

The Development of Aerobic Capacity between the Short-term Training 15"/15" and the Long-term Training 3'/3' for Soccer Players U21

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Abstract

The study aims to identify the type of interval exercises that have an effective impact on developing some aerobic capacities (maximum airspeed - VMA, maximum oxygen consumption - VO2MAX) for football players U21. The researchers proposed two training programs for a sample of 16 players from the youth team of JSMTairet activity in the amateur second division of the Algerian championship center-west for the season 2021/2022. The sample was divided into two groups, where the first group applied the proposed training program using long-term interval training method of 3'/3', while the second group applied the program using short-term interval training method of 15"/15". The proposed training program lasted for 8 weeks, with two sessions per week, under the supervision of the research team. The Intermittent Fitness Test 30/15 IFT was used to measure the rate of aerobic capacities VMA/VO2MAX. After obtaining, processing, analyzing, and interpreting the results, it was found that there were statistically significant differences between the post-tests of the two groups. This suggests that training with short-term interval exercises improves the level of aerobic capacities VMA/VO2MAX for football players. Therefore, the researchers recommend using short-term interval exercises during planning and preparation of training programs in different preparation and competition periods to develop physical fitness for players and achieve the highest levels of sports achievement.

Keywords: Long Duration Interval Training, Short Duration Interval Training, Aerobic Capacities, VMA/VO2MAX.

Introduction

The rapid development in achieving high levels in football is now moving in parallel with the technology of sports training sciences. The current level of world football is not a coincidence, but rather the result of applying different sciences and the efforts of scientists and researchers (Mohr, Krusturup, and Bangsbo, 2003) in this field to develop the level of players in all aspects, whether physical, mental, strategic, technical, in addition to the means and the environment. The goal of every coach is to raise the level of his players from all aspects, as achieving success in football depends on a set of aspects, where the physical aspect of the football player is considered one of the fundamental and important aspects in the development and raising the level of players. Therefore, specialists attach great importance to this aspect, and it is necessary to identify the most important modern training methods for improving the athlete's physical efficiency in order to save time, effort, and money. Thus, athletic achievement requires the interaction of a set of technical, strategic, psychological, and physical factors, in addition to other factors such as climate, methods, and training tools used (Morgans, Orme, Anderson, and Drust, 2014).

Physical preparation of football players should be based on scientific principles, using the latest training methods according to the type of efforts that the athlete performs during competition. For certain success in football, there must be a high level of physical fitness. The methods and techniques of physical preparation have varied and diversified through different research and experiments by specialists and experts. The periodic training method is one of the most important and modern training methods and most commonly used in football, because it is similar to the efforts that the player makes during the match, as seen by (Bush, Barnes, Archer, Hogg, and Bradley, 2015). Scientists have divided this method into timing, performance method, and the nature of the activity, as the performance of this method is at a speed above the player's maximum airspeed (Gilles Cometti, 1993).

1. Research Problem: Air abilities are considered the basic foundation that any athlete, especially football players, should possess. They have a positive effect on the player's other physical aspects and are the basis upon which other physical abilities are built. In football, success depends on the player's ability to perform high-intensity efforts and their ability to repeat them, as Jean-Paul Ancien (2008) states. Air abilities play a crucial role in completing the match and in rapid recovery after high-intensity efforts, as mentioned by Erick Mombaerts (1996). Football is a sport characterized by intermittent or periodical efforts, which include high-intensity efforts interspersed with positive or negative periods.

Therefore, football training content should be consistent with the efforts that the player exerts during the match, as interval training methods are suitable for the type of effort exerted by the player.

Modern football requires the development of all physical abilities according to the player's position on the field. The coach must use the latest and most effective training methods and techniques to save time and reduce effort, so that the player can effectively perform their role on the field. Based on previous research and studies, specialized coaches have developed proficient training programs that rely on the results of tests and measurements, which provide the real indicator of the physical and mental reality that young people need, as they are the strong foundation upon which to build an advanced level in the future.

Physical fitness and its physical qualities play an important role in the game, and most experts believe that everything that happens in the game depends on the components of physical fitness, which in turn develop specific physical elements. Aerobic capacity is one of its important elements that have a significant impact on the player, and coaches must focus on developing it. Players must possess it to serve the continuity of executing skills, carrying the burden of the game, and maintaining physical fitness during different stages of the game. This has become a hallmark of modern play for most advanced teams in the world, creating differences in many matches through high fitness levels of the teams and enabling players to know the distribution of their energy and maintain their physical fitness throughout the game.

Through this, researchers wanted to investigate to find the most effective modern methods used in the preparation process to reach the ideal form that allows players to improve their physical fitness. They proposed two training programs using long and short interval training methods, diversifying the included exercises and trying to achieve the best results. To solve this problem, researchers see the importance of answering various questions:

General Question:

What type of periodic training improves aerobic capacity VMA/VO₂MAX for football U21?

Sub-questions:

Does short-duration 15/15 interval training improve aerobic capacity VMA/VO₂MAX for football players U21?

Does long-duration 30/30 interval training improve aerobic capacity VMA/VO₂MAX for football players U21?

Research Objectives:

To study the comparison between long-term interval training and short-term interval training in developing some of the aerobic capabilities VMA/VO2MAX for football players U21.

To identify the type of interval training that has an effective impact on developing aerobic capabilities.

Research Hypotheses: General Hypothesis: Short-term interval training (15"/15") develops VMA/VO2MAX aerobic capabilities compared to long-term interval training (3'/3').

Specific Hypotheses:

Short-term interval training (15"/15") develops VMA/VO2MAX aerobic capabilities for football players U21.

Long-term interval training (3'/3') develops VMA/VO2MAX aerobic capabilities for football players U21.

Importance of the research: Scientific progress requires us to keep up with scientific research to solve problems in different areas of life and to achieve desired goals, by using the best and latest training methods to reach high levels of athletes. Therefore, the importance of the research lies in the following:

Shortening time, effort, and money by identifying the optimal method for developing maximum aerobic speed for football players.

Understanding the relationship between interval training and aerobic capabilities.

Identifying the training methods and techniques used in developing and training VMA/VO2MAX aerobic capabilities.

Identifying the physical level of football players U21 in terms of aerobic capabilities in general, maximum aerobic speed, and maximum oxygen consumption in particular.

Definition of Research Terms: Interval Training: Bernard Turpin (2002) defines it as alternating periods of work and rest, with work time ranging from 5 to 30 seconds and at an equal or greater intensity than the athlete's maximum aerobic speed (VMA). (Bernard Turpin, 2002)

Maximum Aerobic Speed (VMA): It is the speed at which the athlete can consume maximum oxygen (VO2max) and varies from test to test. It is a true indicator for programming and planning training as it allows the team to be classified into groups according to the maximum aerobic speed of each athlete and thus achieve the principle of individual differences in training.

Research Methods and Tools: In light of this, researchers chose the experimental method to fit the nature of the problem. The researchers

relied on a single sample from the youth team of Tiaret, under 21 years old, active in the national second division, central-west of the Algerian championship for the 2021/2022 sports season, where the sample consisted of 16 players divided into two groups:

Group 1: Represented by 08 players who were trained with long-term periodic exercises.

Group 2: Represented by 08 players who were trained with short-term periodic exercises.

The researchers applied the Intermittent Fitness Test (IFT) 30/15 to measure the VMA/VO2MAX aerobic capacity rate (C. Thomas, 2016), and scheduled a series of personal interviews with trainers and physical trainers to coordinate the preparation of the training programs and the distribution of training loads according to scientifically studied principles that suit the players' abilities. Eight weekly training sessions were proposed, equivalent to two months, with two sessions during each cycle at a rate of 16 sessions as follows.

Steps and stages of applying the training units: Duration of applying the training units: The researchers were able to determine a period of 8 weeks as a period for applying the proposed training units, according to experts, with one session every week, considering it a sufficient period for developing and enhancing aerobic capacities. The researchers relied on several references and studies by some experts in this field, in addition to previous similar studies that agreed that an 8-week period is sufficient to achieve development in maximum aerobic speed, where ERICK MOMBEARES stated that an 8-week period of intermittent training increases oxygen consumption by 20% to 24%. General planning of training units: The period of applying the training units coincided with the second half of the 2021-2022 training season, where the period was divided into two monthly training periods, each lasting 4 weeks, MESOCYCLE, which was then divided into 3 small training cycles MICROCYCLE + recovery cycle for each group, where each cycle consisted of different exercises and loads according to the principles of scientific planning of sports training.

- Analysis of Results:
- Homogeneity between the two groups before the experiment:

		Unit of measurement	Mean or arithmetic mean	Standard deviation	Median.	Coefficient of variation.
Growth Rates	Age	Year	20.65	1.09	20	-0.36
Physical Test	Weight	Kilogram	72.1	2.36	71	0.81
30/15 IFT	Heights	Meter	1.75	0	1.75	0
Intermittent Fitness Test Age Years	Maximum Airspeed	Km/h	16.96	1.48	14	-0.17
	Maximum Oxygen Consumption Limit	Milliliters of O2 per minute	59.36	2.44	54	0.61

Demonstrates the homogeneity between the pre-measurements of the two experimental samples. According to the table above, it is shown that the coefficient of variation ranges from 0.17 to 0.81, which indicates the normality of the distribution for the two samples, thus indicating the homogeneity of the two samples.

Table No. 02: Illustrates the pre- and post-test results for the first experimental sample, which underwent the long-duration endurance exercises '3/'3, in the 30/15 Intermittent Fitness Test (IFT).

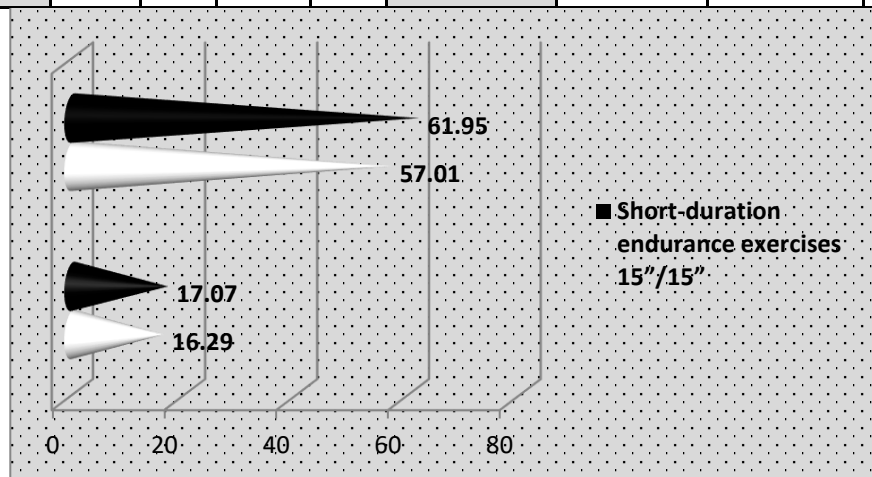
Results of pre- and post-tests for experimental sample 01: Long-duration endurance exercises '3/'3										
The experimental sample	N	Pre-test		Post-test		T-value	Tabulated T	Degree of freedom	Level of significance	Type of difference
		X	Y	X	Y					
	08					1.76	1.83	07	0.01	Statisticaly non-significant
		15.83	0.58	16.29	0.49					
		55,40	2.48	57,01	2,71	1,55				

Table 03: Illustrates the pre- and post-test results for Experimental Sample 02, which underwent short-duration endurance exercises 15"/15" in the 30/15 IFT Intermittent Fitness Test.

Experimental Sample 2: Results of pre- and post-tests for experimental sample 02: Short-duration endurance exercises 15"/15".										
Exerimental Sample 2	N 08	Pre-test		Post-test		Calculated T	Tabulated T	Degree of Freedom	Level of signific ance.	Type of difference Statistically significant.
		X	Y	X	Y	2.7*	1.83	07	0.01	
		16.05	0.58	17.7	0.45					
		56.17	2.56	61.95	2.87	2.91*				

Table No. 04: Illustrates a comparison between the results of the two-dimensional tests of the experimental samples in the 30/15 IFT (Intermittent Fitness Test).

Results of post-tests for Experimental Group 01 and Experimental Group 02 which underwent long-term interval training.										
Experimental Sample 1 Experimental Sample 2	N 16	Pre-test		Pre-test		Calculated T 2.66*	Tabulated T 1.83	Degree of Freedom 14	Level of Significance 0.01	Type of Difference Statistically Significant
		X	Y	X	Y					
		16.29	0.49	17.7	0.45					
		57.01	2.71	61.95	2.87	2.53*				



Based on the results obtained, it appears that the proposed training program with long-periodic exercises of 3/3 had a positive effect on the development of VMA/VO2MAX aerobic capacities, which are considered the determinant factor for long-duration endurance levels. On the other hand, the level of aerobic capacity depends on the maximum ability to absorb oxygen, where it is known that the most enduring athletes are those who have the greatest aerobic capacity. According to C. Thomas (2016), in the case of sports activities that require continuous muscle work for a long period exceeding 5 minutes, the non-aerobic energy production is not considered the main source of energy. Therefore, the muscle relies on oxygen to produce the necessary energy for performance, allowing for long-term muscle work before feeling tiredness. As for football, due to its long duration, its reliance on aerobic capacity is fundamental and very important. Dellel (2008) states that aerobic endurance involves dynamic efforts (running, jumping, dribbling, etc.) that mostly depend on the aerobic system.

In the field of aerobic capacity, as measured by the 30/15 intermittent fitness test (IFT), our study results showed that the proposed training program using long-duration interval exercises of 3/3 led to an improvement in aerobic capacity ratios. This is consistent with many studies that have shown the effectiveness of this method in developing endurance, avoiding fatigue, muscle injuries, particularly among young athletes. Rosch D (2000) found similar results for adult and young athletes between 14 and 16 years of age, where the level of aerobic capacity was measured by equivalent Navette tests and significant differences were found in the application of aerobic tests and maximal oxygen uptake. In general, the variation in results is attributed to the different training programs used in the research samples of various studies, as some training programs effectively enhance aerobic capacity even among amateur athletes. Other factors that play an important role in the variation of results include the effectiveness of the coaching staff, training methods, and volume of training, as well as the biological age variation of young athletes, which directly affects their physical abilities (Malina RM, 2004). This highlights the ability of professional or first-level players to endure and effectively accomplish high-intensity efforts, as evidenced by the elevated concentration of lactic acid in the highest-level players compared to lower-level players (Edwards AM, 2003). On the other hand, heart rate decreased rapidly in elite players after the Cooper test, demonstrating their high recovery ability after both aerobic and anaerobic efforts, as found by Edwards et al. (2003) and Gregson et al. (2010). Young high-level players were able to recover quickly due to their ability to rapidly decrease their heart rate, which was found to be advantageous for players aged 16-18 and 14-16 years old, where high aerobic capacity allowed for long-term endurance and rapid recovery after anaerobic efforts. Additionally, T. Chamari, K. Castagna, and U. Wisløff (2005) emphasized the importance of

consistency in football and summarized it in several points, including the player's ability to recover quickly, which is due to good aerobic endurance and good endurance for repeated sprints.

(Rago, V., Pizzuto, F., Raiola, G., 2017) explained that interval training reduces the speed of fatigue onset because the muscle's ATP stock is replenished during the recovery period through the oxygen system, while there is no recovery in continuous training to replenish ATP during recovery. This explains why athletes can perform intermittent exercise more efficiently than continuous exercise, as the heart rate is typically higher during the recovery period than during training, meaning that more blood is pumped with each beat. The more blood the heart pumps, the more oxygen is delivered to the muscles to work. Interval training is also more efficient than continuous exercise because recovery periods allow the heart to reach a higher level of blood pumping, while there is only one rest period at the end of continuous training. Researchers point out that coaches' familiarity with the theoretical and practical aspects of recovery and rehabilitation processes is of great importance in regulating and programming recovery sessions to overcome the fatigue stage, which may be one of the most significant factors contributing to a decline in the players' physical fitness. The researchers also note that European schools have made significant progress in this field, as evidenced by the high level of play in continental and world competitions, where most clubs can maintain high-paced matches without significant fatigue or exhaustion, unlike what we see in Arab and Algerian football fields. Therefore, it is necessary to keep up with the era of development and technology and try to employ them in our clubs to raise the level at all levels in the football world.

(Paquette, M., Bieuzen, F., & Billaut, F., 2018) confirmed that there are functional changes in the heart that occur after performing physical exercise to enable working muscles to meet their increasing oxygen demands needed to perform the effort, and this is done by increasing both the cardiac output and blood flow velocity. Cazorla also indicated that "engaging in physical training leads to an increase in the thickness of the heart muscle, and therefore its strength, and an increase in the volume of blood ejected from it in a single beat" (Cazorla, Georges, 2003). Additionally, measuring aerobic capacity and the transition from aerobic to anaerobic metabolic processes is a precise reference for comparison between players for coaches. The study also found that these data transform quantitative evaluation into qualitative evaluation of training to make the players as the coach desires. According to the French Society of Sports Medicine, the use of lactate concentration in the blood and pulmonary ventilation is considered a reference method for identifying the intensity zones used in physical training programming. The common method is to identify the lactate threshold or the first and second ventilation thresholds, as well as their corresponding speed and

heart rate, and use the results to determine the intensity of the training program.

As the improvement in maximum aerobic capacity due to short-term interval training in the second experimental group is consistent with several studies, including the study by Edwards (A.M.) and Noakes T.D. in 2009, which found that short-term interval training of 10/10, 15/15, and 15/20 improved maximal oxygen uptake by 8.32%. In addition, the study by Dupont.G, Akakpo.K., and S.Berthoin in 2004 found that short-term interval training improved maximum air speed by 8.1% during the preparation period. Based on the numerous studies that have examined the effects of training programs during the preparation period on athletes' physical condition, researchers believe that achieving the highest level of fitness for athletes is the result of careful planning and adherence to scientific principles. This requires high-level criteria and modern methods for developing athletes' abilities, including the use of field tests to assess their level and the development of training programs to improve their skills. However, Algerian football management focuses mainly on the senior categories and neglects the younger categories, which are the future of the team. Poor management practices and inadequate training programs are the main factors preventing youth teams from reaching their full potential, except for some schools such as the Baradou PAC school under the leadership of Mr. Khair Eddine Zetchi, which has succeeded in developing players at all levels and producing high-level players who currently play in the strongest European leagues, as well as some Algerian teams such as Blouzada and Wifak Setif, which focus on training. Therefore, it is necessary to rely on modern methods to develop Algerian football and young Algerian players in particular, and to avoid haphazard and self-directed methods, especially in the training process.

Conclusions:

Based on the obtained results, statistical analysis, and results discussion, the researchers arrived at the following conclusions:

There is a convergence in the level of the two samples in the results of the measurement of the aerobic capacities during the pre-test.

There is stability and relative consistency in the level of the sample that underwent long-term training.

There is an improvement in the level for the sample that underwent short-term training.

The sample that underwent short-term training showed progress in the level compared to the sample that underwent long-term training.

The use of short-term training to improve VMA and VO₂max aerobic capacities.

Long-term interval training does not improve the maximum aerobic speed (VMA) compared to short-term interval training. According to the obtained results, we conclude that the results support the first hypothesis, which was confirmed when the tests were compared to the pre-test results, as there was an improvement in the maximum aerobic speed (VMA), as discussed by (ARNAUD LESSERTEUR, 2009). Short-term interval training is close to the player's efforts during the game, and its importance lies in training the player with high intensity without exhaustion.

Recommendations:

In light of the conclusions reached by the researchers, they recommend the following:

Emphasizing the use of short-term interval training to improve VMA and VO₂MAX aerobic capacities, especially during the competition period.

Focusing on training the maximum aerobic speed (VMA) as it is one of the physical qualities that determines success in football.

Conducting tests to evaluate the athlete's level in the maximum aerobic speed (VMA) to allow the coach to have a high degree of knowledge about the athlete's capabilities and design training sessions accordingly.

The necessity of conducting similar studies to compare between different types of interval training.

Simplifying the research results and distributing them among coaches to benefit from them in training and preparing players.

Performing training exercises

Performing interval training exercises in a regulated manner while considering individual differences and each player's ability.

General conclusion: With the comprehensive development of various sports activities, especially team games, coaches have become responsible for choosing the optimal method in preparing athletes from a physical standpoint, in order to reach the highest levels of performance and make a difference in these activities that are characterized by variable and irregular play situations. This requires the athlete to possess a high level of physical fitness, which can only be achieved by using the most effective training methods that have a great impact on the athlete's level, while respecting the training principles and bringing the player closer to the conditions similar to those of competition in football, according to the nature of the efforts.

Bibliography

- Edwards (A.M.) et Noakes T.D. (2009). Dehydration. Cause of Fatigue or Sign of Pacing in Elite Soccer? *Sports Med*, 39 (1): 1-13.
- ERICK MOMBAERTS. (1996). *ENTRAINEMENT ET PERFORMANCE COLLECTIVE*. PARIS FRANCE: VIGOT.
- ARNAUD LESSERTEUR. (2009). *ENTRAINEUR DE FOOTBALL LA PREPARATION PHYSIQUE*. PARIS -FRANCE: ACTIO.
- BERNARD TURPIN,. (2002). *ENTRAINEMENT ET PREPARATION DU FOOTBALLEUR*. PARIS FRANCE: AMPHORA TOME 2.
- Bush, M., Barnes, C., Archer, D., Hogg, B., & Bradley, P. (2015). Evolution of match performance parameters for various playing positions in the English Premier League. *Hum. Mov. Sci.*, 39, 1–11.
- C. Thomas, T. D. (2016). Reliability of the 30–15 intermittent fitness test in semiprofessional soccer players. *Int J Sports Physiol Perform*, 172-175.
- Cazorla, Georges. (2003). Expertise des exigences physiques et physiologiques du football de haut niveau. Conséquences pour l'évaluation et la préparation physique du joueur. France: Cahiers de l'INSEP.
- DELLAL, A. (2008). *DE L'ENTRAINEMENT A LA PERFORMANCE EN FOOTBALL*. BRUXELLES BELGIQUE: DE BOECK.
- Dellel, A. (2008). *De L'entrainement a la performance en football*. Bruxelles: Groupe De Boek.
- Dupont.G, Akakpo.K., Et S.Berthoin. (2004). The effect of in-season,high-intensity interval training in soccer players. *J Strength Cond Res*, 18, N° 3: 584–589.
- Eisenmann JC, Cumming SP, Ribeiro B, Aroso J Malina RM. (2004). . Maturity-associated variation in the growth and functional capacities of elite youth football (soccer) players 13-15 years. *Eur J Appl Physiol*. 555-62.
- GILLES COMETTI. (1993). *FOOTBALL ET MUSCULATION*. PARIS -FRANCE: ACTIO.
- Gregson, W., Drust, B., Atkinson, G., & Salvo, V. D. (2010). Match-to-match variability of high-speed activities. *Int J Sports Med*, 31(4), 237-242. doi:10.1055/s-0030-1247546.
- JEAN -PAUL ANCIEN. (2008). *FOOTBALL PREPARATION PHYSIQUE PROGRAMME*. PARIS FRANCE: AMPHORA.
- Macfayen AM, Clark N Edwards AM. (2003). Test performance indicators from a single soccer specific fitness test differentiate between highly trained and recreational active soccer players. *J Sports Med Phys Fitness*. 14-20.
- Mohr, M., Krstrup, P., & Bangsbo, J. (2003). Match performance of high-standard soccer players with special reference to development of fatigue. *J. Sports Sci.*, 21, 519–528.
- Morgans, R., Orme, P., Anderson, L., & Drust, B. (2014). Principles and practices of training for soccer. *J. Sport Health Sci.*, 3, 251–257.
- Paquette, M., Bieuzen, F., & Billaut, F. (2018). Muscle Oxygenation Rather Than VO2max as a Strong Predictor of Performance in Sprint. *Int J Sports Physiol Perform*, 19, 1-9. doi: 10.1123 / ijspp.2018-0077.
- Rago, V., Pizzuto, F., Raiola, G. (2017). Relationship between intermittent endurance capacity and match performance according to the playing position in sub-19 professional male football players:. *Journal of Physical Education and Sport*, 17 (2), art. no. 103, pp. 688-691.

- Ramsbottom, R., Nevill, A., Seager, R., & Hazeldine, R. (2001). Effect of training on accumulated oxygen deficit and shuttle run performance. *J. Sports Med. Phys. Fit.*, 41, 281–290.
- Rosch D, H. R.-B. (2000). Assessment and evaluation of football performance. *Am J Sports Med.* 28 (5 suppl), 29-39.
- T., Chamari, K., Castagna, C., & Wisløff, U. (2005). Physiology of Soccer: an Update. *Sports Medicine*, 35(6), 501-536. doi:0112-1642/05/0006-0501.