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Study on Improving the Physical Fitness Level of Young Football Players

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Abstract: The current study aimed to enhance the level of physical fitness of young football players aged 12-14 years and to verify whether the implementation of a specific motor programmes has positive effects on the development level of general motor skills. This scientific research was intended to make a contribution to the development and assessment of the level of physical fitness of athletes by promoting a set of methods and means for the improvement of physical training process. The research methods used were: literature review, pedagogical observation, verification experiment, mathematical and statistical method, graphical method. The experiment was conducted in the gym of the Middle School no. 13 in Bucharest on a sample of 14 athletes aged 12-14 years and lasted 6 months. Throughout this period, a series of operational structures for the development of physical fitness level were implemented in the training programme. The operational structures were allocated 35 minutes per training session. The study used tests for the assessment of speed, aerobic endurance, explosive power of the lower limbs and abdominal muscle strength. After processing the research results, statistically significant differences have been found between the initial test and the final test, which highlights the efficiency of the methodology used in the physical fitness training optimisation programme. Experimental validation of the methods and means used in the training of the experimental group represents a contribution to increasing the efficiency of the instructive-educational process.

Keywords: *motor skills; football; physical training; children.*

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Introduction

The contemporary football game highlights exceptional technical and tactical progress, being characterised by dynamism and complexity, an aspect that places large energy demands on players. Football can be described as "a predominant aerobic exercise combined with frequent intermittent short intense actions with a high rate of the anaerobic energy turnover" (Boone et al., 2012, p. 2051).

It is noticed that the modern football player is increasingly endowed with high physical potential, can sustain intense efforts in various conditions using changes of pace and acyclic movements and shows increased speed indices in order to possess the ball as long as possible. Knowing current trends in the game of football is very important for the proper guidance of player training in accordance with today's technical and tactical requirements (Cojocaru, 2002; Dima, 2007; Izvernar, 2013).

The achievement of top performance in football has been shown to depend on the quality of physical, technical, tactical, psychological, nutritional and social factors (Dragijsky et al., 2017; Barrett et al., 2018; Botek et al., 2014; Clemente et al., 2013; Clemente et al., 2017; Dragula et al., 2017; Maly et al., 2018; Sarmento et al., 2014). Among these factors, physical training is the "engine" that ensures the technical performance of athletes in both training and games, having a key role in the development of their morphological and functional capabilities, the improvement of their motor potential and the acquisition of basic and specific motor skills and abilities (Ciolcă, 2006).

The extremely high physical demands during a football match or a competitive year emphasise the importance of optimally developing general and specific motor skills. The quality of physical training depends on the optimal combination and mutual conditioning of the two sides of training, namely general and specific training (Ciolcă, 2006).

Specialists in the field of sport and football recognise the importance of physical training as an essential factor of sports training, which is both the basis of sports training and the indispensable support of technical and tactical achievements. Physical preparation determines performance and efficiency in training and competition, representing the pillar for the other components of the athletic training system.

Bangsbo (2003) considers that "for successful competitiveness, the development of speed, agility, strength with combination of aerobic and anaerobic (even maximal) abilities is important" (p. 278). The international

literature also mentions other motor qualities required for a football player, such as: balance, explosive power, general muscle strength, flexibility and appropriate endurance. The development and maintenance of these motor components at a high level throughout the season is a necessity for achieving top sports performance, provided that the basis of these components is laid as early as possible, starting with children's groups (Bloomfield et al., 2007; Dragijsky et al., 2017; Helgerud et al., 2001; Krustrup et al., 2005).

Numerous studies have revealed that age, morphology and physical fitness are important parameters that influence the performance of football players (Al Haddad et al., 2015; Di Salvo et al., 2007; Boone et al., 2012; Matković et al., 2003; Bujnovsky et al., 2019).

The issue regarding both the physical training of young athletes and the possibilities to optimise their physical fitness is a topic of constant debate. Studies concerning the effect of physical training on children aged 12-14 years are complicated because growth and maturation also influence their physical capabilities (Lindquist & Bangsbo, 1993).

The specifics of growth and development at puberty emphasise an extensive process of biopsychic transformation of the body, which will later lead to its maturation during the three stages: prepubertal (10-12 years old), pubertal (13-14 years old) and post-pubertal (14-15 years old) (Lerner, 2002).

According to Bénézet and Hasler (2018), "it has been recognized that the ideal period for training in technical and technical-tactical qualities, as well as coordination and cognitive abilities, is between the first and second growth spurt (between 9-10 and 13-14), that is, during the *golden age for learning*" (p. 122).

Starting with the second stage of puberty, the foundations of physical training can be laid, especially as regards speed in its simple forms of manifestation, dexterity, cardiovascular endurance and even speed-strength. "The second 'training to train' stage represents the key goal for 11-14-year-olds. At this stage, it is suggested that coaches should aim to educate players about how to improve through training not just during organized sessions but also on their own" (Reilly et al., 2004, p. 8). "An understanding of growth and maturation is important for any aspiring youth soccer coach" (Reilly et al., 2004, p. 11). "Intuitively, a combination of growth and training would be expected to optimize performance but there are limited data on this aspect of youth soccer" (Reilly et al., 2004, p. 80).

The importance of physical training is recognised worldwide, which is why coaches should constantly take this factor into account in sports training and act accordingly by identifying physical training programmes

adjusted to the specific age of athletes and their level of training. The current study also aims to identify such physical training programmes and establish efficient operational structures in the training of football players aged 12-14.

Based on the assumption that physical training is the support for the improvement of other training factors (technical, tactical, psychological ones and more), being directly involved in the achievement of top sports performance, we considered it appropriate to address this study. Experimental validation of the research results can represent progress and can be of practical interest for the scientific management of the physical training process in children's football.

Research purpose

The current study aims to improve the physical fitness level of football players aged 12-14 by developing and implementing operational structures appropriate to their age, characteristics and level of training.

In order to fulfil the research purpose, the following objectives were established:

• assessing the initial and final development levels of general motor skills in football players from both groups (experiment and control);

• designing a specific motor programmes for the development of targeted general motor skills components in football players aged 12-14.

To achieve the proposed goals, the following tasks were considered:

• establishing the sample of participants;

• selection of tests/assessments;

• organising and conducting the initial test of research groups;

• development and implementation of the specific motor programmes*;*

• final testing of research groups;

• analysing and interpreting the recorded data;

• drawing final conclusions.

Research hypothesis

The design and implementation of special motor programmes consisting of streamlined and judiciously dosed means focused on the development of football general motor skills will result in increasing the level of physical fitness.

Methodology

Participants

The ascertaining study was conducted on a sample of 14 athletes aged 12-14 years. The research took place at the Middle School no. 13 in Bucharest during extracurricular physical education and sport lessons.

Methods

In this study we used direct observation, which consisted in observing the participants during their training lessons, and indirect observation, which was used to study the planning documents. The method of the ascertaining and longitudinal experiment was used, through which the diachronic conduct of the events was tracked. With the help of mathematical and statistical method the data obtained from measurements and tests were statistically processed using the following indicators: arithmetic mean, standard deviation, coefficient of variation and t-Test for Dependent Samples. Also, graphical method, allowed us the correct evaluation of data, given that it makes an intuitive and synthetic presentation of the collected data.

Instruments

Determination of the physical fitness level of young football players was carried out by the following tests:

• test 1, 50-m speed run. It was performed from standing on a flat surface (Tartan), and the timer was started when the foot first touched the ground at the "go!" command;

• test 2, 1,000-m run. It consisted of 5 laps in the area of the sports field (a full lap measured 200 m). Participants were divided into two equal groups;

• test 3, standing long jump. Two single-balance attempts were made, and the best performance was recorded;

• test 4, sit-ups. From supine with legs fixed at the ankles and palms behind the head, the participant performs as many vertical lifts of the torso as possible for 30 seconds.

Procedure

The ascertaining experiment took place between 1 October 2020 and 1 March 2021 during extracurricular training lessons of the sports group.

The research design included the following steps:

• initial testing: between 01.10.2020 and 04.10.2020;

• implementation of the specific motor programmes: between 05.10.2020 and 01.03.2021;

• final testing: between 02.03.2021 and 05.03.2021.

Research participants performed two training sessions per week of 90 minutes each. Training interventions lasted 35 minutes per lesson and involved operational structures focused on improving travel speed, explosive power of the lower limbs, abdominal strength and aerobic endurance.

For the initiation of experimental research, permission was obtained from the Middle School no. 13 administration. At the beginning of the study all tested athletes were informed about the content and implementation of testing procedures, withdrawing possibility, with no other consequences on their status. At the same time, the written consent through their parents' signatures was obtained because the subjects involved were minors. Measurements were performed in accordance with ethical standards of the Declaration of Helsinki and ethical standards in sport and exercise science research (Harriss et al., 2019). All participants were healthy and voluntarily engaged in the research.

Methodology for implementing specific motor programmes

In order to achieve the proposed goals and verify the research hypothesis, the training of the experimental group also included operational structures focused on the development of the following motor skills components: (travel) speed, (aerobic) endurance and power/strength (explosive power of the lower limbs and abdominal muscle strength). When designing physical training programmes, it is fundamental to establish the operational objectives as well as the methods and means of practice (operational structures).

The operational objectives were aimed at both developing the targeted general motor skills components and learning, consolidating and improving the technical elements and procedures specific to the game of football.

The physical training of the experimental group used the methods of long-duration efforts, segmental efforts and the acquisition of basic motor skills.

The means specific to the game of football and the motor skills used in this study were addressed according to the following methodological requirements:

• they had a degree of complexity accessible to the level of training and the age of 12-14 so as to be performed with maximum speed and efficiency and minimum effort;

• they were focused on the development of motor skills: speed, strength and endurance, being used with progressively increased intensity;

• they were quantified by establishing the exact number of repetitions, with rest intervals and duration allowing for the proper restoration of the main physiological indicators.

Thus, during the 6 months of the experiment, 48 training lessons were conducted for the progressive adaptation of the body to exercise so that athletes could cope with the demands of basic training and improve their physical fitness as easily as possible, special attention being paid to physical training.

Four of the 16 programmes aimed to develop motor skills are presented below:

Programme 1 – development of travel speed

Operational objectives

• developing travel speed;

• developing football-specific anaerobic capacity.

	Methods	Resources	Means (Action systems)	Dosage	Work formation	Methodological indications/Variants
1.	Explanation Demonstration	Hoops	- 15-m knee-up run, 15-m run with hands behind the back - return, walk - 15-m jumped step - return, walk - 15-m hop step - return, walk - 15-m run with the right knee up at every step - return, walk - 15-m run with the left knee up at every step - return, walk - rapid stepping into 8 hoops with a diameter of 50 cm placed on the ground in a row next to	5 reps, 10-sec active break	4 in a line	The pace is gradually increased.

			each other - 10-m run - return, walk			
2.	Explanation Demonstration		- 15-m run - 20-m run - 25-m run	5 reps, 10-sec active break	4 in a line	The pace is gradually increased.
3.	Explanation Demonstration	Hoops	- rapid stepping into 8 hoops with a diameter of 50 cm placed on the ground in a row next to each other - 10-m run - return, walk	10 reps, 10-sec active break	4 in a line	Hoops are placed on the ground next to each other.
4.	Explanation Demonstration	Ladder	- stepping into an 8-step ladder placed on the ground while running forward - return, walk	10 reps, 10-sec active break	4 in a line	The pace is gradually increased.

Source: Authors' own conception

Programme 2 – endurance development

Operational objectives

- developing aerobic endurance;
- developing football-specific aerobic capacity.

	Methods	Resources	Means (Action systems)	Dosage	Work formation	Methodological indications/Variants
1.	Explanation Demonstration		- 400-m flat run	4 reps, 1-min active break	In line in a row	The pace is kept constant.
2.	Explanation Demonstration		- 400-m cross-country run	4 reps, 1-min active break	In line in a row	The pace is kept constant.
3.	Explanation Demonstration		- 800-m run	2 reps, 1-min active break	In line in a row	The pace is kept constant.
4.	Explanation Demonstration		- 1,500-m run	2 reps, 1-min active break	In line in a row	The pace is kept constant.

Source: Authors' own conception

Programme 3 – development of explosive power of the lower limbs

Operational objectives

• developing vertical jump;

• developing football-specific motor ability.

	Methods	Resources	Means (Action systems)	Dosage	Work formation	Methodological indications/Variants
1.	Explanation Demonstration	Hoops	- 15-m hoop jumps with legs apart and together	10 reps, 10-sec active break	4 in a line	Hoops are placed on the ground next to each other.
2.	Explanation Demonstration		- 15-m side jumps	10 reps, 10-sec active break	4 in a line	
3.	Explanation Demonstration	Low hurdles	- 15-m hurdle jumps on 1-2 legs	10 reps, 10-sec active break	4 in a line	Hurdles are 50 cm apart.
4.	Explanation Demonstration	Sticks	- 15-m alternating jumps over sticks placed on the ground	10 reps, 10-sec active break	4 in a line	Sticks are 50 cm apart.

Source: Authors' own conception

Programme 4 – development of abdominal muscle strength

Operational objectives

• developing abdominal muscle strength;

• developing football-specific motor ability.

	Methods	Resources	Means (Action systems)	Dosage	Work formation	Methodological indications/Variants
1.	Explanation Demonstration		- strength circuit, 4 workshops (push-ups, squats, sit-ups, back extensions from lying prone)	5 reps, 2-min semi-active break		

2.	Explanation Demonstration	- strength circuit, 6 workshops (push-ups, squats, sit-ups, back extensions from lying prone, knee-up jumps, half sit-ups)	5 reps, 2-min semi-active break
3.	Explanation Demonstration	- circuit, 6 workshops (sit-ups, dumbbell exercises for the biceps, knee-up jumps, half sit-ups, front lunges while raising the arms with dumbbells in both hands, jackknife sit-ups)	5 reps, 2-min semi-active break
4.	Explanation Demonstration	- circuit, 8 workshops (push-ups, squats, sit-ups, dumbbell exercises for the biceps, knee-up jumps, half sit-ups, front lunges while raising the arms with dumbbells in both hands, jackknife sit-ups)	5 reps, 2-min semi-active break

Source: Authors' own conception

Results

Following the experiment, we analysed and interpreted the motor test results obtained in the initial and final phases to highlight the efficiency

of the teaching strategy used during the proposed programmes, which positively influenced the level of physical training of athletes.

The results achieved were recorded in data sheets, and then statistically and mathematically processed. The following statistical parameters were used: arithmetic mean (AM), standard deviation (SD), coefficient of variation (Cv). In order to validate the working hypothesis, the t-Test for Dependent Samples was used to check the difference between the means of the same variable measured for the same group of participants in different situations (before and after). According to Fisher's Table, the critical t-test value for n = 13, and the critical t-value = 2.16 ($p < 0.05$). Statistical values were calculated with the Microsoft EXCEL program, version 2010. Data were presented in tabular and graphical forms.

Table 1 shows both the results achieved by the target group in the two tests and the calculated statistical indicators.

Table 1. Results obtained by the experimental group in motor tests – Initial test vs. final test

Test	Mathematical and statistical indicators						
	AM/SD IT	AM/SD FT	Progress IT-FT	Cv % IT	Cv % FT	Dependent t-Test	p
50-m speed run	8.14/0.64	8.04/0.47	0.1	5.65	5.84	5.71	< 0.05
1,000-m endurance run	3.94/0.48	3.71/0.63	0.23	12.18	9.7	3.69	< 0.05
Standing long jump	1.79/0.13	1.91/0.26	0.12	7.26	13.61	1.59	> 0.05
Sit-ups	28.07/4.1	39.82/4.4	11.75	14.60	11.04	4.53	< 0.05

Source: Authors' own conception

In the 50-m speed run test, the arithmetic mean is 8.14 seconds in the initial test (IT) and 8.04 seconds in the final test (FT) (Figure 1). The mean difference between IT-FT is 0.1 seconds. The degree of dispersion of the row values represented by the standard deviation has the value 0.64 in the initial test and 0.47 in the final test. The coefficient of variation (Cv) has the value 5.65% in the initial test and 5.84% in the final test, which indicates that the dispersion is average and the sample is homogeneous. The calculated value of Student's t-Test for IT-FT is 5.71, so $5.71 > 2.16$ (at a p-value < 0.05), which shows that there are statistically significant differences between the means of the two tests.

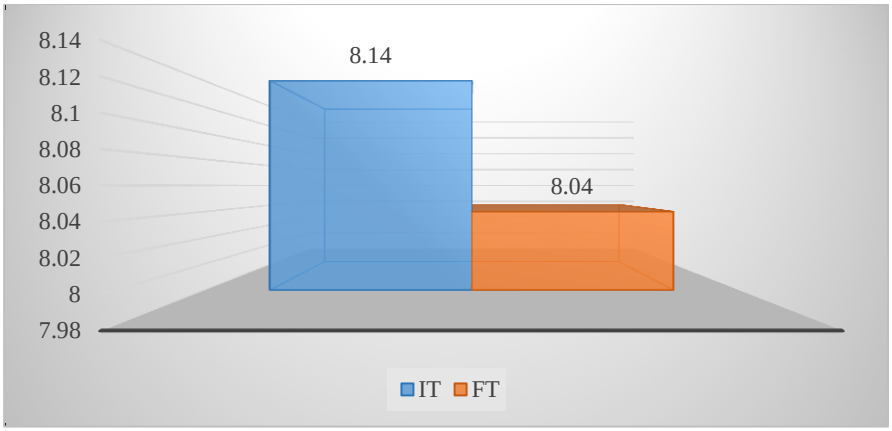


Figure 1. Representation of the arithmetic mean obtained by the experimental group for 50-m speed run – Initial test (IT) and final test (FT)
Source: Authors' own conception

In the 1,000-m endurance run test, the arithmetic mean is 3.94 minutes in the initial test (IT) and 3.71 minutes in the final test (FT) (Figure 2). The mean difference between IT-FT is 0.23 minutes. The coefficient of variation (Cv) has the value 12.18% in the initial test and 9.7% in the final test, which indicates that the sample is homogeneous. The calculated value of Student's t-Test for IT-FT is 3.69, so $3.69 > 2.16$ (at a p-value < 0.05), which shows that there are statistically significant differences between the means of the two tests.

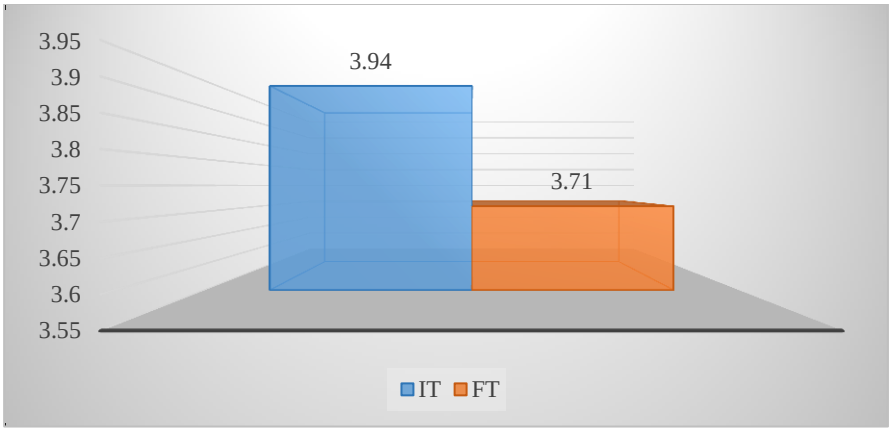


Figure 2. Representation of the arithmetic mean obtained by the experimental group for endurance run – Initial test (IT) and final test (FT)
Source: Authors' own conception

In the standing long jump test, the arithmetic mean is 1.79 m in the initial test (IT) and 1.91 m in the final test (FT) (Figure 3). The mean difference between IT-FT is 0.12 m. The standard deviation has the value 0.13 in the initial test and 0.26 in the final test. The coefficient of variation (Cv) has the value 7.26% in the initial test and 13.61% in the final test. The calculated value of Student's t-Test for IT-FT is 1.59, so 1.59 < 2.16 (at a p-value < 0.05), which shows that there are statistically insignificant differences between the means of the two tests.

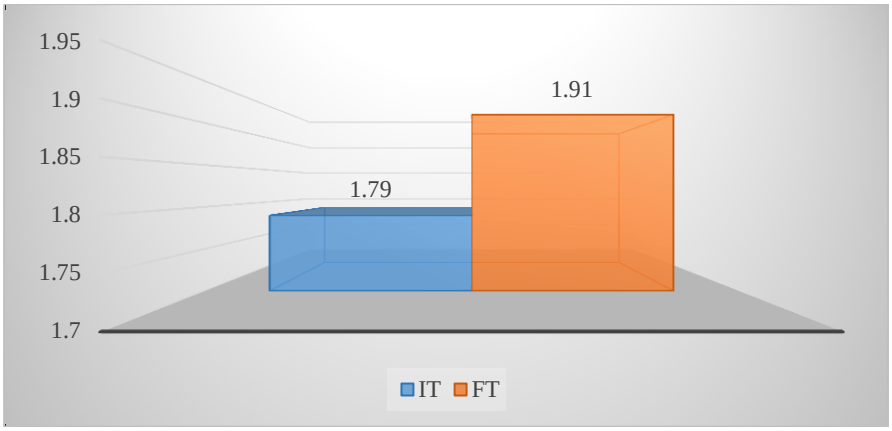


Figure 3. Representation of the arithmetic mean obtained by the experimental group for standing long jump – Initial test (IT) and final test (FT)
Source: Authors' own conception

In the abdominal muscle strength test, the arithmetic mean is 28.07 reps in the initial test (IT) and 39.82 reps in the final test (FT) (Figure 4). The mean difference between IT-FT is 11.75 reps. The coefficient of variation (Cv) has the value 14.60% in the initial test and 11.04% in the final test. The calculated value of Student's t-Test for IT-FT is 4.53, so 4.53 > 2.16 (at a p-value < 0.05), which shows that there are statistically significant differences between the means of the two tests.

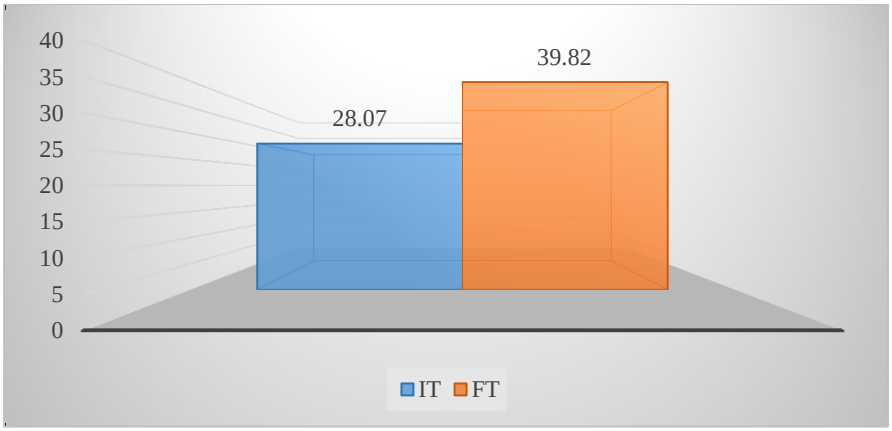


Figure 4. Representation of the arithmetic mean obtained by the experimental group for sit-ups – Initial test (IT) and final test (FT)
Source: Authors' own conception

Discussion

The study results have revealed positive effects on the investigated athletes as regards the development of running speed, aerobic endurance, explosive power of the lower limbs and abdominal muscle strength. Applying the 16 specific motor programmes for 6 months has increased physical performance in three of the four tested parameters, which is highlighted by the significant difference in the results at the initial test compared to the final test (Table 1). The practice of operational structures within the specific training programmes performed twice a week has led to an improvement in the targeted physical parameters. An increase was noted in running speed indices (progress rate = 0.1 sec), aerobic endurance (progress rate = 0.23 sec) and abdominal muscle strength (progress rate = 11.75 repetitions), while the leg muscle strength, although slightly increased (progress rate = 0.12 cm), did not record statistically significant differences between the two tests. These results confirm the findings of other studies conducted with adolescents, which emphasise an improvement in the strength of the upper and lower limbs, speed, flexibility, power and agility through training programmes adapted to the participants' biomotor characteristics (Christou et al., 2006; Kalinowski et al., 2021).

The physical demands during matches have considerably increased in recent years, including for young players. We believe that muscle strength can start to be developed through methods that are adapted for the age

group and focus on the upper body (abdominal and back muscles) using one's own body weight. Leg power is developed through regular activity in sprinting, running, jumping and kicking the ball during training and games. The age range between 12 to 14 years is ideal to develop general strength, which helps increase running speed due to muscle development. Studies have shown that the assessment of speed and strength of young football players at each particular stage should focus on the training complex specific to this period (Bolotin & Bakayev, 2017). Although strength and speed training can enhance endurance performance by improving work capacity, a well-planned endurance programme should be part of the conditioning of a football player (Hoff et al., 2002).

The selection of such means according to which informative indicators are chosen is an important task. The objective data obtained through this study allowed us to determine the most effective means of physical training for young football players.

In light of these observations, preparing a proper physical background at this age ensures that young players will be ready for the game at the highest level.

Conclusion

The superior results obtained by the experimental group in the final test compared to the initial test validate the research hypothesis. The statistically significant difference between the results achieved in the two tests confirms the efficiency of the newly introduced programmes in the physical training of young football players.

The judicious design of operational means based on the development of general motor skills components for the 12-14 age group has led to improved physical fitness, which highlights its contribution to streamlining the methodological content, with a positive effect on the future sports performance of the investigated players.

Experimental validation of the research results can represent progress and can be of practical interest for the scientific management of the physical training process in children's football.

Existing sources in the literature can be supplemented by the data recorded in this experiment, and the results obtained can be useful in the training of football players aged 12-14 years.

Authors' Contributions

All authors have equally contributed to this study and should be considered as main authors.

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