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## **The Effect of Combined Exercises with Different Rest Intervals on a Number of Physical Variables in Junior Football Players**

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### **ABSTRACT**

The present study aimed to Design combined exercises for developing selected physical variables in junior football players. Identify the effect of these exercises on selected physical variables across the three study groups. The research population was selected purposively and comprised the junior players of Samarra Sports Club. The sample represented 70% of the original population. The data were processed using the SPSS statistical package. The findings indicated that the exercises had a significant effect on selected physical variables in junior football players. The results showed that in the three experimental groups there was a significant difference between the pre-test and post-test values for all the physical variables studied (Agility, Coordination, and Sprinting speed), with a Sig. value of  $< 0.05$  so that the improvement occurred meaningfully and better in the post-testt. The exercises exerted a positive effect on the development of selected physical variables in junior football players.

Keywords: Fartlek exercises; Different rest intervals; Physical variables; Football; Juniors Football.

### **ABSTRAK**

Studi ini bertujuan untuk merancang latihan gabungan untuk mengembangkan variabel fisik terpilih pada pemain sepak bola junior. Mengidentifikasi efek latihan ini terhadap variabel fisik terpilih di tiga kelompok studi. Populasi penelitian dipilih secara sengaja dan terdiri dari pemain junior Samarra Sports Club. Sampel mewakili 70% dari populasi asli. Data diproses menggunakan paket statistik SPSS. Temuan menunjukkan bahwa latihan tersebut memiliki pengaruh signifikan pada variabel fisik terpilih pada pemain sepak bola junior. Hasilnya menunjukkan bahwa dalam tiga kelompok eksperimen terdapat perbedaan signifikan antara nilai pra-tes dan pasca-tes untuk semua variabel fisik yang dipelajari (Kelincahan,



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Koordinasi, dan Kecepatan Sprint), dengan nilai Sig. sebesar  $< 0,05$  sehingga peningkatan terjadi secara bermakna dan lebih baik pada pasca-tes. Latihan-latihan tersebut memberikan efek positif pada perkembangan variabel fisik terpilih pada pemain sepak bola junior.

Kata Kunci: Latihan fartlek; Interval istirahat yang berbeda; Variabel fisik; Sepak bola; Sepakbola Junior.

## INTRODUCTION

Sports training science constitutes the principal point of departure for achieving sound results and attaining high performance levels. The success of any training process depends upon the integrated preparation of players in the physical, technical, tactical and mental dimensions required by team sports. Football is one of these sports. The prevailing training perspective in football rests on the principle of interdependence, whereby physical requirements are developed alongside technical and tactical requirements, since the game demands rapid execution of duties on the pitch, both with and without the ball, and requires the player to possess a high level of these attributes and to employ them effectively in performance.

Accordingly, a number of combined exercises that integrate more than one objective within a single exercise should be administered, so as to develop the player's capacity for simultaneous physical, technical and tactical performance. It is well established that football is characterised by movements that are predominantly anaerobic in nature, relying in particular on the phosphagen energy system, or anaerobic movements of a duration in which lactic acid contributes, in addition to the contribution of the aerobic system. The high-speed movements in football, which depend on the anaerobic energy system, lead to energy expenditure and the onset of fatigue, which in turn creates a need for rest in order to promote recovery, with due regard to the length of the rest intervals and their appropriateness during the administration of exercise doses.

This is because "rest intervals differ from one exercise to another according to the nature of each exercise and its objectives, so that such intervals allow the energy resources within the muscle cells to release their maximum capacity during performance, which in turn influences recovery processes. Consequently, raising the level of sports performance in football no longer depends solely on the administration of a high training load, but also on attention to the rest intervals within the training unit and within the various training cycles in a manner commensurate with those loads." In the light of the foregoing, the significance of the present study lies in identifying the effect of specific exercises with different rest intervals on selected physical variables in junior football players.

### Statement of the Problem

Training methods aim to enhance the level of physical and technical performance through the systematic alternation between periods of actual performance and periods of physical rest, which must be regulated on a scientific basis grounded in the principles of training science, so as to contribute to adaptation and stabilisation in the systems and functions of players' bodies across all intermittent sports and activities. Football is one



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of these sports, since its performance is characterised by the reciprocal relationship between intensity and rest; that is, physical, technical and tactical performance as a whole is based on alternation between work and rest, through the execution of the various fundamental skills combined with a number of physical attributes, or through the performance of certain physical attributes in isolation from technical performance, whether performance relies on the aerobic or the anaerobic system.

On this basis, the researcher observed that previous scientific studies were founded on physical performance and remained bound to the propositions, rules and bases of the Fox and Mathews table, particularly with regard to the work-to-rest ratio rule set at 1:3 for training the first zone, and specifically its first part, in which actual performance time does not exceed ten seconds. The present study, by contrast, is based on the use of combined anaerobic exercises through the variation of rest intervals: a ratio of 1:2 for the first experimental group, 1:3 for the second experimental group and 1:4 for the third experimental group, with respect to the first work zone of the first section, in order to develop the phosphagen system in particular and the remaining energy production systems in general. This may be reflected in an improvement in the physical variables of junior football players, and it may further be determined which of these ratios is superior and most effective within the interval training method.

## Objectives of the Study

1. To design combined exercises for developing selected physical variables in junior football players.
2. To identify the effect of combined exercises based on a work-to-rest ratio of 1:2 on a number of physical variables in junior football players.
3. To identify the effect of the specific exercises based on a work-to-rest ratio of 1:3 on a number of physical variables in junior football players.
4. To identify the effect of combined exercises based on a work-to-rest ratio of 1:4 on a number of physical variables in junior football players.
5. To identify the statistical significance of the differences in a number of physical variables among the three experimental groups in the post-test.

## Hypotheses of the Study

1. There are statistically significant differences in selected physical variables between the pre-test and the post-test for the specific exercises based on a work-to-rest ratio of 1:2.
2. There are statistically significant differences in selected physical variables between the pre-test and the post-test for the specific exercises based on a work-to-rest ratio of 1:3.
3. There are statistically significant differences in selected physical variables between the pre-test and the post-test for the specific exercises based on a work-to-rest ratio of 1:4.
4. There are no statistically significant differences in selected physical variables among the three groups in the post-test.

## Scope of the Study

1. Human scope: junior football players of Samarra Sports Club.
2. Temporal scope: the period from 8 March 2025 to 15 May 2025.
3. Spatial scope: the pitch of Samarra Sports Club.

**METHOD**

Research Method

The researcher adopted the experimental method owing to its suitability to the nature of the study.

Population and Sample of the Study

The research population was selected purposively from the junior football players of Samarra Club in the city of Samarra, representing the under-19 age category, and numbered 30 players. The research sample comprised 21 players, selected at random and assigned by lot to three experimental groups, with 7 players in each group, after the exclusion of 9 players for the following reasons:

- 1. The 7 players who participated in the pilot studies.
- 2. Two goalkeepers.

The sample of the study thus represented 70% of the original population, as shown in Table 1.

**Table 1.** The main research sample and the experimental sample

| Variables         | Research population | Research sample                                                        | Excluded players                              |
|-------------------|---------------------|------------------------------------------------------------------------|-----------------------------------------------|
| Number of players | 30                  | 21 (7 first experimental, 7 second experimental, 7 third experimental) | 9 (7 pilot-study participants, 2 goalkeepers) |
| Percentage        | 100%                | 70%                                                                    | 30%                                           |

Experimental Design

The researcher employed the experimental design known as “the design of randomly selected equivalent groups with pre- and post-tests”, as illustrated in Figure (1).

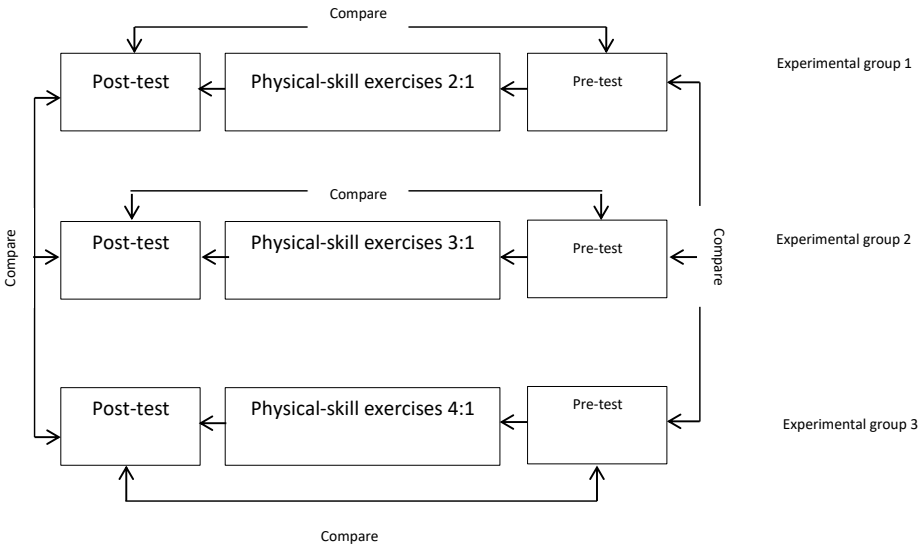


**Figure 1.** Shows the experimental design

Devices, Tools and Means Used in the Study

Devices and Tools



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1. Electronic weighing device (2).
2. Measuring tape for height (2).
3. Stopwatches accurate to 1/100 of a second (6).
4. Marker cones (30).
5. Regulation footballs (30).
6. Training bibs (30).
7. Portable goals (2).
8. Handball goals (2).
9. Small goals (4).
10. Electronic pulse measuring device (2).
11. Whistles (3).
12. Rope.
13. Chalk powder.

## Data Collection Means

1. Content analysis of scientific sources and references.
2. Tests and measurements.
3. The assistant work team.

## Field Procedures of the Study

### Tests of Fundamental Abilities

1. The 30 m sprint test from a flying start (to measure maximum sprinting speed).
2. The numbered circles test (to measure coordination).
3. The 7 m run between cones test (to measure agility).

### Equivalence of the Physical Variables under Investigation

In order to establish equivalence among the three research groups, the researcher conducted a one-way analysis of variance (ANOVA) to determine the differences in the physical variables, these results serving as the pre-tests, as shown in Table (2).

**Table 2.** Equivalence of the three research groups in the pre-tests of the physical and motor fitness elements under investigation, based on the analysis of variance

| No. | Variable     | Unit   | Source of variance | Sum of squares | df | Mean square | F value | Sig.  | Significance    |
|-----|--------------|--------|--------------------|----------------|----|-------------|---------|-------|-----------------|
| 1   | Agility      | second | Between groups     | 0.962          | 2  | 0.481       | 1.877   | 0.195 | Not significant |
|     |              |        | Within groups      | 3.075          | 12 | 0.256       |         |       |                 |
| 2   | Coordination | second | Between groups     | 1.121          | 2  | 0.560       | 1.759   | 0.214 | Not significant |
|     |              |        | Within groups      | 3.824          | 12 | 0.319       |         |       |                 |
| 3   | Speed        | second | Between groups     | 0.023          | 2  | 0.011       | 2.167   | 0.157 | Not significant |
|     |              |        | Within groups      | 0.064          | 12 | 0.005       |         |       |                 |

## Pilot Studies



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The researcher conducted a number of pilot studies together with the assistant work team in order to overcome the obstacles and difficulties that might confront the researcher, the assistants and the players during the implementation of the exercises and tests, and to devise appropriate solutions.

## The First Pilot Study

This study was conducted on 8 January 2025 with 6 players drawn from the research population, with the support of the researcher's assistant work team. Its purposes were as follows:

1. To verify the serviceability of the devices and tools used.
2. To identify the obstacles and difficulties facing the assistant work team.
3. To calculate the time required for administering the tests.
4. To confirm the allocation of duties among the members of the assistant work team.

## The Second Pilot Study

This study was conducted on 9 February 2025, in which the specific exercises were implemented in order to ascertain how the exercises were to be applied and to detect the errors and obstacles arising for the three research groups, so that these might be addressed in the main experiment.

## Pre-Tests

Under the supervision of the researcher, the assistant work team administered the pre-tests to measure the physical variables (agility, coordination and sprinting speed) for the research sample of 21 players on Thursday 11 March 2025.

## The Main Experiment

Following the completion of the pre-tests, implementation of the exercises prepared by the researcher commenced. The exercises were applied to the three experimental groups as follows:

1. First experimental group: implementation of the specific exercises at a work-to-rest ratio of 1:2.
2. Second experimental group: implementation of the specific exercises at a work-to-rest ratio of 1:3.
3. Third experimental group: implementation of the specific exercises at a work-to-rest ratio of 1:4.

Three training units were administered per week (Sunday, Tuesday and Thursday) over a period of eight weeks, giving a total of 24 training units comprising two mesocycles, each consisting of four microcycles. The main experiment was applied to the research sample from 14 March 2025 to 8 May 2025, in accordance with the scientific references and sources of training science.

## Post-Tests

The post-tests were administered to the research sample under the same conditions as the pre-tests, following the completion of the exercises, in order to determine the effect of the independent variable and the extent of development in the three research groups, on 11 May 2025.

## Statistical Means

1. Percentage.
2. Arithmetic mean.
3. Standard deviation.
4. Coefficient of skewness.

5. Simple correlation coefficient (Pearson).
6. One-way analysis of variance.

## RESEARCH RESULT

Presentation and analysis of the differences between the pre-test and the post-test in the physical variables under investigation for the three research groups.

**Table 3.** Differences between the pre-test and the post-test in the physical variables under investigation for the three research groups

| Variable        | Unit   | Group               | Pre-test mean | Pre-test SD | Post-test mean | Post-test SD | t      | Sig.   | Significance |
|-----------------|--------|---------------------|---------------|-------------|----------------|--------------|--------|--------|--------------|
| Agility         | second | First experimental  | 5.720         | 0.270       | 5.184          | 0.153        | 7.237  | 0.002* | Significant  |
|                 |        | Second experimental | 6.204         | 0.543       | 5.368          | 0.424        | 5.483  | 0.005* | Significant  |
|                 |        | Third experimental  | 6.298         | 0.530       | 5.754          | 0.484        | 9.240  | 0.001* | Significant  |
| Coordination    | second | First experimental  | 5.566         | 0.353       | 5.284          | 0.195        | 2.457  | 0.00*  | Significant  |
|                 |        | Second experimental | 5.860         | 0.855       | 4.816          | 0.418        | 3.369  | 0.00*  | Significant  |
|                 |        | Third experimental  | 6.234         | 0.313       | 5.088          | 0.365        | 5.124  | 0.007* | Significant  |
| Sprinting speed | second | First experimental  | 4.478         | 0.075       | 4.372          | 0.455        | 3.830  | 0.002* | Significant  |
|                 |        | Second experimental | 4.560         | 0.075       | 4.200          | 0.273        | 3.203  | 0.033* | Significant  |
|                 |        | Third experimental  | 4.476         | 0.0673      | 4.182          | 0.0148       | 10.049 | 0.001* | Significant  |

\*Significant if the significance level (Sig.) is less than 0.05.

Table (3) shows that all significance (Sig.) values were smaller than the 5% error level, indicating statistically significant differences between the pre-test and the post-test in the physical variables for the three research groups, in favour of the post-tests.

Presentation of the differences between the post-tests of the physical variables under investigation for the three research groups

**Table 4.** Analysis of variance among the three research groups in the post-tests of the physical variables

| No. | Variable        | Unit   | Source of variance | Sum of squares | df | Mean square | F value | Sig.  | Significance    |
|-----|-----------------|--------|--------------------|----------------|----|-------------|---------|-------|-----------------|
| 1   | Agility         | second | Between groups     | 0.846          | 2  | 0.423       | 2.891   | 0.094 | Not significant |
|     |                 |        | Within groups      | 1.756          | 12 | 0.146       |         |       |                 |
| 2   | Coordination    | second | Between groups     | 0.552          | 2  | 0.276       | 2.389   | 0.134 | Not significant |
|     |                 |        | Within groups      | 1.387          | 12 | 0.116       |         |       |                 |
| 3   | Sprinting speed | second | Between groups     | 0.110          | 2  | 0.055       | 2.136   | 0.161 | Not significant |
|     |                 |        | Within groups      | 0.309          | 12 | 0.026       |         |       |                 |

Table (4) shows that all significance (Sig.) values were greater than the 5% error level, indicating that there were no statistically significant differences among the post-tests in the physical variables under investigation for the three research groups.

## Discussion

Differences between the Pre- and Post-Tests and of the Differences among the Post-Tests of the Physical Variables for the Three Research Groups

In the light of the results obtained in Table (3), it is evident that there are statistically significant differences between the means of the pre-tests and the post-tests, in favour of the post-tests, in all the physical variables under investigation for the three experimental groups, which employed different work-to-rest ratios.

The researcher attributes this development to the positive effect of the combined exercises with their differing work-to-rest ratios, which extended over eight weeks at a rate of three training units per week (that is, 24 training units in total), and through which the energy system governing the physical attribute was systematically stressed. One of the foremost requirements for developing a physical attribute is to stress the working energy system under whose control that attribute falls, since all energy systems contribute to the achievement of performance; through the development of the functioning of the energy system, the physical attribute, or the group of physical attributes in which the working energy system predominates throughout the period of the player's performance, is improved.

The foregoing confirms the importance of relying on the specificity of the working energy system and of stressing it, notwithstanding the differences in rest intervals. This is regarded as one of the most important training principles, since each physical attribute was trained by a scientific approach founded upon training bases and rules aimed at achieving the objectives of the study, through the determination of appropriate intensities, volumes and exercise durations.

In view of the above, stressing the working energy system of the physical attribute played an important role in the physical development of all groups when the pre-test and



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the post-test are compared. In this regard, Davis and Kimmet state that "training specificity increases the functioning of the working energy system", which confirms an important fact: that repeating work with short rest intervals leads to muscular adaptation to the performance of the subsequent repetition and to the stressing of the working energy system. On this point, Iman notes that "stressing the working energy system of a physical attribute is among the foremost requirements for developing that attribute".

It should further be noted that each physical attribute was trained through the performance of a single physical exercise, or of a number of physical exercises regulated according to a scientific approach founded upon the bases, rules and conditions of training for each attribute, in order to achieve the objectives of the study. This was in addition to the prescribed performance intensities, the specified stimulus durations, and the rest intervals between repetitions and between sets – what is termed the training specificity of the different type of exercise serving each physical attribute to be developed, through the specificity of training the working muscle group or muscle groups involved in the performance of each physical exercise. All of this constituted a principal factor contributing effectively to raising the level of physical fitness of the football players by means of the development that occurred in the physical attributes. This is confirmed by Allawi and Abdel-Fattah, who state that "the successful coach is the one who plans a training programme that develops the characteristics required by the player's specialised sporting activity, including a focus on developing the working energy system upon which the player relies in his sporting speciality. Focusing on the working muscle groups involved in performing the specialised sporting activity, in accordance with the nature of their work, is more effective and beneficial, and all of this assists in directing the training programme towards the achievement of the required objectives."

The researcher holds that one of the principal factors underlying the development of the physical attributes in the present study is the occurrence of positive physiological adaptations in the players' bodies after they had trained, over a period of eight weeks and in a regular manner, using methods of controlling the intensity, the volume, and both the intensity and volume of the physical training load, following sound scientific planning of all field aspects related to the training process. This is confirmed by Abdel-Fattah, who states that "in order to obtain genuine physiological adaptations, the athlete must be trained regularly and continuously for a period of not less than 8 to 12 weeks". Othman adds, in the same connection, that "the outcome of the entire training process depends upon the extent of the effect produced in the various body systems, that effect (adaptation) resulting from the stresses of the physical training load".

Specialists in sports training science and sports training physiology likewise maintain that "as a result of long periods of continuous and regular training, functional changes occur in the internal systems of the body, which are termed chronic functional adaptation". Salama observes in the same respect that "when we train regularly for weeks, physiological adaptation to this effort occurs, which improves the player's physical and functional capacities, and likewise improves effectiveness and the capacity to sustain performance, as well as the various technical aspects associated with the specialised activity". Ismail et al. and Al-Ta'i concur that training in football "is characterised by planning, organisation and continuity on scientific foundations, thereby ensuring a positive effect on the player's level and the continuity of his progress in the



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various aspects of football, such as the principle of gradual increase in the training load and the correct timing of its repetition". Abdel-Fattah supports the foregoing in stating that "adaptation is the fundamental principle of training".

From the results, analysis and discussion of the physical variables addressed in this study, the researcher attributes the development achieved in all the physical attributes to the sound scientific regulation of the training load in the three training programmes, which was founded upon the bases and principles of sports training science, in addition to due regard for the rules and information pertaining to physiological theory, which forms part of sports training physiology. This led to the intended effects of these training programmes. Moreover, the commitment of the players in the three training programmes to a regular training pattern in performing the physical training prescribed for them within the scheduled training units 24 units in total, at a rate of three units per week likewise contributed to imparting a distinctly positive character to the training process. This is in addition to the complete correspondence and harmony between the time period allocated to the application of the exercises in the present study and the adaptation that occurred in the players' bodies, without which the development in the level of physical capacities of the three experimental groups would not have taken place in a positive manner ensuring the performance of the fundamental skills of football at the best level of physical fitness, and leading ultimately to peak sporting form in both physical and technical performance.

All of the foregoing confirms the fulfilment of the hypotheses of the study concerning the existence of statistically significant differences in selected physical variables of football players between the pre-tests and the post-tests, in favour of the post-tests. The adaptation that occurred as a result of continuity and gradation in training—two important principles of sports training—had a considerable effect on the progress achieved by the three research groups. In the researcher's view, the reason is that the recovery process initially occurs rapidly and thereafter slows down in the development of physical attributes and of movements requiring an improvement in the level of achievement based on the phosphagen and lactic energy systems. Martin and Lumsden state that "50 to 70% of recovery takes place within the first 20 to 30 seconds". Abdel-Fattah has explained in this regard that adaptation is the fundamental principle of training: if the training system is properly planned, the outcome is the development of physical fitness and, consequently, of the level of performance and sporting achievement, whereby physiological adaptation is realised.

## CONCLUSION AND RECOMMENDATIONS

### Conclusions

1. The combined exercises had a positive effect on the development of the physical variables under investigation in junior football players.
2. The three groups that employed the specific exercises with different rest intervals achieved development in the physical variables under investigation, as evidenced by the post-tests.
3. There were no significant differences in the post-tests among the three groups that employed the combined exercises with different rest intervals.

### Recommendations



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1. Emphasis should be placed on the use of combined exercises with junior football players, given their positive effect on the development of the physical variables under investigation.
2. Combined exercises with different rest intervals should be applied in order to determine their effect on the development of the physical variables.
3. Combined exercises with different rest intervals should be applied to other age categories and to other sports, in order to determine their effect on the development of the physical variables in football.

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