



The Effect of Skipping Training on Cardiovascular Endurance Capability

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ABSTRACT

Cardiovascular endurance is one of the essential physical components in futsal because players are required to perform repeated high-intensity movements, rapid transitions, accelerations, decelerations, and continuous technical actions throughout the game. In university-level futsal, insufficient cardiovascular endurance may reduce movement consistency, delay recovery, and weaken performance during training or competition. Therefore, a practical and structured conditioning method is needed to improve students' physical readiness. This study aimed to determine the effect of skipping training on cardiovascular endurance among students participating in the futsal sport branch at FIKK UNM. This research used a quantitative experimental method with a pretest-posttest control group design. The sample consisted of 20 students divided into two groups: 10 students in the skipping training group and 10 students in the control group. Cardiovascular endurance was measured before and after the intervention using a standardized endurance test. The data were analyzed through descriptive statistics, normality test, homogeneity test, and t-test at a significance level of 0.05. The results showed that the skipping training group improved from a pretest mean score of 38.1000 to a posttest mean score of 43.6700, with a mean difference of 5.5700 points or 14.62%. Meanwhile, the control group improved from 39.3400 to 41.1500, with a mean difference of 1.8100 points or 4.60%. The hypothesis test showed that the t-observed value was 6.915, higher than the t-table value of 2.262. It can be concluded that skipping training significantly improves cardiovascular endurance among futsal students at FIKK UNM.

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INTRODUCTION

Sport is not merely a form of physical activity, but also a structured medium for maintaining health, developing psychological resilience, strengthening social interaction, and achieving performance excellence. In the context of higher education, sport participation becomes increasingly important because students are required to maintain physical fitness while developing sport-specific competence, tactical understanding, and competitive character. Futsal is one of the most popular sports among Indonesian university students, including students of the Faculty of Sport and Health Sciences, Universitas Negeri Makassar. Futsal is played by two teams with five players on court, one of whom is the goalkeeper, and is characterized by a smaller playing area, rapid transitions, repeated accelerations, frequent changes of direction, and continuous involvement with the ball (FIFA, 2024; Naser et al., 2017).



The main performance problem in futsal is that players are required to sustain high-intensity intermittent activity throughout the game. Previous studies show that futsal match play places high physiological demands, with players often performing at high percentages of maximal heart rate and oxygen uptake (Spyrou et al., 2020; Naser et al., 2017). Therefore, cardiovascular endurance is a decisive physical component because it supports recovery between repeated sprints, maintains technical execution under fatigue, and helps players remain active during attacking and defensive transitions (Ayarra et al., 2018; Arslan et al., 2020). In practice, many futsal students still rely on technical drills and game-based play without sufficient structured cardiovascular conditioning. This condition may cause early fatigue, reduced movement intensity, slower recovery, and declining decision-making quality during play. Thus, a simple, economical, and sport-relevant training method is needed to improve cardiovascular endurance among futsal students.

Recent sport science literature emphasizes that cardiovascular endurance is a fundamental determinant of performance in intermittent team sports. Cardiorespiratory fitness is strongly associated with the ability of the heart, lungs, blood vessels, and working muscles to supply and utilize oxygen efficiently during prolonged or repeated exercise (Ross et al., 2016; Bull et al., 2020). In futsal, aerobic capacity does not work separately from anaerobic power; instead, it supports repeated high-intensity efforts, rapid recovery, and the maintenance of technical skill quality across match periods (Spyrou et al., 2020; Taufik et al., 2021).

Various training methods have been investigated to improve VO_2max and endurance in futsal players, including interval training, fartlek, circuit training, small-sided games, Tabata training, and high-intensity interval training (Pranata, 2020; Gumantan & Fahrizqi, 2020; Junaedi et al., 2023; Fachrezi et al., 2024; Rasyono et al., 2025). These studies generally indicate that planned and progressive training can increase aerobic capacity and match-related physical performance. However, several methods require large spaces, complex equipment, or high supervision. In this regard, skipping or jump rope training offers a practical alternative. Jump rope training involves repeated rhythmic jumps, coordinated arm-leg movement, ankle stiffness control, rhythm regulation, and continuous cardiorespiratory stimulation (Singh et al., 2022; Zhao et al., 2023). It is inexpensive, easy to implement, space-efficient, and compatible with the movement characteristics of futsal, particularly repeated footwork, quick rhythm, coordination, agility, and lower-limb endurance (Eler & Acar, 2018; Turgut et al., 2016; Ramirez-Campillo et al., 2023).

Empirical evidence supports the effectiveness of skipping training in improving physical and cardiovascular fitness. Singh et al. (2022), through a systematic review and meta-analysis, reported that jump rope training provides small to moderate benefits for health- and sport-related fitness outcomes. Zhao et al. (2023) also found that jumping rope can improve physical fitness components among students. In the Indonesian context, Rahmawati et al. (2016) reported significant improvement in cardiovascular endurance after skipping training among school-age children, while Danubisma and Dewi (2023) found that skipping training improved VO_2max and leg explosive power in taekwondo athletes. These findings suggest that skipping training has potential not only for general fitness development, but also for sport-specific conditioning.

Although previous studies have examined various endurance training methods in futsal, research specifically investigating the effect of skipping training on cardiovascular endurance among university futsal students remains limited. Most futsal studies have focused on HIIT, fartlek, circuit training, small-sided games, or Tabata protocols (Pranata, 2020; Junaedi et al., 2023; Ansori, 2024; Rasyono et al., 2025). Meanwhile, skipping studies have often been conducted on children, school students, volleyball players, swimmers, or martial arts athletes rather than futsal students (Rahmawati et al., 2016; Turgut et al., 2016; Eler & Acar, 2018; Danubisma & Dewi, 2023). This creates a contextual and empirical gap because futsal has unique physiological characteristics: short court dimensions, repeated transitions, high movement density, and continuous technical involvement under fatigue.

In addition, the implementation of skipping training in university futsal programs has not been sufficiently positioned as a structured cardiovascular conditioning model. Many existing studies discuss skipping as a general fitness activity, whereas futsal requires endurance that is closely related to repeated movement efficiency, rhythm, recovery ability, and sustained intensity. Therefore, further research is needed to examine whether skipping training can provide a measurable effect on cardiovascular endurance in futsal students, particularly in the academic and sport coaching environment of FIKK UNM.

This study aims to determine the effect of skipping training on cardiovascular endurance among students participating in the futsal sport branch at FIKK UNM. Conceptually, this study is grounded in the principle that

repeated rhythmic jumping can stimulate cardiovascular adaptation, improve oxygen utilization, enhance lower-limb endurance, and support intermittent sport performance. Empirically, the study seeks to provide evidence on whether skipping training can be used as a practical conditioning strategy for futsal students.

The novelty of this study lies in its specific focus on integrating skipping training into futsal conditioning for university students. Unlike previous studies that mostly examined HIIT, fartlek, circuit training, or game-based conditioning, this research highlights skipping as a simple, low-cost, and space-efficient training model that can be applied in campus-based futsal programs. This study is expected to contribute to sport coaching science, particularly in designing accessible cardiovascular endurance training for student-athletes.

Based on the theoretical and empirical review, cardiovascular endurance is a crucial physical component in futsal because it supports repeated high-intensity movement, recovery, and performance consistency. Skipping training has strong potential as an alternative conditioning method due to its rhythmic, continuous, and whole-body movement characteristics. However, its specific effect on cardiovascular endurance among futsal students at FIKK UNM still requires empirical verification. Therefore, this study is important to strengthen the scientific basis for using skipping training as an effective and practical method to improve cardiovascular endurance in university futsal players.

METHODS

This study employed a quantitative experimental method with a pretest–posttest control group design to examine the effect of skipping training on cardiovascular endurance among futsal students at FIKK UNM. In line with Sugiyono (2015, 2017), experimental research is an appropriate scientific method for testing the causal effect of a specific treatment under controlled conditions. The use of a control group was considered essential because pretest–posttest designs allow researchers to compare the initial and final conditions of participants while reducing threats to internal validity that often occur in one-group intervention studies (Capili, 2024; Bierer et al., 2025).

The population of this study consisted of students who participated in the futsal sport branch at FIKK UNM. The sample was selected based on active participation, physical readiness, and willingness to follow the complete training program. Participants were divided into an experimental group and a control group. The experimental group received structured skipping training, while the control group continued regular futsal activities without specific skipping treatment. Skipping was selected because jump rope training has been reported to improve health-related and sport-related fitness, including cardiovascular capacity, coordination, lower-limb endurance, rhythm, and movement efficiency (Singh et al., 2022; Zhao et al., 2023; Maria et al., 2025).

The dependent variable was cardiovascular endurance, measured before and after the intervention using a standardized field-based endurance test, such as the Multistage Fitness Test/Bleep Test, which is commonly used to estimate $VO_{2\max}$ in intermittent sports. This instrument is relevant because futsal performance requires high aerobic capacity, repeated sprint ability, and rapid recovery during high-intensity game situations (Naser et al., 2017; Spyrou et al., 2020). Previous futsal training studies also used pretest–posttest procedures and $VO_{2\max}$ -based assessment to evaluate the effectiveness of conditioning programs (Junaedi et al., 2023; Sitompul et al., 2026).

Data were analyzed using descriptive statistics and inferential tests. Normality and homogeneity tests were conducted before hypothesis testing. Paired sample t-tests were used to examine within-group improvement, while independent sample t-tests were applied to compare posttest differences between groups. The significance level was set at $\alpha = 0.05$.

RESULTS AND DISCUSSION

Result

This section presents the results of the descriptive analysis, normality test, homogeneity test, and hypothesis testing regarding the effect of skipping training on cardiovascular endurance among futsal students at FIKK UNM. The data were obtained from the pretest and posttest scores of the skipping training group and the control group.

Descriptive Statistical Analysis

Table 1.
Descriptive Statistics of Students' Cardiovascular Endurance

Statistics	Pretest Skipping Training Group	Posttest Skipping Training Group	Pretest Control Group	Posttest Control Group
N	10	10	10	10
Sum	381.00	436.70	393.40	411.50
Mean	38.1000	43.6700	39.3400	41.1500
Standard Deviation	3.91379	3.42217	4.26281	3.48242
Range	14.00	12.00	12.90	11.10
Minimum	33.10	37.80	32.60	35.70
Maximum	47.10	49.80	45.50	46.80

Based on Table 1, the pretest score of the skipping training group, consisting of 10 samples, produced a total score of 381.00, with a mean score of 38.1000 and a standard deviation of 3.91379. The range was 14.00, with the lowest score of 33.10 and the highest score of 47.10. After receiving the skipping training treatment, the posttest score increased to a total of 436.70, with a mean score of 43.6700 and a standard deviation of 3.42217. The range was 12.00, with the minimum score of 37.80 and the maximum score of 49.80. Meanwhile, the control group obtained a pretest total score of 393.40, with a mean score of 39.3400 and a standard deviation of 4.26281. The range was 12.90, with the lowest score of 32.60 and the highest score of 45.50. In the posttest, the control group obtained a total score of 411.50, with a mean score of 41.1500 and a standard deviation of 3.48242. The range was 11.10, with the minimum score of 35.70 and the maximum score of 46.80.

Empirically, the skipping training group showed an increase in mean score from 38.1000 to 43.6700, or an improvement of 5.5700 points. In contrast, the control group only increased from 39.3400 to 41.1500, or an improvement of 1.8100 points. This indicates that the increase in cardiovascular endurance was greater in the skipping training group than in the control group.

Table 2.
Mean Improvement of Cardiovascular Endurance

Group	Pretest Mean	Posttest Mean	Mean Difference	Percentage Increase
Skipping Training Group	38.1000	43.6700	5.5700	14.62%
Control Group	39.3400	41.1500	1.8100	4.60%

The data in Table 2 strengthen the empirical indication that skipping training produced a more meaningful improvement in cardiovascular endurance. Conceptually, skipping training involves continuous rhythmic jumping movements that stimulate the cardiovascular system, increase heart-lung work efficiency, and improve the ability of the body to sustain repeated physical activity. This is highly relevant to futsal, which demands repeated movement, rapid transition, agility, and endurance during high-intensity game situations.

Normality Test

Table 3.
Results of Normality Test

Group	Kolmogorov-Smirnov Statistic	Sig.	α	Description
Skipping Training Group	0.259	0.438	0.05	Normal
Control Group	0.125	0.948	0.05	Normal

Based on Table 3, the normality test using the Kolmogorov-Smirnov test showed that the skipping training group obtained a significance value of 0.438, which was higher than $\alpha = 0.05$. Therefore, the data of the skipping training group were normally distributed. The control group obtained a significance value of 0.948, which was also higher than $\alpha = 0.05$. Thus, the control group data were also normally distributed. These results indicate that the data met the assumption of normality and were appropriate for further parametric statistical analysis.

Homogeneity Test

Table 4.
Results of Homogeneity Test

Initial Test	Levene Statistic	Sig.	α	Description
Skipping Training Group and Control Group	5.406	0.991	0.05	Homogeneous

Table 4 shows the result of the homogeneity test using Levene's Statistic Test at a 95% confidence level. The significance value obtained was 0.991, which was higher than $\alpha = 0.05$. Therefore, it can be concluded that the variance of the skipping training group and the control group was homogeneous. This means that both groups had relatively equal variance before the hypothesis testing was conducted.

Hypothesis Testing

Table 5.
Result of the First Hypothesis Test

t-observed	t-table	df	α	Description
6.915	2.262	9	0.05	Significant

Based on Table 5, the result of the hypothesis test showed that the t-observed value was 6.915, while the t-table value at $df = 9$ and $\alpha = 0.05$ was 2.262. Since the t-observed value was greater than the t-table value, H_0 was rejected and H_1 was accepted. This finding proves that there was a significant difference between the pretest and posttest scores in the skipping training group.

Therefore, the results indicate that skipping training had a significant effect on improving cardiovascular endurance among futsal students at FIKK UNM. The improvement was not only statistically significant, but also practically relevant because the mean score increased by 5.5700 points after the training program. This finding confirms that skipping training can be used as an effective conditioning exercise to improve cardiovascular endurance in futsal athletes, particularly because futsal requires continuous movement, rapid recovery, and the ability to sustain repeated high-intensity actions during play.

Discussion

The results of this study confirmed that the research hypothesis was accepted: skipping training had a significant effect on improving cardiovascular endurance among futsal students at FIKK UNM. Empirically, the mean score of the skipping training group increased from 38.1000 in the pretest to 43.6700 in the posttest, with a mean improvement of 5.5700 points or 14.62%. In contrast, the control group only increased from 39.3400 to 41.1500, with a mean improvement of 1.8100 points or 4.60%. The paired t-test result also showed that the t-observed value was 6.915, which was higher than the t-table value of 2.262 at the 95% significance level. This statistical evidence indicates that the improvement in cardiovascular endurance was not accidental, but was strongly associated with the structured skipping training intervention.

This finding is conceptually relevant to the physiological demands of futsal. Futsal is an intermittent high-intensity sport that requires players to perform repeated accelerations, decelerations, rapid changes of direction, defensive pressure, attacking transitions, and continuous movement in a limited playing area. Naser et al. (2017) emphasized that futsal players need intermittent endurance, repeated sprint ability, leg power, agility, and coordination, while Spyrou et al. (2020) reported that futsal competition commonly involves high cardiovascular load, with average intensity reaching high percentages of maximal heart rate and oxygen uptake. Therefore, cardiovascular endurance is not only a general fitness component, but also a decisive performance foundation in futsal. Players with better cardiovascular endurance are more capable of sustaining movement intensity, recovering between explosive actions, and maintaining technical quality under fatigue.

The significant improvement found in this study can be explained through the physiological characteristics of skipping training. Skipping is a rhythmic, repetitive, and dynamic exercise that activates both upper and lower extremities simultaneously. During skipping, the lower limbs perform repeated jumping actions, while the upper limbs coordinate rope rotation. This whole-body movement pattern increases oxygen demand, stimulates heart rate response, improves blood circulation, and enhances the efficiency of oxygen transport to active muscles. Ross et al. (2016) stated that cardiorespiratory fitness is an important marker of cardiovascular health and physical performance, while Bull et al. (2020) emphasized the importance of regular moderate-to-vigorous physical activity for improving health-related fitness. In this context, skipping training provides an efficient stimulus because it combines aerobic endurance, muscular endurance, coordination, rhythm, balance, and neuromuscular control in one practical exercise model.

The present findings are supported by recent studies on jump rope and skipping exercise. Singh et al. (2022), through a systematic review and meta-analysis, reported that jump rope training produces small to moderate improvements in health- and sport-related fitness outcomes, including cardiorespiratory endurance,

resting heart rate, body composition, strength, jumping, sprinting, and flexibility. Zhao et al. (2023) also found that jumping rope improved several physical fitness components among students, including speed, muscular endurance, agility, coordination, balance, and vital capacity. Huang et al. (2022) similarly reported that jump rope exercise increased moderate-to-vigorous physical activity and improved endurance, speed, power, and core muscular endurance. These findings strengthen the argument that skipping training is not merely a recreational activity, but a valid conditioning method for improving physical fitness.

The results of this study are also consistent with empirical findings in the Indonesian sport context. Kusumaningtyas et al. (2021) found that skipping rope exercise significantly improved cardiorespiratory endurance measured through $VO_2\text{max}$ -based assessment. Padillah et al. (2025) reported that rope skipping training had a significant effect on increasing $VO_2\text{max}$ among futsal extracurricular students. Fitri et al. (2021) showed that endurance training increased $VO_2\text{max}$ in futsal athletes, while Junaedi et al. (2023) found that Tabata training significantly improved $VO_2\text{max}$ in futsal players. In addition, Fitriani et al. (2023), Ma'ruf et al. (2023), Sitompul et al. (2025), and Fudin et al. (2025) demonstrated that structured conditioning methods such as circuit training, fartlek, small-sided games, HIIT, and interval training can improve aerobic capacity and endurance performance in futsal athletes. These studies indicate that systematic and progressive conditioning programs are essential for improving futsal-specific physical capacity.

From a training theory perspective, the improvement in the skipping group can be understood through the principles of overload, specificity, adaptation, and continuity. Skipping training provides repeated cardiovascular stress that forces the heart, lungs, and working muscles to adapt. When performed systematically, this exercise increases stroke volume, improves capillary density, enhances mitochondrial function, and supports more efficient aerobic metabolism. At the same time, the rapid and repetitive jumping pattern also stimulates anaerobic capacity because players must produce short bursts of force repeatedly. This dual aerobic-anaerobic characteristic is highly relevant to futsal, where players must sustain prolonged activity while repeatedly performing explosive actions. Therefore, skipping training is physiologically suitable for futsal because it reflects the rhythm, intensity, and recovery demands of the game.

The greater improvement in the skipping group compared to the control group also shows that regular futsal activity alone may not be sufficient to optimize cardiovascular endurance. Although the control group showed a small improvement, the increase was lower than the experimental group. This suggests that specific, planned, and measurable conditioning exercises are more effective than unsystematic activity. In practical terms, skipping training can be recommended for futsal students because it is low-cost, easy to organize, space-efficient, and does not require complex equipment. This is especially important in university sport settings, where training time, facility access, and equipment availability may be limited.

Overall, the findings confirm that skipping training significantly improves cardiovascular endurance among futsal students at FIKK UNM. The improvement is statistically significant, physiologically logical, and practically relevant. Skipping training enhances aerobic capacity, supports anaerobic tolerance, improves heart efficiency in pumping blood, and increases the ability of students to perform repeated high-intensity movements. Therefore, skipping can be used as an effective complementary conditioning method in futsal training programs, particularly for developing cardiovascular endurance, movement rhythm, coordination, and physical readiness for competitive play.

CONCLUSION

Based on the results of the study, it can be concluded that skipping training has a significant effect on improving cardiovascular endurance among futsal students at FIKK UNM. Empirically, the descriptive data showed that the skipping training group experienced a clear improvement from the pretest to the posttest. The mean score increased from 38.1000 in the pretest to 43.6700 in the posttest, with a mean difference of 5.5700 points or an improvement of 14.62%. This increase was higher than the control group, which only improved from 39.3400 to 41.1500, with a mean difference of 1.8100 points or 4.60%. These findings indicate that students who received structured skipping training showed better cardiovascular endurance development than students who only followed regular activities.

The hypothesis testing further confirmed this result. The t-test showed that the t-observed value was 6.915, which was higher than the t-table value of 2.262 at the 95% significance level with $df = 9$. Therefore, the

null hypothesis was rejected and the alternative hypothesis was accepted. This means that skipping training significantly influenced the cardiovascular endurance of futsal students at FIKK UNM.

Conceptually, skipping training is effective because it involves continuous, rhythmic, and repetitive movements that activate the upper and lower body muscles simultaneously. This activity stimulates heart and lung function, improves oxygen circulation, increases aerobic capacity, and supports the ability to perform repeated high-intensity movements. Therefore, skipping training can be recommended as a practical, low-cost, and effective conditioning method to improve cardiovascular endurance in futsal training programs.

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