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Application of Short Interval Training Method Based on Low Maximum Aerobic Speed Capacity for Improving Aerobic Capacity

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ABSTRACT

Physical condition is defined as a depiction of the human state based on physical attributes or the body's ability to function while performing activities. To determine the significant influence of the application of the Short Interval Training method based on low Maximum Aerobic Speed on the improvement of aerobic capacity.**:** The research method employed in this study is the experimental method, and the design used will be a one-group pretest-posttest design. The population in this experiment consists of 24 female students from student activity units/UKM at the Indonesian University of Education, with sample criteria of an age range of 18 to 21 years. Based on the results, an asymptotic significance (2-tailed) value of 0.109 was obtained (sig. > 0.05), thus it can be concluded that there is no significant difference between the pretest and posttest results. Therefore, the treatment provided has not resulted in a significant change in the results of the sample, which consists of futsal athletes. It can be concluded that the short interval training method implemented based on low maximum aerobic speed capacity does not have a significant effect on improving aerobic capacity. It is recommended for coaches to be selective in designing training programs, particularly for athletes with low VO2 max capacity. It is suggested for future researchers who will study short interval training methods based on maximum aerobic speed capacity in relation to aerobic capacity improvement to consider the initial VO2 max levels of subjects more.

Keywords: Short Interval Training; Maximum Aerobic Speed; Aerobic Capacity

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INTRODUCTION

In the realm of sports, the enhancement of aerobic capacity is one of the fundamental components that supports athletic performance, particularly in disciplines that require high endurance. Thus, athletes must remain active and maintain their physical condition before and after competitions so that they can achieve results that align with their capabilities as determined during their training period (Meliala, 2019). Aerobic capacity describes the body's ability to use oxygen maximally during prolonged physical activity (Anggraini & Widodo, 2021). However, in field practice, many coaches and athletes still employ training methods that have not been fully tailored to individual capacities,

particularly for athletes with low Maximum Aerobic Speed levels. This results in a suboptimal increase in capacity, and may even cause early fatigue or injuries due to the mismatch in training intensity (Prasetyo et al., 2023).

These conditions reflect the existence of issues within the context of physical fitness, which were previously measured through various components such as endurance, strength, flexibility, and speed (Lippincott Williams & Wilkins, 2020). In this regard, the choice of method and intensity must be appropriate, particularly for groups of athletes with insufficient baseline fitness levels. Aerobic training that does not adopt individualized principles often fails to achieve the desired physiological targets. The effectiveness of training is greatly influenced by the duration, intensity, and frequency of the workouts (Irawan et al., 2021). Therefore, there is a need for a measurable and adaptive method tailored to each individual's condition, such as the Short Interval Training method (Busyairi & Ray, 2018).

This research is based on the thought that Short Interval Training can significantly improve VO_2 max for athletes who already possess a sound level of physical fitness. Short Interval Training is a high-intensity interval training designed to enhance both aerobic and anaerobic capacity (Rosdiana et al., 2019). This indicates that Short Interval Training can serve as an effective alternative in training programs to enhance aerobic capacity (Milanović et al., 2015). The duration of the interval is between 5-30 seconds with an intensity of 95% or more of maximum capacity (Hostrup et al., 2019). Short Interval Training, designed based on the adequate aerobic capacity of athletes, is capable of providing a more precise, safe, and effective aerobic stimulus for athletes who are already in a satisfactory fitness range. By utilizing an approach based on Maximum Aerobic Speed, coaches can adjust the intensity of training according to individual physiological capacities, thus allowing the aerobic adaptation process to occur more optimally without excessively stressing the metabolic system (Balasekaran et al., 2023).

Most previous research has placed greater emphasis on the effects of high-intensity interval training or continuous methods without considering individual variables such as Maximum Aerobic Speed capacity. However, each athlete has different metabolic capabilities and maximum aerobic speeds (Sidik, 2019), which means that uniform training treatments do not always yield uniform improvements in performance. The lack of focus on groups with low Maximum Aerobic Speed has resulted in a gap in achieving improvements in VO2MAX or aerobic capacity in general.

Furthermore, studies combining Short Interval Training methods with grouping based on low Maximum Aerobic Speed are still very limited, particularly among student or university athlete populations. It is crucial to address whether short interval training, which involves high-intensity exercise types, can enhance the aerobic capacity of athletes with low Maximum Aerobic Speed, especially in the context of developing a science-based training model that is applicable to support sports performance at the coaching level. Therefore, this research aims to uncover scientific facts through a more personalized approach.

International studies have shown that the Short Interval Training method can significantly enhance aerobic performance in elite athletes (Boullosa et al., 2022). Short interval training also stimulates an increase in maximum heart rate, lung volume, and improves the body's ability to recover after intense exercise (Vaccari et al., 2020). On the other hand, local research is still limited to the implementation of Short Interval Training as a general method without considering initial physiological capacity, specifically Maximum

Aerobic Speed. A study by (Susilo et al., 2024). indicated an increase in VO2 max among adolescent athletes after an 8-week Short Interval Training program; however, it did not specifically account for groups with low Maximum Aerobic Speed. This research aims to refine this approach by taking individual differences into consideration.

The novelty of this research lies in the application of the Short Interval Training method designed based on low Maximum Aerobic Speed capacity. The facts on the ground indicate that Short Interval Training has become an efficient and effective alternative for exercise, especially when training time is limited (Abdul Rahim et al., 2018). This approach has not been widely utilized in the context of aerobic training at the collegiate level in coaching or in the development of young female athletes. By personalizing the training program based on Maximum Aerobic Speed data, this study offers a more effective, efficient, and evidence-based training strategy for maximizing aerobic capacity.

This research consists of two main variables, namely the independent and dependent variables. The independent variable is the Short Interval Training method devised based on low Maximum Aerobic Speed capacity. Short interval training is a training method that relies on the repetition of high-intensity activities over short durations, interspersed with brief rest periods (Iaia et al., 2017). This variable serves as the treatment or intervention to be administered to the research subjects, with regulations on intensity and duration based on the measurement results of each individual's Maximum Aerobic Speed. The implementation of Short Interval Training is adjusted in accordance with the principles of overload, progressive, and specificity to achieve maximal physiological adaptation (Sunaryo, 2023).

Meanwhile, the dependent variable in this study is the improvement of aerobic capacity, which is measured through the VO2 max test using standard protocols. The improvement of aerobic capacity serves as an indicator of the success of the implemented training methods. The relationship between these variables is analyzed to determine the extent of the impact of the Short Interval Training method based on low Maximum Aerobic Speed on statistical changes in aerobic performance.

Physical condition is the primary foundation for athletic performance, especially in sports that require high endurance (Putra, 2025). Physical condition is also a fundamental aspect of sports that includes the body's ability to perform physical activities efficiently and effectively without experiencing excessive fatigue (Arifin, 2023). Physical components such as cardiorespiratory endurance, muscle strength, flexibility, and speed are crucial determinants of an individual's ability to perform physical tasks to the fullest. In the context of aerobic fitness, the cardiovascular and respiratory systems must be capable of working efficiently to transport oxygen to the muscle tissues during activity. Therefore, the development of aerobic capacity is a primary necessity in the physical conditioning of athletes (Sharma & Mujika, 2017).

However, in practice, it has been found that many individuals possess a low Maximum Aerobic Speed capacity, leading to limitations in their ability to engage in high-intensity training consistently. This weakness underscores the importance of implementing training models that not only aim to enhance performance but also take into account the initial physical condition of the individual. The Short Interval Training approach based on low Maximum Aerobic Speed provides an opportunity to gradually and safely improve aerobic capacity, while also promoting the overall development of physical condition.

METHOD

The research method utilized in this study is the experimental method. In experimental research, the researcher observes how at least one independent variable affects one or more dependent variables (Fraenkel & Wallen, 2011). The design that will be used is the one-group pretest-posttest design. According to (Fraenkel & Wallen, 2011), in this research design, one group is measured or observed not only after being exposed to a treatment but also beforehand. A diagram of the one-group pretest-posttest design is presented in the following table:

Table 1. research design

The One-Group Pretest-Posttest Design		
O	*X*	*O*
Pretest	Treatment	Posttest

Source: (Fraenkel & Wallen, 2011)

In this study, 24 athletes were divided into 3 groups, the Short Interval Training group consisted of 7 individuals, which included 4 from the high maximum aerobic speed group and 3 from the low maximum aerobic speed group. The Intermediate Interval Training group comprised 8 individuals, with 4 from the high maximum aerobic speed group and 4 from the low maximum aerobic speed group. And the Long Interval Training group consisted of 9 individuals, made up of 4 from the high maximum aerobic speed group and 5 from the low maximum aerobic speed group. The research subjects for the Short Interval Training group with low maximum aerobic speed capacity amounted to 7 individuals. The population in this experiment comprises 24 female students from student activity units (UKM) at Universitas Pendidikan Indonesia. In this study, purposive sampling techniques were utilized. The sampling was based on specific considerations regarding the characteristics of the population and characteristics that were previously known (Given, 2012).

The instrument used in this study is the Balke Test, which aims to measure an individual's cardiovascular endurance. In its implementation, athletes are required to run or walk as far as possible for 15 minutes on a predetermined track. The distance covered during this period is then used to calculate the VO2max value, which is computed based on the distance traveled during this time (Wahyudi et al., 2020). The objective of the test is to evaluate an individual's aerobic fitness level. This test can be effectively or ineffectively conducted depending on its execution, the strategies used during running, and the motivation levels of the participants. The Balke test should be performed under good conditions as other factors can affect the results.

Determining the population and sampling is the first step in this research procedure. The researcher provides an explanation of the intent and objectives of this study. Afterwards, the researcher conducts a pre-test on the research sample. The research instrument used in this study is the Balke Test. Following that, the research sample receives treatment to ascertain the impact of the treatment. This treatment includes physical strength training with external loads. The training program will take place over 16 sessions spanning 8 weeks. It will be conducted in three phases: initial testing, treatment, and final testing. Data collection will be held at the Sport Hall of FPOK UPI Bandung (Padasuka Campus), and the research will take place over 16 sessions, with 2 sessions each week from 05:00 to 07:00 WIB. The execution of this research must follow several planned steps or

procedures to ensure that the research runs smoothly; the planned steps must be adhered to.

Data that has completed the pre-test and post-test is then analyzed using the related-samples Wilcoxon signed-rank test with the SPSS program. This test is used to determine whether there is a difference or effect. Although the subjects are identical, they undergo two different measurements or treatments, which can be pre-test and post-test, or stage 1 and stage 2 measurements. This research aims to ascertain whether there is a difference or effect from the implementation of the Short Interval Training Method and Low Maximum Aerobic Speed. Descriptive statistical analysis and hypothesis testing are conducted by processing the data using the Statistical Product for Social Science (SPSS).

RESULTS AND DISCUSSION

The results of the data collection obtained will be processed and analyzed using appropriate statistical methods. Data analysis will employ the t-test with the assistance of SPSS version 26. The mean values of test data and percentages are presented in Table 2 as follows:

Table 2. Descriptive Statistics

Data	N	Min	Maks	Rata-rata	Std. De
Pretest	3	34,22	36,57	35,76	1,339
Posttest	3	35,08	38,63	36,97	1,786

Based on the results of the tests obtained, the pretest with a sample size of N = 3 yielded a minimum score of 34.22, a maximum score of 36.57, an average score of 35.76, and a standard deviation of 1.339. The statistical description of the posttest with N = 3 produced a minimum score of 35.08, a maximum score of 38.63, an average score of 36.97, and a standard deviation of 1.786.

This normality test is conducted using the Shapiro-Wilk test, with the decision-making basis as follows:

- If the sig. value ≥ 0.05, then the data is normally distributed.
- If the sig. value ≤ 0.05, then the data is not normally distributed. The results of the normality test that have been analyzed are presented in Table 3.

Table 3. Normality Test

Data	Shapiro-Wilk		
	Statistik	**df**	**Sig.**
Pretest	0,769	3	0,043
Posttest	0,988	3	0,787

Based on table 3 of the normality test results, this shows a significant result of 0.043 which describes a non-normally distributed value, therefore the researcher used the non-parametric test, Wilcoxon signed-rank test presented in Table 4.

After conducting the analysis using the normality test, it can be concluded that the data does not meet the criteria and may proceed to non-parametric testing. The non-parametric test was conducted using SPSS V.26 with the related-samples Wilcoxon signed-

rank test, as the normality test indicated that the pre-test data is not normally distributed. The sample in this study also indicates that there is too little data resulting from the normality test in the pre-test being non-normal. The results from the related-samples Wilcoxon signed-rank test indicate that there is no significant difference in the data from this study.

Table 4. related - samples Wilcoxon signed rank test

	Pretest – posttest
Z	-1,604[b]
Sig. (2-tailed)	0,109

Based on the analysis results using the Wilcoxon signed-rank test, an asymptotic significance (2-tailed) value of 0.109 was obtained (sig. > 0.05), thus it can be concluded that there is no significant difference between the pretest and posttest results. Therefore, the treatment administered has not produced a significant change in the outcomes of the sample, which consists of futsal athletes.

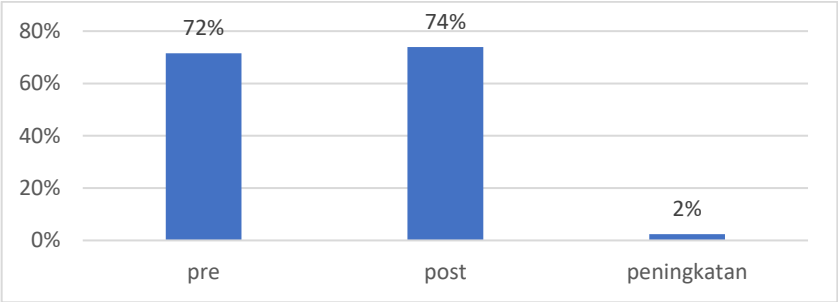

Figure 1. The percentage of aerobic capacity of futsal athletes subjected to short interval training based on low maximum aerobic speed.

Based on the results percentage of the improvement in aerobic capacity from the Short Interval Training based on Maximum Aerobic Speed, there is an increase of 2% in aerobic capacity.

Based on the results of the research that has been conducted, it shows that there is an increase in aerobic capacity, albeit not significant, because theoretically it is stated that if there is high-intensity interval training, certain conditions must be met, namely a high VO2max (Laursen & Buchheit, 2019). When there are individuals in the low group, it is assumed that they will not be able to undergo the training process; even if they are capable, the effort required must be substantial, and even if that effort is considerable, the increase will not be significant.

The results of this study indicate that there is no significant effect of the short interval training method based on low maximum aerobic speed on the improvement of an athlete's aerobic capacity. These findings reinforce the research hypothesis stating that short interval training does not have a significant impact on individuals with low VO2max. Statistically, the difference in scores between the pre-test and post-test of aerobic capacity reveals an insignificant improvement, both practically and according to the inferential analysis employed.

In a practical context, athletes with low VO2max capacity generally do not possess the physiological readiness to undertake high-intensity training loads such as short interval

training. High-intensity exercise demands complex cardiovascular, metabolic, and neuromuscular adaptations, which cannot be optimally achieved by individuals with still limited aerobic systems (Hellsten & Nyberg, 2016), although short interval training is known to be effective in enhancing aerobic capacity in trained athlete populations, this effect does not necessarily apply to subjects with low baseline fitness levels.

Physiologically, the implementation of short interval training in individuals with low VO2max poses a risk of excessive fatigue, an increase in heart rate beyond safe thresholds, and delays in the recovery process. This hinders the adaptation process that should occur through repeated training. In coaching practice, coaches often opt for a gradual approach through basic aerobic training (low-intensity steady state) before introducing high-intensity intervals (MacInnis & Gibala, 2017). Therefore, a more progressive approach is deemed more appropriate to safely and effectively enhance aerobic capacity in individuals with low maximum aerobic capacity.

Based on the explanation above, the research hypothesis can be accepted, as there is no significant effect of the short interval training method based on low maximum aerobic speed capacity on the improvement of aerobic capacity. This finding emphasizes the importance of the principle of individualization in training planning and highlights that the short interval training method should be applied selectively, considering the physiological readiness of the athletes. Adjusting the program based on initial conditions is the key to achieving optimal results.

CONCLUSION

Based on the results of the research and data analysis that have been conducted, it can be concluded that the short interval training method applied to individuals with low maximum aerobic speed does not have a significant effect on increasing aerobic capacity. This indicates that the use of high-intensity training is less effective for individuals or athletes with a low Vo2 max level. This ineffectiveness is suspected to be due to the suboptimal condition of the cardiovascular system and aerobic energy metabolism in these individuals in responding to high, repetitive, and intense training loads.

The facts on the ground support that high-intensity training is not recommended for novice athletes or individuals with low aerobic capacity due to the risk of excessive fatigue, decreased motivation to train, and even injury. Therefore, to achieve optimal improvements in aerobic capacity in this group, a progressive and adaptive training approach is required, such as gradually incorporating low to moderate intensity workouts. Thus, it can be concluded that the short interval training method should not be the primary choice in the early development programs for athletes with low VO2 max, and coaches are advised to be more selective in determining the type of training based on individual physical conditions.

Based on the results of this study, it is recommended that coaches be selective in designing training programs, especially for athletes with low VO2 max capacity. The implementation of high-intensity training should not be provided to beginner athletes or those who do not have a sufficient aerobic foundation. In practice, high-intensity training with low aerobic capacity can increase the risk of chronic fatigue, decrease motivation, and trigger injuries due to the body's physiological unpreparedness to handle heavy training loads. Therefore, coaches are advised to prioritize gradual training programs with light to moderate intensity as a foundation for building aerobic capacity before introducing high-intensity training.

For athletes, it is important to understand that improvements in physical performance can be achieved instantly, and every training program should be tailored to the individual's capabilities. Athletes with low VO2max are advised to follow a progressively structured aerobic development program so that physiological adaptations can occur optimally and safely. It is also recommended that subsequent researchers explore alternative training methods that are more suitable for low aerobic capacity groups, and expand the research subjects with a larger sample size and a more diverse age range, in order to obtain a more comprehensive picture of the effectiveness of intensity-based training methods.

Based on the findings of this study, it is suggested for future researchers who will examine the short interval training method based on maximum aerobic speed capacity to consider the initial VO2 max level of the subjects more specifically. Future researchers are also advised to use a larger and more heterogeneous sample when measuring maximum aerobic speed and VO2 max with more precise methods, in order to obtain more accurate and generalizable data. A comparative approach between groups with low, moderate, and high maximum aerobic speed could provide a deeper understanding of the effectiveness of short interval training on various aerobic capacities, thus making the research results more adaptive in coaching practices.

The contents of the conclusions should be in the form of answers to the questions and research objectives. Conclusions are presented in one paragraph, not in bullet points, and are not expressed in statistical sentences. If necessary, at the end of the conclusion can also be written about the things that will be done in relation to further ideas from the research.

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CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

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