

The Effect of High-Intensity Interval Training During the Specific Physical Preparation Period on the Development of Speed-Strength in U19 Football Players

تأثير التدريب الفكري مرتفع الشدة خلال فترة التحضير البدني الخاص على تطوير القوة المميزة
بالسرعة لدى لاعبي كرة القدم U19

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Abstract : This study aims to propose a training program utilizing the method of high-intensity interval training and to examine its impact on the development of speed-strength in football players during the phase of specific physical preparation among youth athletes. To this end, an experimental study was conducted on two groups comprising 18 players from the Chabab El Milia football team, all under the age of 19, who were intentionally selected. The training program, which consisted of two training sessions per week, was implemented over a duration of eight weeks. The key findings revealed that the proposed training program, based on the high-intensity interval method, produced a significant improvement between the pre- and post-tests in favor of the experimental group. These results indicate that the high-intensity interval training method exerts a positive influence on the development of speed-strength levels among the participants of this study.

Keywords: High-intensity interval training – Specific physical preparation – Speed-strength.

المخلص :

تهدف هذه الدراسة إلى إقتراح برنامج تدريبي باستخدام طريقة التدريب الفكري مرتفع الشدة ومدى تأثيرها في تطوير صفة القوة المميزة بالسرعة لدى لاعبي كرة القدم خلال فترة التحضير البدني الخاص لدى لاعبي كرة القدم صنف أوسط . وعليه أجريت الدراسة التجريبية على عينتين تتكون من 18 لاعب من فريق شباب الميلية لكرة القدم صنف أقل من 19 سنة تم إختيارها بطريقة قصدية , وقد طبق البرنامج التدريبي الذي تضمن وحدتين تدريبيتين في الأسبوع لمدة ثمانية أسابيع . وأهم النتائج المتوصل إليها إليها أن البرنامج التدريبي المقترح باستخدام طريقة التدريب الفكري مرتفع الشدة حقق تطورا إيجابيا بين الإختبارين القبلي والبعدي ولصالح المجموعة التجريبية , ومن هنا يتضح أن لطريقة التدريب الفكري مرتفع الشدة تأثير إيجابي في تطور مستوى القوة المميزة بالسرعة لدى عينة البحث .
- الكلمات المفتاحية : - التدريب الفكري مرتفع الشدة-التحضير البدني-القوة المميزة بالسرعة.

Introduction and Research Problem:

Considering the growing importance of football across both developed and developing nations, experts have consistently sought to identify the most effective scientific approaches to enhance the sport, particularly through the design of training programs capable of raising performance levels. At present, attention is increasingly directed toward innovative approaches in sports training, aiming to generate a qualitative leap that enables players to attain athletic excellence.

This context has motivated researchers to investigate diverse training methods, especially given that the training field in recent decades has been profoundly shaped by advances in science and technology. As a result, training processes have adopted new forms, structures, and organizational frameworks consistent with emerging developments in training methods and tools.

The progress of science and technology has introduced a wide array of contemporary methods adapted to the physiological, physical, and psychological attributes of athletes. Coaches, in turn, strive to select the most effective and innovative techniques that correspond to the specific demands of each specialized activity (Hanafi, 1980, p. 19)

With the evolution of football training methodologies, conceptual frameworks have expanded considerably, and areas of application have become increasingly diverse. Whereas in the mid-1980s similar patterns were frequently repeated (Ekblom, 1986, p. 50), variations in outcomes were largely attributed to the caliber and skill of the players within each team (Eriksson, , Railow, & Goran, 2001).

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Consequently, certain nations emphasized different components: the English national team prioritized the physical dimension, Brazil focused on technical proficiency, Italy highlighted tactical strategies, and Germany relied heavily on psychological preparation. In modern training methodologies, however, all these components are regarded as equally significant, functioning in an integrated and complementary manner.

Since the fundamental rule of any preparation program is specificity—that is, ensuring that exercises and training correspond to the actual demands of official competition (Douvet, 2005) the coach must employ methods and techniques that prepare the player comprehensively on the physical, technical, tactical, and psychological levels. Such an approach guarantees balanced development of the muscles, bodily systems, and all components of performance.

Within the framework of contemporary training methodologies, which have gained broad attention in coaching practices for preparing players across various age groups and developmental stages, particular emphasis has been placed on interval training. This method, widely implemented in football, reflects the nature of the game itself and is characterized by alternating phases of exertion and recovery.

Interval training influences both aerobic and anaerobic capacity, while high-intensity interval training constitutes a specialized form designed specifically to improve endurance and speed in all their dimensions. This approach enhances the adaptability of the muscles to the physical demands of competition (Allawi, 1990), establishing it as a crucial and effective training strategy for football players.

Football is defined by the diversity of its performance demands, skill execution, and repeated fundamental motor actions in both defensive and offensive play. Success depends on the player's ability to integrate physical, technical, tactical, and psychological competencies to achieve superior performance and secure favorable outcomes. Among the essential physical attributes required for success at elite levels, speed and speed-strength occupy a particularly critical role.

Speed is recognized as a fundamental determinant of achievement in physical performance. Its significance in football is evident through its decisive impact on constructing offensive plays, prevailing in one-on-one situations, creating surprise, intercepting or disrupting the opponent, and at a minimum restraining counterattacks (Mundher & Al-Khayyat, 2000, p. 30).

Equally, speed-strength is regarded as one of the most vital and effective qualities for executing the technical demands of modern football, as emphasized by Pagniev (1997), Grindler (1976), and Diatchov (1987). Concentrated game actions that demand high levels of both strength and speed represent a defining feature of contemporary football.

The relevance of this attribute emerges in continuous physical contact, rapid short-distance sprints, and technical maneuvers such as medium- and short-range passes across different zones of the pitch. It is also evident in performing technical skills at high speed under diverse conditions, as well as in actions such as falling, recovering quickly, and regaining control of the ball from challenging positions.

In light of the perspectives advanced by these researchers, it is clear that modern football training emphasizes aligning training methods with the specific movements and rhythms performed in matches, with the aim of developing the

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physical, technical, and tactical dimensions simultaneously. Building on this theoretical framework, combined with the researcher's practical experience as a physical trainer, the central theme of this study is articulated through the following main research question:

Does high-intensity interval training influence the development of speed-strength among U19 youth football players?

• Sub-questions:

- _ Are there statistically significant differences in speed-strength between the pre-test measurements of the control and experimental groups among U19 football players?
- _ Are there statistically significant differences in speed-strength between the pre-test and post-test measurements of the control group among U19 football players?
- _ Are there statistically significant differences in speed-strength between the pre-test and post-test measurements of the experimental group among U19 football players?
- _ Are there statistically significant differences in speed-strength between the pre-test and post-test measurements of both the control and experimental groups among U19 football players?

2- Research Hypotheses:

2.1- Main Hypothesis:

- High-intensity interval training has an effect on the development of speed-strength among U19 youth football players.

2.2- Sub-Hypotheses:

- _ There are no statistically significant differences in speed-strength between the pre-test measurements of the control and experimental groups among U19 football players.
- _ There are no statistically significant differences in speed-strength between the pre-test and post-test measurements of the control group among U19 football players.
- _ There are statistically significant differences in speed-strength between the pre-test and post-test measurements of the experimental group among U19 football players.
- _ There are statistically significant differences in speed-strength between the pre-test and post-test measurements of both the control and experimental groups among U19 football players.

3- Research Objectives:

- _ To determine whether there are statistically significant differences in speed-strength between the pre-test measurements of the control and experimental groups.
- _ To determine whether there are statistically significant differences in speed-strength between the pre-test and post-test measurements of the control group.
- _ To determine whether there are statistically significant differences in speed-strength between the pre-test and post-test measurements of the experimental group.
- _ To determine whether there are statistically significant differences in speed-strength between the pre-test and post-test measurements of both the control and experimental groups.

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4- Study Significance:

- _ To identify the effect of the proposed training program on improving speed-strength among U19 football players.
- _ To highlight the importance of the high-intensity interval training method within the training process.
- _ To emphasize the significance of designing training programs for developing physical qualities, particularly speed-strength.
- _ To provide recommendations and suggestions that contribute to the theoretical background of coaches in this field.

6- Study Concepts:

6.1- High-Intensity Interval Training:

Terminologically: This training method involves the performance of exercises in which the muscles operate in conditions lacking sufficient oxygen due to the elevated training load, resulting in the “oxygen debt” phenomenon after each bout of work. Such training develops the body’s capacity to adapt to physical exertion, thereby delaying the onset of fatigue. (Allawi, 1990, p. 222)

6.2- Speed-Strength:

Terminologically: It refers to the nervous system’s capacity to generate force rapidly. This attribute represents an integration between strength and speed, whereby movements are executed through the coordinated interaction of both components simultaneously (Ahmed, 1993)

7- Previous and Related Studies:

Study by Nehal Abdullah, Nehal Mohamed, and Fghouli Samir (2022) entitled: *The Effect of a Medium-Term Training Cycle Using High-Intensity Interval Training on the Development of Speed Endurance in U19 Football Players*. This study aimed to investigate the effect of a medium-term training cycle using high-intensity interval training on the development of speed endurance among football players under the age of 19. The researchers adopted the experimental method, and the study sample consisted of 20 players from Boukadir Chlef Club, who were intentionally selected and divided into control and experimental groups.

The training program was applied to the experimental group over a period of six (06) weeks. Following the administration of post-tests for speed endurance, the findings revealed statistically significant differences at the 0.05 level in favor of the experimental group. These results demonstrate the effectiveness of the training program during the medium-term cycle employing the high-intensity interval training method.

Study by Fghouli Samir and Hadada Mohamed (2020) entitled: *The Use of Exercises with High-Intensity Interval Training and Repetitive Training in Developing the Performance of Specific Muscular Strength of the Lower Limbs (Strength Endurance, Speed-Strength, Explosive Strength) and Their Impact on the Accuracy of Jump Shot Skills in 21-Year-Old Handball Players*. This study examined the use of high-intensity interval training and repetitive training in developing the performance of specific muscular strength of the lower limbs (strength endurance, speed-strength, and explosive strength) and their impact on the accuracy of jump shot skills among 21-year-old handball players. The researchers employed the experimental method, with a sample consisting of 20

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players from Oued Sly – Chlef – who were intentionally selected and divided into two experimental groups. Pre-tests were conducted for both groups, including strength endurance, speed-strength, explosive strength, and a shooting accuracy test.

After applying the two training programs—one based on the high-intensity interval method and the other on the repetitive method—over six (06) weeks, post-tests were conducted. The findings indicated statistically significant differences at the 0.05 level in favor of the group trained with the high-intensity interval method in strength endurance, speed-strength, and explosive strength. Conversely, statistically significant differences were observed in favor of the group trained with the repetitive method in shooting accuracy.

Study by Hassan Ahmed Shawki and Oubaji Rachid (2016) entitled: *The Effect of the High-Intensity Interval Training Method with Plyometric Style on Improving Speed-Strength in Elite Football Players*. The purpose of this study was to determine the impact of high-intensity interval training using the plyometric style on improving speed-strength in elite football players. The researchers employed the experimental method due to its appropriateness for the nature of the study. The research sample consisted of 20 players from the Oulad Nail team during the 2014–2015 sports season, divided equally into control and experimental groups. After applying the training program to the experimental group, post-tests were conducted, and the findings confirmed that the high-intensity interval training method with plyometric style was effective in enhancing speed-strength among elite football players.

8- Research Methodology and Field Procedures:

8.1- Pilot Study:

The pilot study was conducted on five (05) players drawn from the main research sample. Its purpose was to examine the practical application environment, ensure the feasibility of administering the test in field conditions, verify the appropriateness of the data collection tools, adjust the sample, and identify potential obstacles that might hinder the study's progress. Addressing these issues beforehand allowed for their resolution, ensuring that the study could proceed without complications.

8.2- Research Method:

Given that the study required the implementation of a training program through the integrated training method, it was necessary to adopt the experimental method, incorporating both pre- and post-measurements.

8.3- Research Population and Sample:

The research population comprised the Chabab El Milia U19 football team, affiliated with the Regional First Division of the Constantine Football League, with a total of 23 players. The sample represents the core element around which the research revolves, making its selection a crucial step in ensuring the validity of any scientific investigation.

Careful sampling helps avoid errors and provides greater accuracy and reliability of results. In this study, the sample was intentionally selected and consisted of 23 players from the Chabab El Milia U19 team. Five players who participated in the pilot study were excluded, leaving 18 participants. These were divided into control and experimental groups, with each group comprising nine (09) players.

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8.4- Study Domains:

- **Spatial Domain:** The study was conducted at Boutias Stadium, located in the municipality of El Milia, Jijel Province.
- **Temporal Domain:** The fieldwork was carried out during the preparatory phase, from 01/09/2023 to 05/11/2023.
- **Human Domain:** The study included 18 players from the El Milia Youth Club, U19 category.

8.5- Study Tools:

The study employed a single field test, the 30-meter single-leg hop test.

- **Purpose of the Test:** To measure the speed-strength of the leg muscles.
- **Instruments Used:** Measuring tape, stopwatch, markers for the start and finish lines, and an observer to supervise the measurement process.
- **Performance Procedure:** The player positions themselves at the starting line, with the hopping leg forward and the free leg backward. At the sound of the starting whistle, the player hops on one leg across the designated distance. The time is recorded in seconds. Each player is given two attempts, with the best result taken as the final score.
- **Scientific Conditions of the Test:** For any test to be considered valid, it must meet the essential scientific criteria of reliability, validity, and objectivity.
 - o **Test Reliability:** The researcher administered and re-administered the test to the pilot sample (5 players) and calculated Pearson's correlation coefficient, followed by the determination of the reliability coefficient.

o **Test Validity:** This refers to the test’s capacity to measure precisely what it is designed to measure, and not any other attribute.

Table (1): Results of the Test’s Reliability and Validity Coefficients

Test	Purpose of the Test	Unit of Measurement	Reliability	Self-validity
Single-leg hop over 30 meters	Measure of speed-strength	Seconds	0.85	0.92

- **Objectivity:** Since the test is simple and easy to understand, it is free from subjective interpretation and therefore considered objective.

8-6. Training Program Design

The training program constitutes the most critical part of the study and was required to be scientifically structured to achieve the intended objectives. The most important aspects include:

- The proposed training program lasted for 8 weeks, equivalent to a total of 16 training sessions. Each session did not exceed 90 minutes, including the final part, with two sessions per week before the competition phase.
- The necessity of thorough warm-up exercises before commencing the main part of the training session.
- The exercises were structured in an interval format, both with and without the ball, while clearly defining the work and rest times.

8-7. Statistical Methods Used

This study employed the following statistical measures:

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- Self-validity
- Arithmetic mean
- Standard deviation
- T-test for independent and paired samples
- Pearson’s correlation coefficient

9. Presentation and Analysis of Results

9-1. Presentation and Analysis of Pre-test Results for the Control and Experimental Groups

Table (2): Pre-test Results for the Control and Experimental Groups

Sample	N	Mean	Std. Deviation	df	Significance Level	T-calculated	p-value	Statistical Significance
Control	09	10.55	0.38	8	0.05	0.51	0.79	Not significant
Experimental	09	10.67	0.44					

From Table (2), which presents the physical test results of the control and experimental groups, it is clear that no statistically significant differences were observed. The calculated T-value was (0.51), with a p-value of (0.79), which exceeds the significance threshold of (0.05).

Conclusion: The findings demonstrate that no statistically significant differences were observed between the two groups in the pre-test of speed-strength.

9-2. Presentation and Analysis of Pre- and Post-test Results for the Control Group

Table (03): Pre- and Post-test Results for the Control Group

Test Type	N	Mean	Std. Deviation	df	Significance Level	T-tabulated	T-calculated	Statistical Significance
Pre-test	09	10.55	0.38	8	0.05	1.60	0.78	Not significant
Post-test	09	10.80	0.49					

According to Table (04), the experimental group recorded a mean of (10.67) with a standard deviation of (0.40) in the pre-test. After the intervention, the post-test mean rose to (11.98) with a standard deviation of (0.34). The calculated T-value (2.93) exceeded the tabulated T-value (1.72) at the 0.05 significance level and with 8 degrees of freedom.

Conclusion: These results reveal statistically significant differences between the pre- and post-test outcomes of the experimental group in the speed-strength test, highlighting the effectiveness of the high-intensity interval training program.

9-3. Presentation and Analysis of Pre- and Post-test Results for the Experimental Group

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Table (04): Pre- and Post-test Results for the Experimental Group

Test Type	N	Mean	Std. Deviation	df	Significance Level	T-tabulated	T-calculated	Statistical Significance
Pre-test	09	10.67	0.40	8	0.05	1.72	2.93	Significant
Post-test		11.98	0.34					

From Table (04), the experimental group recorded a mean score of (10.67) with a standard deviation of (0.40) in the pre-test. In the post-test, the mean increased to (11.98) with a standard deviation of (0.34). The calculated T-value (2.93) exceeded the tabulated T-value (1.72) at the 0.05 significance level with 8 degrees of freedom.

Conclusion: These results indicate statistically significant differences between the pre- and post-test outcomes of the experimental group in the speed-strength test, confirming the positive impact of the high-intensity interval training program.

9-4. Presentation and Analysis of Post-test Results for the Control and Experimental Groups

Table (05): Post-test Results for the Control and Experimental Groups

Sample	N	Mean	Std. Deviation	df	Significance Level	T-calculated	p-value	Statistical Significance
Control	09	10.80	0.38	8	0.05	2.94	0.036	Significant
Experimental	09	11.98	0.44					

As presented in Table (05), the post-test comparison between the control and experimental groups revealed statistically significant differences in speed-

strength performance. The calculated T-value (2.94) and p-value (0.036), which is lower than the significance threshold of 0.05, confirm the superiority of the experimental group's results.

Conclusion: It can be concluded that statistically significant differences exist between the post-test results of the control and experimental groups in the speed-strength test, in favor of the experimental group. This confirms the positive impact of implementing a training program based on high-intensity interval training.

10- Discussion of Hypotheses Results

Discussion of the First Hypothesis:

As indicated in Table (02) and confirmed by statistical analysis, no statistically significant differences were identified between the pre-test results of the control and experimental groups. This demonstrates that both groups started from a comparable baseline, with no initial performance disparities, thereby confirming the validity of the first sub-hypothesis.

Discussion of the Second Hypothesis:

According to Table (03), the control group, which did not undergo the proposed training program, showed no progress in the speed-strength component. The absence of significant differences between the pre- and post-test results—reflected in a calculated T-value (0.78) lower than the tabulated T-value (1.60)—supports this outcome. These findings validate the second hypothesis.

Discussion of the Third Hypothesis:

Table (04) highlights clear statistically significant improvements in the experimental group's post-test results following the implementation of the high-

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intensity interval training program, whereas the control group exhibited no improvement in the speed-strength component. The calculated T-value (2.93), which surpasses the tabulated T-value (1.72), confirms this result. These findings are consistent with the study of Fghouli Samir and Hadada Mohamed (2020), who also reported significant gains in speed-strength after applying high-intensity interval training.

Discussion of the Fourth Hypothesis:

Findings from the second and third sub-hypotheses collectively demonstrate that the experimental group, which followed the high-intensity interval training program, achieved superior improvements in speed-strength compared to the control group, which did not participate in a structured program. The statistically significant differences in favor of the experimental group confirm the validity of the fourth hypothesis.

Overall, the analysis of all hypotheses clearly indicates that the high-intensity interval training program effectively enhanced the speed-strength component among football players. This confirms the validity of the main hypothesis and underscores the program's positive impact.

Recommendations and Suggestions:

- Coaches should remain continuously updated with modern training methods in football, particularly in the area of physical preparation.
- A physical preparation program based on high-intensity interval training should be implemented across various sports disciplines, especially in team sports.

- High-intensity interval training should be incorporated into training programs during the physical preparation phase due to its positive impact on the development of physical fitness components in football.
- Training programs should be structured on solid scientific foundations, with careful attention to the selection of physical exercises, training duration and rest intervals, and the tools employed, as these factors significantly influence the development of physical performance.
- Additional studies should be carried out to examine the impact of modern training methods in physical preparation on the development of different physical fitness components.

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