](#) and [Hasibuan et al. \(2021\)](#) concluded that a structured aerobic exercise program can increase cardiorespiratory capacity in a relatively short time. Structured aerobic exercise interventions to increase students' VO₂ max in Indonesian higher education environments are still limited ([Fauzi et al., 2023](#); [Astari et al., 2024](#)). Most existing interventions are only educational in nature without any follow-up in the form of routine physical activity. In addition, few universities have made physical fitness an integral part of their student welfare programs. In fact, higher education institutions have enormous potential in integrating fitness intervention programmes such as aerobics into campus life ([Herbert 2022](#); [Liu et al., 2022](#)).

Aerobics as a routine activity can also have a positive impact on the formation of a healthy community among students ([Van Luchene & Delens, 2021](#)). Through social interaction in physical activities, students can build supportive relationships, which also

contribute to their mental well-being (Wang et al., 2022; Kirby et al., 2022; Simons & Bird, 2023). Researchers can measure the effectiveness of aerobics interventions by tracking changes in students' VO₂ max values before and after the program. With a pre-test and post-test approach, researchers can determine the direct impact of the intervention on participants' cardiorespiratory capacity.

Therefore, a structured and data-based study is needed to assess the impact of aerobics on students' VO₂ max. This study not only contributes to the field of sports science but also provides an empirical basis for the formulation of healthy campus policies. This study aims to examine in depth the effectiveness of the aerobics intervention program in increasing students' VO₂ max at Makassar State University. The results of this study are expected to be the basis for developing health promotion policies in higher education environments and encouraging students to live an active and healthy lifestyle.

2. METHOD

This study used a quasi-experimental approach with a pre-test and post-test design. The subjects of the study consisted of 96 students from the Faculty of Sport Science and the Faculty of Public Health, Makassar State University, aged 19–22 years, who had no history of heart or respiratory disease. The following presents the pre-test and post-test design used in this research in Figure 1.

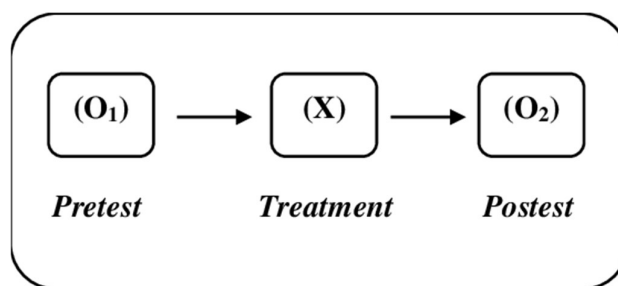


Figure 1. The Pre-test and Post-test Design

Information:

O₁: Pretest

X: Treatment

O₂: Posttest

We carried out the aerobic exercise program for eight weeks, four times a week, with each session lasting 60 minutes. Aerobic Exercise Procedure Each session consists of a warm-up (10 minutes), a core session with aerobic movements lasting 40 minutes, and a cool-down for 10 minutes. The exercise was guided by a certified instructor and carried out in an open campus facility. Measurement and Analysis VO₂ max was measured using the Modified Cooper Test method before and after the program. Statistical analysis used a paired t-test to test the difference in VO₂ max values before and after the intervention.

3. RESULTS AND DISCUSSION

Results

Before the intervention, the average VO_2 max of the participants was 32.1 ml/kg/min. After eight weeks of aerobic exercise, the average VO_2 max increased to 38.7 ml/kg/min. There was a significant increase of 6.6 ml/kg/min, or about 20.5% ($p < 0.001$). Following are the results of the comparison of VO_2 max values before and after the intervention presented in Table 1.

Table 1. Comparison of VO_2 Max Values Before and After Intervention

Measurement Time	Average VO_2 max (ml/kg/min)
Pre-test	32,1
Post-test	38,7

Table 1 shows the average VO_2 max values of students at two measurement times: before the program (pre-test) and after the program (post-test). In the pre-test, the average VO_2 max value of the participants was recorded at 32.1 ml/kg/min, which reflects the level of cardiorespiratory fitness of the students at the beginning, which was moderate. After eight weeks of following the aerobic exercise program with a frequency of four times a week and a session duration of 60 minutes, there was a significant increase in VO_2 max capacity, which was an average of 38.7 ml/kg/min in the post-test. This means that there was an average increase of 6.6 ml/kg/min, or around 20.5%.

The increase in VO_2 max values shows that the aerobic exercise program succeeded in providing positive stimuli to the participants' cardiovascular and respiratory systems. Physiological adaptations that occur during exercise, such as increased cardiac stroke volume, blood oxygenation efficiency, and lung capacity, contribute to increasing the body's ability to supply oxygen optimally during physical activity.

These changes also have important implications in supporting students' physical endurance, increasing stamina, and helping reduce the risk of degenerative diseases associated with low cardiorespiratory fitness. In addition to physical benefits, increasing VO_2 max also has the potential to improve students' concentration and mental endurance, which are very useful in supporting their academic activities. The following presents the results of analysis using a paired t-test in Table 2.

Table 2. Results of analysis using paired t-test

Statistics	Value
Mean VO_2 max Pre-test	32,1 ml/kg/min
Mean VO_2 max Post-test	38,7 ml/kg/min
Mean Difference	6,6 ml/kg/min
Standard Deviation Difference	0,93 ml/kg/min
t Value (t-statistic)	68,71
p Value (p-value)	$8,5 \times 10^{-83}$ (very significant)

Building upon the analysis results with the paired t-test, the statistical value of the t-test shows $t = 68.71$ with a tiny p-value, which is 8.5×10^{-83} . The p-value, which is

much smaller than 0.05, indicates that the increase in VO₂ max experienced by students is statistically significant. This result means that there is strong evidence that aerobic exercise intervention has a really positive effect on increasing students' cardiorespiratory capacity. In other words, aerobic exercise is effective in increasing participants' VO₂ max compared to the initial conditions before the program.

Discussion

The results of this study indicate that an aerobic exercise program carried out routinely for eight weeks can significantly increase students' VO₂ max capacity by 20.5%. This finding is consistent with previous studies that have proven the effectiveness of aerobic exercise in improving cardiovascular and respiratory system function (Amaya et al., 2021; Lan et al., 2022).

Improved heart and lung function occurs due to the body's physiological adaptation to the aerobic exercise load (Serman, 2022; Du et al., 2024). Specifically, the exercise increases the stroke volume, which allows the heart to pump more blood with each beat, and it increases muscle capillaryization so that oxygen can be supplied to the tissues more efficiently. In addition, the capacity of the lungs to take in and distribute oxygen also increases, so that the body's use of oxygen becomes more optimal.

This increase in VO₂ max plays an important role in increasing students' physical endurance so that they are able to carry out physical and intellectual activities longer without getting tired quickly (Pérez-Ramírez et al., 2024). This certainly has a positive impact on academic performance, where stamina and concentration in learning become better.

In addition to physical benefits, aerobic exercise also has a positive impact on psychological aspects. Regular physical activity has been shown to lower stress hormone levels (such as cortisol), increase the production of mood-boosting endorphins, and reduce anxiety and depression. Thus, students who regularly participate in aerobic exercise programs tend to experience increased mental well-being, which supports learning productivity and life balance (Al-Wardat et al., 2024).

This study is in line with the study of Buttar et al. (2019), which found that aerobic exercise also increases body flexibility, an important factor that supports overall physical fitness. The study of Arfanda (2023) also confirmed that aerobic exercise contributes to increased VO₂ max and reduced risk of cardiovascular disease.

Furthermore, the application of aerobic exercise in a campus environment is very relevant because it can be a practical and economical solution to improve student health (Niu et al., 2018; Keating et al., 2020). This exercise does not require special equipment and is easy to do in groups. At the same time, it strengthens social interaction between students, thus promoting a healthy lifestyle in a fun way.

4. CONCLUSION

This study proves that an eight-week aerobic exercise intervention with a frequency of four times per week and a duration of 60 minutes per session significantly increases VO₂

max capacity in higher students. The data showed an average increase in VO_2 max from 32.1 ml/kg/min in the pre-test to 38.7 ml/kg/min in the post-test, or an increase of 20.5% ($p < 0.001$). The paired t-test analysis gave a t value of 68.71 with a very significant p value of 8.5×10^{-83} , which confirms that this increase is not a coincidence but a real effect of the aerobic exercise program. This increase in VO_2 max indicates a positive physiological adaptation to the cardiovascular and respiratory systems, such as an increase in cardiac stroke volume and blood oxygenation efficiency. The practical implication is an increase in physical endurance and stamina in higher students, which also supports their academic performance and mental well-being. With consistent and significant results, aerobic exercise has been proven to be an effective, applicable, and economical intervention to improve the physical fitness of students in a college environment.

Therefore, aerobic exercise programs should be integrated into the campus health agenda to encourage an active and healthy lifestyle in a sustainable manner.

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