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The Effect of Two Different Rest Intervals on the Development of Strength Endurance and Speed Endurance in Soccer Players Aged 12–14 Years

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Abstract:
Improving the training process and raising the level of athletic performance of a player or a team can only be achieved through carefully considered scientific planning of the training process. The training plan must include varied content and draw on diverse sciences, and every stage of training should have clear intermediate and long-term objectives, implemented according to a realistic scientific vision that takes into account the level of the player and the team, as well as the age group and the available resources.

1. Introduction to the Research

1.1 Introduction and Importance of the Research

Planning of sports training is today an undeniable reality and an indispensable necessity for achieving the desired objectives. The training process is no longer a haphazard one in which results and achievements are obtained through trial and error; rather, planning the training process has become one of the most important pillars for improving the level of achievement. Without planning the daily training unit and the weekly, monthly, medium (meso-) and large (macro-) training cycles, or the annual cycle, it is impossible to guarantee the functional responses and adaptations in the player's body systems and organs, nor to guarantee progress in the level of physical, skill, tactical and psychological performance.[1].

Since any physical or skill exercise performed by an athlete produces anatomical, physiological, chemical and psychological changes within the body, the coach, when setting out the items of the training plan, must take into account the components of the training load (volume, intensity and density), all of which must be organized and shaped in accordance with the psychological and functional-practical characteristics of the type of competition and the capabilities of the player.[2].

Accordingly, during the training phases that precede competition, the coach must determine with complete precision which of these components should be emphasized in order to achieve the performance objective set in the training plan. On the other hand, all components of the training load must change in proportion to the overall improvement the athlete achieves; that is, the higher the athlete's level of improvement, the greater the need to modify the components of the training load. Such mechanisms must therefore be monitored by the coach.[3].

Football players, regardless of their ages and categories, therefore need many varied training methods, approaches and plans to develop their physical abilities and functional systems so that they can perform their duties during competitions. Hence, scientists, specialists and researchers in the field of football training have been interested in devising modern, advanced and meticulously planned methods and exercises aimed at raising athletes' physical, functional and skill efficiency and benefiting from them to the maximum extent.

Rest is a fundamental component of the training load, owing to its effective role in regulating the training load and ensuring its effectiveness. Rest is one of the core topics in sports training, and the coach cannot dispense with it during the training process, since training is not based merely on exposing the athlete to high loads; rather, it requires a scientific understanding of how to regulate the training load so as to enable the athlete to perform large volumes of work and obtain the greatest benefit from the training unit, thereby ensuring that the player remains able to work and perform and to accept further training load.

1.2 Research Problem

In the pursuit of identifying the optimal approaches and methods for improving performance in the various sporting events, it has become necessary to intensify rigorous scientific research that investigates the facts contributing to the advancement of physical and skill levels. As is well established in sport, the design of speed-endurance training and its technical specifications is closely tied to the nature of the specific sport; football relies on a variety of training methods, including continuous load training, interval training and repetition training ("Fartlek"), among others[4]. The essence of the difference among these types lies in how the variables are controlled: the duration of the stimulus, the intensity of the load, and the rest intervals. From this standpoint, the researcher decided to conduct an experimental

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[1]Muwaffaq Majeed Al-Mawla et al., Modern Methodology in Planning and Training in Football (2nd ed.; Baghdad: Dar Al-Kutub wal-Watha'iq, 2019), p. 17.

[2]Ali Muhammad Jabir, "The Effect of S.S.G Exercises on Developing Some Special Physical Abilities and Biochemical Variables in Young Football Players," Dhi Qar University Journal of Physical Education Sciences 1, no. 2, part 2 (2023): 95.

[3]University of Babylon, lecture page: http://www.uobabylon.edu.iq/uobcoleges/lecture.aspx?fid=14 7659 (as given in the source).

[4]Abbas Fadhil Abbas Shuhayb, "The Relationship of Maximum Speed and Muscular Power with the Performance Level of Shooting and Dribbling Skills in Football," Dhi Qar University Journal of Physical Education Sciences 1, no. 4, part 1 (2024): 512.

study testing different rest periods in order to determine their effect on developing speed endurance and strength endurance in football players, in a way that serves the specific physical requirements of this sport.

1.3 Research Aim

1. To identify the effect of two rest periods (work-to-rest ratios) on developing speed endurance and strength endurance in football players aged 12–14 years.

1.4 Research Domains

1.4.1 Human domain: Players of the Olympic Champion Project in Dhi Qar Governorate.

1.4.2 Spatial domain: The Sports and School Activity Hall in Dhi Qar Governorate.

1.4.3 Temporal domain: From 15/3/2025 to 15/8/2023 [sic].

2. Research Methodology and Field Procedures

2.1 Research Methodology

Many cases and phenomena can only be studied through a method that suits the problem. The experimental method with tight control was therefore used to address this problem; it is "an attempt to control all the basic factors affecting the dependent variable(s) in the experiment except one factor, which the researcher controls and varies in a particular way in order to determine and measure its effect on the dependent variable(s)" (Nouri Al-Shawk, 2004, p. 59). Accordingly, the researcher adopted the experimental method with two experimental groups, because it suits the nature of the problem and the achievement of the research aims, and adopted the following experimental design:

Table (1) The experimental design of the experiment

Groups	Variables	Pre-tests	Independent variable	Post-tests
First experimental group	Strength endurance and speed endurance	Physical abilities test	Work-to-rest ratio (1:1)	Physical abilities test
Second experimental group			Work-to-rest ratio (1:3)	

2.2 Research Population and Sample

The sample was selected purposively and consisted of 20 players from the Olympic Champion Project in Dhi Qar Governorate. They were divided into two experimental groups of 10 players each.

Table (2) Distribution of the research sample

Total number	Experimental sample 1	Experimental sample 2
20	10	10

To ensure that the sample was homogeneous and normally distributed, the skewness coefficient was calculated for some variables, namely age, body mass and height. All skewness values fell within ±3, which indicates that the study sample is homogeneous, as shown in Table (3).

Table (3) Normal distribution of the sample: arithmetic mean, median, standard deviation and skewness coefficient of the research sample

Variable	Arithmetic mean	Median	Standard deviation	Skewness	Homogeneity
Age (months)	160.55	162	6.41	−0.21	Homogeneous
Height (cm)	61.17	169	5.1	−0.24	Homogeneous
Weight (kg)	69.15	61.0	4.53	0.42	Homogeneous

2.3 Means, Devices and Tools Used in the Research

2.3.1 Means of Data Collection

- Observation
- Tests and measurement
- Arabic and foreign sources
- The Internet
- Personal interviews[5]
- Questionnaire

2.3.2 Devices and Tools Used

- Height and weight measuring device
- Stopwatch
- Computer
- Digital calculator

[5] See Appendix (1).

- Colored adhesive tape
- Plastic cones
- Plastic markers
- Small goal
- Agility ladder
- Agility rings (tape circles)
- Hurdles of different heights
- Footballs (10)
- Football pitch

2.4 Main Research Procedures

2.4.1 Identification of the Variables

In light of the aim of his study, namely identifying some physical variables in football that may be affected by controlling the rest times between repetitions and between sets, and following a rigorous scientific methodology based on modern theoretical and applied foundations in the sport sciences, the researcher analyzed and reviewed a wide range of scientific sources, references and previous studies related to sports training, exercise physiology and football, in order to form a comprehensive picture of the most prominent variables that could be affected by the independent variable. On this basis, strength endurance and speed endurance were selected as the two dependent variables in this study.

2.4.2 Physical and Skill Tests

The selection of the tests used to measure the abilities related to the phenomenon under study should be appropriate and accurate, so that it fulfills the real purpose of measurement and provides valid and objective data. The researcher therefore prepared a questionnaire containing a set of physical tests, in order to determine the most suitable test for measuring each physical ability from among three proposed tests for each. The questionnaire was presented to a sample of seven experts and specialists in sports training, tests and measurement, and football. Their responses were analyzed, the questionnaires were tabulated, and the percentages of selection frequencies were calculated. Based on the results of the analysis, the tests that obtained the highest percentages of expert agreement were adopted and nominated as the most suitable instruments for measuring the physical abilities under investigation, as shown in Table (4).

Table (4) Percentage validity of the physical tests

Physical variable	Proposed tests	Number of experts	Suitable	Not suitable	Percentage
Speed endurance	200 m shuttle run test	7	3	4	42.9%
	20 m × 5 run test	7	2	5	28.6%
	180 m shuttle run test	7	5	2	71.4%
Strength endurance	30-second lateral hurdle jump test	7	7	0	100%
	Standing forward two-footed jump test until exhaustion	7	3	4	42.9%
	Two-footed forward jump test with full knee flexion for 25 seconds	7	2	5	28.6%

2.4.2.1 Speed Endurance Test: 180 m Run[6]

- **Purpose of the test:** To measure speed endurance.
- **Equipment:** Stopwatch; four cones, with a distance of 15 m between one cone and the next.
- **Performance description:** After the start signal is given, the testee runs from the start line to the second cone and returns to the start, runs again toward the second cone and returns to the start, then runs toward the third cone and returns to the start, covering a total of 180 m.
- **Test instructions:** To create a competitive spirit, the test is administered to two players at a time, ensuring harmony between them, and each player is given only one attempt.
- **Scoring:** The elapsed time is calculated and recorded to the nearest 1/100 of a second.

2.4.2.2 30-Second Lateral Hurdle Jump Test

- **Purpose of the test:** To measure the strength endurance of the leg muscles.
- **Test requirements:** A hurdle 70 cm high; a whistle; a stopwatch.
- **Test description:** The player stands sideways to the hurdle and, on hearing the whistle, jumps laterally over it with both feet for 30 seconds.
- **Scoring:** The number of jumps made in 30 seconds.

2.4.3 Organization of the Exercises and the Training Load

Organizing the training load is one of the fundamental pillars of the training process, since controlling the load elements (intensity, volume, density, rest) contributes to achieving the best physical, skill and physiological responses. Based on this principle, the researcher organized the physical exercises within the coach's own training

[6] Zuhair Al-Khashab, op. cit., 1984, p. 44.

unit, with the only change being in the rest intervals between repetitions and between sets, in proportion to the intensity and volume of the exercises and the capabilities of the players. Two different training densities were used, one for each of the two research groups, at (1:1) and (1:3).

2.5 Pilot Experiment

The pilot experiment was conducted on 2/6/2025 on a sample of five players from the original study population who were outside the main research sample. Its purpose was to determine the suitability of the exercises selected by the researcher, which had been prepared in accordance with the requirements of the independent variable of the present study, for the research sample, as well as to determine the timing of performing the physical and skill exercises. The physical tests were also administered to the sample, with the following aims:

1. To determine the suitability of the tests for the level of the sample.
2. To determine the time required to carry out each test.
3. To determine the scientific sequence of the tests in terms of ease and difficulty of performance, and to ensure that no test affects another.
4. To identify the difficulties and problems that the researcher might encounter during the main experiment.
5. To determine the readiness of the assistant work team.
6. To verify the suitability and safety of the devices and tools used in the tests.

2.6 Scientific Bases of the Tests

2.6.1 Validity

The validity coefficient of a test is one of the important scientific criteria that the test designer must verify and attend to. The validity of a test is "its ability to measure what it was designed to measure, or what the test is supposed to measure, whether a physical or skill attribute, a psychological attribute, or a personality trait"[7].

Accordingly, the researcher relied in his study on content validity (face validity) as one of the methods for verifying the validity of an instrument, since this type of validity rests on evaluating the opinions of experts and specialists. To this end, the researcher presented the set of tests to a group of leading experts in football, exercise physiology in sports training, and testing and measurement, in order to evaluate the extent of their suitability for measuring the objectives for which they were designed. After analyzing their opinions and comments, it became clear that these tests are characterized by a high degree of validity, as the experts affirmed that they do indeed measure what they were designed to measure and achieve their intended purpose.

2.6.2 Reliability

Reliability means "that the test yields the same or similar results if it is re-administered to the same individuals under the same conditions more than once"[8]. The researcher determined the reliability coefficient of the tests using the test–retest method, which is one of the common methods for verifying test reliability: the same test is administered twice to the same sample with an appropriate interval, usually ranging between 1 and 7 days, taking care that both administrations are carried out under identical conditions with respect to environment and procedures. The correlation coefficient between the results of the first and second administrations is then calculated. This coefficient is an indicator of the reliability of the test, and the degree of reliability increases the closer the value of the correlation coefficient is to (±1), which indicates the stability of the test results and the possibility of relying on the test to measure the target variable[9].

The first test was conducted on Saturday 7/6/2025 and the same test was repeated after seven days, on Saturday 14/6/2025, on the same sample of five players. The researcher then used Pearson's simple correlation coefficient to determine the reliability of the tests. The results were found to be very close to (±1), which confirms that the tests have a high degree of reliability, as shown in Table (5).

Table (5) Correlation coefficients for the reliability and objectivity of the special physical and skill tests used in the research

No.	Test	Reliability correlation coefficient	Significance of reliability	Interpretation
1	Strength endurance test	0.996	Highly significant	Very high reliability
2	Speed endurance test	1.000	Highly significant	Very high reliability

2.7 Main Experiment

2.7.1 Pre-tests

The pre-tests were conducted on Sunday (15/4/2025) at nine o'clock in the morning. The pre-tests of the physical abilities under study were carried out in the following order:

1. Strength endurance test (lateral jump)
2. Speed endurance test (180 m run)

[7] Loay Ghanem Al-Sumaidaie et al., Statistics and Testing in the Sports Field (1st ed.; Erbil, 2010), p. 102.

[8] Muhammad Jassim Al-Yasiri, Theoretical Foundations of Physical Education Tests (1st ed.; Najaf: Dar Al-Diya for Printing and Design, 2010), p. 52.

[9] Loay Ghanem Al-Sumaidaie, ibid., p. 122.

Before testing the members of the study sample, the researcher explained the tests and how to perform them and demonstrated them in front of the sample so that they could understand them and apply them correctly. The players were also given the opportunity to warm up before starting the tests, and the results were recorded in accordance with the conditions and specifications set for each test.

2.8 Equivalence of the Two Research Samples

Achieving equivalence between the experimental and control groups is important so that the groups are as alike as possible in all the factors that affect the dependent variable. If the equivalence of the groups cannot be established, it cannot be determined whether the differences between, for example, the experimental and control groups are due to the independent variable or to original differences between the two groups[10].

So that the researcher could carry out his experiment and ensure that the changes that would occur in the players were directly attributable to the introduction of the independent variable, it was necessary to establish equivalence in a number of relevant variables, particularly those that fall within the scope of the study. This is a fundamental procedure for controlling variables and their effects, and it helps the research proceed in accordance with the requirements and precise principles of the scientific method.

On this basis, the researcher established equivalence between the two research samples in the two study variables using the independent-samples t-test, as shown in Table (6).

Table (6) Arithmetic means, standard deviations and calculated t-values for the two research groups in the pre-tests

Tests / variables	Unit of measurement	Experimental group 1		Experimental group 2		Calculated t-value	Significance of differences
		Mean ($\bar{x}$)	SD (s)	Mean ($\bar{x}$)	SD (s)		
Strength endurance	Repetitions	20.60	4.09	20.40	3.27	0.12	Not significant
Speed endurance	Seconds	34.68	1.66	33.95	1.43	1.05	Not significant

It is noted from the table above that the calculated t-values for the two research variables were smaller than the tabulated t-value of (2.101) at (18) degrees of freedom and a significance level of (0.05). This indicates that there are no statistically significant differences between the two groups, which confirms the equivalence of the two research groups in these variables before the start of the training program. Consequently, any differences that appear later can be attributed to the effect of the independent variable.

2.9 Organization of the Exercises and the Training Load

Organizing the training load is one of the fundamental pillars of the training process, since controlling the load elements (intensity, volume, density, rest) contributes to achieving the best physical, skill and physiological responses. Based on this principle, the researcher organized a set of physical and skill exercises to be performed in the main section of the training unit only, while retaining the preparatory and concluding sections as set by the team coach, in order to ensure that the team's general training units continued unchanged.

The program, which extended over (12) weeks, aimed to study the effect of controlling training density alone on developing some physiological, physical and skill abilities in football players aged (12–14) years, while keeping both training intensity and training volume constant at levels appropriate to the age group under study. The training load elements were organized as follows:

First: Training intensity. It was fixed at a level ranging between (65% and 75%) of individual maximum performance for both groups, which is an intensity suitable for youth players that provides a sufficient degree of stimulation without overexertion.

Second: Training volume. The volume was set at a relatively constant level in terms of the total time allocated to the main section, which ranged between (75–90) minutes. To achieve this, (5) exercises were placed in the main section of the training unit, with (3) sets per exercise, and the number of repetitions was varied, averaging between 2 and 13 repetitions, to ensure that the total work time of each exercise remained constant.

Third: Training density. This was the only element controlled: a density of (1:1) was set for the first group and a density of (1:3) for the second group. It represents the relationship between work and rest periods within the training unit. The rest periods were adjusted in order to change the density, without changing the intensity or the volume.

The exercises consisted of (25) exercises distributed over (12) weeks, at (3) training units per week, i.e., (36) training units in total. The exercises varied between single physical exercises, which target specific attributes of strength endurance and speed endurance, and compound exercises, which combine a physical attribute with one or more skills, such as (speed endurance + dribbling), and so on.

2.10 Implementation of the Training Units Using Exercises Prepared on the Basis of Controlling Load Density

The main experiment (implementation of the training units) began on (20/4/2025) and continued until (20/7/2025), for a total duration of twelve weeks, during which thirty-six training units were carried out, three units per week, on

[10]Haidar Abdul-Razzaq, Fundamentals of Writing Scientific Research in Physical Education and Sport Sciences (1st ed.; Basra: Al-Ghadeer for Printing and Publishing, 2015), p. 90.

Wednesdays, Fridays and Sundays, which are the days adopted for the team's training units. The units were carried out on the main training pitch and at the same times at which the players were accustomed to training, in order to ensure constant environmental and temporal conditions throughout the duration of the experiment.

Implementation of the units was restricted exclusively to the main section of the training unit, while the preparatory and concluding sections were left to proceed according to the usual program supervised by the team coach. The training units were carried out under the supervision of the researcher and in cooperation with the training staff, consisting of the team coach and his assistants, who managed the training units for the two research groups and exercised general supervision of attendance and discipline, recorded the performance and rest times within the units, measured individual maximum performance, and entered the preliminary data, in order to ensure control of the implementation procedures and to reduce human error in data recording.

To ensure the success of the experiment and achieve the highest degree of internal validity, the researcher adhered to a number of controls, the most important of which were:

1. Fixing the environmental conditions (pitch, time, equipment).
2. Monitoring the players' attendance and recording absences and their effect, if any.
3. Standardizing the methods of explanation and of carrying out the exercises for all members of both groups.
4. Strict adherence to the work and rest periods in accordance with the specified density ratios.
5. Preventing any additional training intervention for the two groups outside the specified program.

Through this careful organization, the researcher was able to isolate the effect of training density and to study its direct effect on the players' physical indicators, while ensuring that the only independent variable acting on them was training density.

2.11 Post-tests

The post-tests of the main research sample were conducted after the completion of the training units, adopting the same procedures and conditions that were applied in the pre-tests, in order to ensure constant conditions and reduce the effect of extraneous variables. They were held on (25/7/2025) at nine o'clock in the morning at the "Al-Talaba" (Students) Stadium, using the same score-recording forms and the same equipment and devices that had been used in the pre-tests.

As in the pre-test, the researcher explained how to perform each test and ensured the players' readiness by having them carry out an appropriate warm-up. The results were then recorded according to the approved conditions and standards, and the tests were conducted in the same sequence as previously adopted:

1. Strength endurance test (lateral jump).
2. Speed endurance test (180 m run).

All results were recorded on the forms designated for making statistical comparisons later between the pre-test and the post-test.

2.12 Statistical Methods

- Percentage
- Arithmetic mean
- Standard deviation
- Simple (Pearson) correlation coefficient
- Paired-samples t-test
- Independent-samples t-test

3. Presentation, Analysis and Discussion of the Results

Having completed in the preceding chapter all the requirements of the fieldwork, including the implementation of the experimental exercises in accordance with the controls specified for the training load, the control of the intensity, volume and density variables and of the constancy of the application conditions, in addition to conducting the pre- and post-tests for the variables under study and collecting the field data from the members of the sample in an accurate and organized manner, the transition to the statistical analysis stage became a scientific necessity for completing the methodological structure of the study. On this basis, this chapter presents the results of the statistical treatments applied to the collected data, using statistical methods appropriate to the nature of the variables.

3.1 Presentation, Interpretation and Discussion of the Results of the Physical and Skill Tests of the First Experimental Research Group

Table (7) Arithmetic mean, standard deviation and calculated t-value of the first experimental group in the pre- and post-tests

Variable	Unit of measurement	Pre-test		Post-test		Mean difference	t-value	Significance level
		Mean	SD	Mean	SD			
Strength endurance	Repetitions	20.60	4.09	20.70	4.08	0.10	0.45	Not significant
Speed endurance	Seconds	34.68	1.66	34.54	1.58	0.14	0.95	Not significant

Tabulated t-value = 2.262, degrees of freedom (df) = 9, at a significance level of 0.05.

The results of the paired-samples t-test showed no significant changes in the level of the physical variables under study among the members of the group when the pre- and post-measurements were compared.

The results for the variable **strength endurance** did not reveal statistically significant differences: the arithmetic mean in the pre-test was (20.60) with a standard deviation of (4.09), while in the post-test it was (20.70) with a standard deviation of (4.08); the mean difference was (0.10), and the calculated t-value was (0.45), which indicates that no significant differences were achieved between the two measurements. The lack of development (stability) in both strength endurance and speed endurance among the members of the first experimental group is attributed to the nature of the load density used (1:1), and this can be analyzed through the following points:

1. Insufficient recovery period: Adopting a density ratio of (1:1) in training that targets "endurance" attributes (whether strength or speed) means that the rest period equals the work period. In high-intensity training, this ratio may not allow enough time for the functional systems to recover[11], which leads to rapid accumulation of lactic acid in the muscles and blood. This accumulation prevents the player from performing the repetitions at the intensity required to develop the physical attribute, which makes the training "maintain" the current level rather than "develop" it.
2. Relationship of density to energy production: Speed endurance and strength endurance depend heavily on the anaerobic energy production systems (phosphagen and lactic). A high density (1:1) places great pressure on the energy stores, and if there is no gradual increase in volume or intelligent manipulation of density (slightly increasing rest to allow high-quality repetitions), the body reaches a state of "training plateau", in which no new physiological adaptations occur.
3. Stimulus intensity and stimulus volume: The absence of significant differences indicates that the training stimulus applied at a density of (1:1) was not sufficient to produce "positive fatigue" that drives the body toward "supercompensation". The intensity used with this density may not have matched the current functional capacities of the sample, so the physical response was limited to resisting momentary fatigue without reaching the stage of structural adaptation.
4. Psychological and physical effect of stress: Working at a very high density with short rest (relative to endurance attributes) may lead to signs of cumulative fatigue, which makes performance in the post-test equal to that in the pre-test as a result of functional exhaustion. This explains the very close arithmetic means (20.60 versus 20.70 in strength endurance).

Therefore, the results confirm that using a fixed density ratio of (1:1), without taking into account a gradual increase or decrease of rest periods based on heart-rate response, did not achieve the required effect for developing the combined physical attributes (strength endurance and speed endurance). This calls for reconsidering the design of the training loads for this group, and perhaps resorting to a density that provides longer rest (for example, 1:2) to allow repetitions of better quality that lead to the desired development.

3.2 Presentation, Interpretation and Discussion of the Results of the Physical and Skill Tests of the Second Experimental Research Group

Table (8) Arithmetic mean, mean difference, standard deviation and calculated t-value of the second experimental group in the pre- and post-tests

Variable	Unit of measurement	Pre-test		Post-test		Mean difference	t-value	Significance level
		Mean	SD	Mean	SD			
Strength endurance	Repetitions	20.40	3.27	26.60	2.95	6.20	13.80	Significant
Speed endurance	Seconds	33.95	1.43	31.31	1.15	2.64	11.54	Significant

Tabulated t-value = 2.262, degrees of freedom (df) = 9, at a significance level of 0.05.

The results of the paired-samples t-test showed a marked and statistically significant development in all the physical and skill variables under study among the members of the second experimental group when the pre- and post-measurements were compared, which reflects the effectiveness of the training program applied.

With regard to **strength endurance**, it recorded the highest levels of improvement: the arithmetic mean rose from (20.40) repetitions with a standard deviation of (3.27) in the pre-measurement to (26.60) repetitions with a standard deviation of (2.95) in the post-measurement, the mean difference was (6.20), and the calculated t-value was (13.80).

The results for **speed endurance** showed a marked significant improvement: the arithmetic mean decreased from (33.95) seconds with a standard deviation of (1.43) in the pre-measurement to (31.31) seconds with a standard deviation of (1.15) in the post-measurement, the mean difference was (2.64), and the calculated t-value was (11.54), which indicates a highly statistically significant difference in favor of the post-test. The precise organization of the training load, through precise control of the load density within (1:3), contributed to developing strength endurance by adopting exercises that require repeated performance under the effect of fatigue and at an appropriate intensity, which enhanced the efficiency of the muscles in resisting stress and maintaining the level of performance for longer periods. Mark (2014) indicates that "high-intensity functional training leads to a significant development in leg

[11] Amjad Abdul-Kadhim, "The Effect of Speed-Strength Training and Strength Endurance on the Accuracy of the Spike Serve in Volleyball," Dhi Qar University Journal of Physical Education Sciences 1, no. 2, part 2 (2023): 44.

strength, general strength and cardiovascular endurance"[12]. Specific endurance is one of the physical abilities on which most sports events and activities are based, including football, where it is one of the abilities that are needed to a great extent, because modern football genuinely requires players to develop well through skill performance and other aspects, which demand high physical capabilities in order to reach positive levels of performance and to link physical and skill abilities. This was also confirmed by Al-Mawla and Al-Rubaie (1988), who stated that "strength endurance has an extremely important effect and is among the requirements for determining the level of many dual movements, as they show the extent of the capacity of the athlete's body muscles to endure varied performance during training and competition"[13]. This qualitative development of the second experimental group is due to the following factors:

1. Functional suitability of the load density: Unlike the first group, this group appears to have been subjected to an ideal load-density ratio that allowed the functional systems to reach a state of "supercompensation". The balance of rest and work gave sufficient opportunity to rebuild the energy sources (ATP-PC) and to partially clear lactic acid, which allowed the players to perform the subsequent repetitions at a high intensity that stimulated adaptation.
2. Development of energy-production efficiency: Regular training improved the anaerobic pathways of energy production and increased the capacity of the blood and muscles to act as "buffers" to counter blood acidity. This physiological adaptation is what allowed the players to continue performing with high strength and speed without a sudden drop in level.
3. Neuromuscular adaptation: The development in strength endurance reflects an improvement in neuromuscular coordination and in the ability of the nervous system to send successive signals to the muscle fibers to maintain their contraction for a longer period despite the accumulation of fatigue. This type of adaptation appears clearly when appropriate and repeated training volumes are used.
4. Cumulative effect of the program: The large difference in the arithmetic means indicates that the program followed the principle of "progressive overload", as the training stimuli were strong enough to produce change but did not reach the stage of excessive stress that hinders development, so that the fruits of training appeared clearly in the post-test.

Conclusion: The development in the second group confirms that the load density used was the "key" that allowed the sample to convert physical effort into positive physiological responses, which reinforces the importance of choosing the right rest ratios in endurance training programs.

3.3 Presentation, Interpretation and Discussion of the Results of the Physical and Skill Post-tests of the Two Research Groups

Table (9) Arithmetic mean, standard deviation, calculated t-value and significance level for the two groups in the post-test

Variable	First experimental group		Second experimental group		t-value	Significance level
	Mean	Standard deviation	Mean	Standard deviation		
Strength endurance	20.70	4.08	26.60	2.95	4.15	Significant
Speed endurance	34.54	1.58	31.31	1.15	5.68	Significant

The results of the independent-samples t-test showed statistically significant differences between the two research groups in the two variables under study, which reflects a difference in performance level between the two groups.

For **strength endurance**, the results showed a significant difference between the two groups: the arithmetic mean of the first group was (20.70) repetitions with a standard deviation of (4.08), while the arithmetic mean of the second group was (26.60) repetitions with a standard deviation of (2.95), and the calculated t-value was (4.15), which indicates a significant superiority of the second experimental group. These significant differences in favor of the second experimental group are explained by the program's ability to produce adaptation in the working system of the muscles. By raising the density through reducing the rest intervals between repetitions and between sets, the efficiency of the muscle fibers in resisting the accumulation of biological waste products such as lactic acid, and in continuing physical work with the same force, increased. This is what Mark (2014) confirmed, that "frequent high-intensity exercises develop strength endurance and increase work capacity, that is, the ability to withstand a high degree of intensity for a longer period"[14]. In addition, the experimental group benefited from repeating strength exercises using body weight and the ball, which enhanced the efficiency of the local cardiorespiratory system of the muscle.[15]

[12]Mark Jones, HIIT: How to Lose Weight, Get Shredded Muscles and Improve Your Health with High… (CreateSpace Independent Publishing, 2014), p. 52.

[13]Kazim Al-Rubaie and Muwaffaq Al-Mawla, Physical Preparation in Football (University of Mosul: Dar Al-Kutub for Printing and Publishing, 1988), p. 243.

[14]Mark Jones, HIIT: How to Lose Weight, Get Shredded Muscles and Improve Your Health with High… (CreateSpace Independent Publishing, 2014), p. 52.

[15]Jaafar Ahmed Mahdi, "The Effect of Graded Activities Strategy on Learning to Perform Rolling and Deception Skills in Football for Students," Dhi Qar University Journal of Educational Sciences 2, no. 3, part 2 (2025): 204.

The results for **speed endurance** also showed statistically significant differences between the two groups: the arithmetic mean of the first group was (34.54) seconds with a standard deviation of (1.58), compared with (31.31) seconds with a standard deviation of (1.15) for the second group, and the calculated t-value was (5.68). This reflects a significant superiority in favor of the second experimental group, since training that is systematically regulated and based on sound principles must yield positive results, which in turn contribute to raising the player's general level. This is what happened with speed endurance, which all football players need throughout the match; football coaches advise developing specific muscle groups in the direction of speed endurance because of its importance in play.[16]

4. Conclusions and Recommendations

4.1 Conclusions

In light of the results obtained by the researcher from applying his experiment in the present study, the following conclusions were reached:

1. The training program based on densities of (1:3) and (1:1) achieved a statistically significant development in all variables for both groups.
2. The second experimental group outperformed the first group in the post-tests.

4.2 Recommendations

1. The researcher recommends the need to use the proposed training program based on (density control) in training youth players (12–14 years) in order to develop the physical aspects in an integrated manner.
2. The researcher recommends that coaches of age-group teams focus on manipulating one component of the training load (such as intensity or volume) while keeping the other components constant, in the hope of reaching positive results as in the present study, which serves the interest of sport and athletes.

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