INDONESIAN JOURNAL OF SPORT MANAGEMENT
Department of Physical Education, Universitas Majalengka, Indonesia
ISSN 2776-706X.

Application of Long Interval Training Method Based on Low Maximum Aerobic Speed Capacity to Improve Capacity Anaerobic Alactacid

Arif Fadillah[1A-D], Dikdik Zafar Sidik*[2BD], Pipit Pitriani[3C], Fitri Rosdiana[4B]

[1-4]Sport Coaching Education, Faculty Of Sport And Health Education, University Of Education Indonesia, Indonesia

ABSTRACT

This study aimed to determine the effect of Long Interval Training (LIT) based on low Maximum Aerobic Speed (MAS) on improving anaerobic alactate capacity in female futsal athletes. The research involved 24 athletes from Universitas Pendidikan Indonesia, divided into groups according to training type—Short Interval Training (SIT), Intermediate Interval Training (IIT), and Long Interval Training (LIT)—and MAS level, either high or low. Each group was assessed on dependent variables including aerobic capacity, anaerobic lactacid, and anaerobic alactacid capacity. LIT is designed to stimulate the anaerobic energy system through a combination of high-intensity work and adequate recovery periods. The primary analysis focused on four athletes with low MAS who participated in 16 LIT sessions. The study employed a one-group pretest-posttest design, and data were analyzed using a paired sample t-test to evaluate performance changes. The results indicated an increase in the average 20-meter sprint time from 3.34 seconds to 3.69 seconds; however, this change was not statistically significant ($p = 0.296$). Despite the lack of statistical significance, low MAS-based LIT demonstrated practical potential in improving anaerobic alactate performance, particularly in athletes with lower aerobic capacity. This study has limitations, such as the small sample size and short intervention duration, which may affect generalizability. Future research should include larger samples, longer training periods, and control groups for more robust results. The findings imply that incorporating LIT into training plans can enhance explosive performance in futsal athletes, offering coaches a practical, physiologically based approach to improve competitive readiness.

Keywords: Long Interval Training, Maximum Aerobic Speed, Anaerobic Alactacid

Corresponding author:
*Dikdik Zafar Sidik, Program Study of Sports Coaching Education, Universitas Pendidikan Indonesia, Bandung 40154. Email: dikdikzafarsidik@upi.edu

Article History:
Submitted: July, 2025
Accepted: August, 2025
Published: August, 2025

Authors' contribution:
A) Conception and design of the study;
B) Acquisition of data;
C) Analysis and interpretation of data;
D) Manuscript preparation;
E) Obtaining funding.

Cite this article:
Fadillah, A., Sidik, D. J., Pitriani, P., & Rosdiana, F. (2025). The Effect of Implementing the Long Interval Training Method and Low Speed Maximum Aerobic Capacity on Increasing Anaerobic Alactacid Capacity. *Indonesian Journal of Sport Management, Vol. 5*(3), 544-522. https://doi.org/10.31949/ijsm.v5i3.15367

INTRODUCTION

An athlete's performance in sports like futsal is greatly influenced by their physical ability to produce energy quickly and efficiently. One aspect that determines this performance is anaerobic endurance, specifically the anaerobic alactacid energy system (Rosdiana et al., 2019). This system allows the body to produce energy in a very short time without oxygen, primarily supported by ATP and phosphocreatine reserves (Sidik, 2013). This ability is very much needed in explosive moments such as sprints, acceleration, or quick changes of direction (Muluk, 2011).

In the context of a dynamic and fast-paced sport like futsal, the need for an alactic acid anaerobic energy system becomes even more crucial. Futsal demands repeated explosive movements, both in attacking and defensive situations. The nature of this game,

played in confined spaces and at a high tempo, makes anaerobic capacity one of the physiological foundations of athlete performance (Limbong et al., 2022). Therefore, a training approach that can develop this capacity is highly relevant to implement.

One training method considered effective in stimulating both anaerobic and aerobic energy systems is Long Interval Training (LIT). LIT is a form of interval training with work periods ranging from 2 to 5 minutes at high intensity (85–90% of maximum performance), interspersed with relatively long recovery periods. (Brent S. Rushall and Frank S, 1990). Although LIT is known as a method of increasing aerobic capacity, in repeated repetitions and less than maximal recovery, LIT can also provide a significant stimulus to the anaerobic alactacid system. Previous research has shown that interval training methods have a positive effect on increasing VO_2max, endurance, and speed (Sumpena, 2013). However, most of these studies have focused on the aerobic aspect and have not specifically evaluated the impact of LIT on anaerobic alactacid capacity. Furthermore, very few studies have considered the response of athletes with low Maximum Aerobic Speed (MAS) to this type of training (Sepriadi et al., 2018).

MAS is the maximum speed that can be achieved in full aerobic conditions and is an important indicator in determining the intensity of exercise that is appropriate to an individual's capacity (Bellenger et al., 2015). Athletes with a low MAS will likely respond differently to interval training than athletes with a high MAS, due to limitations in aerobic energy use under high loads (Bok et al., 2023). Thus, MAS-based training is considered more accurate and individualistic, allowing for more effective and safe adaptation (Muluk, 2011)

Study from (Rønnestad et al., 2021) showed that both short and long interval training can improve performance, but results are often influenced by the training design, load volume, and recovery used. They emphasized that approaches that equate training volume based on duration or energy expenditure do not necessarily reflect real-world training conditions. This reinforces the importance of an individualized approach using parameters such as MAS. On the other hand, in practice, many trainers still develop training programs based on experience or intuition, without a clear physiological basis. However, physiology-based training, such as the use of MAS, can minimize the risk of overtraining and increase training effectiveness (Prakoso & Sugiyanto, 2017). By knowing an athlete's actual capacity, coaches can adjust the training load to provide optimal stimulation according to each athlete's condition.

Low anaerobic alactate capacity can hinder performance in sports that require rapid, sudden bursts of power. Therefore, a training approach that is not only intensive but also adaptive is necessary. Long Interval Training based on low MAS is one potential method for developing this capacity because it considers training intensity, recovery time, and an individual's aerobic capacity. Although there has been a lot of research on interval training, limitations in the number of subjects, differences in training strategies, and non-standardized intensity variables make the generalizability of the results limited (Cavar et al., 2019). Thus, research that specifically examines the relationship between low LIT and MAS on anaerobic alactacid capacity is important, both from the perspective of developing theory and coaching practice.

Based on this, this study aims to scientifically examine the effect of applying a low-MAS capacity Long Interval Training method on increasing anaerobic alactacid capacity. The results are expected to contribute to the development of more targeted, effective training programs based on athletes' actual physiological data, particularly in the context of fast-paced sports like futsal (Masjid et al., 2024).

METHOD

This study used a quantitative approach with an experimental method, aiming to empirically test the effect of implementing the Long Interval Training (LIT) method based on low Maximum Aerobic Speed (MAS) on increasing anaerobic alactacid capacity. The research design used was a one-group pretest-posttest design, involving one group without a control group. This design allows researchers to compare performance before and after treatment, in order to see the direct impact of the intervention given. This design was chosen because the focus of the study was to evaluate the physiological responses of individuals with special characteristics (low MAS), without comparing them with other groups. The intervention was implemented in a structured and systematic manner for four weeks with a training frequency of twice per week, resulting in a total of 16 training sessions.

This study involved 24 female futsal athletes from Universitas Pendidikan Indonesia, who were divided into several groups based on the type of training and Maximum Aerobic Speed (MAS) capacity. The Short Interval Training (SIT) group with high MAS capacity consisted of four athletes, measured on the dependent variables of aerobic and lactacid anaerobic capacity. The Intermediate Interval Training (IIT) group with high MAS capacity also included four athletes, measured on the dependent variables of aerobic and anaerobic capacity. Furthermore, the Long Interval Training (LIT) group with high MAS capacity comprised four athletes, whose dependent variables included aerobic, lactacid anaerobic, and alactacid anaerobic capacity.In the groups with low MAS capacity, the SIT group consisted of three athletes, measured on the dependent variables of aerobic, anaerobic, and lactacid anaerobic capacity. The IIT group included four athletes, while the LIT group also comprised four athletes, both measured on the dependent variables of anaerobic and alactacid anaerobic capacity.

The subjects in this study were 4 female students from the Women's Futsal Student Activity Unit (UKM) at the University of Education of Indonesia, who were categorized as athletes with low MAS capacity based on initial measurements. The sampling technique was purposive sampling, based on consideration of specific characteristics that were in accordance with the research objectives. The training program provided referred to the characteristics of LIT, which included a work duration of 2–5 minutes, a training intensity of 85–90% of best performance, a recovery period of 2–8 minutes, and a work-rest ratio of 1:1 to 1:2 (Rushall & Frank, 1990). The entire training series was carried out on campus under direct supervision by the researcher, ensuring consistency in program implementation and minimizing bias during the intervention. After the program was completed, the data obtained were analyzed using parametric statistical tests to see any significant differences between pre- and post-training conditions (Fahrudin et al., 2024).

The data obtained were analyzed quantitatively using descriptive and inferential statistical approaches. Descriptive tests were used to describe the mean, standard deviation, minimum, and maximum values of the pretest and posttest results. Furthermore, a normality test was performed using the Shapiro-Wilk test to ensure normal data distribution due to the small sample size. To test the significance of the difference between the pretest and posttest, a paired sample t-test was used, with a significance level of 0.05. All analysis processes were carried out using SPSS 25 software to ensure the accuracy of statistical calculations (Fadluloh et al., 2024).

RESULTS AND DISCUSSION

Findings

Based on the results of the analysisDescriptive analysis in Table 1 shows that the average pretest score was 3.34 with a standard deviation of 0.177, while in the posttest the average score increased to 3.69 with a standard deviation of 0.487. This indicates an increase in scores after the intervention in the form of low MAS-based Long Interval Training. The minimum and maximum scores also changed: pretest (min 3.20; max 3.59) and posttest (min 3.19; max 4.36), which illustrates that the training had a positive impact on improving the participants' anaerobic alactacid performance.

Table 1. Descriptive Analysis Test

	N	Minimum	Maximum	Mean	Standard Deviation
Pretest	4	3.20	3.59	3.3400	.17720
Post-test	4	3.19	4.36	3.6925	.48733
Valid N (listwise)	4				

Normality test was performed using Shapiro-Wilk for small samples (n < 50). BBased on the results in Table 2, the Shapiro-Wilk significance value for the pretest was 0.299 and for the posttest 0.552. Since both sig. values are > 0.05, the data are normally distributed. This indicates that the data is suitable for testing using parametric tests such as the paired sample t-test.

Table 2. Normality Test

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
Pretest	.250	4	.	.870	4	.299
Post-test	.301	4	.	.923	4	.552

Test resultspaired sample t-testTable 3 shows that the average difference between the pretest and posttest is -0.35250. The significance value (Sig. 2-tailed) is 0.296, which means it is greater than 0.05. Therefore, statistically there is no significant difference between the pretest and posttest results. However, although not statistically significant, there is an increase in the average value from pretest to posttest which may indicate a positive trend in increasing anaerobic alactacid capacity after low MAS-based Long Interval Training exercise. This may also be due to the very small sample size (n=4) so that the test power is low.

Table 3. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Standard Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	pretest - posttest	-.35250	.55805	.27903	-1.24049	.53549	-1.263	3	.296

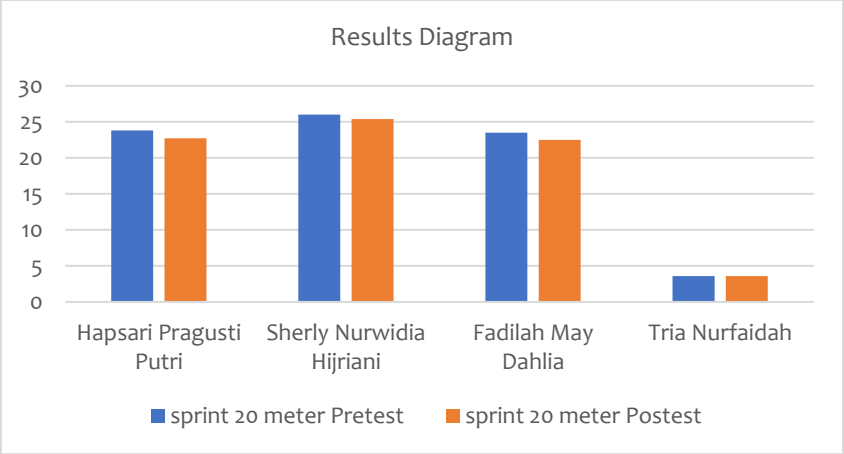

Figure 1. Results Diagram

Based on the results of the 20-meter sprint test, it can be seen that all four participants showed relatively consistent results between the pretest and posttest, although there was a slight decrease in some participants. Hapsari Pragusti Putri recorded a time of around 24 in the pretest and a slight decrease to 23 in the posttest. Sherly Nurwidia Hijriani had the highest results among the participants, with around 26 in the pretest and a slight decrease to 25 in the posttest. Fadilah May Dahlia also experienced a slight decrease from around 23 on the pretest to 22 on the posttest. Meanwhile, Tria Nurfaidah showed the same results on both the pretest and posttest, around 3, so there was no significant change in her performance. Overall, the changes in results among the four participants were small and relatively stable.

Discussion

This study aims to determine the effect of the application of the Long Interval Training (LIT) method based on low Maximum Aerobic Speed (MAS) on increasing anaerobic alactacid capacity in students who are members of the Female Futsal UKM at the University of Education Indonesia. Based on the results of the data analysis conducted, it was found that there was an increase in the average value from the pretest of 3.34 seconds to 3.69 seconds in the posttest after participants underwent the training program for 16 meetings. This increase indicates a positive trend in anaerobic alactacid capacity. Although the results of the paired sample t-test showed a significance value of 0.296 ($p > 0.05$) which means that the increase was not statistically significant, but practically it can be said that the LIT program based on low MAS was able to provide a response to increase anaerobic performance.

Theoretically, these results align with the characteristics of the anaerobic alactacid energy system used in short sprints and high-intensity explosive activities. This energy system is also known as the ATP-PC (Phosphagen System), where energy is provided rapidly in the absence of oxygen and without the production of lactic acid. As explained in the literature review, anaerobic alactacids use the ATP-PC system for energy needed during short or sudden movements, for example, from 0.0 seconds to 10.0 seconds (Muluk, 2011). In the context of this study, the 20-meter sprint used as a measurement instrument is a form of activity that optimally represents the anaerobic alactacid energy system.

The training method used in this study, namely Long Interval Training, has the characteristics of high-intensity training and a relatively long working time duration, namely between 2 to 5 minutes, with an intensity reaching 85–90% of maximum

performance, and a recovery time of between 2 to 8 minutes. In Chapter II, it has been explained that the characteristics of this long interval are as follows: training duration of 2–5 minutes, training intensity reaching 85–90% of the best performance standard, recovery period duration of 2–8 minutes, training: recovery ratio of 1:1 to 1:2, repetitions of 3–12" (Brent S. Rushall and Frank S, 1990). hese characteristics allow athletes to stimulate both aerobic and anaerobic energy systems simultaneously. In low MAS-based training, individuals will train at a speed adjusted to their aerobic capacity, so as not to overexert the system and are able to provide targeted stimulus to the alactacid anaerobic energy system.

This is reinforced by the statement in the background that anaerobic alactacid capacity is closely related to the muscle's ability to produce energy without oxygen in a short time", and "the LIT method is a type of training that involves periods of high-intensity work followed by longer recovery periods compared to other interval methods. The application of this method is very suitable for developing the capacity of the anaerobic system, especially in futsal athletes who require high explosive power and speed in a short duration. Thus, the program used in this study theoretically has a suitability with the physiological needs of futsal activities (Septiaji et al., 2025; Yunus & Raharjo, 2022).

The statistically insignificant results in this study are likely due to the very small sample size, which was only 4 people. In quantitative methods, sample size significantly affects the statistical power of a statistical test; the smaller the sample size, the less likely the statistical test is to detect a true difference. As explained by (Etikan, 2016) that the purposive sampling technique has advantages in selecting participants with characteristics relevant to the research objectives, but does not guarantee generalization due to the limited number of participants.

On the other hand, the average increase from pretest to posttest remains evidence that, in practice, participants experienced performance improvements. This is in line with the opinion of (Sumpena, 2013) in his research, he stated that the interval training method contributes to increasing anaerobic capacity and speed in athletes. Even in several other studies, such as by (Cavar et al., 2019) And (Rønnestad et al., 2021), it was found that interval training, both short and long, produced significant physiological adaptations to athlete performance, particularly in anaerobic and aerobic aspects. Therefore, although the results were not statistically significant, the direction of the changes in the data in this study supports the effectiveness of the training method used.

The MAS-based method itself is very strategic for use in training programs because it allows coaches to adjust training intensity according to each athlete's physiological capacity. As explained, maximum aerobic speed is used in sports to optimize training programs that focus on aerobic dominance by measuring the average speed achieved in a specific time or distance trial (Bellenger et al., 2015) and that by understanding and utilizing MAS, coaches and athletes can design better training programs that optimize performance and minimize the risk of overtraining or injury.(Bok et al., 2023)In this study, the use of low MAS became the basis for determining the intensity of LIT training, thus allowing for more optimal adaptation in groups of athletes with relatively low aerobic capacity.

In addition, it is important to note that an individual's physical abilities also greatly influence training results. As stated by (Prakoso & Sugiyanto, 2017) that differences in ability occur primarily due to differing physical qualities and internal conditions, including factors inherent in the individual. In this study, due to the small sample size, interindividual variability (such as endurance, motivation, and recovery) is likely to have a significant

impact on the final results. These differences broaden the data range and increase the standard deviation in the posttest (0.487) compared to the pretest (0.177), ultimately reducing the significance of the statistical test.

In the context of futsal, anaerobic alactate capacity is crucial because the activity in the game tends to be intermittent, with very short, intense bursts of energy. Chapter I explains that futsal is a sport that requires players to actively participate in the game in a balanced manner, both in defense and attack, and that it requires speed and explosive power in a short period of time. Therefore, developing anaerobic capacity through methods such as LIT is contextually relevant to the needs of futsal athletes.

This study also emphasizes the need to design training programs based on scientific studies, not solely on practical experience. Chapter II emphasized that many coaches still rely solely on personal experience in training athletes. Therefore, the researchers wanted to understand how the long interval training method, using low maximum aerobic capacity speed, improves anaerobic alactic capacity. This study provides a preliminary scientific basis for coaches that the use of physiological parameters such as low MAS can be a guideline for designing effective and measurable training.

In conclusion, although this study did not show statistically significant results, the trend of improved post-exercise performance remains a practically important finding. The implication of this study is that a low-MAS-based LIT training program has the potential to increase anaerobic alactate capacity in female futsal athletes. Future research is recommended to use a larger sample size, longer training duration, and possibly additional measurement tools to strengthen the validity and reliability of the results.

CONCLUSION

Based on the research results, the application of the Long Interval Training (LIT) method based on low Maximum Aerobic Speed (MAS) showed a positive trend towards increasing anaerobic alactidic capacity in female futsal athletes. Although the increase was not statistically significant, descriptive results showed an improvement in speed performance after the training program was carried out for 16 sessions. This indicates that the low MAS-based training approach can provide a stimulus that is appropriate to the physiological needs of athletes, especially for those with relatively low aerobic capacity. LIT is able to encourage adaptation of the anaerobic alactidic energy system in a more targeted manner, thus potentially being an alternative effective training strategy in sports characterized by short bursts of power such as futsal. Therefore, these findings provide an initial basis that can be further developed in the design of individualized training based on the actual physical capacity of athletes.

CONFLICT OF INTEREST

There were no conflicts that occurred in this study.

REFERENCES

Bellenger, C. R., Fuller, J. T., Nelson, M. J., Hartland, M., Buckley, J. D., & Debenedictis, T. A. (2015). Predicting maximal aerobic speed through set distance time-trials. *European Journal of Applied Physiology*, *115*(12), 2593–2598. https://doi.org/10.1007/s00421-015-3233-6

Bok, D., Gulin, J., Škegro, D., Šalaj, S., & Foster, C. (2023). Comparison of anaerobic speed reserve and maximal aerobic speed methods to prescribe short format high-intensity interval training. *Scandinavian Journal of Medicine and Science in Sports*, *33*(9), 1638–1647. https://doi.org/10.1111/sms.14411

Cavar, M., Marsic, T., Corluka, M., Culjak, Z., Cerkez Zovko, I., Müller, A., Tschakert, G., & Hofmann, P. (2019). Effects of 6 Weeks of Different High-Intensity Interval and Moderate Continuous Training on Aerobic and Anaerobic Performance. *Journal of Strength and Conditioning Research*, *33*(1), 44–56. https://doi.org/10.1519/JSC.0000000000002798

Etikan, I. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, *5*(1), 1. https://doi.org/10.11648/j.ajtas.20160501.11

Fadluloh, F. M., Sartono, H., Kusumah, W., & Mulyana, M. (2024). *Athletes ' Perception of Parental Support and Achievement Motivation : A Correlational Study with Early Age Individual Sport Athletes in Swimming*. 412–421. https://www.ejournal.unma.ac.id/index.php/ijsm/article/view/11454

Fahrudin, A., Sutrisno, B., & Nugroho, Y. (2024). Pengaruh Kombinasi Small-Sided Games dan High-Intensity Interval Training terhadap Daya Tahan Anaerobik Pemain Futsal. *Jurnal Teknologi Keolahragaan*, *13*(2), 150–160. https://ejournal.upi.edu/index.php/JTIKOR/article/view/29023

Hernández, J., Pérez, R., & Soto, L. (2022). Effects of High-Intensity Interval Training on Performance in Team Sports: A Systematic Review. *International Journal of Sports Science and Coaching*, *17*(4), 890–902. https://doi.org/10.1177/17479541221089456

Hidayat, J. (2023). *Pengaruh Latihan Interval terhadap Peningkatan VO_2 Max Atlet Futsal*. https://repository.upi.edu/90870

Limbong, A., Ridlo, A. F., & Iskandar, T. (2022). Peningkatan Kualitas Bermain Dalam Cabang Olahraga Futsal. *An-Nizam*, *1*(2), 103–110. https://doi.org/10.33558/an-nizam.v1i2.4362

Masjid, I., Suryadi, A., & Prasetyo, D. (2024). Efektivitas High-Intensity Interval Training terhadap Kapasitas Aerobik dan Anaerobik Pemain Futsal. *Jurnal Prestasi Olahraga*, *8*(1), 22–30. https://ejournal.unesa.ac.id/index.php/jurnal-prestasi-olahraga/article/view/64330

Mubaraq, R. (2017). *Peningkatan Daya Tahan Kecepatan Melalui Metode Long Interval Training dan Short Interval Training pada Atlet Sepakbola PERSIB U-19*.

Muluk, S. & D. (2011). *Pengantar Teori dan Metodologi Melatih Fisik*.

Prakoso, G. P. W., & Sugiyanto, F. (2017). Pengaruh metode latihan dan daya tahan otot tungkai terhadap hasil peningkatan kapasitas VO2Max pemain bola basket. *Jurnal Keolahragaan*, *5*(2), 151. https://doi.org/10.21831/jk.v5i2.10177

Rønnestad, B. R., Øfsteng, S. J., Zambolin, F., Raastad, T., & Hammarström, D. (2021). Superior physiological adaptations after a microcycle of short intervals versus long intervals in cyclists. *International Journal of Sports Physiology and Performance*, *16*(10), 1432–1438. https://doi.org/10.1123/IJSPP.2020-0647

Rosdiana, F., Sidik, D. Z., & Rusdiana, A. (2019). *The Implementation Impact of High Intensity Interval Training (HIIT) Methods for the Increase of Anaerobic Abilities (Experimental study of physical training for 28 day meeting on student activity unit women futsal UPI Bandung)*. *11*(Icsshpe 2018), 17–19. https://doi.org/10.2991/icsshpe-18.2019.5

Rushall, B. S., & Frank, S. P. (1990). *Training for Sports and Fitness*. Macmillan Education Australia Pty Ltd.

Sepriadi, Arsil, & Mulia, A. D. (2018). Pengaruh Interval Training Terhadap Kemampuan daya tahan aerobik pemain futsal. *Jurnal Penjakora*, *5*(2), 121–127.

Septiaji, A., Lestari, R., & Firmansyah, I. (2025). Penerapan High-Intensity Interval Training terhadap Peningkatan VO_2 Max Pemain Futsal UNDIKMA. *Jurnal Ilmiah Olahraga*, *9*(1), 55–64. https://ejournal.undikma.ac.id/index.php/jurnal-ilmiah-olahraga

Sidik, D. Z., & Rosdiana, F. (2023). Reverse Periodization Model to Increase Anaerobic and Aerobic Capacity. *International Journal of Human Movement and Sports Sciences*, *11*(1), 65–70. https://doi.org/10.13189/saj.2023.110108

Sidik, S. G. & D. Z. (2013). *Ilmu Faal Olahraga*. PT Remaja Rosdakarya.

Sumpena, A. (2013). *Dampak Metode Latihan Dan Kapasitas Aerobik Terhadap Peningkatan Kemampuan Dinamis Anaerobik*.

Yunus, M., & Raharjo, A. (2022). Pengaruh Latihan Sirkuit dan Interval terhadap VO_2 Max Pemain Futsal Profesional. *Kinestetik: Jurnal Ilmiah Pendidikan Jasmani*, *6*(2), 208–215. https://ejournal.unib.ac.id/kinestetik/article/view/20801