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

Application of The Interval Training method based on Maximum Aerobic Speed Capacity Towards increasing Anaerobic capacity

Mohammad Khalid Norman[1], Dikdik Zafar Sidik[1*], Fitri Rosdiana[1]

[1]Sports Physical Coaching Study Program, Faculty of Sports Education and Health, Indonesian University of Education

ABSTRACT
This study aims to analyze the effect of the Maximum Aerobic Speed (MAS)-based interval training method on improving the anaerobic capacity of female futsal athletes at Universitas Pendidikan Indonesia. The background of this research is based on the need for precise training strategies capable of simultaneously developing both the alactic and lactic anaerobic energy systems. The study employed an experimental method with a one-group pretest-posttest design, involving a sample of 16 athletes aged 18–21 years selected through purposive sampling. The intervention was conducted over eight weeks (16 training sessions), divided into short interval training and long interval training groups based on MAS. Measurement instruments included the Running-Based Anaerobic Sprint Test (RAST) for lactic anaerobic capacity and the 5m × 4 Shuttle Run for alactic anaerobic capacity. Data were analyzed using paired sample t-tests after the Shapiro–Wilk normality test. The results showed a significant improvement in both variables (p = 0.000). The average RAST completion time decreased from 42.58 seconds to 39.17 seconds, while the Shuttle Run time decreased from 6.84 seconds to 6.42 seconds, accompanied by a reduction in standard deviation, indicating improved performance consistency. These findings confirm that a combination of short and long MAS-based interval training is effective in enhancing anaerobic capacity. This research contributes to the development of evidence-based training models for optimizing athlete performance in high-intensity intermittent sports and provides practical recommendations for coaches in designing precise and efficient training programs.

Keywords : Interval Training; Maximum Aerobic Speed; Anaerobic.

The author concerned:
*Dikdik Zafar Sidik, Sports Physical Coaching Study Program, Indonesian University of Education, 40154
E-mail:dikdikzafarsidik@upi.edu

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

Author contributions:
A) Research conception and design;
B) Data acquisition;
C) Data analysis and interpretation;
D) Manuscript preparation;
E) Get funding.

Quote this article:
Norman, M. K., Sidik, D.J., & Rosdiana, F. (2025). Application of the interval training method based on Maximum Aerobic Speed to increase anaerobic capacity. Indonesian Journal of Sports Management, Vol 5(3), 636-646. https://doi.org/10.31949/ijsm.v5i3.155454

INTRODUCTION

Sport has been an integral part of human civilization from ancient times to the modern era. Its role has evolved from mere entertainment and recreation to a vital instrument in building public health, strengthening social bonds, and enhancing achievements that bring honor to the nation. In the context of globalization and technological advancement, sport is now viewed as a strategic investment for a country, not only in terms of public health but also as a symbol of national strength in international diplomacy. In Indonesia, the government's commitment to sports development is reflected in Sports Law Number 11 of 2022, which classifies sports into three main categories: educational sports, community sports, and competitive sports. Competitive sports, in particular, play a strategic role because they provide a platform for producing highly competitive athletes ready to compete at the national and international levels.

The development of high-achieving sports is carried out through a systematic and continuous process, covering four main aspects, namely physical, technical, tactical and mental training (Harsono & Drs, 1988). These four aspects are interrelated and form the foundation for an athlete's success. Among these four aspects, physical fitness holds a fundamental position because it is the basis for all technical and tactical performance. Good physical condition allows athletes to execute game strategies efficiently, reduce the risk of injury, and maintain high performance over long periods of competition.

Physical condition itself consists of various components such as strength, endurance, speed, agility and flexibility (Kazemi et al., 2024; Henjilito et al., 2025). Muscle strength allows for maximum force production in a single contraction and is a key determinant in sports such as weightlifting or wrestling. Endurance, both cardiovascular and muscular, allows the body to work for extended periods without significant performance degradation (Branquinho et al., 2025). Speed refers to the ability to move from one point to another in the shortest possible time, while agility refers to the ability to respond quickly to changing situations. Flexibility, on the other hand, supports optimal joint range of motion and helps reduce the risk of injury (Henjilito et al., 2025).

In modern sports, increasing anaerobic capacity is a key focus of physical conditioning, particularly in sports that require high-intensity and explosive movements. Anaerobic capacity is the body's ability to produce energy without oxygen, which is crucial for activities such as sprinting, jumping, or rapid changes of direction (Rosdiana, 2018). Athletes with high anaerobic capacity have an advantage in maintaining performance during critical phases of competition, where energy demands are high but oxygen supply is limited (Yin et al., 2025; Shirzadi et al., 2024).

Anaerobic capacity is divided into two main energy systems: anaerobic alactacid and anaerobic lactacid. The anaerobic alactacid system, also known as the ATP-PCr system, works by utilizing adenosine triphosphate (ATP) and phosphocreatine (PCr) stored in muscles to produce instant energy without producing lactic acid (Sidik & Rosdiana, 2023). This system is very effective in very short duration maximal activities, generally 0–10 seconds, such as the 100 meter sprint, long jump, or maximum weight lifting (Dong et al., 2025). The anaerobic lactacidic system, on the other hand, produces energy through anaerobic glycolysis, which breaks down muscle glycogen into ATP, with the production of lactic acid as a byproduct. This system dominates activities lasting 10 seconds to about 2 minutes, such as a 400-meter dash or a short round in a martial arts match (Wen et al., 2025).

These two systems complement each other in supporting athlete performance. The alactacid system provides immediate explosive power, while the lactacid system maintains energy supplies during slightly longer, high-intensity activities. However, the accumulation of lactic acid in the lactacid system can lower muscle pH and trigger fatigue. Appropriate training adaptations can improve the body's ability to tolerate and clear lactate, thus maintaining performance (Suarez-Arrones et al., 2025).

A training method that has proven effective in developing the capacity of these two systems is interval training. This method combines periods of high-intensity work with periods of active or passive recovery (Ramírez-Munera et al., 2025)The basic principle is to provide repeated high-load stimuli to trigger physiological adaptations in the cardiovascular, energy metabolism, and neuromuscular systems (Zhang et al., 2025).

Based on duration and intensity, interval training is divided into three main types. First, short interval training, lasting 10–30 seconds at an intensity of 90–100% of VO_2max, focuses on developing anaerobic capacity and muscle explosive power (Pancar et al., 2025). Second, medium interval training lasts 30 seconds–2 minutes at an intensity of 80–95% of VO_2max, which is beneficial for increasing muscle endurance and metabolic efficiency (Zhao & Lu, 2024). Third, long interval training lasting 2–5 minutes at an intensity of 70–85% of VO_2max, which focuses more on increasing aerobic capacity (Businaro et al., 2025). The combination of these three forms, if designed properly, can provide comprehensive benefits to the body's energy system.

One of the important parameters in designing interval training is Maximum Aerobic Speed (MAS), which is the minimum speed at which oxygen consumption reaches maximum capacity (VO_2max) (Buchheit & Laursen, 2013). MAS allows trainers to precisely adjust training intensity according to individual capacity, resulting in optimal adaptation (González-Mohíno et al., 2016). MAS-based training not only improves aerobic capacity, but also contributes to increased anaerobic capacity when combined with HIIT (Mohammadnia Ahmadi et al., 2025).

Research shows that the combination of interval training and MAS can increase anaerobic capacity by 15–25% in just 6–8 weeks (Yin et al., 2025). Adaptations that occur include increased glycolytic enzyme activity, mitochondrial capacity, lactate threshold, biomechanical efficiency, and accelerated recovery (Christoulas et al., 2024; Wiesinger et al., 2025). This approach is effective in sports such as soccer, basketball, athletics, and martial arts that require a combination of high aerobic and anaerobic capacity.

However, most previous studies have focused more on the effect of interval training or MAS separately on aerobic capacity, while studies that integrate both with a focus on the development of the anaerobic system (alactacid and lactacid) are still limited (See, 2024 ;Mexis et al., 2025). Theoretically, this approach is supported by the Anaerobic Threshold Theory (Kindermann et al., 1979), Metabolic Energy Theory (Brooks & Mercier, 1994), and High-Intensity Training Theory (Buchheit & Laursen, 2013). These three theories provide a scientific basis for how the body adapts to high-intensity exercise and how energy systems contribute to athletic performance.

Based on this presentation, there is a research gap in the application of MAS-based interval training combinations for comprehensive anaerobic capacity development. Research in this area is crucial, both to expand the scientific literature and to provide practical recommendations to coaches and athletes. The expected contribution is the development of evidence-based training strategies that can optimize athlete performance across various sports, extend athlete careers, and minimize the risk of injury due to excessive muscle fatigue.

METHOD

This study used an experimental method designed to test the effect of one variable on another with the goal of clearly understanding cause-and-effect relationships. This approach was chosen because of its characteristics, which allow for direct intervention to determine the consequences of a given treatment (Fraenkel et al., 2011). The design used was a one-group pretest-posttest design, where measurements are taken on one group before and after treatment. This model allows researchers to observe changes that occur after treatment without the need for a comparison group. In the context of this study, the treatment in question is the application of an interval training method adapted to Maximum Aerobic Speed (MAS) to determine its effect on anaerobic capacity.

This study was conducted at the Faculty of Sports and Health Education, Indonesian University of Education, Padasuka Campus, Bandung, for eight weeks with a total of sixteen training sessions, held every Tuesday and Thursday at 05.00–07.00 WIB. This location was selected based on the availability of adequate facilities and ease of controlling the training environment conditions. The study population was 24 female futsal players from Universitas Pendidikan Indonesia, divided into three groups. However, this study used 16 athletes divided into two groups, namely the short interval training group and the long interval training group. The inclusion criteria were athletes aged 18–21 years who actively participated in training, while the exclusion criteria were athletes with a history of injury or medical conditions that prevented participation. Sample selection was carried out by purposive sampling with consideration of characteristics that were in accordance with the research objectives (Given, 2012).

The research procedure began with population and sample determination, followed by an explanation of the research objectives to participants. The next stage was a pre-test to measure baseline anaerobic capacity using the Running-Based Anaerobic Sprint Test (RAST) to measure lactase anaerobic capacity and the 5m × 4 Shuttle Run to measure alactase anaerobic capacity. Afterward, participants underwent a 16-session MAS-based interval training program consisting of a warm-up phase, interval training according to their respective groups, and a cool-down. The program concluded with a post-test using the same instrument to measure changes that occurred.

The RAST instrument measures two main components: average power and fatigue index. This test involves running 35 meters for six repetitions with a 10-second rest period, while recording the time for each repetition. The results are used to calculate speed, acceleration, force, and power, which are then analyzed to obtain a fatigue index value. The validity and reliability of this instrument are 0.987 and 0.919, respectively (Wibisana, 2020), so it is suitable for use in assessing anaerobic capacity.

The 5m × 4m Shuttle Run test measures agility and the ability to change direction quickly. Participants run a four-meter shuttle run five times, with time serving as a performance indicator. The test is performed twice with a three-minute rest interval, and the best recorded time is used as the test result (Malasari, 2019). Data obtained from the pre-test and post-test were analyzed using SPSS version 27 software. The analysis was conducted using a paired sample t-test to determine significant differences between pre- and post-treatment results on the same subjects. Normality testing was performed using the Shapiro–Wilk method to ensure normal distribution of the data, while homogeneity testing used Levene's statistic to check for equality of variance between groups. If the data did not meet parametric assumptions, the nonparametric Wilcoxon Signed Ranks Test was used as an alternative. In addition, descriptive analysis was conducted to present the minimum, maximum, mean, and standard deviation values of each variable. The final results were also displayed in the form of a percentage change diagram on the average as a visual illustration of the increase in anaerobic capacity due to the treatment.

This methodological approach is designed to ensure the internal validity of the study through rigorous variable control and the use of scientifically tested instruments.

Thus, the results are expected to provide a credible contribution, both theoretically and practically, to the development of evidence-based exercise training programs.

RESULTS AND DISCUSSION

Findings

Table 1. Descriptive Test of RAST Test Analysis (Anaerobic Lactacyd)

	N	Minimum	Maximum	Mean	Standard Deviation
RAST Initial Test	16	36.64	48.13	42.5813	2.88031
RAST Final Test	16	35.86	41.64	39.1738	1.52010
Valid N (listwise)	16				

Source: personal data

The descriptive analysis results in Table 1 show that in the RAST Initial Test (16 samples), the fastest time obtained was 36.64 seconds and the longest was 48.13 seconds, with an average of 42.58 seconds and a variation of 2.88 seconds, indicating that the participants' anaerobic running abilities were quite varied. In the Final Test, the fastest time was 35.86 seconds and the longest was 41.64 seconds, with an average decreasing to 39.17 seconds and a variation narrowing to 1.52 seconds. The decrease in average time and the reduction in variation indicate an increase in speed as well as consistency of performance, indicating the success of the training program provided.

Table 2. Descriptive Test Analysis of Shuttle Run Test (Anaerobic Alactacid)

	N	Minimum	Maximum	Mean	Standard Deviation
Initial Shuttle Run Test	16	5.91	7.49	6.8388	.45592
Shuttle Run Final Test	16	5.86	6.81	6.4163	.27464
Valid N (listwise)	16				

Source: personal data

The results of the descriptive analysis showed that in the Shuttle Run Initial Test (16 samples) the fastest time was 5.91 seconds and the slowest was 7.49 seconds, with an average of 6.84 seconds and a standard deviation of 0.46 seconds, reflecting a fairly visible variation in agility performance. In the Final Test, the fastest time was 5.86 seconds and the slowest was 6.81 seconds, with an average decreasing to 6.42 seconds and a standard deviation decreasing to 0.27 seconds. The decrease in average time and the reduction in variation indicate an increase in speed and consistency of performance, which indicates the success of the training program or intervention implemented.

Table 3. Normality Test of RAST Test (Anaerobic Lactacid)

Tests of Normality			
	Shapiro-Wilk		
	Statistics	Df	Sig.
RAST Initial Test	.980	16	.960
RAST Final Test	.965	16	.749

Source: personal data

The normality test was performed using Shapiro-Wilk for small samples (n < 50). Based on the results in table 4.4, the Shapiro-Wilk significance value for the pretest is**0.960**and for the posttest**0,749**. Since both sig. values are > 0.05, the data is normally distributed. This indicates that the data is suitable for testing using parametric tests such as*paired sample t-test*.

Table 4. Shuttle Run Normality Test (Anaerobic Alactacid)

Tests of Normality			
	Shapiro-Wilk		
	Statistics	Df	Sig.
Initial Shuttle Run Test	.955	16	.575
Shuttle Run Final Test	.957	16	.615

Source: personal data

The normality test was performed using Shapiro-Wilk for small samples (n < 50). Based on the results in table 4.5, the Shapiro-Wilk significance value for the pretest is**0,575**and for the posttest**0,615**. Since both sig. values are > 0.05, the data is normally distributed. This indicates that the data is suitable for testing using parametric tests such as*paired sample t-test*.

Table 5. Paired Samples t-Test RAST Test (Anaerobic Lactacyd)

Paired Samples Test									
		Paired Differences							
		Mean	Standard Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	RAST Preliminary Test - RAST Final Test	3.40750	1.89087	.47272	2.39993	4.41507	7,208	15	.000

Source: personal data

Based on the results of the Paired Sample T-test, the average difference (Mean Difference) between the initial test and the final test was 3.40750 with t = 7.208 and p-value = 0.000 (p < 0.05). This indicates a statistically significant difference between anaerobic capacity before and after treatment. The 95% confidence interval ranges from 2.39993 to 4.41507, meaning all values within this range indicate a positive increase.

Table 6. Paired Samples t-Test Shuttle Run (Alactacid)

Paired Samples Test									
		Paired Differences							
		Mean	Standard Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Shuttle Run Initial Test - Shuttle Run Final Test	.42250	.23399	.05850	.29781	.54719	7,222	15	.000

Source : author/personal data

The analysis results showed an average difference of 0.4225 seconds between the initial test and the final Shuttle Run test, with a t-value = 7.222 and a p-value = 0.000 ($p < 0.05$). This means that the increase in anaerobic capacity after treatment was statistically significant. The 95% confidence interval ranged from 0.29781 to 0.54719, all of which were above zero, thus strengthening the evidence of consistent improvement.

Discussion

This study proves that the application of the Maximum Aerobic Speed (MAS)-based interval training method for eight weeks with sixteen training sessions has a significant effect on increasing the anaerobic capacity of female futsal athletes at the Indonesian University of Education. The results of the 35-meter RAST test showed a decrease in average travel time from 42.58 seconds in the pre-test to 39.17 seconds in the post-test, while the 5m × 4 Shuttle Run test showed a decrease from 6.85 seconds to 6.42 seconds. This decrease in time reflects improvements in speed, explosive power, and the efficiency of the anaerobic energy system, both anaerobic lactacid and anaerobic alactacid. In addition, the reduction in standard deviation values in both tests indicates an increase in performance consistency among participants. The Paired Sample t-test statistical test produced a p value = 0.000 in both instruments, confirming that this increase is a real effect of the training program provided, in line with the High-Intensity Training theory (Buchheit & Laursen, 2013) and the concept of anaerobic threshold (Kindermann et al., 1979)

Reflecting on these results shows that the adaptations that occur in athletes are not only caused by increased physiological capacity alone, but also by the optimization of neuromuscular coordination and movement efficiency achieved through repeated, high-intensity training. The combination of short and long interval training within the MAS framework forces the body to adapt to two forms of energy stress: a rapid and intense stress on the anaerobic alactacid system, and a sustained stress on the anaerobic lactacid system. This pattern allows for simultaneous improvements in lactate tolerance, ATP-PCr resynthesis capacity, and accelerated oxygen uptake kinetics, all of which are important indicators of high performance in high-intensity sports like futsal (Girard et al., 2011).

The reasons for these findings can be explained both empirically and theoretically. Empirically, MAS, as an intensity parameter, allows for personalized training loads so that each athlete trains at their optimal capacity without the risk of overtraining. Theoretically, MAS-based interval training leverages the principle of specificity of training (Bompa & Buzzichelli, 2019), where the training stimulus is directed at the energy system most relevant to the demands of the sport. For alactacid anaerobes, short intervals at maximal intensity rely on phosphocreatine as the primary energy source, whereas in lactacid anaerobes, longer intervals force the body to produce ATP through rapid glycolysis, thereby increasing tolerance to lactate accumulation (Gastin, 2001). This dual adaptation explains the significant increases measured in both types of anaerobic capacity.

When compared with previous research, these results are consistent with the findings Yin et al. (2025) who reported a 25% increase in anaerobic capacity through the MAS-based HIIT method, and is in line with studies Bendo et al. (2025). who found improvements in metabolic efficiency and explosive power in young athletes. The novelty of this study lies in the structured use of a combination of short and long intervals within a single training program, a practice rarely used together in previous MAS studies. These findings also extend the results of previous research Dupont et al. (2004), which shows that interval training with an intensity exceeding MAS is able to increase time to exhaustion and repeated sprint capacity in episodic sports.

The practical implication of these findings is the need to consider MAS as a key parameter in training program planning, not only for increasing aerobic capacity, as is commonly applied, but also for the simultaneous development of anaerobic capacity. For coaches of futsal, soccer, and other episodic sports, this training model can be adapted to maximize performance with a relatively short but effective program duration. In physical education, this approach can be utilized to improve student fitness through high-intensity game-based learning. Future research could test the effectiveness of this method in different populations, such as junior athletes or athletes with specific playing positions, to broaden its application and build more comprehensive, evidence-based training policies.

CONCLUSION

The results of this study indicate that the application of the Maximum Aerobic Speed (MAS)-based interval training method for eight weeks significantly increased the anaerobic capacity of female futsal athletes at the University of Education Indonesia, both in the lactacid anaerobic system as measured by RAST and in the alactacid anaerobic system as measured by the 5m × 4 Shuttle Run. The decrease in travel time and the increase in performance consistency reflect optimal physiological and neuromuscular adaptations due to the combination of short and long intervals within the MAS framework, which effectively increases lactate tolerance, ATP-PCr resynthesis ability, and movement efficiency. These findings confirm the relevance of MAS as a precision parameter for designing high-intensity training that is able to develop anaerobic energy capacity simultaneously. In the future, this model can be implemented more widely in episodic sports and its effectiveness analyzed in athlete populations with different characteristics to broaden its understanding and application in evidence-based training practices.

CONFLICT

There are no conflicts of interest in conducting this research, whether financial, personal, or professional, that could affect the results and objectivity of the study.

REFERENCE

Bendo, A., Brovina, F., Bushati, S., Salllaku, D., Bushati, M., & Papa, E. (2025). The Effect of High Interval Intensity Training (HIIT) on the Performance of Basketball Players 10-15 Years Old. *Retos: nuevas tendencias en educación física, deporte y recreación*, 62, 627–636.

Bompa, T. O., & Buzzichelli, C. (2019). *Periodization: Theory and methodology of training*.

Branquinho, L., Forte, P., De França, E., Ferraz, R., Teixeira, J. E., & Thomatieli-Santos, R. (2025). Training load in sport: current challenges and future perspectives. In *Frontiers in Sports and Active Living* (Vol. 7, hal. 1574500). Frontiers Media SA.

Brooks, G. A., & Mercier, J. (1994). Balance of carbohydrate and lipid utilization during exercise: the" crossover" concept. *Journal of applied physiology*, *76*(6), 2253–2261.

Buchheit, M., & Laursen, P. B. (2013). High-intensity interval training, solutions to the programming puzzle: Part II: Anaerobic energy, neuromuscular load and practical applications. *Sports Medicine*, *43*(10), 927–954. https://doi.org/10.1007/s40279-013-0066-5

Businaro, R., Dhahbi, W., Chamari, K., & Stefanica, V. (2025). *Physical activity and neuroplasticity in neurodegenerative disorders : a comprehensive review of exercise interventions , cognitive training , and AI applications. February*. https://doi.org/10.3389/fnins.2025.1502417

Christoulas, Y., Bourdas, D. I., Michailidis, Y., Mavrovouniotis, I., Metaxas, T. I., Christoulas, K., & Koutlianos, N. A. (2024). Acute ergogenic effects of repetitive maximal breath-holding maneuvers on hematological and physiological responses: a graded exercise test investigation. *European Journal of Applied Physiology*, 1–13.

Dong, K., Tang, J., Xu, C., Gui, W., Tian, J., Chun, B., Li, D., & Wang, L. (2025). The effects of blood flow restriction combined with endurance training on athletes' aerobic capacity, lower limb muscle strength, anaerobic power and sports performance: a meta-analysis. *BMC Sports Science, Medicine and Rehabilitation*, *17*(1), 24.

Dupont, G., Akakpo, K., & Berthoin, S. (2004). The effect of in-season, high-intensity interval training in soccer players. *The Journal of Strength & Conditioning Research*, *18*(3), 584–589.

Fraenkel, J. R., Norman E., W., & Helen H., H. (2011). How To Design and Evaluate Research in Education. In *Sustainability (Switzerland)* (Vol. 11, Nomor 1). http://scioteca.caf.com/bitstream/handle/123456789/1091/RED2017-Eng-8ene.pdf?sequence=12&isAllowed=y%0Ahttp://dx.doi.org/10.1016/j.regsciurbeco.2008.06.005%0Ahttps://www.researchgate.net/publication/305320484_SISTEM_PEMBETUNGAN_TERPUSAT_STRATEGI_MELESTARI

Gastin, P. B. (2001). Energy system interaction and relative contribution during maximal exercise. *Sports Medicine*, *31*(10), 725–741. https://doi.org/10.2165/00007256-200131100-00003

Girard, O., Mendez-Villanueva, A., & Bishop, D. (2011). Repeated-sprint ability—part I: factors contributing to fatigue. *Sports medicine*, *41*(8), 673–694.

Given, L. (2012). The SAGE Encyclopedia of Qualitative Research Methods. *The SAGE Encyclopedia of Qualitative Research Methods*, 741–744. https://doi.org/10.4135/9781412963909

González-Mohíno, F., González-Ravé, J. M., Juárez, D., Fernández, F. A., Barragán Castellanos, R., & Newton, R. U. (2016). Effects of Continuous and Interval Training on Running Economy, Maximal Aerobic Speed and Gait Kinematics in Recreational Runners. *Journal of Strength and Conditioning Research*, *30*(4), 1059–1066. https://doi.org/10.1519/JSC.0000000000001174

Harsono, M. S., & Drs, M. S. (1988). Coaching dan aspek-aspek psikologis dalam coaching. *Direktorat Jendral Pendidikan Tinggi: Jakarta*.

Henjilito, R., Zulkifli, A. Y., Setiawan, B. A., & Pardilla, H. (2025). *Reliability Assessment of Physical Education Students' Discus Throwing Competencies: A Cross-sectional Study*.

Kazemi, A. S., Daneshmandi, H., Sedaghati, P., & Hoseini, Y. (2024). Comparison of the Effect of Sportsmetrics Soccer Training on Movement Performance in Soccer Players with and without Anterior Cruciate Ligament Reconstruction. *Muscles, Ligaments & Tendons Journal (MLTJ)*, *14*(2).

Kindermann, W., Simon, G., & Keul, J. (1979). The significance of the aerobic-anaerobic transition for the determination of work load intensities during endurance training. *European journal of applied physiology and occupational physiology*, *42*, 25–34.

Malasari, C. A. (2019). Pengaruh latihan shuttle-run dan zig-zag run terhadap kelincahan atlet taekwondo. *Gelanggang Olahraga: Jurnal Pendidikan Jasmani Dan Olahraga*, *3*(1), 81–88.

Mexis, D., Nomikos, T., & Kostopoulos, N. (2025). Effect of Three Pre-Season Training Protocols with Different Training Frequencies on Biochemical and Performance Markers in Professional Female Basketball Players. *Applied Sciences*, *15*(4), 1833.

Mohammadnia Ahmadi, M., Najarian, E., Nezamdoost, Z., Sadeghi-Tabas, S., & Abtahi Eivary, S. H. (2025). Effects of Supramaximal Intensity Interval Training on Resistin and Cardiometabolic Health Indices in Overweight Nonpostmenopausal Women. *Sports Health*, *XX*(X), 1–9. https://doi.org/10.1177/19417381251315059

Pancar, Z., Akay, M. K., İlhan, M. T., Karaday, E., Karaca, B., Ulema, M. S., Taşdoğan, A. M., Makaracı, Y., & González-Fernández, F. T. (2025). Effects of Intermittent Versus Continuous Small-Sided Games on Athletic Performance in Male Youth Soccer Players: A Pilot Study. *Life*, *15*(3), 364.

Ramírez-Munera, M., Arcusa, R., López-Román, F. J., Ávila-Gandía, V., Pérez-Piñero, S., Muñoz-Carrillo, J. C., Luque-Rubia, A. J., & Marhuenda, J. (2025). Relationship Between Anthropometric Profile, Body Composition, and Physical Performance in Spanish Professional Female Soccer Players at Pre-Season Onset: A Cross-Sectional Study. *Journal of Functional Morphology and Kinesiology*, *10*(1), 79.

Rosdiana, F. (2018). *DAMPAK PENERAPAN METODE LATIHAN HIGH INTENSITY INTERVAL TRAINING (HIIT) TERHADAP PENINGKATAN KEMAMPUAN ANAEROBIK: Studi Eksperimen Pelatihan Fisik Selama 28 Hari Pertemuan Pada UKM Futsal Putri UPI Bandung*. Universitas Pendidikan Indonesia.

See, J. M. (2024). *Effects of Repeated Hypoxic Exposure with High Intensity Interval Cycling in Trained Athletes*. Tunku Abdul Rahman University of Management and Technology.

Shirzadi, M., Mirnasuri, R., & Rahmati, M. (2024). The Effect of 8 Weeks of Training on Various Slopes on Performance Factors of Mountain Runners. *Applied Research in Sports Nutrition and Exercise Science*, *1*(3), 73–88.

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.

Suarez-Arrones, L., Mascherini, G., Izzicupo, P., Nakamura, F. Y., Benítez-Porres, J., Galán-Mercant, A., Murri, M., & Petri, C. (2025). *Diet and Training Strategies to Optimize Health Parameters*. Frontiers Media SA.

Wen, X., Song, F., Zeng, X., Lai, X., & Zhou, Y. (2025). Comparing Physical Fitness Adaptations Induced by Small-Sided Soccer Games with and Without Ball Touch Limitations: A Randomized Parallel and Controlled Study. *Journal of Sports Science & Medicine*, *24*(1), 217.

Wibisana, M. I. N. (2020). Analisis Indeks Kelelahan dan Daya Tahan Anaerobic Atlet Futsal SMA Institut Indonesia Semarang. *Jurnal Terapan Ilmu Keolahragaan*, *5*(2), 140–144. https://doi.org/10.17509/jtikor.v5i2.26956

Wiesinger, H.-P., Stöggl, T. L., Haller, N., Blumkaitis, J., Strepp, T., Kilzer, F., Schmuttermair, A., & Hopkins, W. G. (2025). Meta-analyses of the effects of high-intensity interval training in elite athletes—part I: mean effects on various performance measures. *Frontiers in Physiology*, *15*, 1486526.

Yin, M., Deng, S., Deng, J., Xu, K., Nassis, G. P., Girard, O., & Li, Y. (2025). Physiological adaptations and performance enhancement with combined blood flow restricted and interval training: a systematic review with meta-analysis. *Journal of Sport and Health Science*, 101030.

Zhang, H., Li, S., & Yang, B. (2025). Comparative analysis of consistency of adaptations to interval interventions individualized using sport-specific techniques in well-trained soccer players. *Scientific Reports*, *15*(1), 4822.

Zhao, X., & Lu, M. (2024). The Impact of Running-Based and Drop Jumping Interval Interventions on Cardiorespiratory Fitness and Anaerobic Power of Collegiate Volleyball Players: A Comparative Analysis of Inter-Individual Variability in the Adaptive Responses. *Journal of Sports Science* & *Medicine*, *23*(4), 863.