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VO2 Max Levels of Sepak Takraw Athletes at Muhammadiyah University of Education Sorong

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Abstract

This study aimed to determine the VO_2max level of sepak takraw athletes. The findings are expected to provide valuable information for athletes and coaches in evaluating cardiorespiratory endurance as a basis for designing appropriate training programs and improving athletic performance during both training and competition. This study employed a quantitative descriptive research design using a survey method with a multistage fitness test (beep test) to estimate the athletes' VO_2max. The participants consisted of 13 sepak takraw athletes. The results showed that 1 athlete (6%) was classified in the very good category, 7 athletes (67%) were in the good category, and 5 athletes (28%) were in the moderate category. The mean estimated VO_2max score was 45.6 $mL \cdot kg^{-1} \cdot min^{-1}$, indicating that the overall cardiorespiratory fitness level of the athletes was in the good category. Maintaining an adequate VO_2max is essential for sepak takraw players to sustain training intensity, optimize competitive performance, and minimize physical fatigue during matches.

Introduction

Sepak takraw is a sport that requires a high level of composure and involves keeping the ball in the air so it doesn't fall to the floor or ground. This sport is widely enjoyed by everyone from beginner children to adults both men and women because the gameplay is fairly complex and can be a challenge for anyone who wants to try it: keeping the ball in the air using their feet. Sepak takraw is a very unique team sport, and its gameplay is a combination that closely resembles soccer, volleyball, and badminton. This can be seen in the equipment and facilities used, such as the court dimensions, the shape of the net, and the ball, which is made of rattan. Sepak takraw is a team sport played by teams of three players each. In Indonesia, the governing body for sepak takraw is the Indonesian Sepak Takraw Association (PSTI).

VO_2max is the maximum volume of oxygen processed by the human body during intense physical activity. This VO_2max volume represents a measure of the body's capacity, expressed in liters per minute or milliliters per minute per kilogram of body weight. A person's VO_2max level correlates with their ability to perform physical activities. The higher a person's VO_2max, the higher their activity level and the lower their fatigue level. VO_2max levels are related to a person's muscular work capacity. When a person performs work, the heavier the workload, the higher their oxygen consumption. The amount of muscle involved in the body's ability to utilize the supplied oxygen is influenced by muscle mass. The greater the skeletal muscle mass subjected to a workload, the greater the potential to increase oxygen uptake. The ability of tissues to take up oxygen varies according to their oxygen extraction capacity or VO_2max level. The higher the VO_2max, the longer the muscles can sustain work meaning they do not tire quickly; conversely, the lower the VO_2max, the shorter the duration of work the muscles can sustain, causing them to tire quickly. (Tishandra & Rois, 2022) VO2max is the maximum amount of oxygen that can be taken in during exercise. The VO2max value depends on cardiovascular, respiratory, and hematological conditions, as well as the muscles' oxidative capacity. (Ismi Mori Saputra et al., 2022).

Many sepak takraw athletes who do not recognize the importance of VO_2max have low VO_2max levels; one example is the athletes competing in Sukatani. On average, players have a VO_2max value of 44.56 ml/kg/minute, which falls into the low category; this is caused by several factors, including a lack of a well-structured

training program, a scarcity of competitions, and training methods that are not specifically designed to improve endurance or VO_2max (Busyairi, 2018). Research by (Warganegara, 2015) indicates that low physical fitness, coupled with reduced cardiorespiratory endurance, can lead to a decline in speed and skill in playing sepak takraw. General endurance is a person's ability to use their cardiovascular and respiratory systems effectively and efficiently to perform continuous work involving the contraction of multiple muscles at a certain intensity. According to (M. Akbar Husein Allsabah, 2021) cardiorespiratory endurance is the ability of the heart, lungs, blood vessels, and large muscles to perform strenuous exercise over a long period of time. Cardiorespiratory endurance is the most important component of physical fitness. A person with a high VO2max indicates that they have good physical fitness. VO_2max describes how much oxygen a person takes in from the atmosphere into the lungs and blood via the working heart muscle. Thus, an athlete's performance can be maximized during a competition. Definition of VO_2max: Maximum oxygen uptake (VO_2max) can be defined as the body's maximum capacity to take in, transport, and utilize oxygen during exercise (Alfian, 2016). VO_2max is the maximum rate of oxygen consumption during aerobic metabolism. The VO2max value indicates a person's level of cardiorespiratory endurance. Cardiorespiratory endurance is a component of physical fitness that is related to a person's health. The cardiorespiratory system is the body's circulatory system, which involves the functioning of the heart and lungs as well as blood circulation. Thus, it is understandable that physical fitness—or cardiorespiratory endurance serves as the foundation for a person's health. (Almy & Sukadiyanto, 2014). VO2max is limited by cardiac output, the respiratory system's ability to deliver O2 to the blood, or the muscles' ability to utilize oxygen. As such, VO2max serves as the upper limit of aerobic capacity and is therefore considered the best parameter for measuring an individual's aerobic or cardiorespiratory capacity. The greater a person's muscle mass, the more O2 (ml/minute) is utilized during maximal exercise. To account for differences in body size and muscle mass, VO2max can be expressed as the maximum amount of O2 in ml that can be utilized in one minute per kilogram of body weight (ml/kg/minute). According to (Hayashi & Tanaka, 2024) Factors Affecting VO2max Age Cardiorespiratory endurance in men peaks between the ages of 18 and 25, coinciding with peak muscle mass (Candra, 2020). In general, aerobic capacity declines gradually after the age of 25.

A 1995 study by Jackson A. S. et al. found that the average annual decline in VO2max was 0.46 ml/kg/minute for men (1.2%) and 0.54 ml/kg/minute for women (1.7%). This decline is due to a reduction in maximum heart rate and maximum stroke volume (Ely Yuliawan, 2019). Gender A person's gender determines their body composition. Women have more body fat than men, whose bodies are dominated by muscle. Men have more tissue actively involved in metabolism due to their body composition, which contains a higher proportion of muscle. Type of Exercise: Physical exercises that can improve cardiac performance and VO_2max are aerobic exercises. The best training methods for developing cardiac performance and aerobic capacity are: circuit training, continuous exercise, and interval training. VO_2max can be increased through physical exercise; the exercises performed must place a sufficiently heavy load on the cardiorespiratory system. This load is intended to increase stroke volume and cardiac output. Aerobic exercise can increase VO2max because, during such exercise, oxygen supply to the muscles increases, thereby enabling athletes to engage in physical activity for longer periods and achieve a higher maximum oxygen consumption.

Physical exercise can increase VO2max. However, VO2max is not fixed at a specific value; rather, it can vary depending on the level and intensity of physical activity. For example, prolonged bed rest can reduce VO2max by 15% to 25%, while regular, intense physical exercise can increase VO2max by a similar amount (Ibrahim & Bakti, 2020). Exercise can increase the muscles' ability to use fat as an energy source; the increased fat metabolism that occurs during prolonged exercise helps conserve glycogen and improve physical endurance (Ibrahim & Bakti, 2020).

Methods

Based on the research problems and objectives outlined above where the objective is to determine the level of hydration and fluid intake among college students after participating in one-on-one training in the sport of sepak takraw the type of research employed is quantitative with a descriptive approach. Quantitative research was used in this study because the research was conducted through the distribution of questionnaires, so the results are presented in numerical form. Quantitative research methodology (Sugiyono, 2016) Quantitative research methodology is a type of research defined by its paradigm. The quantitative approach is based on a

paradigm that holds that researchers can intentionally bring about changes in the surrounding world by conducting various experiments.

This is consistent with the view that (Abdullah, 2015) A quantitative approach is based on a paradigm that holds that researchers can intentionally bring about changes in the surrounding world by conducting various experiments. The descriptive approach is a method for studying the current status of a group of people, an object, a set of conditions, a system of thought, or a system of events. The purpose of this research is to create a description, a systematic, factual, and accurate portrayal or depiction of the facts, characteristics, and relationships among the phenomena under investigation. (Sugeng, 2020) Numerical data is used in qualitative research as part of the triangulation of qualitative findings and/or to determine whether the results of in-depth interviews are consistent with the views of those who were not interviewed, given the time and effort required.

This study employs a survey design because, according to (Muqarrobin, 2015), survey research is used to collect information in the form of opinions from a large number of people regarding a specific topic or issue. Survey research itself is a method that collects information from a sample by asking questions via a questionnaire or interview in order to describe various aspects of the population (Meivawati, 2017). This study employs a descriptive survey research method. The population in this study consists of all 18-year-old Persik soccer players... A population is the domain of generalization consisting of: objects/subjects that possess certain qualities and characteristics defined by the researcher for the purpose of study, from which conclusions are subsequently drawn. Thus, the total population consists of 13 sepak takraw athletes. According to (Sugiyono, 2019) A sample is a subset of a population that reflects the population's size and characteristics. In this study, the population size is relatively small fewer than 100 people or the researcher aims to make generalizations with a very small margin of error. Another term for saturated sampling is a census, in which all members of the population are included in the sample.

Data Analysis Techniques, Instruments, and Standards in the research to be conducted by the researcher which will be applied to 18-year-old Persik players, as described in the book by (Fenanlampir, A. and Faruq, M., M., 2015) make this study worthwhile. Data Collection Steps: Test participants will run back and forth over a

distance of 20 meters. Participants who cannot keep up will be stopped. This test consists of 21 levels with 16 round trips; the higher the level, the better the individual's cardiovascular fitness. The data obtained by the researchers through tests and measurements of the variables in this study consist of the MFT or Blepp test. Type of Data Analysis: In accordance with the research objectives and research questions, the collected data will be analyzed using descriptive statistics (frequency tables). This involves describing the research results obtained from various measurements (tests) of physical fitness levels and performing analyses using formulas such as the following: P = f / n × 100% Explanation: P: Percentage of VO_2max level; f: Frequency or number of values; n: Total population size.

Results

VO_2max data for 18–19-year-old sepak takraw athletes at Muhammadiyah University of Education Sorong were obtained through the Multistage Fitness Test (Beep Test). The test results were then analyzed using a VO_2max prediction table to estimate each athlete's VO_2max value. Next, these values were classified into categories of cardiorespiratory fitness levels based on VO_2max norms. The data obtained were analyzed using quantitative descriptive statistics with percentage calculations and presented in tabular form.

This study involved 13 sepak takraw athletes as research subjects. The VO_2max measurement results for each athlete are presented in Table 1.

Tabel 1. Hasil Tes VO_2max Atlet Sepak Takraw

Muhammadiyah University of Education, Sorong

No.	Name	Level	Shuttle	VO_2max (mL/kg/min)	Category
1	JK	9	6	42.2	Very Good
2	HN	7	7	39.3	Good
3	IM	7	5	38.1	Good
4	FT	7	4	39.0	Good
5	IP	8	5	40.2	Good
6	WE	7	3	38.4	Good
7	WD	8	5	41.2	Good
8	WS	6	4	33.1	Moderate
9	SD	7	3	39.3	Good
10	DR	7	2	39.1	Good
11	EU	7	6	39.2	Good
12	ER	7	4	39.3	Good
13	FI	6	6	33.1	Moderate
Mean				**38.55**	**Good**

Based on Table 1, it was found that the VO_2max values of the sepak takraw athletes at Muhammadiyah University of Education Sorong ranged from 33.1 to 42.2

mL/kg/minute, with an average value of 38.55 mL/kg/minute; thus, in general, the athletes' cardiorespiratory fitness level falls into the "good" category. Furthermore, the distribution of the athletes' VO_2max categories is presented in Table 2.

Table 2. Frequency Distribution of VO_2max Categories for Sepak Takraw Athletes

Category	Frequency	Percentage (%)
Very Good	1	7.69
Good	10	76.92
Moderate	2	15.39
Poor	0	0.00
Very Poor	0	0.00
Total	**13**	**100.00**

Based on Table 2, most athletes fell into the "good" category, totaling 10 athletes (76.92%). Furthermore, 1 athlete (7.69%) fell into the "very good" category, while 2 athletes (15.39%) fell into the "moderate" category. No athletes fell into the "poor" or "very poor" categories.

These results indicate that the majority of sepak takraw athletes at Muhammadiyah University of Education Sorong already possess an adequate level of cardiorespiratory fitness to support training and competition activities. However, there are still several athletes in the "moderate" category, so a more structured aerobic endurance training program is needed to improve their VO_2max capacity. Improving VO_2max is crucial because it is linked to athletes' ability to maintain game intensity, accelerate recovery during matches, and reduce fatigue when facing long matches.

Discussion

This study aimed to determine the VO_2max levels of 18–19-year-old sepak takraw athletes at Muhammadiyah University of Education Sorong using the Multistage Fitness Test. The results showed an average VO_2max value of 38.55 mL/kg/minute, which falls into the "good" category. Of the 13 athletes who participated in the study, 1 athlete (7.69%) was in the "very good" category, 10 athletes (76.92%) were in the "good" category, and 2 athletes (15.39%) were in the "moderate" category. These results indicate that the majority of athletes possess sufficient aerobic capacity to support training and competition activities, although there are still some athletes who need to improve their physical condition, particularly their cardiorespiratory endurance.

VO_2max is a primary indicator of cardiorespiratory fitness that reflects the body's maximum ability to take in, transport, and utilize oxygen during high-intensity physical activity. VO_2max is the most widely used physiological parameter for measuring an individual's aerobic capacity because it is directly related to athletic performance that requires repetitive activity over a relatively long period. The higher an athlete's VO_2max value, the greater the body's ability to produce energy through the aerobic system, thereby delaying fatigue and maintaining performance throughout a competition.

In the sport of sepak takraw, aerobic capacity plays a crucial role even though the game is dominated by explosive movements, such as kicking, jumping, smashing, and defending. During a match, athletes perform repetitive activities with relatively short rest periods, so the aerobic energy system functions to accelerate the recovery process between rallies. (Bompa and Buzzichelli, 2019) explain that athletes with high aerobic capacity will recover their heart rate more quickly, reduce lactic acid accumulation, and be able to maintain technical and tactical quality throughout the match.

The results of this study indicate that the majority of athletes fall into the "good" category. This suggests that the implemented training program has led to physiological adaptations in the cardiorespiratory system. These adaptations include increased stroke volume, improved cardiac efficiency, enhanced muscle capillarization, and the muscles' ability to utilize oxygen more optimally. According to (Jiki, 2025), Regular aerobic exercise increases oxygen transport capacity, resulting in a gradual increase in VO_2max in accordance with the frequency, intensity, duration, and type of exercise performed.

However, there are still two athletes in the moderate category. This may be influenced by various factors, such as suboptimal exercise intensity, nutritional status, rest patterns, training experience, body composition, or motivation during the test. (Kurniawan et al., 2026) states that VO_2max is influenced by genetic factors, age, gender, level of physical activity, and a consistent exercise program. Therefore, athletes in the moderate category need a more systematic aerobic exercise program to increase their maximum oxygen capacity.

The findings of this study are consistent with a study (Nugroho et al., 2022) that reported that the majority of team sport athletes fell into the "good" VO_2max

category after undergoing a regular training regimen throughout one competitive season. That study explained that structured aerobic training can improve the efficiency of the cardiovascular system, thereby enabling athletes to maintain their physical performance during matches.

The results of this study are also supported by research by (Pratama and Nurhasan, 2021), which found that the VO_2max levels of team sport athletes were predominantly in the "good" category. That study concluded that good aerobic capacity influences an athlete's ability to maintain movement intensity during matches, particularly in sports characterized by repetitive activities with short recovery intervals.

Furthermore, a study by (Kurniawan et al, 2023) on the physical condition of sepak takraw athletes showed that VO_2max is one of the key physical components that determine an athlete's success in maintaining the quality of their play. Athletes with high VO_2max are able to maintain movement speed, coordination, and technical accuracy even when matches are played at a high tempo. Conversely, athletes with low VO_2max tend to experience a decline in performance due to the onset of fatigue sooner.

Physiologically, the results of this study indicate that the aerobic capacity of sepak takraw athletes at Muhammadiyah University of Education Sorong is already in the "fairly good" category; however, further improvement is still needed through more specific training. Training programs such as continuous training, interval training, high-intensity interval training (HIIT), or modified small-sided games can serve as alternatives to increase athletes' VO_2max. The ACSM (Xu et al., 2022) recommends aerobic exercise at 60–90% of maximum heart rate, performed regularly 3–5 times per week, to significantly improve cardiorespiratory capacity.

Based on these research findings and theoretical reviews, it can be concluded that the VO_2max levels of the sepak takraw athletes at Muhammadiyah University of Education Sorong are already in the "good" category; however, improvements in the quality of physical training are still necessary for all athletes to reach the "very good" category. An increase in VO_2max will lead to improved aerobic endurance, the ability to maintain game intensity, faster recovery during matches, and support for achieving more optimal athletic performance.

Conclusion

Based on the research findings, it can be concluded that the VO_2max levels of the 18–19-year-old sepak takraw athletes at Muhammadiyah University of Education Sorong generally fall into the "good" category. These results indicate that most athletes already possess adequate aerobic capacity to support their training programs and meet the physical demands of competition.

However, there are still some athletes whose aerobic capacity needs to be improved. Therefore, a structured, systematic, and sustained physical training program is needed particularly one focused on improving aerobic endurance—so that the athletes' VO_2max levels can continue to develop. It is hoped that an increase in VO_2max will help athletes maintain game intensity, accelerate recovery after physical activity, reduce fatigue during matches, and optimally enhance the performance and achievements of sepak takraw athletes.

References

Alfian, U. (2016). *Efektivitas Peningkatan Vo2max Dengan Metode Kontinyu Dan Fartlek Ssb Matra Utama Tahun 2016*. (2), 1–10.

Almy, M. A., & Sukadiyanto, S. (2014). Perbedaan Pengaruh Circuit Training Dan Fartlek Training Terhadap Peningkatan Vo2Max Dan Indeks Massa Tubuh. *Jurnal Keolahragaan*, *2*(1), 59–68. https://doi.org/10.21831/jk.v2i1.2603

Candra, O. (2020). Tingkat Kemampuan Vo2Max Pada Atlet Bola Basket Puteri POMNAS Riau. *Journal Sport Area*, *5*, 106–115. https://doi.org/10.25299/sportarea..vol().3761

Ely Yuliawan, B. I. (2019). Penyuluhan Pentingnya Peningkatan Vo2max Guna Kecamatan Rantau Rasau. *Jurnal Ilmiah Sport Coaching And Education Vol. 1 Januari 2019 PENYULUHAN*, *1*, 41–50.

Hayashi, K., & Tanaka, H. (2024). Alcohol consumption after downhill running does not affect muscle recovery but prolongs pain perception in East Asian men. *Physical Activity and Nutrition*, *28*(4), 24–30. https://doi.org/10.20463/pan.2024.0029

Ibrahim, M. M., & Bakti, A. P. (2020). Analisis Kemampuan VO2max Dan Heart Rate Wasit Bola Tangan Provinsi Jawa Timur. *Jurnal Kesehatan Olahraga*, *8*(4), 55–60.

Ismi Mori Saputra, D., Saleh, K., & Andra, Y. (2022). Pengaruh Latihan Fartlek dan

Interval terhadap Peningkatan Vo2max Pemain Futsal Berkah United Merangin. *Jurnal Muara Pendidikan*, *7*(2), 386–394. https://doi.org/10.52060/mp.v7i2.1016

Jiki, R. (2025). *Dasar-dasar latihan fisik: teori dan aplikasi*. Azzia Karya Bersama.

Kurniawan, F., Gustiawati, R., & Taroreh, B. S. (2026). *Landasan Ilmiah Untuk Optimalisasi Program Latihan Vo_2Max Analysis Of Football Athletes At Ppopm Bogor District : A Scientific Basis For Optimizing Training Programs*. *9*(June), 29–35.

Sugiyono. (2016). *Metode penelitian kuantitatif, kualitatif dan R&D*. Alfabeta.

Sugiyono. (2019). *Metodelogi Penelitian Kuantitatif dan Kualitatif Dan R&D.* Alfabeta.

Tishandra, J., & Rois, M. (2022). Pengaruh Latihan Circuit Training Terhadap Kondisi Fisik Atlet Dalam Olahraga Sepakbola Pada Klub PS Debai Kota Sungai Penuh. *Jurnal Muara Olahraga*, *4*(2), 11–18. https://doi.org/10.52060/jmo.v4i2.816

Xu, Z., Wang, S., Li, D., Wang, Y., Wang, S., & Guo, K. (2022). Exercise/Physical Activity in Individuals with Type 2 Diabetes from the American College of Sports Medicine: Interpretation and Clinical Significance. In *Chinese General Practice* (Vol. 25, Number 25). https://doi.org/10.12114/j.issn.1007-9572.2022.0353