

Analysis of the intermittent training method and the small-sided games training method and their impact on maximum aerobic speed in football players under 19 years old.

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Abstract: The study aims to improve maximum aerobic speed by applying a training program using intermittent training and small-sided games for football players under 19 years old, for the youth team of Mila Municipality, which competes in the inter-regional league, eastern group. The players, numbering 28, were divided into three groups: the first group, a sample of 5 players, the control group of 10 players, and the experimental group of 10 players. We used the experimental method, which includes the application of the progressive shuttle run test (luc leger) specific to maximum aerobic speed. At the end of the research, we concluded that there was a statistically significant difference in favor of the post-tests of the experimental group, indicating the effectiveness of the training program.

KEY WORDS: Intermittent training; Small-sided games training; maximum aerobic speed; football.

المخلص: تهدف الدراسة إلى تحسين السرعة الهوائية القصوى من خلال تطبيق برنامج تدريبي باستخدام التدريب المتقطع والألعاب المصغرة للاعبين كرة القدم تحت 19 عامًا، لفريق شباب بلدية ميلة، الذي يتنافس في دوري المناطق، المجموعة الشرقية. تم تقسيم اللاعبين، وعددهم 28 لاعبًا، إلى ثلاث مجموعات: المجموعة الأولى، عينة مكونة من 5 لاعبين، والمجموعة الضابطة المكونة من 10 لاعبين، والمجموعة التجريبية المكونة من 10 لاعبين. استخدمنا المنهج التجريبي، والذي يتضمن تطبيق اختبار الجري المكوكي التدريجي (لوك ليجيه) الخاص بالسرعة الهوائية القصوى. في نهاية البحث، توصلنا إلى وجود فرق ذي دلالة إحصائية لصالح الاختبارات البعدية للمجموعة التجريبية، مما يدل على فعالية البرنامج التدريبي.

الكلمات المفتاحية: التدريب المتقطع؛ التدريب بالألعاب المصغرة؛ السرعة الهوائية القصوى؛ كرة القدم.

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1-Introduction:

Football is considered the most popular sport worldwide, which has garnered significant attention from experts and researchers in the field of sports. The development of football has encompassed all aspects of physical, skill-based, tactical, psychological, and cognitive preparation. The physical aspect in sports in general, and in football in particular, is one of the most important aspects that must be considered and given attention. The physical qualities required by a football player vary between basic physical qualities and complex physical qualities. Among these physical qualities, endurance is considered the fundamental basis for a football player. The coaching staff, especially physical trainers, work to enhance the endurance efficiency of football players to the best possible level, using various training methods based on studied scientific approaches.

The aim of physical preparation in football is to develop various physical qualities (endurance, speed, strength, flexibility, etc.), as sports training has become a process directed at improving the player's level through specific indicators aimed at enhancing their competencies according to the performance requirements in modern football, as well as building high physical fitness that enables them to perform the necessary skills and implement the required strategies during the match (Khater, 1989, p78). Additionally, physical abilities determine the execution of skillful movements and can hinder their execution if the player suffers from a lack of physical fitness. Therefore, improving the level of physical fitness enhances the ability to perform skills effectively (Cervera, 2008, p. 82).

The capacity for athletic performance represents the degree of possible development of motor activity within a complex framework through a set of specific factors. Athletic performance varies between individual and team activities. In a team sport like football, achieving performance depends on a set of interrelated factors related to player coordination and harmony (Weienek, 1997, P17). Football is characterized by alternating periods of rest and play, making the effort non-continuous. The average time for alternating between rest and play is 15 seconds, which represents 30% of the playing time in a match and can be utilized during training (Vigne, 2011, P19).

The intermittent training method is considered one of the modern methods that has proven its effectiveness, as it is derived from

the actual performance of a football player during a match. It is defined as a training style that includes a very important form for improving maximum aerobic capacity in team sports through the stimulation of mixed aerobic-anaerobic energy (Dellal, 2013, P14). The method of training with small-sided games is no less important than the intermittent training method, as it is similar to the conditions of activity and is more enjoyable and exciting for players, aiming to develop the physiological and physical abilities of players with the same efficiency as traditional training (Hourcad, 2018, P44). With the variety of different training methods aimed at developing maximum aerobic speed, which is considered one of the most important physical requirements in modern football, where football is anaerobic and controlled by a key factor, which is maximum aerobic speed, defined as the speed attained by an athlete when their oxygen consumption is at its peak, it is considered the primary weapon for a player in the physical aspect (Reiss, 2013, 139).

Based on the aforementioned information about maximum aerobic speed, which requires the use of specific training methods for its development, and considering our coaching experience in the field of football, particularly in youth categories that receive less attention in Algerian football, we wanted to propose a training program that includes a combination of intermittent training and small-sided games training to assess its effectiveness in developing maximum aerobic speed.

After reviewing previous and similar studies related to the topic of our study, such as the study of Tamrabet Khoula and Gelati Yazid entitled “The effectiveness of intermittent training on the development of maximum aerobic speed in middle football players” (2021), which aimed to identify the effectiveness of the training program based on interval training in developing maximum aerobic speed in football players, where the researchers used the experimental method. The study sample included 20 players from the Fakraia team (Oum El Bouaghi wilaya) under the age of 18 years who were divided into 10 players as a control sample and the same number as an experimental sample, the (luc leger) test was used and a training program was applied to the experimental sample for 8 weeks at the rate of two sessions per week, and the research concluded that interval training develops maximum aerobic speed in football players. We also have the study of Sayeh Abdel Rahman, Aisou Abdel Rahman and Zemam Abdel Rahman entitled “The effect of intermittent high-

intensity training on recovery efficiency and maximum aerobic speed in senior football players” (2024), which aimed to identify the extent of the effect of intermittent high-intensity training on recovery efficiency and maximum aerobic speed in senior football players, The researchers used the experimental method and the study sample included 20 players from the Zawiya youth team, which is active in the Central West Inter-League Division, they were divided into two groups of 10 players each (two control and experimental samples), the (Ruffier Dickson) test and the (luc leger) test were used and a training program was applied to the experimental sample, the research concluded that the application of the proposed training program by intermittent training method has positively affected the improvement of recovery efficiency and maximum aerobic speed in senior soccer players, the research concluded that the application of the proposed training program in the intermittent training method has positively affected the level of recovery efficiency and maximum aerobic speed in senior soccer players.

Based on the aforementioned information about intermittent training and small-sided games and their relationship to the development of maximum aerobic speed, as well as what has been recounted in the studies related to our research topic, we decided to pose the following general question:

- Does the proposed training program using intermittent training and small-sided games have an effect on developing maximum aerobic speed in football players under 19 years old?

From this general question, we derive the following sub-questions:

- Are there statistically significant differences between the pre-test of maximum aerobic speed for the control and experimental groups?
- Are there statistically significant differences between the post-test of maximum aerobic speed for the control and experimental groups?
- Are there statistically significant differences between the pre-test and post-test of maximum aerobic speed for the experimental group?

Through these questions, we decided to provide answers in the form of hypotheses as follows:

- The proposed training program using intermittent training and small-sided games has a positive effect on developing maximum aerobic speed in football players under 19 years old.
- There are no statistically significant differences between the pre-test of maximum aerobic speed for the control and experimental groups.
- There are statistically significant differences between the post-test of maximum aerobic speed in favor of the experimental group over the control group.
- There are statistically significant differences between the pre-test and post-test of maximum aerobic speed for the experimental group in favor of the post-test.

2- General objective of the study:

The research aims to identify the effectiveness of the proposed training program using intermittent training and small-sided games training in developing maximum aerobic speed in football players under 19 years old. It also aims to understand the impact of combining intermittent training and small-sided games training on football players under 19 years old and to determine their effect on developing maximum aerobic speed.

This research can be of great importance from both scientific and practical perspectives. From the scientific side, it can be used by researchers and students to increase knowledge and gain insights into the information produced during the research and the effectiveness of the training program. From the practical side, it helps coaches build training programs based on scientific and methodological foundations, and to use the training methods developed in the research and apply them to the target group or adapt them to other groups.

3- Procedural definition of the concepts mentioned in the research:

- **Intermittent training:** (Bernard Turpin, 2002) defines it as work that involves alternating between work periods, which are relatively short (5 to 30 seconds) at speeds close to maximum aerobic speed, and rest periods of 15 to 30 seconds (Bernard Turpin, 2002, P19).

We conclude from this that interval training is an effort that involves alternating between work and rest for short periods not exceeding 30 seconds.

- **Small-sides games training:** It is defined by (Hanefi Mahmoud, 1992) as those exercises favored by players, which are conducted in small spaces and with a specific number of players, and this number may be equal or varied according to the set goals (Hanefi, 1992, P135).

We conclude from this that training with small games consists of exercises similar to real competition conducted in small areas according to specific objectives.

- **Maximum aerobic speed:** It is defined by (Didier reiss, 2013) as the maximum running speed to reach the maximum oxygen consumption (Didier reiss, 2013, P139).

We conclude from this that the maximum aerobic speed is the highest speed at which the player achieves their maximum oxygen consumption.

- **Football:** It is defined by (Moustafa Kamel and Mahmoud Houssam, 1999) as a sport played between two teams, each consisting of eleven players who use an inflated ball on a rectangular field. At each end of the field, there is a goal, and each team tries to score the maximum number of goals in the opponent's goal to win. The ball is moved with the feet, and only the goalkeeper is allowed to catch the ball with his hands inside the penalty area (Moustafa Kamel and Mahmoud Houssam, 1999, P5).

We conclude from this that football is a sport played with the feet on a rectangular field between two teams, each team having a goal and a goalkeeper who can catch the ball with his hands, and each team tries to score goals in the opponent's goal.

4- The methodological procedures used in the study:

4-1 Method and tools:

- **The adopted methodology:** Given the nature of our study, which relies on implementing a training program and conducting pre- and post-tests, we had to use the experimental method. The experimental method is defined as controlling all factors affecting the dependent variables in the experiment except for one factor that the researcher controls and changes in a specific manner with the aim of determining and measuring its impact on the dependent variables (Nouri Ibrahim and Rafea Saleh, 2003, P59).

- **Exploratory Study:** Before starting the research, we reviewed scientific references related to our study topic. We also worked on defining the study population and sample, choosing the Mila Youth team, which plays in the inter-league division (Eastern Group), given that the researcher was a former coach in the team's youth categories and we have a good relationship with the coaches and team management. We initially identified the target group, which is the U19 category (juniors), before the end of the 2023/2024 season, where we received a welcome from the category's coach. At the beginning of the 2024/2025 season, we conducted an exploratory study that included a sample of 05 players (outside the main research sample). We applied the test to them on 16/09/2024, and a week later, on 23/09/2024, we repeated the test under the same conditions, interspersed with two sessions to test the program and identify difficulties and obstacles that we might face during implementation in the field. Afterwards, we collected and analyzed the test results.

- **Sample and Selection Methods:** Our research population includes teams active in the youth categories championship of the Constantine Regional Football League. We selected the research sample intentionally. The research sample consisted of the Mila Municipality Youth team, U19 category, comprising 28 players. We excluded the three goalkeepers, and then divided the research sample into 5 players for the exploratory sample, 10 players for the control sample, and 10 players for the experimental sample.

- **Study Scope:**

Spatial Scope: The study was conducted at the Belkacem Belaid Municipal Stadium - Mila.

Temporal Scope: The study was conducted from September 2024 to January 2025.

Human Scope: The study was conducted on a sample of 20 players divided into two groups: a control group and an experimental group, in addition to 05 players for an exploratory sample.

- **Study procedures: Identifying variables and how to measure them.**

The independent variable: Sometimes referred to as the experimental variable, it is the variable that the researcher assumes to be the cause or one of the causes of a certain outcome, and its study may lead to understanding its effect on another variable (Mohamed Hassan and Oussama Kamal, 1999, P219). In our study, the independent variable

is represented by the methods of intermittent training and small-sided games training.

The dependent variable: It is the phenomenon that exists, disappears, or changes when the researcher applies or exerts the independent variable (Hassan Ahmed and others, 2009, P74). In our study, the dependent variable is represented by maximum aerobic speed.

Extraneous variable: It is a type of independent variable that does not enter into the research design, nor is it controlled by the researcher, but it affects the research results in an undesirable way. Therefore, these factors must be controlled to allow only one variable and thus its effect on the dependent variable (Mohamed El-Sayed, 2011, P391). There are multiple extraneous variables in our study, which we can mention, including: the time of conducting the tests and their conditions, the tools used, and individual differences in sample division.

- **Study tools:** The tools used in the study included the following:

- **Data collection tools:** sources and references, observation and experimentation, tests and measurements, computer and internet.
- **Pedagogical tools:** the field, footballs, vests, cones, plates, stopwatch, whistle, camera, laptop.
- **The training program:** We formulated a training program based on scientific principles, relying on our expertise in the field. The program included exercises using both intermittent training and small-sided games training. We implemented the program on the experimental sample over a period of two months (9 weeks), with 2 to 3 sessions per week.

- **The test:** During our study, we applied one of the maximum aerobic speed tests using the (Luc leger) test.

- **The purpose of the test:** To measure the maximum aerobic speed.
- **Tools used:** A field or area exceeding 20 meters, a whistle, cones, a timer, a recorded test protocol, a laptop, a loudspeaker.
- **Performance procedures and conditions:** The field is marked with two parallel lines using cones, with a distance of 20 meters between them, and a meter marked before each end to identify players who are behind the line. Players perform warm-ups before starting.

- **Method of performance and execution:** The players stand behind the starting line, and upon hearing the start signal, they sprint towards the opposite line, trying to match the running pace according to the initial speed of the test, which is set at 8 km/h. They must reach the line with the test signal. Each player runs for as long as possible, following the speed progression of the test. If a player is unable to maintain the test pace at a certain stage, the test ends for them.
- **Recording the results:** The stage at which each player stopped is recorded according to the audio protocol of the test, which specifies the running speed at which the player stopped. Then, the maximum aerobic speed for each player is extracted from the test table according to the running speed rhythm at which they stopped during the test.

- The scientific foundations of the tool:

Stability: stability is statistically measured by calculating the correlation coefficient between the scores obtained by individuals the first time and the test results the second time. It is the ratio of the true variance included in the variance of the experimental scores. We can infer from the test's validity that it is stable, while a stable test is not necessarily valid (Iman Houssin, 2005, P76). After conducting a pilot study on a sample of 5 players (outside the main research sample) and applying the test and retest for maximum aerobic speed, we calculated the Pearson correlation coefficient and found it to be 0.825, which is close to one, confirming the test's stability.

Validity: The validity of the test indicates the extent to which the test or measure is suitable for measuring what it was intended to measure (Layla Al-Sayed, 2007, P209). To ensure the validity of the test, we calculated the self-validity, which is expressed by the square root of the stability coefficient, and found it to be 0.908, which is close to one, confirming the validity of the test, as shown in Table No. (01).

Objectivity: It means describing an individual's abilities, as they actually exist, not as we want them to be. It is the lack of disagreement among evaluators in judging something or a specific subject (Iman Houssin, 2005, P77). Considering that the test applied in our study is scientifically credible and was developed by an expert in the field, the test is considered to have a high degree of objectivity.

Table N°01: Shows the results of the validity and stability test for the (Luc leger) test.

| Test | Sample | Stability coefficient | Validity coefficient | Level Sig | Degree of freedom |
|------------------|---------------|------------------------------|-----------------------------|------------------|--------------------------|
| Luc Leger | 05 | 0.825 | 0.908 | 0.05 | 04 |

- Statistical tools:

- SPSS statistical package.
- Pearson correlation coefficient.
- Test of Self-validity.
- The arithmetic average.
- Standard deviation.
- Difference test (T-test).

4-2 Presentation and Analysis of Results:

- **Presentation and analysis of the pre-test results of maximum aerobic speed for the control and experimental groups:**

Table N°02: Shows the results of the pre-test of maximum aerobic speed for the control and experimental groups.

| Sample | Arithmetic average | Standard deviation | Degree of freedom | Level Sig | Value T Calculated | Value Sig | Statistical Sig |
|---------------------|---------------------------|---------------------------|--------------------------|------------------|---------------------------|------------------|------------------------|
| Control | 14.99 | 1.17 | 18 | 0.05 | 0.30 | 0.768 | Not Sig |
| Experimental | 14.85 | 0.89 | | | | | |

Through Table N° (02), which shows the results of the pre-test for maximum aerobic speed for the control and experimental samples, we notice that the arithmetic average of the pre-test for the control sample is (14.99) with a standard deviation of (1.17), while the arithmetic average of the pre-test for the experimental sample is (14.85) with a standard deviation of (0.89). The result shown in the table for the T value, which was estimated at (0.30) with a significance level of (0.768), is greater than the significance level (0.05). Therefore, there are no statistically significant differences between the pre-test results

of the control and experimental samples in the maximum aerobic speed test.

- **Presentation and analysis of the post-test results of maximum aerobic speed for the control and experimental groups:**

Table N°03: Shows the results of the post-test for maximum aerobic speed for the control and experimental groups.

| Sample | Arithmetic average | Standard deviation | Degree of freedom | Level Sig | Value T Calculated | Value Sig | Statistical Sig |
|---------------------|--------------------|--------------------|-------------------|-----------|--------------------|-----------|-----------------|
| Control | 15.29 | 1.05 | 18 | 0.05 | -2.17 | 0.044 | Sig |
| Experimental | 16.35 | 1.13 | | | | | |

Through Table N° (03), which shows the results of the post-test for maximum aerobic speed for the control and experimental groups, we notice that the arithmetic average of the post-test for the control group is (15.29) with a standard deviation of (1.05), while the arithmetic average of the post-test for the experimental group is (16.35) with a standard deviation of (1.13). The result shown in the table indicates a T value of (-2.17) with a significance level of (0.044), which is less than the significance level (0.05). Therefore, there are statistically significant differences between the post-test results of the control and experimental groups, favoring the experimental group in the maximum aerobic speed test results.

- **Presentation and analysis of the pre-test and post-test results of the maximum aerobic speed for the experimental sample:**

Table N°04: Shows the results of the pre- and post-test of maximum aerobic speed for the experimental sample.

| Test | Arithmetic average | Standard deviation | Degree of freedom | Level Sig | Value T Calculated | Value Sig | Statistical Sig |
|------------------|--------------------|--------------------|-------------------|-----------|--------------------|-----------|-----------------|
| Pre-test | 14.85 | 0.89 | 09 | 0.05 | -10.16 | 0.000 | Sig |
| Post-test | 16.35 | 1.13 | | | | | |

Through Table N° (04), which illustrates the results of the pre-test and post-test for maximum aerobic speed for the experimental sample, we observe that the arithmetic average of the pre-test is (14.85) with a standard deviation of (0.89), while the arithmetic average of the post-test is (16.35) with a standard deviation of (1.13). The T value shown in the table is (-10.16) with a significance level of (0.000), which is less than the significance level (0.05). Therefore, there are statistically significant differences between the pre-test and post-test for the experimental sample, favoring the post-test in the results of the maximum aerobic speed test.

4-3 Discussion and interpretation of the results:

Discussion and interpretation of the results of the first hypothesis:

The first hypothesis states that there are no statistically significant differences between the pre-test of maximum aerobic speed for the control and experimental groups. Based on the observations in the results related to the hypothesis in Table (02) and after analysis, we found that the results of the control and experimental groups in the pre-test of maximum aerobic speed were close. We can say that this is due to both groups undergoing the same training before the implementation of the training program. In addition, we should have distributed the samples according to equal capabilities to avoid a significant difference between the two samples, which could later affect the post-results. This aligns with the study by Hajjaj Saad and Barakat Houssin (2021), where they stated, "We did not record any difference in the value ratios, which is naturally due to the absence of the training program application, as neither group underwent any training program. Based on the aforementioned, we can say that the first partial hypothesis is confirmed, and therefore "there are no statistically significant differences between the pre-test of maximum aerobic speed for the control and experimental groups".

Discussion and interpretation of the second hypothesis results:

The second hypothesis states that there are statistically significant differences between the post-test of maximum aerobic speed for the control and experimental groups. Based on the observations from the results related to the hypothesis in Table No. (03) And after analysis, we found that the results of the control and experimental groups in the post-test of maximum aerobic speed were different. We observed, through the arithmetic average of both groups, a noticeable improvement in the experimental group compared to the control group, which showed slight improvement. It can be said that this is

due to the application of the training program using the methods of intermittent training and small-sided games training, which were applied to the experimental group but not to the control group. This contributed to the development of the maximum aerobic speed of the experimental group. This aligns with the findings of the study by Tamrabat Khawla and Gelati Yazid (2021), where they "absolutely proved the effective impact of the proposed training program using the intermittent training method to develop the maximum oxygen consumption and thus the maximum aerobic speed. Based on the aforementioned, we can say that the second partial hypothesis is confirmed, and thus "there are statistically significant differences between the post-test of maximum aerobic speed for the control and experimental groups".

Discussion and interpretation of the third hypothesis results:

The third hypothesis states that there are statistically significant differences between the pre-test and post-test of maximum aerobic speed for the experimental sample in favor of the post-test. Based on the observations in the results related to the hypothesis in Table No. (04) And after analyzing them, we found that the results of the experimental sample in the pre-test and post-test of maximum aerobic speed were different. We observed, through comparing the arithmetic average of both tests (pre-test and post-test), a noticeable improvement, as the arithmetic average of the sample experimental in the post-test increased compared to the arithmetic average of the pre-test. We can say that this development is attributed to the implementation of the training program using the methods of intermittent training and small-sided games training, which were applied to the experimental sample over a period of 9 weeks. This contributed to the development of the maximum aerobic speed of the experimental sample. This aligns with the findings of the study by Tamrabat Khawla and Gelati Yazid (2021), where they found in their study that "the proposed training program using intermittent running, which lasted for eight weeks, led to physiological adaptations that contributed to the development of maximum aerobic speed. As indicated by the study of Sayeh Abdel Rahman and others (2024), the post-test results of the experimental group members showed a significant change and improvement in the level of maximum aerobic speed after comparing the post-test results of maximum aerobic speed with the pre-test results of the experimental group. Based on the aforementioned, we can say that the third partial hypothesis is

confirmed, and thus "there are statistically significant differences between the pre-test and post-test of maximum aerobic speed for the experimental sample in favor of the post-test".

5- Conclusion:

At the end of our study, we can say that sports in general and football in particular, require significant attention to the physical aspect. It is essential to work according to scientific methods and to program training in a studied manner, especially for youth categories, which often suffer from a lack of proper coaching. Considering that maximum aerobic speed is one of the most prominent indicators through which we can measure the development in endurance according to regulated training methods, the results of our study concluded that the proposed training program using intermittent training and small-sided games training has positively contributed to the development of maximum aerobic speed in the experimental sample on which the program was applied. This is due to the presence of statistically significant differences between the pre-test and post-test of the experimental sample, as well as the presence of statistically significant differences between the post-test of both the control and experimental groups in favor of the experimental group, while there were no statistically significant differences in their pre-tests. This highlighted the effectiveness and efficiency of the applied training program.

Based on the results we reached in our study, we are honored to present some suggestions that may benefit specialists in the field. We recommend that coaches focus on working according to well-studied scientific methods and use known training techniques and methods, being familiar with their intricate details, as well as keeping up with the latest modern methods. Additionally, they should work on developing various physical attributes of the players, especially endurance, as it is the foundational attribute for physical performance. We also advise coaches to consider the specific characteristics of different age groups in the physical preparation process according to the requirements of each group. Team managers should pay more attention to youth teams and support them in all aspects. Furthermore, we encourage researchers to conduct studies that address other physical attributes or training methods, especially modern ones, in football and other activities.

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