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Optimizing Aerobic Capacity Through Long Interval Training Based on High Maximum Aerobic Speed

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Abstract

This study aims to examine the effectiveness of the Long Interval Training (LIT) method adapted to high Maximum Aerobic Speed (MAS) capacity on increasing aerobic capacity. Aerobic capacity is the body's ability to absorb and use oxygen during exercise and is closely related to VO_2max. This capacity is important for physical performance, especially in middle and long distance races. This study used an experimental method with a One Group Pretest-Posttest design through purposive sampling. The treatment was given for 16 training sessions, and the measurement test was carried out with the Balke Test before and after treatment (pre-test and posttest). Data were analyzed using Data Descriptive Analysis, Shapiro-Wilk normality test, and Paired Samples t-Test test. The results showed a significant increase in VO_2max value after treatment. The Paired Samples t-Test test shows a significance value (Sig. 2-tailed) of 0.018, which is smaller than 0.05, so there is a significant difference between the pre-test and post-test scores. This proves that the high MAS-based LIT method is effective in increasing aerobic capacity. This study emphasizes the importance of good training load management, close supervision, and proper recovery strategies. Therefore, although the LIT method was shown to be effective, safe and sustainable implementation should consider the athlete's overall training load to prevent injury and fatigue.

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INTRODUCTION

Exercise is an activity performed regularly with an intensity and duration intended to maintain and improve one›s fitness level over a long period of time. Exercise is also a healthy lifestyle, which helps you feel better overall. (Warburton & Bredin, 2017) . Improve aerobic ability, or the body›s ability to efficiently utilize, circulate and consume oxygen during sustained physical activity. Therefore, exercising regularly can improve aerobic ability and cardiovascular health. Besides benefiting physical health, better aerobic ability is also good for mental health as it reduces stress and improves mood. (Kandola et al., 2019) . Therefore, it is very important to exercise regularly to improve overall health in addition to improving aerobic ability. VO_2 is a measure of aerobic capacity, which indicates how well the cardiovascular and respiratory systems work to support physical performance. (Dasso, 2019)

The ability to race both medium and long distances is greatly influenced by aerobic capacity. The maximum oxygen uptake parameter (VO_2) indicates how effectively the body utilizes oxygen during physical activity. (Giuliano et al., 2017) . The aerobic capacity of athletes is closely related to the level of effective oxygen consumption, burning fat, increasing metabolism, improving cardiovascular health, improving mood and mental health, and reducing body weight and body fat percentage. (Al-khusaini et al., 2024) . In addition, Maximum Aerobic Speed (MAS), which is a good signal for endurance performance, is the speed achieved when reaching VO_2max. Aerobic capacity is the body›s ability to absorb and use oxygen during exercise. The parameter peak VO2max, or maximum oxygen volume, is used to measure aerobic capacity. Aerobic capacity also indicates heart function and health. (Xie et al., 2017)

Aerobic capacity is the body›s ability to utilize oxygen during physical activity. Aerobic capacity can be measured by the VO_2max parameter, which shows the amount of oxygen the body can use during high-intensity exercise. (Giuliano et al., 2017) . Maximum Aerobic Speed (MAS) is the highest speed a person can sustain during the highest aerobic activity. It is a term often used in sports, as it indicates aerobic ability and cardiovascular fitness. (Jurov et al., 2023) . Maximum Aerobic Speed (MAS)-based training is thought to improve oxygen transport, cardiac efficiency, and the ability of muscles to use energy. Athletes who optimize their training using this concept can significantly increase their aerobic capacity, making them better equipped to meet the physical demands of competition and daily training. (Paul & Nassis, 2015)

MAS indicates the athlete›s ability to maintain high speed under high-intensity conditions and for longer periods of time. (Chiwaridzo et al., 2017) . MAS is often used to design interval training programs, interval training can also consist of duration, intensity, interval, and total work duration (Sidik & Rosdiana, 2022) . This includes High Interval Training (HIIT) and Long Interval Training (LIT). Long Interval Training allows the body to work at a high intensity for a longer amount of time. It increases aerobic capacity, cardiac stroke volume, and muscle capillarization, allowing for efficient aerobic production (Macinnis & Gibala, 2017) . The Long Interval Training method can be expected to significantly increase VO2, this method allows for better physiological adaptations, including increased efficiency of the cardiovascular system and lactate threshold (Rasidyanto et al., 2019) .

Previous research has shown that High Intensity Interval Training (HIIT), an exercise method that involves short periods of high-intensity exercise interspersed with low rest durations, can effectively improve aerobic capacity (Poon et al., 2024) . Meanwhile, the fartlek training method has also been shown to improve athletes› endurance, especially in sports that require strong cardiorespiratory strength and physical endurance. (Kumar, 2015) .

The novelty in this study is the use of Long Interval Training tailored to the athletes› Maximum Aerobic Speed. This method is set individually based on the physiological capacity of each athlete, by adjusting the intensity and duration of the interval appropriately. Training can be more effective in improving aerobic ability, because the stimulus given is optimal and relevant to the threshold of individual ability, so as to maximize physiological adaptation and prevent ineffective or excessive training.

Therefore, this study was formulated to answer the question: Does the application of the Long Interval Training method and high Maximum Aerobic Speed (MAS) capacity have a significant effect on increasing aerobic capacity? The purpose of this study is to determine the effect of the application of Long Interval Training method and Maximum Aerobic Speed (MAS) capacity on increasing aerobic capacity. Based on the formulation of the problem, the hypothesis is proposed that the application of the Long

Interval Training method and high Maximum Aerobic Speed (MAS) capacity has a significant effect on increasing aerobic capacity.

METHOD

This study applied an experimental method with a One Group Pretest-Postes design, to measure the dependent variable before and after the intervention without using a control group. (Knapp, 2016) . By using purposive sampling technique or non-random sampling method (Etikan, 2016) , which obtained 3 athletes from a total population of 24 athletes. Data analysis techniques used data description analysis, normality test, and hypothesis testing (Paired Sample T-Test) with the SPSS 28 program.

Table 1. Research Design

Pre-test	Treatment	Post-test
O1	X	O2

(Knapp, 2016)

This study conducted treatment to the Women's Futsal Student Activity Unit in accordance with the criteria and obtained 3 athletes from 24 athletes. The stages begin with a pre-test by doing the Balke Test. After conducting the test, sample determination is carried out, which has been divided into 4 groups, one of which, Long Interval Training MAS High.

Furthermore, athletes perform treatment with a training duration of 2-5 minutes performed 4-12 repetitions, training intensity 85-90% of the best performance standard, resting every repetition 2-8 minutes which is carried out for 16 meetings (twice a week which lasts for 8 weeks). On the first three days athletes performed a 5-minute x 4-repetition training program with 85% training intensity, and 2 minutes of rest time. Then on the next three days, 4 minutes 30 seconds x 5 reps and 2 minutes 30 seconds rest. Likewise, the next week and finally do the Post-Test.

RESULTS AND DISCUSSION

The results of the study showed that the use of the Long Interval Training method with adjusted intensity based on high Maximun Aerobic Speed (MAS) capacity had a significant effect on increasing the aerobic capacity of athletes. The pre-test and post-test results using the Balke Test showed an increase in participants' VO_2max values after 16 training meetings. These results support the theory that Long Interval Training can increase muscular and cardiovascular oxidative metabolism. In addition, these findings are in line with previous research emphasizing how important it is to combine the right aerobic intensity and speed to achieve the best physiological adaptations.

Descriptive statistical analysis of the data showed that the pre-test score had a minimum value of 38.52 and a maximum of 40.58, with an average (mean) of 39.86 and a standard deviation of 1.16. Meanwhile, the post-test score increased, with a minimum value of 39.49 and a maximum of 42.10, and an average of 41.18 and a standard deviation of 1.47. This data shows that there is a difference in the average value that increases after the treatment is given.

The basis for decision making in the Normality Test:

1. If the significance value (Sig.) is greater than 0.05, the research data is normally distributed.
2. Conversely, if the significance value (Sig.) is smaller than 0.05 then the research data is not normally distributed.

Based on the normality test results in the table, the pre-test (PRE) and post-test (POS) score data were tested using the Shapiro-Wilk method with a sample size of three people (df = 3). The Shapiro-Wilk statistical value for both data is the same, which is 0.790 with a significance (Sig.) of 0.091. Since the significance value is greater than 0.05, it can be concluded that the pre-test and post-test score data are normally distributed. This shows that the data meets the assumption of normality, so it can be continued with parametric statistical analysis, namely Paired Samples tTest, to test the average difference before and after treatment.

Furthermore, the Paired Samples t-Test results show an average difference between the pre-test and post-test scores with a Mean Difference value of -1.32667. The calculated t value is obtained as -7.430 with degrees of freedom (df) = 2. The significance value (Sig. 2-tailed) is 0.018, smaller than 0.05, which means there is a significant difference between the pre-test and post-test scores. Thus, it can be concluded that the application of the Long Interval Training method adapted to high Maximum Aerobic Speed (MAS) capacity has a significant effect in increasing aerobic capacity in this study sample.

Compared to previous studies that highlighted the benefits of fartlek can increase the aerobic capacity of athletes without involving Maximum Aerobic Speed. (Kumar, 2015) . But for athletes who want to have more optimal running performance, it should be programmed based on

more specific parameters such as involving Maximum Aerobic Speed. Maximum Aerobic Speed shows the athlete's ability to maintain high speed under conditions of intensity and longer time. (Casado et al., 2022) . The findings in the field show that some athletes experience fatigue due to the tight schedule of classes and activities outside the training program. This condition makes them unable to carry out the training program optimally, this shows that external factors such as athlete time management are crucial and can be one of the limitations in implementing an intensive training program. External factors experienced by athletes have a close relationship that can also affect the recovery process and hinder optimal training. (Schinke et al., 2017) . Therefore, aerobic exercise must be done consistently and optimally with a fit body condition, so that every training program can always be fulfilled. (Jurov et al., 2023) .

In line with research (Thron et al., 2022) , Maximum Aerobic Speed serves as a specific parameter to optimize athlete performance during exercise such as interval training. It emphasizes the importance of tailoring exercise to the physiological capacity of the individual to provide an optimal and relevant stimulus. This approach can also prevent overloading the training program, thus helping to maximize physiological adaptation and reduce the risk of injury and fatigue. Thus, Long Interval Training based on high Maximum Aerobic Speed not only improves aerobic performance, but also helps athletes achieve the best level of performance in the long term by maximizing physiological changes during exercise.

Long Interval Training adjusted to a high Maximum Aerobic Speed can effectively increase the aerobic capacity of athletes significantly. This was shown by an increase in VO_2max values after 16 intervention sessions conducted over 8 weeks, with an average VO_2max value from 39.86 to 41.18 ml/kg/min which showed a positive effect of the training intervention and there was a consistent improvement in athletes, despite the small sample size (n = 3). The results of this study indicate that using the Long Interval Training method with adjusted intensity to increase Maximum Aerobic Speed can significantly improve their aerobic capacity. The difference in pre-test and post-test values shows an increase, in the data that has been analyzed shows statistically significant results. Therefore, the Long Interval Training method can be used as one of the effective training approaches for athletes and can improve athletes' cardiovascular endurance capabilities. In addition, intensity adjustments tailored to the capacity of each athlete have been shown to be able to maximize the physiological changes that occur during exercise, which can help achieve the best level of performance in the long run.

CONCLUSION

This study concludes that the application of Long Interval Training based on high Maximum Aerobic Speed, can effectively increase the aerobic capacity of athletes significantly. The athletes showed significant improvement in VO_2max values after the treatment which was conducted 16 sessions during 8 weeks of intervention. This approach emphasizes the importance of tailoring training to an individual's physiological capacity to provide optimal stimulus, taking into account training load management exercises and appropriate recovery strategies to prevent injury and fatigue. The findings suggest that the use of Long Interval Training based on high Maximum Aerobic Speed as an effective strategy to improve aerobic performance is good for individual conditioning programs in team sports.

It is recommended that future research be conducted with a larger sample size and a wider variety of athlete characteristics. This will make the results more representative and generalizable. In addition, future research is expected to apply tighter control of other factors, also reducing the risk of fatigue and injury for athletes. Researchers are advised to combine the Long Interval Training program with active recovery techniques, training load management, and injury prevention instructions. During the program, it is expected to use more diverse test instruments in order to provide a more accurate picture of the development of aerobic ability and physical readiness of athletes.

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