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Abstract:

The study aimed to investigate the impact of electrical stimulation and plyometric methods on enhancing strength and speed among U17 football players. The researchers employed the experimental method, selecting a sample of (20) players from an indigenous community (the Cubs of the National Amateur Football League Second Division). The sample was evenly divided into two experimental groups, with ten (10) players in each group. The first group underwent plyometric training exclusively, while the second group utilized the combined method of electrical stimulation and plyometrics.

Following pre-tests, the proposed training program was implemented during the preparatory phase over eight (8) weeks, with (2-3) sessions per week. Post-test results indicated significant differences in all tests favouring the second experimental group (electrical stimulation - plyometric). The study recommendsa training regimen combining electrical stimulation and plyometrics during preparation. This approach yielded notable results in research tests, emphasizing the importance of selecting plyometric exercises tailored to football players' skills and physical abilities in the junior varsity category. The study also underscores the necessity of adhering to the guiding rule in training for shaping the most appropriate training load.

Key Words: Electrical Stimulation, Plyometrics, Physical Characteristics, Strength, Speed.

Introduction

Football specialists aim to elevate players to the highest levels of skill performance, aesthetic,and artistic expression through systematic and scientific training programs. Achieving the ideal performance level necessitates training curricula, enabling coaches to attain their goals efficiently and reach success.

Physical preparation, involving the development of various motor abilities, forms a fundamental basis for skill and tactical performance, focusing on critical aspects such as strength and physical speed. The emphasis on enhancing both strength and speed becomes crucial in preparing football players, particularly during the age stage when the nervous and muscular systems are fully mature.

Muscular strength, a fundamental quality in football, plays a pivotal role in decisive actions during a match, including bilateral struggles, short-distance sprints, rising, throwing, and injury prevention (Anton et Nawlin, 2013, p. 255).

Speed, another critical characteristic in the physical fitness system of football players, distinguishes individuals and significantly influences their sporting future. It encompasses the ability to execute various movements sequentially and swiftly, including quick reactions, directional changes, and strategic interventions during gameplay (Gartand, 2014, p. 221).

While efforts in sports training have yielded advancements in football, persistent problems in the training process call for scientific solutions. Coaches and specialists in football must explore modern scientific means and methods, integrating experiences to enhance players' physical performance.

Reviewing prior studies in different sports reveals effective methods for developing strength and speed during training, including the combination of electrical stimulation and plyometrics. This method involves electrical stimulation through specialized devices and plyometric training, utilizing jumps and throws for the lower and upper limbs and torso.

Despite the potential effectiveness of this approach, questions arise from observations of junior football teams. The study addresses whether players' humility is attributed to training style, deficiencies in skills and functional capabilities, unfamiliarity with scientific foundations among trainers, or the inadequacy of traditional versus modern training methods.

A review of related studies reveals limited research on this topic. Notable studies, such as Sherif Fouad Al-Jarwani's (1999) investigation into the effect of electrical stimulation on boxers' muscle activity, highlight positive outcomes in developing strength and transitional speed. Similarly, studies by BushraKazem Abdel Reda Al-Hamash (2005), Zainab MazmarKhalaf (2013), and Haider Abdel-Jabbar and Aqeel Marah Abdel-Rahman (2013) showcase positive effects of electrical stimulation on muscle development and explosive power.

The current study distinguishes itself as the first in Algeria, focusing on electrical stimulation and plyometric methods in developing strength and speed in football players. Despite the novelty of this approach, scientific attention and research in the country remain limited.

The research problem emerges from the perceived lack of information and knowledge among football coaches in advanced training methods. The study aims to address this gap, accelerate the development of players' muscular capabilities, and contribute to the progress of football training. Key questions driving the research include:

General question: What is the effect of using both the training method (electrical stimulation - plyometrics) and the plyometric training method in developing the strength and speed characteristics of U17 football players?

Partial questions:

1. Are there statistically significant differences at the significance level of 0.05 between the average scores of the first and second experimental groups in the pre-measurement of the strength and speed tests?
2. Are there statistically significant differences at the significance level of 0.05 between the pre-and post-measurements of the strength and speed tests for the first and second experimental groups?
3. Are there statistically significant differences at the significance level of 0.05 between the average scores of the first and second experimental groups in the post-measurement of the strength and speed tests?

Material & methods

The chosen research methodology for this study is the experimental program, a widely employed scientific research method in sports due to its direct and realistic engagement with various phenomena. It relies on observation and experimentation, forming the basis for this research. The chosen experimental design is a single-group design based on the problem's nature.

Research Areas:

-Human Field: The field study involves Cubs Football players in the second national division, amateur sports season 2021-2022, specifically the U17 team of the municipality of OuedSelli.

-Time Field: The study spans various periods, including defining the research problem after the end of the football season for the study sample in 2020-2021, theoretical study, exploratory study, and the main experiment phase from 09/04/2021 to 11/03/2021.

-Spatial Field: The field study procedures were conducted in Chlef, specifically at Salwachi Mohammed Sports Complex, Mohamed Boumezrag Stadium, and Al-Shifa Center for Rehabilitation and Physiotherapy.

-Physical Tests: Essential for objective evaluation, including Sargent's vertical jump test, stationary long jump test, 3 kg medicine ball throwing test, 30-meter speed test, coordination speed test, maximum strength of the quadriceps muscle, and sitting from lying position test.

-Scientific Foundations of Tests:

The selection or development of tests to measure variables is crucial for the scientific weight of the research. The tests used in this study are selected based on clarity, objectivity, and reliability, ensuring high rates of honesty, consistency, and objectivity in evaluation. The reliability coefficient (Pearson correlation) results affirm the tests' high objectivity.

Table 1: Reliability coefficient and self-validity coefficient for adopted tests in the study

Test	Sample Volume	Stability Coefficient	Self-Honesty Coefficient
Vertical Jump Test (Sargent)	8	0.994	0.996
Long Jump Stability Test		0.98	0.98
Medicine Ball Throwing Test (3kg)		1	1
Test 10x5m (Coordination Speed)		0.999	0.99
Maximum Strength of Quadriceps Muscle		1	1
30-Meter Speed Test		0.999	0.999
Sitting from Lying Position Test		0.999	0.999

Training Units:
The training program involved applying electrical stimulation and plyometric training during the particular preparation phase, lasting eight weeks. The number of training units per week varied between 2-3 sessions.

Table 2: Number of repetitions and number of muscle groups in plyometric training

Muscles	**Repetitions**	**Number**
Legs	156	51
Arms	155	83
Abdomen	1511	32

Steps of the Electrical Stimulation Process:
1. During the procedure, perform electrical stimulation immediately after the warm-up to activate the stimulation area and ensure sufficient blood flow to nourish the muscle.
2. Warm the muscle to be stimulated to activate it and enhance blood circulation.
3. The process affects the percentage of glycogen in the muscle, particularly the fast-type (IIA) fibres.
4. Inoka et al. (1990) found that electrical stimulation primarily affects large, fast motor units, contrary to typical motor unit commands.
5. Electrodes are placed on specific muscles while the individual is in a sitting position with relaxed muscles.

-The calf muscles.
-The vastus medialis and lateral muscles
-The vastusmedialis muscle
-Abdominal muscles
-The biceps and triceps muscles of the humerus

General Plyometric Exercises:
Fourteen general plyometric exercises were identified and applied to both experimental groups. Additionally, 13 football-specific exercises, designed by the researchers, and eight abdominal muscle exercises were integrated during the 8-week training units. The integration and organization of work between electrical stimulation and plyometric exercises were carefully managed.
The combination of these exercises during the training units aimed to optimize the impact on strength and speed development among U17 football players. Integrating electrical stimulation and plyometric exercises adds a comprehensive dimension to the training program, enhancing its effectiveness.
Primary Study (Main Experiment):
Pre-tests were conducted during the initial training session during the first week of implementing the main experiment. Physical tests were applied to the first and second experimental groups under the supervision of researchers and the club's training staff. This diagnostic training session, held on Saturday, September 4, 2021, at Mohamed Boumezrag Stadium, was part of planning the training loads for the proposed program.

Results/ Discussion

Discussing and comparing the results with the first hypothesis, which assumes no statistically significant differences at the significance level of 0.05 between the average scores of the first and second experimental groups in the pre-measurement of strength and speed tests:
The statistical analysis, utilizing the Student's t-test (T), revealed results summarized in Table 3. The outcomes indicate no statistically significant differences in the pre-measurement of strength and speed tests between the first and second experimental groups. This suggests equality and homogeneity between the two research samples. Factors such as height, weight, age, and pre-level physical abilities were controlled carefully, ensuring no differences before implementing the two programs. This meticulous control of research variables aligns with the requirements of designing effective training programs.
The first hypothesis is affirmed based on the results, stating that "there are no statistically significant differences at the significance level of 0.05 between the average scores of the first experimental group and the second experimental group in the pre-measurement of the strength and speed tests."

Table 3: Results of the Student's t-test for the significance of differences between the average scores of the first two experimental groups for the pre-physical tests

Tests	The first experimental group (n1=10)		The second experimental group (n2=10)		Calculated T value	Tabular (T) value	Statisticalfunction of differences
	The arithmeticmean	Standard deviation	The arithmeticmean	Standard deviation			
Test 1	3.59	0.48	3.12	0.57	1.97	2.10	Not StatisticallySignificant
Test 2	16.30	0.56	16.25	0.51	0.19		
Test 3	39.80	3.91	40.60	4.50	0.42		
Test 4	0.42	0.04	0.43	0.11	0.27		
Test 5	2.01	0.09	2.04	0.11	0.53		
Test 6	4.55	0.33	4.54	0.20	0.09		
Test 7	14.80	1.13	15.20	1.03	0.98		

Discussing and comparing the results with the Second Hypothesis:

The second hypothesis posited that there would be statistically significant differences, at a significance level of 0.05, between the pre-and post-measurements of the strength and speed tests for both the first and second experimental groups. The results of the Student T-test, shown in Table 4, support this hypothesis, indicating significant differences in favour of the post-measurement for both experimental groups.

For the first experimental group, the improvement in post-measurement results is attributed to the effectiveness of the proposed plyometric exercises. These findings align with previous studies by BukratamBelkacem in 2008, supporting the positive impact of plyometric training on strength, speed, and basic football skills.

Regarding the second experimental group, which utilized the electrical-plyometric stimulation method, the researchers attribute significant improvements to the combined effects of electrical stimulation and plyometric training. This aligns with various studies, including Sherif Fouad Al-Jarwani's study in 1999, highlighting the positive role of electrical stimulation in developing muscle strength and speed.

The Statistical function of differences, as indicated by the T values in Table 4, emphasizes the statistical significance of the improvements observed in both groups. These results confirm the achievement of the second hypothesis, showing statistically significant differences in the strength and speed tests between the pre-and post-measurements for both experimental groups, favouring the post-measurement.

Table 4.Results of the Student's t-test indicating differences between the mean scores of the first two experimental groups for physical performance tests

Tests	The first experimental group (n1=10)		The second experimental group (n2=10)		Calculated T value	Tabular (T) value	Statisticalfunction of differences
	The arithmeticmean	Standard deviation	The arithmeticmean	Standard deviation			
Test 1						2.10	StatisticallySignificant
Test 2	15.18	0.69	13.86	0.35	5.30		StatisticallySignificant
Test 3	44.7	4.59	51.20	5.99	2.72		StatisticallySignificant

Test 4	0.54	0.46	0.72	0.11	4.66		StatisticallySignificant
Test 5	2.66	0.18	3.97	0.23	14.02		StatisticallySignificant
Test 6	3.28	0.27	2.25	0.31	7.83		StatisticallySignificant
Test 7	15.90	0.99	21.90	1.66	10.98		StatisticallySignificant

Discussing and comparing the results with the Third Hypothesis:
The third hypothesis posited that there would be statistically significant differences, at the significance level of 0.05, between the average scores of the first and second experimental groups in the post-measurement of the strength and speed tests. Table 4 presents the statistical analysis supporting this hypothesis, revealing statistically significant differences in favour of the second experimental group.
While both groups demonstrated positive results in post-measurement, the researchers emphasize that the plyometric electrical stimulation training group achieved superior arithmetic averages across all tests. This reinforces the effectiveness of the proposed plyometric electrical stimulation method in developing strength and speed, aligning with Maffiuletti Na's study in 2002.
The Statistical function of differences, with the T values in Table 04, underscores the statistical significance of the observed differences between the first and second experimental groups in the post-physical tests. These results confirm the achievement of the third hypothesis, indicating statistically significant differences in the post-measurement of the strength and speed tests between the first and second experimental groups, favouring the second experimental group.

Conclusions

Within the scope of the study's objectives and based on the statistical analysis of pre- and post-tests for both experimental groups, the researchers concluded that the method of electrical stimulation-plyometrics during the particular physical preparation period has a practical impact on developing the qualities of strength and speed among U17 soccer players. The superiority of the electrical-plyometric stimulation method over traditional plyometric training was established, supporting the main hypothesis of the research.

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