

## Students' Cardiorespiratory Fitness Responses to the Implementation of Structured Aerobic Exercise

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### ABSTRACT

Cardiorespiratory fitness is a fundamental component of physical fitness that plays a crucial role in supporting students' health, academic performance, and participation in daily physical activities. However, sedentary lifestyles among university students may contribute to decreased cardiorespiratory capacity, highlighting the need for effective exercise interventions. This study aimed to analyze students' cardiorespiratory fitness responses to the implementation of a structured aerobic exercise program in the campus environment of the Faculty of Sport and Health Sciences, Universitas Negeri Makassar (FIKK UNM). The study employed a quantitative approach using a quasi-experimental method with a one-group pretest-posttest design. A total of 60 students were selected through purposive sampling. Participants engaged in a structured aerobic exercise program for eight weeks, performed three times per week, with a duration of 45-60 minutes per session at moderate intensity (60-75% of maximum heart rate). Cardiorespiratory fitness was assessed using the Multistage Fitness Test (Beep Test). Data were analyzed using descriptive statistics and a paired sample t-test with a significance level of 0.05. The findings revealed a significant improvement in cardiorespiratory fitness following the intervention. The mean fitness score increased from  $34.65 \pm 3.12$  in the pretest to  $38.92 \pm 3.45$  in the posttest, with an average increase of 4.27 points. The paired sample t-test indicated a statistically significant difference between pretest and posttest scores ( $t = -9.84$ ;  $p = 0.000$ ). These results demonstrate that structured aerobic exercise implemented within the campus environment provides a positive and significant effect on improving students' cardiorespiratory fitness. Therefore, structured aerobic exercise programs can be recommended as an effective strategy to promote health and physical fitness among university students.

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A. Conception and design of the study;  
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## INTRODUCTION

Physical fitness is a physical condition that reflects a person's ability to carry out daily activities effectively and efficiently without experiencing excessive fatigue, and still having energy reserves to carry out further activities (Nurulita et al., 2024). One of the most important components of physical fitness is cardiorespiratory fitness, which

reflects the ability of the heart, lungs, and blood vessels to supply oxygen effectively during physical activity (Soraya, 2017). A good level of cardiorespiratory fitness plays an important role in supporting a person's ability to carry out daily activities and academic activities without experiencing excessive fatigue (Eriksen et al., 2013).

Besides being influenced by physical activity levels, cardiorespiratory fitness is also closely related to systematic and structured exercise patterns. College students, as a productive age group, face various high academic demands, including lectures, academic assignments, and intensive use of digital technology. These conditions have the potential to reduce physical activity levels if not balanced with an active lifestyle. Even among students of the Faculty of Sport and Health Sciences (FIKK), whose academic background is closely related to physical activity and sports, it is possible that physical fitness declines due to a lack of structured physical activity outside of class.

The phenomenon of declining physical activity among college students is a serious concern because it directly impacts cardiorespiratory fitness and long-term health. Low cardiorespiratory fitness can impact endurance, concentration, and physical readiness for sports activities (Dinata et al., 2023). Regular moderate-intensity aerobic exercise is recommended to improve cardiorespiratory fitness (Riebe et al., 2018). Therefore, systematic and planned efforts are needed to improve and maintain students' cardiorespiratory fitness through the implementation of structured and sustainable physical activity.

Aerobic exercise is a form of physical activity that is rhythmic, continuous, and involves large muscle groups with moderate intensity (Nurulita, Hanafi, et al., 2025). Aerobic exercise has advantages in terms of ease of implementation, flexibility of movement, and can be done in groups without requiring complex facilities and infrastructure (Arfanda, 2023). Physiological adaptations due to aerobic exercise include increased cardiac stroke volume, efficiency of oxygen use, and increased lung capacity (Arfanda et al., 2025). Aerobic exercise as a form of aerobic exercise has the characteristics of dynamic, rhythmic movements, and is easily modified, so it is suitable for students with heterogeneous fitness levels (Nurulita & Yusnadi, 2025). The implementation of structured and programmed aerobic exercise is believed to provide optimal training stimulus for the cardiorespiratory system. Regular aerobic exercise with controlled intensity, duration, and frequency can trigger physiological adaptations in the form of increased heart and lung efficiency. The campus environment is a strategic space for implementing a structured aerobic exercise program due to its easy access and high potential for student participation (Hudain et al., 2025).

Many studies have been conducted on the effectiveness of aerobic exercise in improving physical fitness across various age groups (Nurulita, Arfanda, et al., 2025). One relevant study, conducted among adolescents in Makassar City, examined the effectiveness of aerobic exercise on improving physical fitness. The results showed that regular, programmed aerobic exercise significantly improved participants' physical fitness components, particularly cardiorespiratory endurance. These findings indicate that aerobic exercise is an effective form of physical activity for increasing the body's

functional capacity through physiological adaptation mechanisms resulting from aerobic exercise.

Another relevant study was conducted among university students, a conference study entitled "The Effect of Aerobic Exercises on Students' Physical Fitness (Agus et al., 2021). The study reported that a structured aerobic exercise program implemented over 24 sessions significantly improved students' physical fitness. The exercise program was designed with controlled intensity and implemented continuously, thus providing an effective training stimulus for the cardiorespiratory system and other components of physical fitness. Therefore, research is needed that empirically examines the impact of implementing structured aerobic exercise on the cardiorespiratory fitness of students at the Faculty of Health Sciences (FIKK) of Makassar State University. Based on this description, this study aims to analyze the cardiorespiratory fitness responses of students to the implementation of structured aerobic exercise on the FIKK UNM campus. The results of this study are expected to provide a scientific contribution as a basis for developing structured physical activity programs in higher education environments, particularly in efforts to improve student fitness and health.

## **METHODS**

This study used a quantitative approach with a quasi-experimental method. The research design applied was a one-group pretest-posttest design, which aimed to identify changes in students' cardiorespiratory fitness before and after being given a structured aerobic exercise program. The one-group pretest-posttest design was chosen due to limited field conditions and ethical considerations, and was deemed adequate for identifying changes in cardiorespiratory fitness due to exercise interventions in the context of sports education. The population in this study were all students of the Faculty of Sport and Health Sciences (FIKK) of Makassar State University. Sampling was drawn using a purposive sampling technique. According to (Sugiyono., 2017), purposive sampling is a sampling technique with certain considerations, where the sample is selected because it is considered to best understand and represent the characteristics needed in the research. The research sample consisted of 60 students selected using a purposive sampling technique with the following inclusion criteria: (1) active students of FIKK UNM, (2) aged 18–20 years, (3) in good health and with no history of cardiovascular disease, and (4) willing to participate in the entire series of research. The treatment in the form of a structured aerobic exercise program was carried out for eight weeks with a frequency of three times per week. The exercise program was designed referring to the principles of aerobic exercise recommended internationally. (Johnson et al., 2019). Each training session lasted 45–60 minutes, consisting of a warm-up (10 minutes), core training (25–35 minutes), and a cool-down (5–10 minutes). The training intensity was moderate, at around 60–75% of HR<sub>max</sub>, adjusted to the characteristics of the research subjects.

All training sessions were conducted on the FIKK UNM campus under the supervision of researchers. The instrument used to measure cardiorespiratory fitness was a multistage fitness test (bleep test) tailored to the characteristics of the students. This test has good validity and reliability for measuring aerobic capacity in young adults. Test results are expressed as a cardiorespiratory fitness score obtained from the conversion of the level and shuttle achieved by the participants. Cardiorespiratory fitness data were collected through a pretest before the aerobic exercise program and a posttest after the entire treatment series was completed. All data collection processes were conducted according to standard fitness testing procedures.

The obtained data were analyzed using descriptive statistics to determine the mean and standard deviation. Before hypothesis testing, the data were tested for normality using the Kolmogorov–Smirnov test. If the data were normally distributed, analysis continued with a paired sample t-test to determine differences in cardiorespiratory fitness before and after treatment. All data analyses were performed at a significance level of  $p < 0.05$ .

## RESULTS AND DISCUSSION

### Result

#### Descriptive Statistics of Cardiorespiratory Fitness

The research results were obtained from measurements of students' cardiorespiratory fitness before (pretest) and after (posttest) participating in a structured aerobic exercise program. Measurements were conducted using a multistage fitness test (bleep test) on 60 FIKK UNM students. Descriptively, the students' cardiorespiratory fitness data showed an increase in average scores after the treatment. A summary of the descriptive statistical results of the pretest and posttest is presented in Table 1.

**Table 1.**

Descriptive Statistics of Cardiorespiratory Fitness of College Students

Measurement	N	Minimum	Maximum	Average	Standard Deviation
Pretest	60	28,40	41,20	34,65	3,12
Posttest	60	32,10	46,80	38,92	3,45

Table 1 shows that the average cardiorespiratory fitness score in the pretest was 34.65, with a minimum score of 28.40 and a maximum score of 41.20. After being given structured aerobic exercise treatment, the average cardiorespiratory fitness score in the posttest increased to 38.92, with a minimum score of 32.10 and a maximum score of 46.80. This increase in the average score indicates a change in the students' cardiorespiratory fitness after participating in the exercise program. The standard deviation in the pretest was 3.12 and in the posttest was 3.45. These values indicate that the variation in the students' cardiorespiratory fitness data was relatively homogeneous, both before and after the treatment. Before conducting the hypothesis test, the cardiorespiratory fitness data were tested for normality using the Kolmogorov–Smirnov test. The results of the normality test are presented in Table 2.

## Data Normality Test

**Table 2.**  
 Cardiorespiratory Fitness Data Normality Test Results

Variable	Statistical K-S	Sig.	Description
Pretest	0,086	0,200	Normal
Posttest	0,091	0,200	Normal

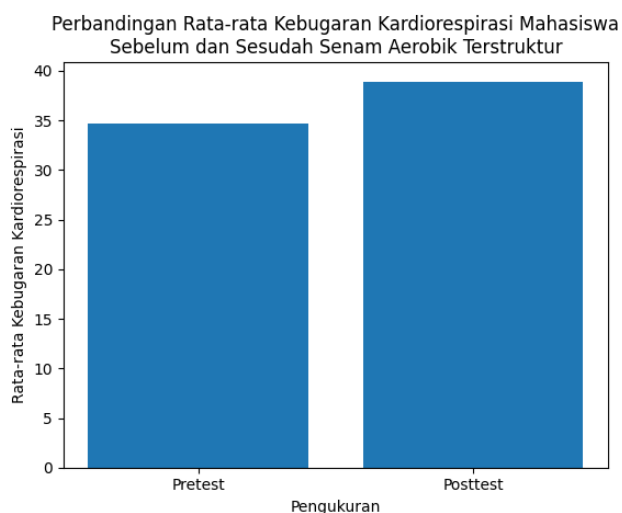
Based on the results of the normality test, the students' cardiorespiratory fitness data are presented in Table 2. Based on the table, the Kolmogorov–Smirnov significance value for the pretest data was 0.200 and the posttest was 0.200. The significance value for both data is greater than 0.05, so it can be concluded that the students' cardiorespiratory fitness data in the pretest and posttest were normally distributed. With the assumption of normality met, the statistical analysis can be continued using parametric tests. The results of the paired sample t-test are presented in Table 3.

## Hypothesis Testing

**Table 3.**  
 Paired Sample t-Test Results for Cardiorespiratory Fitness

Variable	Mean	SD	t hitung	df	Sig. (2-tailed)
Pretest	34,65	3,12			
Posttest	38,92	3,45	-9,84	59	0,000
Selisih (Post-Pre)	4,27	3,36			

The results of the paired sample t-test showed a t-value of -9.84 with a significance value of 0.000 ( $p < 0.05$ ). This indicates that there is a significant difference between the cardiorespiratory fitness of students before and after participating in the structured aerobic exercise program. The average cardiorespiratory fitness value in the posttest was higher than the pretest, with an average difference of 4.27. Thus, it can be statistically stated that the implementation of structured aerobic exercise provides a significant response to the cardiorespiratory fitness of students at the Faculty of Psychiatry, Makassar State University.



**Figure 1**  
 Comparison of Average Cardiorespiratory Fitness

The diagram shows an increase in the average cardiorespiratory fitness score from 34.65 (pretest) to 38.92 (posttest). This visualization aligns with the results of the paired sample t-test, which showed a significant difference ( $p < 0.05$ ).

## Discussion

The findings of this study demonstrated that the implementation of a structured aerobic exercise program significantly improved the cardiorespiratory fitness of students at the Faculty of Sport and Health Sciences, Universitas Negeri Makassar (FIKK UNM). The average cardiorespiratory fitness score increased from  $34.65 \pm 3.12$  before the intervention to  $38.92 \pm 3.45$  after the eight-week training program, with a mean increase of 4.27 points. Furthermore, the paired sample t-test revealed a statistically significant difference between pretest and posttest scores ( $t = -9.84$ ;  $p = 0.000$ ), indicating that structured aerobic exercise effectively enhanced students' cardiorespiratory capacity.

These findings support the fundamental principle of exercise physiology that regular aerobic exercise stimulates positive cardiovascular and respiratory adaptations, leading to improvements in oxygen transport and utilization efficiency (Garber et al., 2019; Milanović et al., 2020). Cardiorespiratory fitness, commonly represented by maximal oxygen uptake ( $VO_{2max}$ ), reflects the body's ability to deliver oxygen to working muscles during prolonged physical activity and is widely recognized as a strong indicator of overall health status and physical performance (Ross et al., 2016; Ortega et al., 2018). The observed improvement in fitness scores suggests that the aerobic exercise stimulus provided during the intervention was sufficient to induce meaningful physiological adaptations.

The significant increase in cardiorespiratory fitness may be explained by several physiological mechanisms. Regular aerobic training promotes increases in stroke volume, cardiac output, capillary density, mitochondrial biogenesis, and oxidative enzyme activity, all of which contribute to enhanced aerobic metabolism (Bassett & Howley, 2017; Granata et al., 2018). Additionally, moderate-intensity exercise performed consistently for eight weeks has been shown to improve pulmonary ventilation efficiency and oxygen extraction by skeletal muscles (Montero & Lundby, 2018; Astorino et al., 2019). These adaptations collectively enhance the body's ability to sustain physical activity and delay fatigue.

The present findings are consistent with previous studies reporting significant improvements in cardiorespiratory fitness following structured aerobic exercise interventions among university students. Research by Suryadi et al. (2022) found that aerobic exercise conducted three times per week for six weeks significantly increased  $VO_{2max}$  among Indonesian university students. Similarly, Prasetyo et al. (2021) reported substantial improvements in cardiovascular endurance after the implementation of campus-based aerobic training programs. International studies have also demonstrated that structured aerobic exercise is an effective strategy for improving aerobic capacity in young adults (Northey et al., 2018; Batrakoulis et al., 2020).

The frequency, duration, and intensity of exercise applied in this study align with recommendations from the American College of Sports Medicine (ACSM), which advocates moderate-intensity aerobic activity performed at least three to five times per

week to improve cardiorespiratory fitness (ACSM, 2022). The exercise intensity of 60–75% HRmax used in the present study falls within the optimal training zone for stimulating aerobic adaptations while maintaining participant safety and adherence (Piercy et al., 2018). Previous investigations have shown that moderate-intensity aerobic exercise is particularly suitable for university students because it effectively improves fitness while minimizing excessive fatigue and injury risk (Bull et al., 2020).

Another important aspect contributing to the effectiveness of the intervention is the structured nature of the exercise program. Structured training provides systematic progression, clear exercise objectives, and consistent monitoring, which are essential factors for achieving physiological adaptations (Bompa & Buzzichelli, 2019). Several studies have highlighted that exercise programs with planned progression produce greater improvements in aerobic fitness than unstructured physical activities (Huang et al., 2021; Gallo-Villegas et al., 2022). Therefore, the positive outcomes observed in this study may partly reflect the benefits of systematic exercise prescription implemented throughout the intervention period.

From a health perspective, the improvement in cardiorespiratory fitness observed in this study carries important implications. Numerous epidemiological studies have established that higher levels of cardiorespiratory fitness are associated with lower risks of cardiovascular disease, metabolic syndrome, obesity, hypertension, and premature mortality (Kodama et al., 2019; Blair et al., 2021). Among university students, improved aerobic fitness has also been linked to better cognitive performance, academic achievement, psychological well-being, and stress management (Álvarez-Bueno et al., 2017; Kandola et al., 2019; Singh et al., 2023). Consequently, structured aerobic exercise may contribute not only to physical health but also to academic success and overall quality of life.

The campus environment of FIKK UNM likely played a supportive role in facilitating exercise participation and adherence. Environmental factors such as accessible sports facilities, supportive peer interactions, and institutional encouragement have been identified as important determinants of physical activity engagement among university students (Keating et al., 2020; Plotnikoff et al., 2021). The integration of structured exercise programs within university settings can therefore serve as an effective approach to fostering healthy lifestyles and improving student fitness levels.

Despite the positive findings, several limitations should be acknowledged. The study employed a one-group pretest-posttest design without a control group, limiting the ability to attribute changes exclusively to the intervention. Future studies should utilize randomized controlled trial designs and include larger samples from multiple universities to enhance generalizability. Additionally, future research may investigate the comparative effectiveness of different aerobic training modalities, such as high-intensity interval training (HIIT), circuit training, and sport-specific conditioning programs.

Overall, the results confirm that structured aerobic exercise implemented in the FIKK UNM campus environment significantly improves students' cardiorespiratory

fitness. These findings reinforce current evidence supporting the role of regular aerobic training as an effective strategy for enhancing cardiovascular health, physical fitness, and student well-being. Therefore, integrating structured aerobic exercise into university health promotion programs may represent a valuable investment in developing healthier, more physically active, and academically productive student populations.

## CONCLUSION

Based on the results of a study involving 60 students from the Faculty of Sport and Health Sciences at Makassar State University, it can be concluded that the implementation of structured aerobic exercise significantly improved the students' cardiorespiratory fitness. This improvement was demonstrated by an increase in the average cardiorespiratory fitness score from 34.65 in the pretest to 38.92 in the posttest. The results of a paired sample t-test supported this finding with a significance value of 0.000 ( $p < 0.05$ ), indicating a significant difference between the pre- and post-treatment conditions. These findings confirm that a structured aerobic exercise program, implemented at moderate intensity and regular frequency, can positively impact the students' cardiorespiratory system. Therefore, structured aerobic exercise can be an effective and applicable form of physical activity to improve the cardiorespiratory fitness of students on the campus of the Faculty of Sport and Health Sciences at Makassar State University.

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