Factor structure of the complex preparedness of young football players 12-13 years old

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How to Cite

Abstract

Purpose: to determine the factor structure of the complex readiness of young football players 12-13 years old based on the level of development of physical qualities, mastery of technical elements and indicators of psychophysiological functions.

Material and methods. Participants: 48 football players 12-13 years old participated in the study of the sports club “Kolos”, Kharkiv, Ukraine. All children started to play football in the age of 10-11, that is, the duration of football classes was 1-2 years. Research methods. The following data were determined: indicators of the level of physical preparedness, indicators of the level of technical preparedness, indicators of the psychophysiological functional state. The structure of complex preparedness was determined using factor analysis (SPSS-17, Dimension Redaction - Factor; Extraction Method: Principal Component Analysis; Varimax with Kaiser Normalization).

Results. In the structure of complex training of young football players aged 12-13, 4 main factors were identified: 1 - "Speed-power and technical training" (30.36% of the total dispersion); 2 - "Attention switching” (20.7% of the total variance); 3 - "Sensitivity of the nervous system" (15.4% of the total dispersion); 4 - "Mobility of the nervous system" (13.9% of the total dispersion).

Conclusions. Speed and strength, technical training in combination with switching of attention and mobility of the nervous system are dominated in the structure of complex training of young football players aged 12-13. The obtained data create conditions for recommendations in the training process of young football players aged 12-13 increase the number of exercises that require the development of speed and strength, technical training in combination with exercises to switch attention.

Keywords: football, training structure, factors, speed and power qualities, technique, attention switching
Анотація

Цеслицька М., Мушкета Р., Бейтка М., Гринь І. Факторна структура комплексної підготовленості юних футболістів 12-13 років

Мета: визначити факторну структуру комплексної підготовленості юних футболістів 12-13 років на основі показників фізичної, технічної підготовленості та показників психофізіологічних функцій.


Результати. В структурі комплексної підготовленості юних футболістів 12-13 років було виділено 4 основних фактори: 1 - «Швидкісно-сила та технічна підготовленість» (30,36% від загальної сумарної дисперсії); 2 - «Перетворення уваги» (20,7% від загальної сумарної дисперсії); 3 - «Чутливість нервової системи» (15,4% від загальної сумарної дисперсії); 4 - «Рухливість нервової системи» (13,9% від загальної сумарної дисперсії).

Висновки. В структурі комплексної підготовленості юних футболістів 12-13 років переважає швидкісно-сила, технічна підготовка у поєднанні з перемиканням уваги та рухливістю нервової системи. Отримані дані створюють умови для рекомендацій в тренувальному процесі юних футболістів 12-13 років збільшувати кількість вправ, що вимагають розвитку швидкісно-силових якостей, технічної підготовленості у поєднанні з вправами на перемикання уваги.

Ключові слова: футбол, структура підготовленості, фактори, швидкісно-силові якості, техніка, перемикання уваги.
Introduction

Football attracts and captures millions of fans [1, 2]. It is recognized as one of the most common sports games [3]. Games on the green field attract both kids and people of a fairly solid age. The diverse impact of football on all functional systems of man and the requirements of football for the development of functional systems [4] indicate the integral impact of football on the body. Modern football is an Olympic sport that requires lightning filigree technique, virtuoso variety of tactics, advanced comprehensive training [5]. That is why at the present stage the training of young football players is of great importance.

Football belongs to sports in which the success of competitive activities depends not only on the development of motor skills, but also on the nervous system, which is reflected in increasing the speed of response to various stimuli, the speed of switching attention [6-8]. In the process of training young football players, the amount of special tools that affect the development of psychophysiological functions is constantly increasing [9]. For rational management of the training process of young athletes it is necessary to have information about the peculiarities of the dynamics of development of physical development, psychological characteristics, physical and technical fitness of players [10-12]. These issues are widely covered in modern scientific research.

Da Silva et al. [13] showed that there are differences in the somatotipological construction in football players of different ages and different regions. Neogi et al. [14] showed the influence of different training systems on the somatic, physiological aspects and indicators of physical and technical fitness of young players.

Duncan et. al [5] found that the best technical skills (passing, dribbling, hitting) in youth football are due to age and a more positive attitude towards the development of individual skills. Therefore, Duncan et. al [5] recommend that coaches avoid one-sided training, paying attention not only to football-type exercises, but also to a number of sports with children aged 8-12. Duncan et. al [5] also recommend creating and strengthening a broad framework for the development of fundamental motor skills and strategies that positively influence a child's perception of competence.

Jagim et. al. [15] showed that subjective perception of exercise intensity can help predict neuromuscular fatigue rates the next day. The authors [15] recommend the use of subjective perception of load intensity for small sports programs, which may not have the resources to purchase modern wearable technogical systems. Internal and external derivatives of training load affect both neuromuscular and subjective indicators of recovery, which should be taken into account when observing athletes. The authors [15] also found that positional differences in mechanical load can occur during the pre-season training period. Therefore, the combination of indicators can provide the most reliable profile of training loads and general recovery indicators.

Thus, for the rational construction of the training process it is necessary to monitor not only the indicators of physical and technical fitness, but also the psychological state, the subjective perception of the load. Currently, psychophysiological indicators have been widely used to monitor the functional state of athletes [16–19]. Computer programs for registration of psychophysiological functions are being developed [20, 21].

However, the question of how to combine the development of psychophysiological functions with the development of technical and physical fitness of young athletes remains unclear. The application of methods of multidimensional analysis of testing indicators of athletes - factor and cluster analysis - has shown high efficiency. Factor analysis allows us to identify hidden relationships between indicators that reflect different aspects of fitness: functional status, psychophysiological functions, technical and physical fitness [22]. Indicators, combining into factors in the degree of interrelationships, allow us to determine what is most important for the studied group of athletes in terms of quantity and quality of relationships with other indicators [22]. Therefore, to determine what is most important for football players aged 12-13, it is necessary to identify the factor structure of the training of young athletes on the basis of extensive testing.

Purpose: to determine the factor structure of complex preparedness of young football players 12-13 years old on the basis of indicators of physical, technical fitness and indicators of psychophysiological functions.

Material and Methods

Participants

48 football players participated in the study 12-13 years old of the spot club “Kolos”, Kharkiv, Ukraine. All children started to play football in the age of 10-11, that is, the duration of football classes was 1-2 years.
Experimental protocol

Initially, the level of psycho-physiological functions, physical and technical preparedness of young football players of 12-13 and 15-16 years at the beginning of the preparatory period of the annual cycle of the training process was determined. Young footballers have been tested for 2 training sessions. On the first day, testing was conducted on the level of technical preparedness. The second day was tested on the level of physical fitness. Psychophysiological testing was conducted on the third day from 17-00 to 19-00.

Determination of the level of physical preparedness

1. Running for 60 m (s)
   This test was conducted on treadmills, running from a high start, the assistant coach gives the team "For start! Warning! Rush! ". And at the finish, the coach with the stopwatch determines the time for which the footballers ran, the races were held by two men.
2. Running for 1000 m (min)
   This running test was carried out at speed and measured by time, the players started on the starting line, on the team "Rush! ", The players began to move, at the finish the final results were fixed assistant coach.
3. Shuttle run 4x30 meters (s)
   Conducting this test was on the football field, it was performed 30x4, that is, you need to run 4 times in 30 meters, the start was arbitrary on the whistle, this test was measured in seconds, you need to run as soon as possible distance.
4. Pull-up (number)
   The test for physical strength, performed very simply, the young athlete approaches the crossbar, he needs to climb on the crossbar. The test is measured in the quantities of correctly executed repetitions.
5. Jump from place (m)
   This test is carried out from place, the player is in front of the line, he has 3 attempts, the best goes off, it is measured in centimeters.

Determination of the level of technical preparedness

1. Juggling ball. The main task of this test, the player needs to fill the ball so that it does not fall to the ground, it is done by the feet, the athlete must fill the ball as many times as possible.
2. Shock on range. Being out of the line of the field, the player must strike the ball from the run as far as the distance, this distance is measured in meters.

Psychophysiological methods

The following parameters characteristic of the psychophysiological state, typological features of the nervous system, indicators of the nervous system efficiency, and attention indicators [21] have been set using the computer program "Psychodiagnostics" (Kharkiv, Ukraine, KhNPU):

- A set of indices for the time of a simple visual-motor reaction (mean of 30 attempts (ms), standard deviation (ms), number of errors); duration of exposure (signal) – 900 ms.
- A set of indicators of a complex visual-motor reaction of selecting 2 element from 3 (mean value of 30 attempts (ms), standard deviation (ms), number of errors); duration of exposure (signal) – 900 ms.
- A set of indicators of a complex visual-motor reaction of selecting 2 elements out of 3 in the feedback mode, i.e. as the response time changes, the signal delivery time changes. The short version is carried out in the feedback mode, when the duration of exposure changes automatically depending on the response of the subject: after a correct answer, the duration of the next signal is reduced by 20 ms, and after a wrong one, it increases by the same amount. The range of the signal exposure change during the test subject’s operation is 20–900 ms, with a pause between exposures of 200 ms. The correct answer is to press the left (right) mouse button while displaying a certain exposure (image), or during a pause after the current exposure. In this test, the time to reach the minimum exposure of the signal and the time of the minimum exposure of the signal reflect the functional mobility of the nervous processes; the number of errors reflects the strength of the nervous processes (the lower these parameters, the higher the mobility and strength of the nervous system). The duration of the initial exposure is 900 ms; the amount of change in the duration of the signals with correct or erroneous responses is 20 ms; pause between the presentation of signals – 200 ms; the number of signals is 50. The indicators are fixed: the average value of the latent period (ms); root mean square deviation (ms); number of errors; duration of exposure (signal); minimum exposure time (signal); time of exposure to the minimum exposure (s).

The indicators of mental working capacity were also determined in accordance with the Schulte test. In this test, the subject needs 5 × 5 tables of 25 digits (from 1 to 25) arranged in a random order, to mark the numbers from 1 to 25. After passing the first table, the second with a different order of digits immediately appears, and so on. In total, the subject passes 5 tables. The reported outcomes were: the time of work on each of the 5 tables (min), the
efficiency of work as the arithmetic average of the
time of operation on 5 tables (min), the performance
of the nervous system as a private time of work on
the 4th and 1st tables, and the workability of the
nervous system as a private work time for the 2nd and
1st tables.

The response time of the selection for the
signals appearing at various points of the screen in a
button selection program ('Ermakov test') was also
determined [21].

Diagnosis of the psychophysiological state
of a person according to the program of measuring
the reaction of choosing a point in space: "Select a
button" ('Ermakov test') (1 series, 15 s).

In this test, the time of the reaction of the
choice of a point in space is measured, which
includes conducting one series or several series of
tests, which according to the algorithm consists of a
sequence of actions:

- on the touch screen of the electronic device,
displays the image of the object for response, and the
object is displayed each time in a new location, the
time interval between the appearance of the object
is not constant;
- response to the appearance of the object on
the screen is carried out by touching the image of the
object,
- Sum up the number of items in each series,
the number of correct touches and the number of
series

Parameters to be recorded: Total test run
time; The total number of correct answers; Number
of errors.

Ethical approval

The research related to human use has been
complied with all the relevant national regulations
and institutional policies, has followed the tenets of
the Declaration of Helsinki, and has been approved
by the authors’ institutional review board.

Informed consent

Informed consent has been obtained from the
participant included in this study.

Table 1

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Descriptive Statistics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Time of simple visual-motor reaction (ms)</td>
<td>389,00</td>
<td>552,00</td>
</tr>
<tr>
<td>Time of reaction of choice of 2 elements from 3 (ms)</td>
<td>483,00</td>
<td>534,00</td>
</tr>
</tbody>
</table>

Results

The digital material obtained during the
study was processed using traditional methods of
mathematical statistics. For each indicator, the
arithmetic mean X, the standard deviation S
(standard deviation), the value Minimum, Maximum,
Variance were determined using the program SPSS-
17 (Descriptive Statistics - Descriptives).

The structure of complex preparedness was
determined using factor analysis (SPSS-17,
Dimension Reduction - Factor; Extraction Method:
Principal Component Analysis; Varimax with Kaiser
Normalization). When conducting factor analysis by
the method of principal components, indicators that
are obviously correlated with each other were
excluded. The following indicators were selected for
factor analysis: Time of simple visual-motor reaction
(ms); Time of reaction of choice of 2 elements from
3 (ms); Mistakes in the test of reaction of choice of 2
elements from 3 in the mode of feedback (number);
Time of minimum signal exposure in the test of
reaction of choice of 2 elements from 3 in the mode
of feedback (ms); Time of exposure to the minimum
exposure in the test of reaction of choice of 2
elements from 3 in the mode of feedback (s); Working
time on the table 2 in the Schult test (s); Reaction
of choosing a point in space: "Select a
button" ('Ermakov test') (the number of correct
touches); Running 60 meters (s); Running for 1000
meters (min); Shuttle run 4x30 meters (s); Pull-
up (number); Jump in length from the place (m);
Juggling ball (number); Shock on range (m).

The results of testing the level of
psychophysiological condition, physical and
technical fitness of young football players aged 12-
13 years showed that most indicators correspond to
the level of training of young athletes aged 12-13
years [4] (Table 1).
### Mistakes in the test of reaction of choice of 2 elements from 3 in the mode of feedback (number)

|        | 19.00 | 28.00 | 24.42 | 2.39 | 5.70 |

### Time of minimum signal exposure in the test of reaction of choice of 2 elements from 3 in the mode of feedback (ms)

|        | 340.00 | 420.00 | 376.67 | 28.38 | 805.67 |

### Time of exposure to the minimum exposure in the test of reaction of choice of 2 elements from 3 in the mode of feedback (s)

|        | 22.00 | 87.00 | 53.08 | 24.07 | 579.48 |

### Working time on the table 2 in the Schult test (s)

|        | 74.00 | 101.00 | 88.67 | 7.66 | 58.61 |

### Reaction of choosing a point in space: "Select a button" (Ermakov test) (the number of correct touches)

|        | 32.00 | 40.00 | 35.83 | 2.10 | 4.40 |

### Running 60 meters (s)

|        | 8.20 | 10.30 | 9.80 | 0.55 | 0.30 |

### Running for 1000 meters (min)

|        | 4.22 | 4.44 | 4.31 | 0.07 | 0.01 |

### Shuttle run 4x30 meters (s)

|        | 35.00 | 55.03 | 42.52 | 5.21 | 27.12 |

### Pull-up (number)

|        | 3.00 | 11.00 | 6.17 | 2.50 | 6.27 |

### Jump in length from the place (m)

|        | 1.45 | 2.43 | 1.67 | 0.26 | 0.07 |

### Juggling ball (number)

|        | 20.00 | 144.00 | 39.17 | 32.63 | 1064.48 |

### Shock on range (m)

|        | 11.00 | 44.00 | 16.83 | 8.48 | 71.97 |

**Table 2**

<table>
<thead>
<tr>
<th>Component</th>
<th>Total</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
<th>Rotation Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% of Variance</td>
<td>Cumulative %</td>
<td>Total</td>
</tr>
<tr>
<td>1</td>
<td>5,421</td>
<td>38,724</td>
<td>38,724</td>
<td>5,421</td>
</tr>
<tr>
<td>2</td>
<td>2,696</td>
<td>19,259</td>
<td>57,983</td>
<td>2,696</td>
</tr>
<tr>
<td>3</td>
<td>1,774</td>
<td>12,675</td>
<td>70,658</td>
<td>1,774</td>
</tr>
<tr>
<td>4</td>
<td>1,348</td>
<td>9,629</td>
<td>80,287</td>
<td>1,348</td>
</tr>
<tr>
<td>5</td>
<td>0.948</td>
<td>6,773</td>
<td>87,06</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>0.784</td>
<td>5,601</td>
<td>92,662</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>0.581</td>
<td>4,147</td>
<td>96,809</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>0.269</td>
<td>1,923</td>
<td>98,732</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>0.105</td>
<td>0,753</td>
<td>99,485</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>0.06</td>
<td>0,43</td>
<td>99,915</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>0.012</td>
<td>0,085</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>-3.60E-17</td>
<td>-2,57E-16</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>-2.54E-16</td>
<td>-1,81E-15</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>-3.78E-16</td>
<td>-2,70E-15</td>
<td>100</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes: Extraction Method: Principal Component Analysis
The first factor (30.36% of the total dispersion) (Table 3) included the following indicators: Running 60 m (s) ($r = 0.97$), Juggling ball (number) ($r = 0.93$), Shock on range (m) ($r = 0.91$), Jump in length from the place (m) ($r = 0.87$), Running for 1000 meters (min) ($r = -0.52$). It should be noted that the first factor includes indicators that reflect the level of speed and strength training (Running 60 meters (s), Jump in length from the place (m)) technical readiness (Juggling ball (number), Shock on range (m)) and overall endurance (Running for 1000 meters (min)). Running 60 meters (s) and Running for 1000 meters (min) were included in the factor with negative correlation coefficients, all other indicators were included in the factor with positive correlation coefficients. The shorter the running time of different distances, the better the level of preparedness. The higher the scores in the tests Juggling ball (number), Shock on range (m) and Jump in length from the place (m), the higher the level of technical training and endurance. Thus, all indicators included in the first factor reflect the level of physical and technical fitness. It should be noted that running at 1000 m reflects the level of overall endurance, and other indicators of this factor in physical fitness reflect the level of speed and strength training. Indicators of endurance and speed-strength training were included in this factor with the coefficients of interrelation of different strength (Table 2). Running time per 1000 m was included in this factor with a correlation coefficient of -0.52 (average relationship), and Running 60 meters (s) and Jump in length from the place (m) were included in this factor according to the correlation coefficients -0.97 and 0.87 (high correlation with the factor) (Table 3). This reflects the physiological mechanisms of energy supply of muscular activity, as endurance and speed-strength training require different mechanisms of energy supply and inclusion of different muscle fibers. But football requires a comprehensive development of endurance and speed and strength. That is why the endurance index was included in this factor not with a small correlation coefficient, but with an average one. In addition, this factor included indicators of technical readiness (Shock on range (m) and Juggling ball (number)) with high correlation coefficients (Table 3). This is a reflection of the fact that in football, speed training and technical skills are closely linked. Based on the data obtained, the first factor was called "Speed and power and technical training."

The second factor (20.7% of the total variance) includes such indicators as Time of simple visual-motor reaction (ms) ($r = -0.92$), Shuttle run 4x30 meters (s) ($r = -0.86$), Working time on the table 2 in the Schult test (s) ($r = -0.66$), Reaction of choosing a point in space: "Select a button" ('Ermakov test') (the number of correct touches) ($r = 0.61$) (Table 3). It is easy to note that the indicators included in the second factor mainly reflect the level of reaction rate (Time of simple visual-motor reaction (ms)), switching of attention (Working time on the table 2 in the Schult test (s), Reaction of choosing a point in space: "Select a button" ('Ermakov test') (the number of correct touches)) and dexterity (Shuttle run 4x30 meters (s)). It should be noted that the Time of simple visual-motor reaction also partially determines the level of attention switching. In addition, the Shuttle run time of 4x30 meters (s) is also determined by the speed of the
simple reaction and the level of attention switching, because in this test you need to react quickly to the signal to move and quickly switch from one running direction to another. Based on the data obtained, the second factor was called "Attention Switching".

The third factor (15.36% of the total variance) included such indicators as Mistakes in the test of reaction of choice of 2 elements from 3 in the mode of feedback (number) ($r = 0.93$) and Time of reaction of choice of 2 elements from 3 (ms) ($r = 0.78$) (Table 3). Mistakes in the test of reaction of choice of 2 elements from 3 in the mode of feedback (number) is a reflection of the strength and sensitivity of the nervous system: the fewer errors, the higher the strength of the nervous system; the greater the number of errors, the higher the sensitivity of the nervous system. The reaction time of the choice of 2 elements from 3 (ms) is also an indirect reflection of the sensitivity of the nervous system. Since all these indicators were included in the third factor with positive correlation coefficients, we regarded the third factor as a reflection of the sensitivity of the nervous system, i.e. quality, the opposite of the strength of the nervous system. Therefore, the third factor was called "Sensitivity of the nervous system."

The fourth factor (13.87% of the total variance) includes the following indicators: Time of minimum signal exposure in the test of reaction of choice of 2 elements from 3 in the mode of feedback (ms) ($r = -0.93$), Pull-up (number) ($r = 0.78$) (Table 3). Time of minimum signal exposure in the test of reaction of choice of 2 elements from 3 in the mode of feedback (ms) reflects the mobility of the nervous system. Pull-up (number) indicates the force. We took as a basis for the name of this factor indicator Time of minimum signal exposure in the test of reaction of choice of 2 elements from 3 in the mode of feedback (ms), since the correlation coefficient with the factor Time of minimum signal exposure in the test of reaction of choice of 2 elements from 3 in the mode of feedback (ms), since the correlation coefficient with the factor Time of minimum signal exposure in the test of reaction of choice of 2 elements from 3 in the mode of feedback (ms) is higher than the indicator Pull-up (number). And so the fourth factor was called "Mobility of the nervous system."

### Table 3

Rotated Component Matrix of test indicators for physical, technical preparedness and psychophysiological state of young football players 12-13 years old (n=48)

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Rotated Component Matrix(a)</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running 60 meters (s)</td>
<td>-0.965</td>
<td>1</td>
</tr>
<tr>
<td>Juggling ball (number)</td>
<td>0.925</td>
<td>2</td>
</tr>
<tr>
<td>Shock on range (m)</td>
<td>0.908</td>
<td>3</td>
</tr>
<tr>
<td>Jump in length from the place (m)</td>
<td>0.873</td>
<td>4</td>
</tr>
<tr>
<td>Running for 1000 meters (min)</td>
<td>-0.518</td>
<td></td>
</tr>
<tr>
<td>Time of simple visual-motor reaction (ms)</td>
<td>-0.916</td>
<td></td>
</tr>
<tr>
<td>Shuttle run 4x30 meters (s)</td>
<td>-0.864</td>
<td></td>
</tr>
<tr>
<td>Working time on the table 2 in the Schult test (s)</td>
<td>-0.655</td>
<td></td>
</tr>
<tr>
<td>Reaction of choosing a point in space: &quot;Select a button&quot; (Ermakov test) (the number of correct touches)</td>
<td>0.607</td>
<td>0.574</td>
</tr>
<tr>
<td>Mistakes in the test of reaction of choice of 2 elements from 3 in the mode of feedback (number)</td>
<td>0.894</td>
<td></td>
</tr>
<tr>
<td>Time of reaction of choice of 2 elements from 3 (ms)</td>
<td>0.874</td>
<td></td>
</tr>
<tr>
<td>Time of minimum signal exposure in the test of reaction of choice of 2 elements from 3 in the mode of feedback (ms)</td>
<td>-0.931</td>
<td></td>
</tr>
<tr>
<td>Pull-up (number)</td>
<td>0.782</td>
<td></td>
</tr>
</tbody>
</table>

Discussion

The purpose of this study was to determine the structure of training of young football players aged 12-13, taking into account the indicators of the level of technical skills of physical qualities and psychophysiological condition. We determined the factor structure of complex training of young football players aged 12-13, with the main factors in terms of quantity and quality of interrelations formed indicators of speed and strength, attention switching, sensitivity and mobility of the nervous system.

We believe that such a structure of training of young football players aged 12-13 is provided by their age characteristics. This is consistent with current research. It is during this period that the intensity of physical development, reaction speed, and cognitive functions of children aged 12–13 increases.

Adolescence is the first transition period from childhood to adulthood. Qualitative changes taking place in the intellectual and emotional spheres of the adolescent's personality (intensive, uneven development and growth of the organism, personal characteristics, etc.) create a new level of self-awareness, the need for self-affirmation, equal and trusting communication with peers and adults.

This age is a sensitive period for the development of speed, agility. This is reflected not only in the development of physical qualities, but also psychophysiological functions. The results obtained by us on the peculiarities of the factor structure of training of young football players aged 12-13 confirm the position of the relationship of psychophysiological functions with the level of development of physical qualities and technical skills. The findings also confirm the results of studies that revealed the effects of various training programs on the level of physical and technical fitness of young football players [4, 23–25], as well as anthropometric indicators [4, 13].

In our study, young football players trained using standard programs for football players of the corresponding age. In both age groups, there was a positive dynamics of the relationship of psychophysiological indicators with indicators of physical and technical readiness. However, in the age group of 15–16 years, a change in the quantity and quality of the interrelations studied during 3 months of training is more pronounced than in the age group of 12–13 years. This may be due to the age characteristics of young football players, since in 15–16 years there is some mismatch in the interaction of various functions due to puberty, the change in psycho-physiological functions occurs faster than in older ones [20, 21].

In studies Mikheev et. al. [26] it was shown that the development of speed abilities is associated with an increase in myelination of nerve fibers and an increase in the amount of white matter in the brain, which contributes to an increase in the rate of impulse transmission along the nerve pathways. An increase in the reaction rate in various test modes is also due to an increase in the rate of impulse transmission through the nerve fibers. In this regard, we can conclude that by the age of 15-16 a specific neurodynamic type of football player is formed, which is characterized by a high level of neurodynamic processes in combination with a high level of development of speed and speed-power capabilities.

Due to the interrelationships between psycho-physiological indicators and indicators of physical and technical preparedness, in the training process of young football players should pay attention to the development of reaction speed, speed of switching attention, speed of thinking in combination with the development of speed and speed-power qualities in physical training. This leads to an intensification of the processes of conducting the impulse along nerve fibers, and increasing the speed of response to various signals [27–29].

Relatively new knowledge obtained in our study is the identification of hidden relationships between indicators of psychophysiological functions and indicators of physical and technical readiness.

Recommendations

Based on the obtained data, it is possible to give recommendations in the training process of young players to focus on the development of qualities that require the activation of psychophysiological functions, especially - the reaction rate, the speed of switching attention, mental performance, etc. Psychophysiological functions are largely hereditary, and their development is difficult, therefore, emphasis should be placed on their development, since in adults the level of psychophysiological functions is more difficult to develop that can play a decisive role in improving the athlete in football.

Conclusions

1. In the structure of complex training of young football players aged 12-13, 4 main factors were identified: 1 - "Speed-power and technical preparedness" (30.36% of the total variance); 2 -
"Attention switching" (20.7% of the total variance); 3 - "Sensitivity of the nervous system" (15.4% of the total variance); 4 - "Mobility of the nervous system" (13.9% of the total variance).

2. The first factor includes indicators: Running 60 m (s) (r = -0.97), Juggling ball (number) (r = 0.93), Shock on range (m) (r = 0.91), Jump in length from the place (m) (r = 0.87), Running for 1000 meters (min) (r = -0.52). The second factor included indicators: Time of simple visual-motor reaction (ms) (r = 0.92), Shuttle run 4x30 meters (s) (r = -0.86), Working time on the table 2 in the Schult test (s) (r = -0.66), Reaction of choosing a point in space: "Select a button" ('Ermakov test') (the number of correct touches) (r = 0.61). The third factor included indicators: Mistakes in the test of reaction (number) (r = 0.93) and Time of reaction (ms) (r = 0.78). The fourth factor includes indicators: Time of minimum signal exposure in the test of reaction of choice of 2 elements from 3 in the mode of feedback (ms) (r = -0.93), Pull-up (number) (r = 0.78).

3. The structure of complex training of young football players aged 12-13 is dominated by speed and strength, technical training in combination with exercises to switch attention.

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Conflict of interest

The authors declare that there is no conflict of interest.

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