

Distinctive characteristics of physical, technical, and functional fitness in young football players with varied levels of speed development

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Abstract:

To enhance the educational and training processes for young football players, there is a need for further scientific investigation into specific aspects related to the manifestation of athletes' physical qualities, functional capabilities, and technical readiness. The objective is to establish the correlation between the levels of basic motor qualities, cardiorespiratory system function, and technical preparedness in football players aged 12-13, considering their varying degrees of speed abilities. **Materials and methods.** The research was conducted among football players aged 12-13, who showed different levels of speed abilities and engaged in this sport from 4 to 5 years. Training sessions were conducted according to the federal standard for the sport of "football" 4 times a week for 3 hours. In connection with the speed data of football players, the motor qualities manifestation peculiarities were studied. Generally accepted motor tests were used for this purpose. The values of heart rate and blood pressure, Robinson index, lung capacity and hypoxic samples were analyzed. Using tests, the state of young football players' technical readiness was assessed. **Results.** During the research, it was revealed that the "faster" football players had significantly high values of indicators in all motor qualities compared to their "slow" peers, with the exception of running time for 1000 m and results in the flexibility test. The functional parameters of the cardiovascular system of the young men in the two groups practically did not differ from each other. Higher values of respiratory system parameters were found in the group of "fast" football players compared with "slow" ones. Technically, the "fast" athletes turned out to be more trained. **Conclusions.** The use of the obtained data by football coaches will allow more effective training sessions in 12-13-years-old football players. The use of these techniques will prevent retraining of young football players.

Key Words: motor qualities, cardiorespiratory system, young football players

Introduction

The game of football is one of the most famous and popular sports (Barber et al. 2020). Such popularity of it is due to the significant development of positive morphofunctional changes in the body of those involved (Berger et al., 2020). It is known that sports games are the best means of improving health and its state, physical condition and cognitive abilities of a person (Griban et al., 2018). During playing sports, there is a high production of dopamine, which motivates a person to physical activity (Biino et al., 2020; Bocharin et al., 2022).

A large number of people start playing football from an early age. The age period from 12 to 14 years is crucial for technical skills formation among football players. Skipping this training period creates problems for the athlete's further progress. It is generally believed that the basis of the game of football is some well-developed motor qualities (Kokstejn, & Musalek, 2019). Strength, endurance and movement speed are especially important in football (Caruso et al., 2019). These qualities make it possible to develop a football player's technical abilities, which are later successfully used by an athlete at the competitive stage (Jaspers et al., 2017). Players with high speed qualities are able to move ahead of their rivals and better solve tactical tasks. The speed of an athlete's movement refers to a quality that decreases rapidly without constant training (Evstafiev, 2017). With a decrease in football players' movement speed during training, their technical level is rapidly decreasing. Some authors note that the technique of modern football is characterized by a system of movements that make it possible to maximize the accuracy and speed of game actions (Hakman et al., 2018). Therefore, an important

point of training should be training for high-speed qualities development. Trampoline acrobatic (Maschenko et al., 2020) and jumping exercises, sprints (Lisenchuk et al., 2021) can be used for this purpose. Researchers Fernando Barba et al. (2020) used small one-sided games to develop the speed and coordination qualities of junior football players, which improved the results in the vertical jump and the ability to repeat explosive efforts against the background of fatigue.

Experts in the field of football, based on the largest football competitions analysis in recent years, predict a further increase in the requirements for the athletes' speed and strength qualities. Therefore, the values of speed, coordination abilities, technical and special physical fitness, speed, "explosive" speed and speed of movement on the football field will increase. These qualities must be developed from childhood (Sami Sermakhaj et al., 2017; Kryzhevsky et al., 2022; Harman et al., 2018). It is known that in humans, speed qualities are genetically determined. Reducing the motor reaction time, increasing the level of the fastest possible movement, the speed of movement with maximum frequency and the complex execution of one motor movement is a natural process of motor development in childhood and adolescence (Harvey, & Dargvont, 2016).

At the higher sportsmanship stage, the study and improvement of new and effective technologies for the speed development continues. Another aspect of speed is the speed at which movement begins (called "sharpness" in sports practice). In practice, it is the speed of performing a general motor action (running) that is most important. It is important to note that a person's speed abilities are a genetically determined quality and, least of all, undergo significant changes under the influence of purposeful training. As a result, it is of such great importance to study the speed properties of the muscular apparatus of football players in the early training stages, as well as the associated functional characteristics of the athlete's body. Therefore, the football players' speed is considered one of the main points in determining the effectiveness of their sports activities. Incorrect construction at various stages of the training process does not allow many athletes to achieve the level of speed and strength qualities in various competitions (Kryzhevsky, & Mishchenko, 2022). An important condition for the successful improvement of the motor quality of speed is the conduct of additional scientific studies of the body functional systems state and, above all, the cardiovascular and respiratory systems. These systems limit the performance of training work (Bellenger & Buckley, 2021; Guryanov et al., 2022).

The lack of data on an athlete's body physiological parameters can lead to incorrect planning of the training process, which reduces the effectiveness of adapting functional systems to high training loads (Dupuy & Dugué, 2018). It affects the athlete's performance. It is generally believed that in the early stages of sports, a parallel increase in strength, speed, endurance and agility gives significant positive results in the young athletes' training (Drandrov, 2017). Intensive growth of speed and muscle qualities is observed in children and adolescents aged 10-13. At the same time, it is necessary to take into account the structure of a young football player's motor training and the functional system one. At the same time, the scientific literature has not fully studied the relationship between the level of speed development and the state of other motor qualities in 12-13-years-old football players. There is limited information in the scientific literature on the relationship between the level of novice football players' speed development with the state of their functional indicators (Lebediev et al., 2020) and technical readiness. Unconspicuousness or ignoring of these issues by coaches can cause incorrect planning of the annual training macrocycle of athletes, which will reduce the effectiveness of football players' sports training.

Research aim. Establishing the relationship between the level of the state in 12-13-years-old football players with different levels of their speed abilities manifestation basic motor qualities, their cardiorespiratory system and technical readiness.

Material & methods

The research project was carried out in 2022-2023 at the sports base of the institution of additional education in Krasnoyarsk (Russia). The project involved 34 young football players aged 12-13 (12.7 ± 1.1) who have been involved in this sport at the stage of sports specialization for at least 4-5 years. The parents of the teenagers gave their voluntary written consent for the young men to participate in the research project. The conducted survey does not violate the ethical principles of the Helsinki Declaration of 2003. The training process among all football players was carried out according to the federal standard for the sport of football (Federal standard of sports training for the sport "football", approved by order of the Ministry of Sports of Russia dated November 16, 2022, N 1000). The training sessions were conducted 4 times a week for 3 hours.

According to the results of the "speed" motor quality test (the "30 m run" test), all athletes were divided into 2 groups. The first group ($n = 15$) included "fast" young men who showed high results in the "30 m running" test (the range of the indicator value ranged from 5.0 to 5.7 seconds). The second group ($n = 19$) consisted of "slow" football players who showed running speed in the range of fluctuations in the value of the indicator from 5.8 to 6.5 and more s. In addition to the speed test, other motor qualities were evaluated in all young men. To assess the overall endurance, the test "1000 m run, m/s" was used.; coordination skills and agility "shuttle run 10x3, s"; muscle strength of the lower extremities used the test "standing long jump, decimeter"; flexibility "bend forward from a standing position, cm"; muscle strength of the upper extremities "throwing a tennis ball at a range, m"; strength of the trunk muscles was evaluated according to the test results "abdominal crunch, the

number of times". All these indicators are important for determining a person's physical abilities. They may differ depending on the individual characteristics and requirements of the sport. Their assessment allows revealing strengths and creating individual training programs to achieve maximum athletic results.

The functional parameters of the cardiovascular and respiratory systems were studied. To do this, the heart rate was measured at rest for 60 seconds. Systolic and diastolic blood pressure in mmHg was determined using a tonometer at rest. Systolic heart function was assessed by the value of the Robinson index index (Robinson, 1967). The vital capacity of the lungs was measured using an air spirometer, decaliter. The hypoxic resistance of the athletes' body was assessed based on the results of a study of samples of Stange and Genchi, s.

The assessment of the young football players' technical readiness was carried out using The Thefa Soccerstar Challenge tests (Guba, Leksakov, 2018). The following tests were selected: dribbling for 30 yards, s; body rotations with the ball 9 times for 0.5 yards, s; headshot on goal 3 times, the number of goals; kicking the ball with the foot (laces kicks) three times from the right and left sides of the goal, the number of points. Statistical processing of the obtained digital material was carried out using the software product "Microsoft excel", "Statsoft statistica 6.1". The value of the arithmetic mean, its errors and the reliability of the difference in indicators were determined.

Results

A comparative analysis of the results of the motor qualities study in athletes with different levels of their speed development is presented in Table 1.

Table 1. Values of physical fitness indicators for football players with different levels of speed qualities development, $M \pm m$

Tests	"Fast" football players (n= 15)	"Slow" football players (n=19)
1. 30 m standing start run, s	5.44±0.18*	7.02±0.34*
2. 1000 m run, m/s	7:54±1:22*	5:27±0.15:13*
3. Shuttle run 10x3, s	8.0±0.24	9.41±0.86*
4. Standing long jump, decimeter	17.5±1.23	15.14±.1.12*
5. Bend forward from a standing position, cm	12.75±1.10	11.31±0.95
6. Throwing a tennis ball at a range, m	22.4±2.32	15.8±1.87*
7. Abdominal crunch, the number of times	12.75±0.73	11.31±0.67*

* Note. The reliability of the difference in indicators, $p < 0.05$

In six of the seven motor tests, significant differences were found between football players with different levels of speed qualities development, $p < 0.05$. There is no significant difference in the motor quality of flexibility, $p > 0.05$. The analysis of Table 1 indicates that "fast" football players show less successful results in running 1000 m compared to their "slow" running peers 5:27±0.15:13 and 7:54±1:22 m/s, respectively, $p < 0.05$. "This fact may seem unexpected, since usually "fast" players are associated with high physical fitness and the ability to move quickly. However, the results of testing other motor qualities indicate that "faster" football players still have advantages over their "slower" peers. In "fast" athletes, compared with "slow" ones, the values of indicators of coordination abilities and speed (the 10x3 shuttle run test), muscle strength of the lower extremities (the "standing long jump" test), strength abilities of the muscles of the upper shoulder girdle (the "throwing a tennis ball at a range" test) were significantly higher, the muscles of the trunk (the test "abdominal crunch"), $p < 0.05$. The difference in the values of indicators in motor tests for football players with different levels of "speed" motor quality is shown in Figure 1.

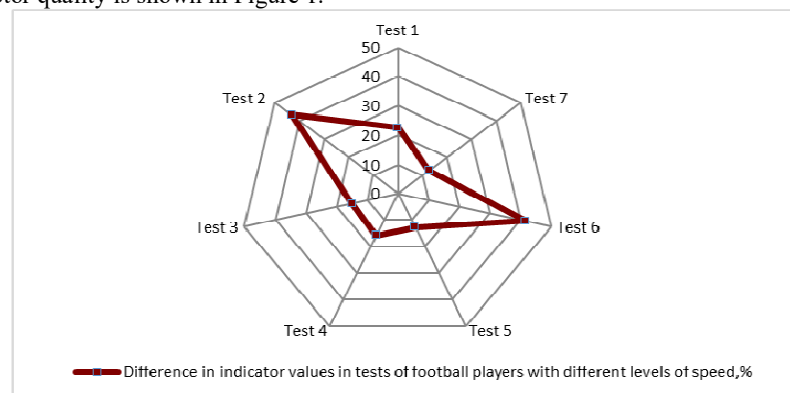
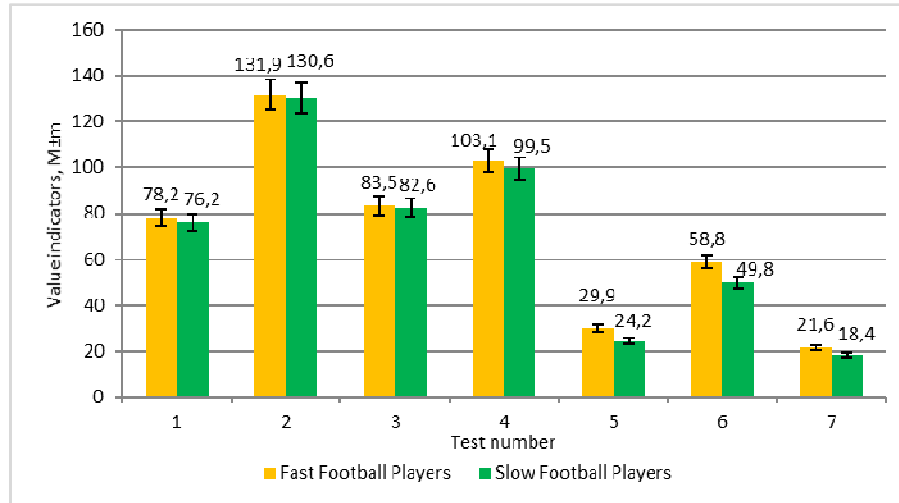


Fig. 1. The difference in the motor test scores values between "fast" and "slow" football players, %

The largest difference in the values of indicators in motor tests between "fast" and "slow" football players was found in test No. 2 ("1000 m run") – 43.1% and test No. 6 ("Throwing a tennis ball at a range") - 41.7%. The difference in other places ranged from 12.7% (test No. 5 and No. 6) to 22.5% (test No. 1).

The analysis of the functional parameters of the cardiovascular system indicates that there are no statistically significant differences between the examined football players of the "fast" and "slow" groups, $p > 0.05$, Figure 2.



Note. 1 – heart rate, beats; 2- systolic blood pressure, mmHg; diastolic blood pressure, mmHg; 4- Robinson index, c.u.; 5- vital capacity of the lungs, dl; 6 – Stange’s test, s; 7- Genchi test, s.

Fig. 2. The value of functional testing indicators of the football players’ cardiovascular and respiratory systems, $M \pm m$

A significant difference between these groups of football players was found in the values of the respiratory system indicators. In comparison with the "slow" athletes, the value of the lung vital capacity index was 23.6% higher, the Stange’s test was 18.1% higher and the Genchi test was 17.4% higher.

To identify the relationship between the motor quality of speed and technical readiness, it was evaluated using tests, Table 2.

Table 2. The value of technical readiness indicators of "fast" and "slow" football players, $M \pm m$

Tests	"Fast" football players (n= 15)	"Slow" football players (n=19)
1. Dribbling for 30 yards, s	4.8±0.78	6.7±1.10*
2. Body rotations with the ball 9 times for 0.5 yards, s	25.5±2.34	19.6±2.13*
3. Headshot on goal 3 times, the number of goals	3.0±0.16	3.0±0.11
4. Kicking the ball with the foot (laces kicks) three times from the right and left sides of the goal, the number of points	16.6±1.78	12.4±1.43*

* Note. The reliability of the difference in indicators, $p < 0.05$

A comparative analysis of the data obtained showed that the "fast" football players had three tests of technical readiness significantly more than the "slow" athletes, $p < 0.05$. There is no difference between the athletes in the test "headshot on goal", $p > 0.05$.

In the tests of technical readiness between athletes with different levels of "speed", the difference in the values of the indicators was in the tests: "dribbling for 30 yards" - 39.5%, "body rotations with the ball 9 times for 0.5 yards" - 30.1% and "kicking the ball three times from the right and left sides of the goal" - 33.8%. The obtained research results indicate that football players with a higher level of the motor quality "speed" development have not only significantly higher values of indicators in motor tests, but also more developed technical readiness, compared with "slow" athletes.

Dicussion

The performance of sports teams in game sports is largely determined by their athletes’ physical and technical fitness (Pietro, Filomena, 2019). In modern football, the technique is characterized by locomotion, which allows significant developing the accuracy and speed of game actions (Hakman et al., 2018). However, to date, some issues related to the assessment of the level of basic motor qualities, functional body systems and

technical readiness of young football players with different speed indicators have not been fully studied. Therefore, this research topic relates to the relevant field of training for novice football players.

The results of the research project obtained by us indicate that football players with well-developed speed qualities have significantly high values of indicators in almost most motor tests. The "fast" athletes turned out to have significantly more developed coordination abilities, strength indicators of the lower and upper extremities muscles. These qualities are important in game sports, including football. Such athletes have the ability to quickly adapt and adapt to various game situations. Our research data are consistent with the results of other authors who observed adult athletes during training (Ceruso et al., 2019) and at the competitive stage (Jaspers et al., 2017). At the same time, according to our data, "fast" football players show less successful results in the motor quality of "endurance" (test "1000 m run") compared to their "slower" running peers. We believe that this issue requires additional in-depth study.

Due to the fact that the athlete's cardiorespiratory system is a limiting one for performing physical activity (Bellenger& Buckley, 2021; Guryanov et al., 2022), we studied the relationship between the level of speed qualities development and the functional state of this system. We have not established reliable differences between the values of the football players' cardiovascular system indicators and the level of their high-speed qualities. We believe that this is due to the athlete performing mainly acyclic physical activities in game sports. These loads in football, unlike cyclical kinds of sport, have the least effect on increasing the reserve capacity of the cardiovascular system. At the same time, positive functional changes have occurred in the young football players' respiratory system. There is a significant increase in the vital capacity of the lungs, hypoxic functional Stange and Genchi tests. The data obtained by us are consistent with the observations results by other researchers (Lebedev et al., 2020). We agree with the authors' opinion that the obtained research results of the cardiorespiratory system indicate optimal physical activity on the body of young football players engaged in accordance with approved standards of football training (Kryzhevsky et al., 2022).

One of the main tasks of coaches of young football players is to develop their physical abilities. According to our data, a more significant development of motor qualities in "fast" football players led to the formation of significantly higher indicators of technical readiness in them compared to "slow" young men. This dependence is registered in other sports (Mischenko et al., 2020).

As part of the training process, coaches pay special attention to the development of the players' speed qualities, both "fast" and "slow". Football is a game where every second can have a decisive impact over the match outcome. Therefore, "fast" young football players can provide a significant advantage for their teams. Speed training includes training for the development of speed qualities such as initial speed, development of maximum speed, acceleration, change of direction and fast starts (Hakman et al., 2018; Sami Sermahaj et al., 2017; Drandrov, 2017). Acceleration, as one of the most important characteristics of speed, is also an important component of training. Acceleration training includes exercises aimed at developing leg power and strength, as well as acceleration techniques. It is also important for fast players to train their ability to change direction quickly. It includes flexibility training, exercises to change direction and change the trajectory of running. However, it is equally important to develop the speed qualities of "slow" young football players. It is important to remember that speed is a relative concept, and each player can develop their potential. Coaches of "slow" players can give them delayed commands so that they have time to make decisions and adapt to the game situation. Thus, the development of speed is an important aspect of the training of young football players, regardless of their initial physical characteristics.

Conclusions

The results of the conducted research project confirm that the manifestation of motor qualities in young football players depends on their speed status. Faster football players outperform their slower peers in most motor tests, with the exception of general endurance. These results indicate that the development of speed abilities is an important aspect of training for achieving athletic success in football, which is confirmed by higher values of technical testing indicators for "fast" football players compared to "slow" ones. The ability to run fast, maneuver, jump and make accurate throws allows a football player to be more efficient and competitive on the field.

The research showed that the heart rate, blood pressure and systolic heart function in 12-13-years-old football players has no statistically significant differences between the groups of "fast" and "slow" athletes. Significantly high rates were noted in the respiratory system in the group of football players with more developed speed qualities.

The acquired knowledge about the peculiarities of the motor qualities, functional indicators and technical readiness manifestation from the level of speed abilities should be used in the educational and training process of young football players. It will allow for more effective training of football players, which will prevent the athletes' re-training, which requires a lot of effort and cost.

Conflicts of interest. The authors declare no conflict of interest.

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