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ORIGINAL ARTICLE

The Effect of Skipping Exercise on Increasing VO_2Max in Extracurricular Basketball Participants at Pirngadi Christian High School, Surabaya

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Abstract:
Background: Cardiorespiratory endurance is an important component in basketball performance that requires repeated intensive physical activity. VO_2Max describes the body's maximum ability to absorb and utilize oxygen during aerobic activity. One simple and effective exercise to increase VO_2Max is skipping (jumping rope). Objective: To analyze the effect of skipping exercise on increasing VO_2Max in basketball extracurricular participants at Pirngadi Christian High School, Surabaya. Method: The study used a quasi-experimental design with a one-group pre-test and post-test design. A total of 20 students participating in the basketball extracurricular were selected using a purposive sampling technique. The skipping exercise intervention was carried out for 6 weeks, 3 times per week. VO_2Max was measured using a bleep test. Data analysis used a paired sample t-test with a significance level of 0.05. Results: The results of the normality test showed that the data were normally distributed. The paired t-test results showed $p = 0.000$ ($p < 0.05$), indicating a significant difference between VO_2Max before and after skipping training. Conclusion: Skipping training significantly increased VO_2Max in extracurricular basketball participants at Pirngadi Christian High School, Surabaya.
Keywords: skipping training; VO_2Max; cardiorespiratory endurance; basketball.

1. Introduction

Good cardiovascular endurance allows an athlete to maintain the intensity of training and competition for longer durations without experiencing excessive fatigue (Zhou, 2021). In today's society, more and more adult women are engaging in popular sports, namely fitness, to maintain their physical condition and health. Overall fitness improves a good quality of life, combining social, mental, spiritual, and physical factors (Mozolev et al., 2021). Fitness is an opportunity to change the quality of life without excessive effort; it includes the most advanced training systems that include the most effective techniques for improving the body and posture (Mozolev et al., 2021). The effects of fitness on improving health are related to increased physical activity, strengthening the function of the musculoskeletal, cardiovascular, and respiratory systems, activating metabolism, and reducing body weight (Maciaszek & Skrypnik, 2016).

One of the training methods that is often used to increase cardiovascular endurance is rope jumping (Hunta et al., 2025). The function of the cardiovascular system is the most important physiological basis for the level of aerobic endurance of the human body. The human body's ability to absorb and utilize oxygen under extreme conditions is called maximum aerobic activity capacity, and an indicator that reflects this ability is maximum oxygen uptake (Zhou, 2021). This is related to the function of the heart and lungs, the size and activity of muscles, the ability of the blood to carry and transport oxygen, and the ability of tissues to absorb and utilize oxygen (Zhou, 2021). Jumping rope is a form of plyometric exercise that is effective in increasing heart and lung capacity, as well as increasing the efficiency of the circulatory system (Mozolev et al., 2021).

This exercise also has the added benefit of improving coordination, leg muscle strength, and agility, all of which contribute to physical performance. Cardiorespiratory fitness is a crucial aspect of sports that require high aerobic endurance, such as basketball. VO_2Max, the body's ability to

maximally utilize oxygen, is an important indicator of a person's aerobic capacity (Yudiansyah & Ika, 2024). Basketball players need high endurance because during the game, about 34% of the time is spent running and jumping (Illa & Reche, 2022). However, many high school students who participate in extracurricular basketball activities are not yet in optimal physical condition, especially in terms of VO_2Max. One training method that can be used to increase VO_2Max at a low cost and easily is skipping. Skipping is an aerobic exercise that involves working the leg muscles and the cardiovascular system simultaneously (Gulati, 2024). Several studies show that skipping exercises can increase lung capacity, improve blood circulation, and strengthen leg muscles (Chen, 2022). Therefore, this study aims to analyze the effect of skipping exercises on increasing VO_2Max in extracurricular basketball participants at Pirngadi Christian High School, Surabaya.

2. Materials and Methods

This study used a quasi-experimental one-group pre-test and post-test design. Population: Basketball extracurricular participants at Pirngadi Christian High School, Surabaya. Sample: 20 students (male and female), selected using purposive sampling.

Intervention: Skipping exercises for 6 weeks, 3 times per week.
• Exercise duration: 30 minutes per session.
• Intensity: medium–high (60–80% HRmax).
• Exercise structure: warm-up (5 minutes), core skipping exercises (20 minutes), cool-down (5 minutes).
Instrument: Bleep test used to measure VO_2Max before and after exercise.
Data analysis: Paired t-test to determine significant differences between VO_2Max values before and after exercise. The significance level was set at $\alpha = 0.05$.

3. Results

The results of the study showed that there was an increase in VO_2Max values after being given skipping training for six weeks.

Variables	Before (Mean ± SD)	After (Mean ± SD)	p-value
VO_2Max (ml/kg/menit)	34.1 ± 3.5	38.9 ± 3.2	0.000

The results of the paired t-test showed $p = 0.000$ (< 0.05), which means that skipping exercise had a significant effect on increasing participants' VO_2Max.

4. Discussion

The purpose of this study was to determine the effect of skipping training on increasing VO_2Max in extracurricular basketball participants at Pirngadi Christian High School, Surabaya. The results showed that skipping training significantly increased VO_2Max values in extracurricular basketball participants. This is in line with research Kirthika et al., 2019 which states that jumping rope can increase lung capacity and leg muscle strength by increasing the efficiency of blood circulation and heart function. This study also confirms these findings Chen & Lin, 2011 regarding the positive impact of rope jumping on the balance of children with mild mental disorders. A study conducted by Singh & Rajan, 2015 demonstrated that rope jumping exercises improve leg strength and agility in girls. In this study, the experimental group performed better than the control group due to an eight-week progressive training program. It was concluded that regular conditioning or training at

optimal intensity leads to specific changes in various parameters such as the cardiovascular system, muscular system, and body composition.

Skipping is a rhythmic aerobic exercise that involves coordination between the arms, legs, and respiratory system. When done regularly, skipping increases the heart's stroke volume, pulmonary ventilation efficiency, and the number of active muscle capillaries (Purba et al., 2021). These physiological mechanisms lead to an increase in maximal oxygen capacity, or VO_2max. Increased whole-body oxygen consumption (VO_2max) results from increased exercise intensity, driven by increased oxygen demand from active muscles. This surge in oxygen demand is primarily due to nearly all of the energy (ATP) expended during endurance exercise, such as aerobic exercise, being regenerated in the mitochondria through oxidative metabolism. Along with increased oxygen consumption, there are concomitant increases in various cardiovascular and respiratory variables, including heart rate, ventilation, and stroke volume (Jatmiko et al., 2024). Essentially, VO2max can be conceptualized as the capacity for oxygen delivery and utilization by muscles during exercise (Santisteban et al., 2022).

Adenosine triphosphate (ATP) synthesis occurs via both anaerobic and aerobic pathways during intense physical activity. Given the impact of ATP resynthesis on athletic performance, sports focused on high-intensity activity seek to increase energy release from both the aerobic and anaerobic energy systems (On, 2022). Furthermore, it is very effective in improving cardiovascular function, optimizing the maximum capacity of the lungs to retain and utilize oxygen efficiently (Wajib et al., 2022). Increased maximum oxygen consumption (VO2max) can promote exercise-related adaptations that increase oxygen delivery to muscles and improve oxygen utilization by muscles (Tasew, 2020). Increased VO2max is caused by two main factors: central circulation factors and peripheral factors (Lee & Zhang, 2020). First, the central factor emphasizes that maximal stroke volume and peak oxygen consumption respond positively to increases in VO2max. Assessment of VO2max through endurance reflects the capacity of the heart, lungs, and blood to utilize oxygen, as measured by standardized cardiorespiratory fitness metrics (Ariestika & Nanda, 2020).

Various factors influence VO2max, including gender, age, physical activity, temperature, cardiovascular and pulmonary function, hemoglobin levels in red blood cells, body composition, and altitude. Theoretically, VO2max is a crucial indicator of aerobic capacity limitations, making it the most important parameter for assessing an athlete's aerobic ability (Ariestika & Nanda, 2020). Improved physical fitness and biometric components are closely linked to higher VO2max. An increased VO2max indicates an increased oxygen-consuming capacity in metabolism, underscoring its crucial role. Therefore, it's crucial to maintain optimal fitness through regular exercise, such as skipping.

Research Limitations

This study has limitations in that it has a small number of respondents and is only limited to skipping interventions and its impact on VO2Max.

Directions for Future Research

Further research could explore the effects of skipping exercise on molecular biomarkers for laboratory testing.

5. Conclusions

Skipping significantly increased VO_2Max in extracurricular basketball participants at Pirngadi Christian High School, Surabaya. This exercise is recommended as an easy, inexpensive, and effective aerobic exercise alternative to improve cardiorespiratory endurance in students.

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Conflict of Interest

The authors declare no conflict of interest.

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