



Aerobic Endurance ($VO_2\text{Max}$) Male Volleyball Student Activity Unit Doktor Nugroho University Magetan

R Hariyo Padmoyo^{1✉}, Ridha Kurniasih Astuti^{2✉}

Study Program of Physical Education, Health and Recreation, Doctor Nugroho University Magetan, Indonesia¹

Physical Education, Health and Recreation, STKIP PGRI Pacitan, Indonesia²

History Article

Received Desember 2024
Approved Desember 2024
Published vol 11 no 2 2024

Keywords

Aerobic Endurance; Multi-stage Fitness Test; Volleyball

Abstract

The background of this research is that there is no measurement of aerobic endurance ($VO_2\text{Max}$) for participants in the Men's Volleyball Student Activity Unit Doktor Nugroho University Magetan. With the aim to determine the level of aerobic endurance. This research is a descriptive study with survey methods and data collection using test and measurement techniques. The population used was all participants of the Men's Volleyball Student Activity Unit Doktor Nugroho University Magetan totaling 23 students and the samples taken from purposive sampling were 18 students. Aerobic endurance data was taken by measuring the multistage fitness test. The data analysis technique used quantitative descriptive analysis with percentages. There are 33.3% good criteria, 55.5% enough and 11% less. So the analysis of the largest number of levels of Maximum Oxygen Volume ($VO_2\text{Max}$) in the Men's Volleyball Student Activity Unit Doktor Nugroho University Magetan is a sufficient criterion with a figure of 55.5%.

How to Cite

Padmoyo, R. H., & Astuti, R. K. (2024). Aerobic Endurance ($VO_2\text{Max}$) Male Volleyball Student Activity Unit Doktor Nugroho University Magetan. *Journal of Physical Education, Health and Sport*, 11 (2), 120-125.

INTRODUCTION

Fitness is the ability of an individual to perform daily tasks efficiently without excessive fatigue, allowing them to still enjoy their leisure time (Irianto, 2004). According to Lutan (2001), physical fitness refers to a person's capacity to perform physical tasks that require strength, endurance, and flexibility. Within physical fitness, there are several components that need to be considered as supporting factors in exercising, one of which is aerobic fitness. Muhajir (2007) states that physical fitness is the ability of the body to adjust (adapt) to the physical demands placed upon it (from daily work) without causing excessive fatigue. In his book on Physical Fitness, Suharjana (2013) mentions, "Physical fitness can be defined as an individual's ability to carry out daily activities without experiencing excessive fatigue and still having the capacity to engage in other light tasks."

Every individual has 24 hours in a day, but not everyone can utilize that time effectively to engage in various activities. Those who possess good physical fitness can perform numerous activities without feeling overly fatigued. The same applies in the realm of sports, particularly for athletes, where each athlete has different levels of physical fitness that ultimately affect their performance. Factors that can influence physical fitness include: (1) age, (2) gender, (3) genetics, (4) diet, (5) smoking, and (6) exercise (Irianto, 2004). Based on the opinions of the experts mentioned above, it can be concluded that physical fitness is the ability of an individual to carry out their daily tasks with adequate strength and endurance without causing significant fatigue, thus leaving them with energy to enjoy leisure time and manage sudden or unexpected activities.

Maximal Oxygen Volume, referred to as ($VO_2\text{Max}$), is defined as the body's capacity to take in, transport, and utilize oxygen during exercise (Iqlima Safitri, 2015). ($VO_2\text{Max}$) indicates an individual's cardiovascular endurance as a parameter of aerobic fitness. ($VO_2\text{Max}$) is fundamentally influenced by genetics and physical training (Dhara S and Chatterjee K, 2015). Other terms with similar meanings include aerobic capacity, cardiovascular endurance, and cardiorespiratory fitness. Although terms like cardio (heart), respiratory (lungs and ventilation), vascular (blood vessels), and aerobic (related to oxygen) have distinct meanings, they are all interconnected. Based on this explanation, it can be concluded that aerobic endurance ($VO_2\text{Max}$) is a measure of the heart and lungs' ability to

pump oxygen-rich blood throughout the body, as well as the body's ability to adapt and recover after physical activity.

Aerobic endurance ($VO_2\text{Max}$) and mastery of fundamental techniques significantly contribute to playing skills or performance in volleyball. While good aerobic endurance is important, achieving success is very difficult without the support of strong technical, tactical, and mental skills. Conversely, even if an athlete has poor aerobic endurance, having solid technique, tactics, and mental strength still makes it challenging to achieve optimal results. The relationship between aerobic endurance and technique shows that an athlete with good technique, but who does not train their aerobic endurance, will struggle to apply their techniques optimally due to quick fatigue. Therefore, the development of aerobic endurance and mastery of basic techniques is crucial, especially in the sport of volleyball.

Cardiopulmonary endurance can be measured through maximal oxygen consumption, known as ($VO_2\text{Max}$), which indicates how efficiently the body uses oxygen during moderate-intensity physical activity. Several tests can be used to measure ($VO_2\text{Max}$), including the multistage running test, step-up test to rhythm, 12-minute run, and others. However, this study utilized the multistage fitness test. Based on previous explanations, ($VO_2\text{Max}$) can be concluded as the body's ability to use oxygen, measured in liters per minute or milliliters/minute/kg of body weight. Every cell in the human body requires oxygen to convert food into ATP (Adenosine Triphosphate), which is used for cellular activities. Muscles at rest use the least oxygen, while contracting muscles require a significant amount of ATP, thus trained muscles need more oxygen and produce CO_2 .

The training activities of the Volleyball Student Activity Unit (UKM Voli) began in 2023, involving students in Physical Education from their initial to final semesters. One of the issues faced by this Volleyball Student Activity Unit is the decline in the physical condition of athletes, which impacts their performance. This decline in physical condition is attributed to the suboptimal implementation of training programs provided by coaches, which was one of the complaints from the Student Activity Unit Voli supervisor during interviews. The physical decline is observable in the fourth set of matches, leading to decreased performance. When performance diminishes, it affects concentration and accuracy in the game. Based on this background problem, the

author formulated the title: «Aerobic Endurance ($VO_2\text{Max}$) of the Male Volleyball Student Activity Unit at Universitas Doktor Nugroho Magetan.» The aim to determine the level of aerobic endurance

This research is expected to have the following benefits: the results provide scientific information regarding the benefits of aerobic endurance ($VO_2\text{Max}$) for participants in the Volleyball Student Activity Unit. This study can serve as a reference that broadens knowledge in sports science, particularly concerning the multistage fitness test. Additionally, this research can be used as a consideration for evaluating the aerobic endurance ($VO_2\text{Max}$) levels of participants in the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan, thus helping them achieve better performance. The results of this study can also serve as guidelines for participants in the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan to improve their aerobic endurance ($VO_2\text{Max}$). Furthermore, the results of the aerobic endurance ($VO_2\text{Max}$) measurements can provide a foundation for designing future training programs for the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan.

METHOD

Descriptive research is a method aimed at researching the status of a group of people, an object, a set of conditions, a system of thought, or a class of events in the present (Sugiyono, 2011). The method used in this study is descriptive research with a survey technique, where data collection is done through tests and measurements. The instrument used in this study is the multistage fitness test. This test involves running a distance of twenty meters back and forth past cone markers, starting with a slow pace that gradually increases in speed until the individual can no longer keep up with the running rhythm, indicating their maximum ability at that back-and-forth level (Suharjana, 2013). According to Arsil (2015), the data collection technique in this study is through a survey method employing measurement tests ($VO_2\text{Max}$) using the Bleep Test or multistage running test, with the following steps: Facilities and equipment: a flat track of 20 meters; a distance measuring device; beep tape and tape recorder; cones; a stopwatch; and calculation forms.

The survey method is used to obtain data from a specific natural setting (not artificial), but the researcher conducts treatment in data collection (not like in an experiment), such as distributing

questionnaires, tests, structured interviews, and so on (Sugiyono, 2011). According to Arikunto (2011), a survey aims not only to understand the status of symptoms but also to determine similarities in status by comparing it to preset standards. A test is a series of exercises or assessments used to measure the skills, knowledge, attitudes, intelligence, capabilities, or talents possessed by individuals or groups (Khomsin, 2008). Based on the explanation of this research method, the form or method of this research is quantitative descriptive. The quantitative research method is an analysis based on numerical calculations, thus the data processed or to be processed must be in the form of numbers, and the results must also be in numerical form (Nurgiyantoro, 2000).

The population in this study refers to all subjects of the research. Thus, the population encompasses all objects to be studied, whether they are entities, individuals, events, or phenomena that are to occur (Arikunto, 2010). Hadi (1989) states that “The entire population intended for investigation is referred to as the population or universe.” The population used in this study is the participants of the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan, totaling 23 individuals. A sample, according to Sugiyono (2011), is a portion of the number and characteristics possessed by the population. The sampling technique used in this research is purposive sampling, which means the samples are selected based on specific criteria set by the researcher. Therefore, the researcher selected a portion of the Male Volleyball Student Activity Unit participants from Doktor Nugroho University Magetan, totaling 18 individuals.

The research instrument is a tool used to measure natural or social phenomena being observed (Sugiyono, 2011). This test is conducted in the field and is simple yet provides a fairly accurate estimate of maximal oxygen consumption for various purposes (Ismaryanti, 2011). The instrument used in this study is the multistage fitness test. The multistage fitness test is conducted by running back and forth over a distance of twenty meters through cone markers, starting with a slow run that gradually accelerates until the individual can no longer keep up with the running rhythm, indicating their maximum capacity at that level (Suharjana, 2013). The technique used for data collection in this study is the survey method with the aerobic endurance measurement test ($VO_2\text{Max}$). The multistage fitness test (multistage running test) is conducted with the following steps: 1) The multistage fitness test involves running a distance of 20 meters back and forth,

starting with gradual slow running that increasingly speeds up until an individual can no longer keep pace. 2) Each level is timed for 1 minute. 3) At level 1, the 20-meter distance is covered in 8.6 seconds for 7 laps back and forth. 4) At levels 2 and 3, the 20-meter distance is covered in 7.5 seconds for 8 laps back and forth. 5) At levels 4 and 5, the 20-meter distance is covered in 6.7 seconds for 9 laps back and forth, and so on. 6) Each completed 20-meter distance and at the end of each level will have a sound indicator indicating completion. 7) The start is executed from a standing position with both feet behind the starting line. When the command "ready" is given, the runner must adhere to the rhythm to reach a boundary line so that one foot crosses it. 8) If the sound indicator has not been heard and the runner has crossed the boundary line, they must wait for the sound indicator before running back. Conversely, if there is a sound indicator but the runner has not reached the boundary, they must speed up to cross it and immediately run back. 9) If the runner cannot keep pace with the running rhythm for two consecutive attempts, it means that their maximum capacity is only at that level and back-and-forth distance.

In the data analysis technique, members first undergo the multistage fitness test to determine their level and the number of laps completed. The data obtained is raw data. This raw data is then entered into test norms. After entering the data into the test norms, the maximum aerobic endurance estimate for the Male Volleyball Student Activity Unit participants at Doktor Nugroho University Magetan is obtained. This estimate is then adjusted according to the evaluation norms as follows **Table 1**.

Table 1. Standardization Norms for Aerobic Endurance (VO₂Max)

| Category | Age | | |
|------------|------------|-------------|-------------|
| | Man | 14-15 | 16-17 |
| | | | 18-25 |
| Very well | 8/10 – 9/8 | 9/10 – 11/3 | 10/2 – 11/5 |
| Good | 7/5 – 8/9 | 8/3 – 9/9 | 8/6 – 10/1 |
| Enough | 6/2 – 7/4 | 6/9 – 8/2 | 7/2 – 8/5 |
| Not enough | 4/7 – 6/1 | 5/1 – 6/8 | 5/2 – 7/1 |
| Not enough | KD 4/7 | KD 5/1 | KD 5/2 |

Source: (Ramsbottom et al, 1988)A Progresive Shuttle Run Test To Estimate Maximal Oksygen Uptake

The data results were then grouped into five classifications of aerobic endurance: very poor, poor, fair, good, excellent, and superior. This classification was based on statistical cal-

culations of the estimated data, and tables and graphs were created regarding the levels of aerobic endurance (VO₂Max) of the Male Volleyball Student Activity Unit participants at Doktor Nugroho University Magetan. The results of this study allow for the formulation of conclusions and recommendations.

RESULTS AND DISCUSSION

Based on the research conducted using the multistage running test, the sample for this study consisted of 18 students from the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan. This research was carried out on the campus grounds of Doktor Nugroho University Magetan, located at Jalan Sendang Kamal No. 50, Kraton Village, Maospati District, Magetan Regency. Before data collection began, the staff gathered for a briefing to ensure a shared understanding and to prepare the equipment that would be used for data collection.

This study aims to determine the maximal oxygen volume (VO₂Max) using the multistage test among participants of the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan. After measurements were taken, calculations were conducted using descriptive statistical percentages. This descriptive percentage calculation is intended to understand the condition of the entire sample in relation to the variables being studied.

The description of the research results regarding the levels of aerobic endurance (VO₂Max) in participants of the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan can be seen in the following **Table 2**.

Table 2. Results of the Study on the Levels of Aerobic Endurance (VO₂Max) of the Male Volleyball Student Activity Unit Participants at Doktor Nugroho University Magetan

| Classification | Frequency | Percentage |
|----------------|-----------|------------|
| Very poor | 0 | 0% |
| Poor | 2 | 11% |
| Fair | 10 | 55,5% |
| Good | 6 | 33,3% |
| Excellent | 0 | 0% |
| Superior | 0 | 0% |

Distribution of Frequency of Maximal Oxygen Volume (VO₂Max) Levels in the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan. Based on the table, it can be observed that in the very poor category,

the percentage is 0%, followed by the poor category at 11%, the fair category at 55.5%, the good category at 33.3%, the excellent category at 0%, and the superior category at 0%. This result indicates that the aerobic endurance of the participants in the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan is classified as Fair (sufficient).

The definition of $VO_2\text{Max}$ is equivalent to aerobic fitness as the maximum capacity to inhale, deliver, and use oxygen (Sharkey, 2011). $VO_2\text{Max}$ measures maximum oxygen uptake, indicating the amount of oxygen (in liters or milliliters per kilogram of body weight per minute). Individuals who exercise regularly will generally have sufficient aerobic endurance to supply oxygen. Heart rates will decrease over time if a person ceases physical activity. Based on interviews with the managers of the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan, it was noted that training is conducted only twice a week, and there are no intense physical training sessions. This contributes to the suboptimal $VO_2\text{Max}$ capacity they possess. Yunus (1992) emphasizes that physical preparation is essential for developing specific aspects of physical condition according to the demands of the volleyball sport for performance enhancement. Therefore, conducting endurance training, particularly for the lungs and heart related to blood circulation, is always associated with aerobic and anaerobic energy, which is connected to the energy systems required.

The development of talent and interest among participants in the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan to achieve good performance must also be supported by good physical abilities and quality aerobic endurance. Hence, participants are encouraged to engage in regular physical training to improve their foundational skills in volleyball. Limitations in the facilities and training resources posed challenges, including poor weather and frequent rain, which hindered the implementation of the study, necessitating rescheduling of data collection. Another challenge was individual factors, as some students arrived late for the test while others were warming up.

According to Sukadiyanto (2011), training is a process of change toward improvement, enhancing technical quality, physical quality, functional body ability, and mental quality of an individual. The more intense the physical activity performed daily, the better the physical fitness attained. To achieve good aerobic endurance, activities must be designed to enhance the aerobic

endurance of the members, such as regularly attending training at clubs supplemented by independent physical exercise.

For training programs to proceed as intended, the training must be structured according to established training principles. The FITT concept (frequency, intensity, time, type) is a widely accepted training framework among sports experts (Suharjana, 2013). Training frequency refers to the number of workouts per week. A good frequency for endurance training is 2 to 5 times per week, and for anaerobic training, it is 3 times per week. According to Suharjana (2013), training twice a week is better than not training at all, but improvements in physical fitness occur slowly. It can be concluded that training should be performed at least three times a week to maintain physical fitness and prevent decline.

Additionally, several other factors can influence aerobic fitness, such as heredity, training, gender, age, body fat, and activity levels (Sharkey, 2011). In the process of physical growth and development, it is essential for individuals to maintain good physical fitness by participating in various activities, such as those offered by the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan. This Student Activity Unit plays a vital role in helping to achieve good aerobic endurance.

A similar study on aerobic endurance was conducted by Emilda Novitasari, titled "Survey of Aerobic Endurance ($VO_2\text{Max}$) at the LEO Krajan FC Soccer School (SSB) in Madiun Regency." The results of her research showed the following categories: very poor at 0%, poor at 0%, fair at 20%, good at 60%, excellent at 20%, and superior at 0%. The study concluded that the $VO_2\text{Max}$ of the students of the LEO Krajan FC Soccer School (SSB) in Madiun Regency is classified as Good.

CONCLUSION

Based on the analysis of data and discussion of the results, descriptions, testing of research outcomes, and discussions, it can be concluded that volleyball requires a significant level of aerobic endurance ($VO_2\text{Max}$) because this sport involves a lot of continuous movement for extended periods. Therefore, it is necessary to engage in regular training to improve aerobic endurance ($VO_2\text{Max}$). According to the research findings, the results show that there are 11% classified as poor, 55.5% in the fair category, and 33.3% in the good category; hence, the analysis indicates that the level of Maximal Oxygen Volume ($VO_2\text{Max}$)

among the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan falls within the sufficient criteria, with a score of 55.5%.

In line with the findings of this study, the implication is that the results can be used as a consideration for trainers to evaluate and provide appropriate training programs for the Male Volleyball Student Activity Unit at Doktor Nugroho University Magetan.

REFERENCES

- Arikunto, S. (2011). *Prosedur Penelitian Suatu Pendekatan Praktik* (PT. Rineka Cipta, Ed.).
- Arikunto, Suharsimi. (2010). *Prosedur Penelitian Suatu pendekatan Praktek*. Rineka Cipta.
- Arsil. (2015). *Evaluasi Pendidikan Jasmani dan Olahraga* (Wineka Media, Ed.).
- Dhara S dan Chatterjee K. (2015). A Study of VO2 Max in Relation With Body Mass Index (BMI) of Physical Education Student. *Research Journal of Physical Education Science*, 3(6), 2320–9011.
- Hadi, S. (1989). *Metodologi Research Jilid I & II* (Andi Offset, Ed.).
- Iqlima Safitri. (2015). *Daya tahan kardiovaskuler*. (Pena Pundi Aksara, Ed.).
- Irianto, D. Pekik. (2004). *Pedoman Praktis Berolahraga untuk Kebugaran dan Kesehatan*. (Penerbit Andi, Ed.).
- Ismaryanti. (2011). *Tes dan pengukuran olahraga* (LPP UNS dan UNS Press, Ed.).
- Khomsin. (2008). *Metodologi Penelitian Dasar. urusan Pendidikan Kepelatihan Olahraga FIK UNNES*.
- Lutan, R. (2001). *Pendidikan Kebugaran Jasmani*. Depdiknas Dirjen Pendidikan Dasar dan Menengah.
- Muhajir. (2007). *Pendidikan jasmani, kesehatan dan rekreasi*. Yudhistira.
- Nurdiyantoro, B. dkk. (2000). *Statistik Terapan*. Gajah Mada University Press.
- Ramsbottom et al. (1988). A progressive shuttle run test to estimate maximal oxygen. *Uptake British Journal of Sports Medicine*.
- Sharkey, Brian. J. (2011). *Kebugaran dan Kesehatan*. PT Raja Grafindo Rajawali Pers.
- Sugiyono. (2011). *Metode Penelitian Pendidikan*. Alfabeta.
- Suharjana. (2013). *Kebugaran jasmani*. Jogja Global Media.
- Sukadiyanto. (2011). *Pengantar Teori dan Metodologi Melatih Fisik*. Lubuk Agung.
- Yunus, M. (1992). *Bola Voli Olahraga Pilihan*. Depdikbud Dikti Proyek Pembina Tenaga Kependidikan.