NORMATIVE FRAMEWORK FOR CONTROL AND OPTIMIZATION OF THE PHYSICAL DEVELOPMENT AND SPECIFIC WORKING CAPACITY OF 17-19-YEAR-OLD HANDBALL PLAYERS

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ABSTRACT

The purpose of this study is to reveal the average level and variability of the signs of physical development and specific working capacity of 17-19-year-old Bulgarian handball players and, on this basis, to develop an up-to-date norm framework for control and optimization of sports training in the studied age group. The object of the study is the characteristics of physical development, specific physical fitness, technical and tactical skills, and some mental characteristics. The research was done among 115 handball players between the age of 17 and 19 from the top 10 teams, participating in the national championship for juniors under 19 years old. Anthropometric measurements and sports-pedagogical testing were conducted for the needs of the study with a total of 34 indicators for establishing the level of physical development, specific physical and technical-tactical preparation and some mental characteristics and qualities of the handball players of the studied age group. The following research methods were applied to solve the purpose and tasks of the research: review study and theoretical analysis of the specialized literature, anthropometry, manual dynamometry, sports-pedagogical testing and ascertaining psychological experiment. Frequency analysis and descriptive statistics, sigma estimation method, and index method were used for mathematical-statistical data analysis. The applied approach allowed developing normative tables for evaluation of the results of each competitor or team, based on which, person or team optimization models could be developed, revealing both strengths and weaknesses in their preparation.

Key words: handball, adolescents, physical development, specific working capacity, control, optimization

INTRODUCTION

Control is part of a person's cognitive activity (Zhelyazkov, Dasheva, 2017) or a cognitive process (Brogli, 2012), during which information is collected and the current state of an object (system) is assessed in view of the purposefully (pre-planned) development and perfection.

The main factors of sports achievement, which are related to the basic parameters (signs, qualities, properties) of human motor skills, are the object of control (Brogli, 1991). Permanent monitoring and evaluation of the state of preparation of the competitors and the teams, allows making timely adjustments of

the training programs to improve the training process and to increase the level of specific working capacity (Tzarova, 2013).

In 1982, for the purposes of controlling physical, technical, and tactical preparation, Krastev and Nikolaev, developed the Handball Program, providing a regulatory framework for the evaluation of children from mini-handball groups, boys, girls, and adolescents. However, this norm framework is very old - it was developed more than 35 years ago.

A System for control and evaluation of the training process of handball player is developed in the current Unified Handball Program (Krastev, Varbanov, 2014). This System al-

lows the assessment of sports working capacities, based on 9 indicators, to be made, but the 3-point rating scale greatly limits coaches in their attempts to obtain a more accurate assessment of the state of the various signs of their players' training. The monitoring of the dynamics of the basic parameters of the specific current working capacity, as well as the comparative analysis of the results of the students from the 5th to the 12th grade with the Handball profile in Bulgarian sports schools, allows Chaney (Tzarova et al., 2012) to develop a system for evaluation of sports' preparation. This enables teachers and coaches to manage the training process of their players, but the used test battery includes only 7 indicators, and a 16-point rating scale is applied, which also imposes some limitations.

We think that such studies are much more valuable when control is exercised on all aspects of sports training, and especially when it concerns youth players from our age group (17-19-year-old) who are a reserve of high sports performance. Moreover, the used evaluation scale needs to be more sensitive, like the 50-point one we decided to use (Chaney, 2017), which sequentially allows smaller differences in the level of development of each of the observed signs to be correctly evaluated and compared.

It is correct to also note the scientific articles of Nikolaev (1978), Krastev and Nikolaev (1982), Avramov (2007, 2015), Valkov (2011), but in them the normative tables also include a smaller number of indicators or are aimed at younger age groups.

From the theory of sports science (Zhelyazkov & Dasheva, 2017) we know that depending on the current state of the parameters for which the relevant indicator carries information, with the same amount of training work, a different increase in the results on the indicators can be obtained. The reason for this

is that the adaptation process is a nonlinear function of physical activity, i.e., dose-effect dependence develops in the so-called logistic curve. Therefore, the higher the level of development of this trait, i.e., the better the achievement, the less growth can be expected on it per unit of training work. This suggests that it is more correct in the training process to focus on improving the performance of those indicators that have a lower level at the time of preparation in the future, i.e., a lower value of the calculated by the normative framework T.

According to Zhelyazkov (1978) and Tzarova (2013), establishment of the similar norm framework is one of the most important circumstances for optimizing sports training and will certainly assist sports specialists with the preparation of young players. The authors believe that deriving the factor weights of the variables and revealing of the factor structure of the sports preparedness enable the optimization of the training in a strategic aspect (depending on the importance of separate performance variables), while evaluating the results through tables of norms allows for tactical (ongoing) optimization of the training, depending on the current level of preparation.

The study of literary sources allowed the following *work hypothesis* to be formulated:

The generation of up-to-date information on the state of the physical development, the physical fitness and the specific technical-tactical preparedness and the mental qualities of the best Bulgarian handball players from the age group 17-19 years will make it possible to develop an up-to-date regulatory basis with high sensitivity (50-ball evaluation scale) for control on a large number of indicators, which will allow the coaches to gain information both for the well-developed and for the weakly developed qualities and skills of their athletes and to develop mechanisms for optimizing the future training process of all

sides of the sports training.

Therefore, *the purpose of this study* is to reveal the average level and variability of the signs of physical development and the specific working capacity of 17-19-year-old Bulgarian handball players and, on this basis, to develop an up-to-date norm framework for control and optimization of sports training in the studied age group.

METHODS

This study was conducted from 2014 to 2017. The subject of the research is handball among adolescents. The object of the study is the parameters of physical development, special physical preparation, specific technical and tactical skills, and some mental characteristics.

The subject of research were 115 students from the second educational level (10th, 11th, and 12th grade) from Bulgarian schools, training in an organized way handball in 10 Sports Handball Clubs, whose teams won the right to participate in the Bulgarian National Championship for juniors under 19 in 2017. The surveyed sample represents 87% of the total population (participants in the National Championship), which is a guarantee for high statistical reliability of the obtained results. The average age of the general totality is 18 years.

The sport-pedagogical testing of the players, taking part in the research, was conducted in the period of 1-1.5 months before the finals of the National Championship`2017 (in May) in the time of 2 training activities for each of the teams. Each player participated in the testing voluntarily – at the beginning of the sports-competition year, each handball player signs a document for informed consent for participation in the training process, including in various medical and sports-pedagogical research such as our testing. For eliminating the risks of injuries, before the start of the specific test exercises, a standard warm-up of the play-

ers was conducted.

The applied methodology is borrowed from another scientific research (Chaney, 2017), aiming to reveal the age peculiarities in the development of the specific working capacity of adolescent Bulgarian handball players, successfully defended before the Scientific Jury for awarding the educational and scientific degree “Ph.D.”.

The following research methods were applied to accomplish the goal and tasks of the research:

1. *Survey and theoretical analysis* of the specialized literature.

2. *Anthropometry* - information was collected along 10 anthropometric indicators (from 1st to 9th and 12th - Table 1) at the beginning of the first training activity for each of the teams. Measurements were made with the use of standard instruments (Silver Crest, GPM - Swiss Made and Silver Crest - Germany) and standard methods (Slanchev et al., 1992). For more complete characteristics of physical development, the so-called Body Mass Index (BMI) recommended by the World Health Organization (Petkov, Toteva, Maznev and Dimitrova, 2012) was calculated.

3. *Manual dynamometry* - for measuring the grip strength of both the comfortable and the uncomfortable upper limb (Table 1 - indicators 10 and 11), using the so-called manual dynamometer (Drp 90 - URSS), according to the standard procedure of Slanchev et al. (1992);

4. *Sports-pedagogical testing* - for determining of the level of development of the special motor and specific technical and tactical preparation. The test battery includes 14 sports-pedagogical tests (Table 1), divided into two groups:

- *for special fitness* - 8 tests (indicators 14 to 21);
- *for specific technical and tactical prepara-*

tion - 6 tests (indicators from 22 to 27).

The testing on the indicators, characterizing the special physical fitness (from 14th to 21st), was made in the time of the first training activity for each of the teams, after measuring

the anthropometric indicators. The tests, characterizing the specific technical and tactical preparedness (indicators from 22 to 27) was made during the second training activity for each of the teams, after the psychological tests.

Table 1. List of the indicators of the physical development and the specific working capacity of the handball players

Nº	Variables	Measure units	Precision	Growth direction
1.	Height	cm	1,0	+
2.	Height with arms outstretched	cm	1,0	+
3.	Stretch (horizontal)	cm	1,0	+
4.	Length of upper limb	cm	1,0	+
5.	Length of lower limb	cm	1,0	+
6.	Span length	cm	0,5	+
7.	Span width	cm	0,5	+
8.	Breaststroke - Pause	cm	1,0	+
9.	Breathing difference	cm	1,0	+
10.	Strength of comfortable upper limb	kg	0,1	+
11.	Strength of uncomfortable upper limb	kg	0,1	+
12.	Weight	kg	1,0	
13.	Body Mass Index	kg/m ²	0,01	+
14.	20 m sprint	s	0,01	-
15.	Running around stands	s	0,01	-
16.	Long jump from place	m	0,05	+
17.	Triple jump from place	m	0,05	+
18.	Vertical bounce	cm	0,5	+
19.	Vertical bounce after reinforcement	cm	0,5	+
20.	Crunches	number	1,0	+
21.	Shuttle - 10 x 15 m	s	0,01	-
22.	Dribbling around stands	s	0,01	-
23.	Ball dribbling index	s	0,01	-
24.	Throwing handball ball in length	m	0,5	+
25.	7-meter throw in goal - % successful	%	0,01	+
26.	Long jump throwing the ball - % successful	%	0,01	+
27.	Moving in defence	s	0,01	-
28.	Coordination-motor test - t	s	0,01	-
29.	Coordination-motor test - errors	N	1,0	-
30.	Coordination-motor test - coefficient	s	0,01	+
31.	Black and red Schulte table	s	0,01	-
32.	Short-term memory test - t	s	0,01	-
33.	Short-term memory test - replied	number	1,00	+
34.	Short-term memory test - coefficient	s	0,01	-

The sports-pedagogical tests are applied as follows:

- *Indicator 14 (20 m sprint)* – From the starting position a high start, the player runs at a maximum speed a distance of 20 m. He starts after a whistle signal. The result is read with an accuracy of 0.01 s. Two runs are performed and the better achievement is respected.

- *Indicator 15 (Running around stands)*

– Eight running is performed between two cones, located at a distance of 15 m from each other. The player starts optionally (left or right) after a whistle signal. Two experiments are performed, taking into account the better achievement, with an accuracy of 0.01 s (*Figure 1*).

Figure 1. Running and dribbling around the stand

- *Indicator 16 (Long jump from place)*
 - From the starting position - standing with arms forward and upwards (feet slightly open, located on one line), squatting is performed, combined with swinging the arms through the bottom to the back, followed by reversing the arms and bouncing the length of two legs with an aim to land as far as possible. The distance from the starting line to the last mark left by the jumper's feet is recorded to the nearest 1.0 cm. Two attempts are performed, respecting the better achievement.

- *Indicator 17 (Triple jump from place)* - Starting position - standing with hands up, feet slightly apart, located in a line. A swing of the arms through the front and bottom to the back is performed, combined with springing of the legs, followed by a reverse swing of the arms through the bottom to the front and up and a bounce from both legs (simultaneously). The player lands first on one foot, then on the other, and finally lands on both feet. The distance from the starting line to the last track left by the jumper is recorded to the nearest 1.0 cm. Two attempts are made. The better achievement is respected.

- *Indicator 18 (Vertical bounce)* – The test is performed next to a wall (or a lath), delineated by every centimeter. The player stands with his face close to it, without taking his heels off the floor, and stretches his most comfortable hand up the wall (lath). The height reached point (h) is read, to the nearest 0.5 cm. Then he makes a maximum bounce of two legs from

a place. Preliminary swinging of the arms and springing of the legs is allowed, but without separating the feet from the floor. At the highest point of the vertical bounce, the fingers of the hand touch the wall (lath) and the height reached (H) is measured with an accuracy of 0.5 cm. As a final result of the test, the value $X = H - h$ is calculated.

- *Indicator 19 (Vertical bounce after reinforcement)* – The preparation and reporting of the result is as in indicator 18, but the player stands at a distance of 2.5-3 m from the place of rebound, performs 3 running steps and bounces in the vertical direction of one leg, with a strive to reach maximum height.

- *Indicator 20 (Crunches)* - It works in pairs. The performer is in the initial position, lying on the floor (occipital position) with knees bent at 90°, feet spread shoulder-width apart, hands placed on the nape of the neck with elbows to the side. The partner holds the ankles and fixes the feet to the floor. The player performs lifts to the seat position, with the forehead trying to touch the knees. There should be a fist distance between the chin and the chest at all times. The elbows remain directed to the side. The number of correctly performed abdominal presses for 30 s is reported.

- *Indicator 21 (Shuttle - 10 x 15 m)* – The player stands on the starting line in the high start position. After a sound signal, he performs sprints with a change of direction along a section with a length of 15 m. The corresponding line must be stepped before each turn. There

are 5 cycles “going - returning”. The time is recording with an accuracy of 0.01 s.

- *Indicator 22 (Dribbling around stands)*

– The test is the same as at indicator 15 (see Figure 1), but the exercise is performed with a dribble.

- *Indicator 23 (Ball dribbling index)* – The results for this indicator are calculated as the difference between the achievements of each handball player in test 22 and test 15.

- *Indicator 24 (Throwing handball ball in length)* – Starting position standing, the ball is held with both hands in front of the body. The player carries the ball over the shoulder, combined with one step back with the foot of the same name on the throwing hand, and the center of gravity is transferred to it. This is followed by a sharp movement of the leg and arm in the opposite direction, followed by throwing the ball lengthwise. Two experiments are performed, respecting the better achievement, with an accuracy of 0.5 m.

- *Indicator 25 (7-meter throw in goal - % successful)* – A number of six 7-metres throws are performed, as, at the first 4, the ball is directed consistently to the each of the squares

(measuring 50 by 50 cm), putting in each corner of the door. For the last 2 throws the player can choose the corner. The final result is calculated like the percentage (%) of successful hits.

- *Indicator 26 (Long jump throwing the ball - % successful)* – A number of six throws are performed with a rebound in length after a deceptive movement (a feint) to the free hand against a cone, placed directly against the door of the free throw line. The final result is calculated like the percentage (%) of successful hits.

- *Indicator 27 (Moving in defence)* – The player performs moving in defense position of the body around an isosceles triangle with a base of 4 m and a thigh of 3 m. Cones are placed at each corner of the triangle (Figure 2). He starts after a whistle signal and performs a lateral movement along the base of the triangle to the right, a sharp change of direction and return to the starting position, an attack forward to the right to the top of the triangle and a movement back and right to the it base. The route is passed without interruption. Two attempts are made. The better performance is reported, with accuracy of 0.01 s.

Figure 2. *Moving in defence*

5. *Ascertaining psychological experiments*

- to establish some psychological abilities and qualities, at the beginning of the second training activity for each of the teams, the psychological tests were performed. Appropriate test methodologies (Table 1 - indicators 28 to 34) are applied as follows:

- *Indicators from 28 to 30 (Motor coordination test)* - after signal, the players try for the shortest time to draw a continuous line (with a pencil) from the entrance to the exit of the labyrinth drawn on a sheet of paper. The time for passing through the labyrinth and the number of mistakes are taken into account and on this basis the so-called coordination-motor coefficient is extracted, which represents the average time (in seconds) for one error;

- *Indicator 31 (Black-and-red table)* - black-and-red digital tables (a modified version of Schulte's methodology) are used. The work is carried out in a group. After a signal, the players find the numbers written in the colour indicated by the researcher (black or red), in a sequential order from 1 upwards, and write in a special form the letters in the lower corner of the square of each number, trying to reach as fast as possible to 24. The time for detecting all digits of the respective colour shall be recorded, with an accuracy of 0.01 s. Then the table is inverted, and the procedure is repeated. The evaluation takes the better achievement;

- *Indicators from 32 to 34 (Short-term memory)* - the test consists of nine geometric signs as substitution incentives. The subjects examine and memorize the signs for 30 s. Then, for an unlimited time, they reproduce the received information on a special form. The time for filling in the entire form (indicator 32) is reported, with an accuracy of 0.01 s, as well as the number of errors. Based on this, the number of correct answers is calculated (indicator 33), as well as the short-term memory ratio (STMCo - indicator 34), according to the

following formula (1):

$$(1) \text{ STMCo} = t / \text{number of correct answers} * 75$$

The results of the study were subjected to *mathematical and statistical* processing by:

1. *Frequency analysis* - to establish the relative shares (in %) of the successful hits in the door when performing 7-meter throws from place and with rebound in length.

2. *Descriptive statistics* - to determine the average levels and variability of the studied variables total for the whole group observed.

3. *Sigma evaluation method* - for quantitative assessment of the condition of the measured features. Based on the average level, a normative table was designed for the whole population (17-19-year-old handball players), which makes it easy and quick to evaluate each individual or team result. The T scores are normalized values presented in our research in a 50-point scoring system that allows comparisons to be made of scores across differently sized tests and indicators (measured in s, m, cm, kg, number, %, etc.). The average of the whole population corresponds to 25 points. In cases where a lower quality score for a given variable corresponds to a higher quality (for example, time to travel a given distance), the rating scale is reversed. In our case, this was done along 11 of the examined indicators. For each competitor, the so-called summary score, as an average sum of his grades on all indicators, which bears information on his level of physical development and specific performance and can be considered as an analog of his fitness ($\Sigma T_{\text{average}} = \Sigma T_{1-34} / 34$). The procedure for applying the sigma estimation method is completely correct, since the shape of the distribution of our traits, with few exceptions, is close to the so-called normal Gauss-Laplace distribution. This was confirmed by the calculated values of the asymmetry coefficients (As) and kurtosis (Ex).

4. *Index method* - for calculating the so-

called Body Mass Index (BMI) with the following formula (2):

$$(2) \text{ BMI} = \text{Weight (kg)} / \text{Height (m)}^2$$

For the qualitative evaluation of body mass indexes of our handball players, we used the adapted table of Slanchev et al. (1992) for the diagnosis of obesity.

RESULTS

The processing of the collected information, with the help of descriptive statistics, allowed gaining an idea of the average level and variability of the basic signs of physical development, the specific physical and technical-tactical preparation, as well as the stud-

ied psychological abilities and qualities of the surveyed Bulgarian handball players (Table 2).

The analysis of the first group of indicators (from 1 to 13) provided information about the physical development of the handball players. The average height of the surveyed players was 178.36 cm, and the average weight was 74.05 kg. The estimate body mass index calculated was generally around normal body mass ($\text{BMI} = 23.32 \text{ kg/m}^2$). However, a detailed observation on the individual values of the index showed that 13% of the surveyed Bulgarian handball players competing in the age group up to 19 years were overweight, and another 3.50% were obese (Figure 3).

Figure 3. Relative shares of the degree of obesity

Table 2. Mean values and variability of the indicators of the physical development and the specific working capacity of the 17-19-year-old handball players

№	Variables / Parameters	Mean	S	V	min	max
1.	Height	178.36	6.27	3.52	159	195
2.	Height with arms outstretched	230.42	8.95	3.89	197	254
3.	Stretch (horizontal)	180.99	6.76	3.73	154	200
4.	Length of upper limb	77.59	3.29	4.24	67	85
5.	Length of lower limb	101.35	4.68	4.62	88	114
6.	Span length	19.05	1.18	6.19	17	23
7.	Span width	23.29	1.37	5.88	21	26.5
8.	Breaststroke - pause	93.59	6.65	7.10	76	119
9.	Breathing difference	6.15	1.29	20.99	3	11
10.	Strength of comfortable upper limb	52.83	8.92	16.89	30	80
11.	Strength of uncomfortable upper limb	46.46	8.32	17.90	25	69
12.	Weight	74.05	11.47	15.49	45	118
13.	Body Mass Index	23.32	3.26	13.98	17.79	34
14.	20 m sprint	3.35	0.21	6.14	3.92	2.82
15.	Running around stands	6.90	0.57	8.20	8.64	5.88
16.	Long jump from place	2.34	0.20	8.36	1.8	2.75
17.	Triple jump from place	6.79	0.61	8.94	5.2	8.3
18.	Vertical bounce	48.17	5.83	12.11	32	68
19.	Vertical bounce after reinforcement	57.34	6.82	11.90	39	74
20.	Crunches	24.95	2.90	11.64	16	32
21.	Shuttle - 10 x 15 m	34.56	1.70	4.92	41.66	31.22

22.	<i>Dribbling around stands</i>	7.58	0.77	10.11	10.4	6.08
23.	<i>Ball dribbling index</i>	0.67	0.36	52.97	2.73	0.04
24.	<i>Throwing handball ball in length</i>	35.23	4.03	11.44	25.5	44
25.	<i>7-meter throw in goal - % successful</i>	48.21	17.26	35.80	17	100
26.	<i>Long Jump Throw - % successful</i>	48.47	12.57	25.94	17	83
27.	<i>Moving in defence</i>	11.02	0.68	6.16	12.56	9.05
28.	<i>Coordination-motor test - t</i>	111.32	27.32	24.54	209	53
29.	<i>Coordination-motor test - errors</i>	18.11	12.27	67.75	2	69
30.	<i>Coordination-motor test - coefficient</i>	11.07	11.70	105.68	1.17	51.25
31.	<i>Black and red Schulte table</i>	114.39	24.88	21.75	202	59
32.	<i>Short-term memory test - t</i>	197.77	23.40	11.83	272	126
33.	<i>Short-term memory test - replied</i>	69.21	6.58	9.50	38	75
34.	<i>Short-term memory test - coefficient</i>	217.13	38.86	17.90	127.7	404.27

As we can see from Figure 3, the relative share of those who were underweight (12.20%) is very close to that of overweight boys.

Connected to the study is indicator 9, which carries information about the functional capacity of the chest, the variation table shows that the average life expectancy for the whole group was 6.15 cm. At the same time, however, in the group there were both boys with a respiratory difference of only 3 cm and others with almost 4 times higher values (11 cm).

All this, quite naturally, affects the variability of the studied groups in terms of respiratory volume of the chest, an indicator that is extremely important for the coach because it carries information about the ability of athletes to support volume training loads.

The second group of indicators (from № 14 to № 21) provides information about the level of special physical fitness of the studied handball players. The analysis showed that the physical abilities of boys, in general, were quite close, although among them there were some whose achievements were twice lower than the achievements of the best players. For example, with an average vertical rebound of 48.17 cm for the group, the highest level of development of the explosive strength of the lower extremities in vertical muscular effort was demonstrated by A. N. (18 years old), who reached 68 cm. The lowest level of development of this important motor quality for

handball was reported in H. L., who reached only 32 cm.

As shown in Table 2, the studied handball players made an average of 24.95 lifts sit-up for 30 seconds.

The third group of indicators (from № 22 to № 27) provides information about the level of specific technical and tactical training of young handball players. It is noticeable that some competitors showed a small difference between the achievements in crossing the route on Figure 1, with running (indicator 15) and with dribbling the ball (indicator 22). The evidence is the value of $X_{\max}$ at indicator 23, which was only 0.04 s. But, at the same time, in the group there was a boy who covered the distance with the ball 2.73 s ($X_{\min}$) slower. That means, the surveyed handball group was heterogeneous concerning the ability to move on the field with a ball, as evidenced by the high coefficient of variation ($V_{23} = 52.97\%$).

The analysis of indicators 25 and 26 that showed the efficiency of throwing the ball into the goal (see Table 2) from 7-meter and in throwing with a rebound in length was almost the same (respectively 48.21% and 48.47%).

The first three indicators for the fourth group are shown in Table 2. They reveal the level of the psychological qualities, carrying information about the coordination-motor abilities of the young handball players. Based on the obtained individual results, the relative

shares of the level of development of these important for sports games abilities of the organism were determined (Figure 4).

It is clear from the figure that more than half of the surveyed players (56.52%) had a good level of development of coordination skills. Very good and high level was observed

at 11.30% and 8.70%, respectively. The relative share of handball players demonstrating a satisfactory level was higher (15.65%). On the positive side, only 7.83% of the juniors participating in the national championship during the studied year had a low level of development of coordination skills.

Figure 4. Relative shares of the level of development of coordination-motor abilities

These differences in the level of development of coordination skills affect the variability of indicators. As we can see from Figure 5, the coefficients of variation for the indicators

29 and 30 were extremely high - 67.75% and 105.68%, respectively, and they evidence the heterogeneity of the observed players concerning the studied coordination-motor features.

Figure 5. Dispersion of the studied variables of physical development and specific working capacity

The results from “Black and Red Schulte Table” (indicator 31) allowed us to determine

the level of concentration, distribution, and flexibility of attention. The analysis of Table

2 and Figure 5 shows that the average time for detection and writing in the form of the numbers from 1 to 24 in total for the studied handball players was 114.39 seconds. It means that the players were relatively homogeneous concerning the of attention parameters ($V_{31} = 21.75\%$).

The last three psychological indicators carry information about the level of develop-

ment of short-term memory. The analysis of Figure 6 shows that in the area „ $\bar{X} \pm S$ ” are included almost 74% of the surveyed players (73.91%). Unfortunately, the lowest percentage (11.30%) was the relative share of young handball players, having a high level of development of short-term memory. Positively, the relative share of those with a low level was below 15% (14.78%).

Figure 6. Distribution of the studied handball players, according to the level of development of short-term memory

Following the variability of all indicators included in the attached test battery gives reason to consider that the population surveyed (over 88%) was homogeneous and relatively homogeneous in terms of the observed features. An exception, as we mentioned, is the indicators characterizing the level of development of the coordination abilities of the competitors (indicators 30 and 29 - $V_{30} = 105.68\%$ and $V_{29} = 67.75\%$), the ability of young handball players to run the ball at high speed (indicator 23 — $V_{23} = 52.97\%$) and the efficiency of the 7 m target throw (indicator 25 — $V_{25} = 35.80\%$).

To solve the purpose and tasks of the study, based on the average levels of all studied features, using the sigma method for evaluation, a normative table was developed to assess the physical development, the specific physical and technical-tactical preparation, as well as the examined psychological abilities and qualities of the best 17-19-year-old Bulgarian handball players, competing in the age group of 19. As an example, here is part of the normative table that contains the standards for physical fitness (Table 3) and technical-tactical skills (Table 4).

Table 3. Normative table (sample) for evaluation of the physical development and the specific performance of 17-19-years-old Bulgarian handball players

Value T (points)	Value P (%)	Long jump	Triple jump	Vertical jump - from place	Vertical jump - after runout	Sit-up
		16.	17.	18.	19.	20.
50	99.38	2.84	8.32	65.25	74.39	32.20
49	99.18	2.82	8.26	64.56	73.71	31.91
48	98.93	2.80	8.20	63.88	73.03	31.62
47	98.61	2.78	8.14	63.20	72.35	31.33
46	98.22	2.76	8.07	62.51	71.66	31.04

45	97.73	2.74	8.01	61.83	70.98	30.75
44	97.13	2.72	7.95	61.15	70.30	30.46
43	96.41	2.70	7.89	60.47	69.62	30.17
42	95.55	2.68	7.83	59.78	68.94	29.88
41	94.52	2.66	7.77	59.10	68.25	29.59
40	93.32	2.64	7.71	58.42	67.57	29.30
39	91.93	2.62	7.65	57.73	66.89	29.01
38	90.32	2.60	7.59	57.05	66.21	28.72
37	88.50	2.58	7.53	56.37	65.53	28.43
36	86.44	2.56	7.46	55.68	64.84	28.14
35	84.14	2.54	7.40	55.00	64.16	27.85
34	81.60	2.52	7.34	54.32	63.48	27.56
33	78.82	2.50	7.28	53.64	62.80	27.27
32	75.81	2.48	7.22	52.95	62.12	26.98
31	72.58	2.46	7.16	52.27	61.43	26.69
30	69.15	2.44	7.10	51.59	60.75	26.40
29	65.54	2.42	7.04	50.90	60.07	26.11
28	61.79	2.40	6.98	50.22	59.39	25.82
27	57.93	2.38	6.92	49.54	58.71	25.53
26	53.99	2.36	6.85	48.85	58.02	25.24
25	50.00	2.34	6.79	48.17	57.34	24.95
24	46.01	2.32	6.73	47.52	56.66	24.60
23	42.07	2.30	6.66	46.87	55.98	24.25
22	38.21	2.84	8.32	65.25	74.39	23.90
21	34.46	2.82	8.26	64.56	73.71	23.55
20	30.85	2.80	8.20	63.88	73.03	23.20
19	27.42	2.78	8.14	63.20	72.35	22.85
18	24.19	2.76	8.07	62.51	71.66	22.50
17	21.18	2.74	8.01	61.83	70.98	22.15
16	18.40	2.72	7.95	61.15	70.30	21.80
15	15.86	2.70	7.89	60.47	69.62	21.45
14	13.56	2.68	7.83	59.78	68.94	21.10
13	11.50	2.66	7.77	59.10	68.25	20.75
12	9.68	2.64	7.71	58.42	67.57	20.40
11	8.07	2.62	7.65	57.73	66.89	20.05
10	6.68	2.60	7.59	57.05	66.21	19.70
9	5.48	2.58	7.53	56.37	65.53	19.35
8	4.45	2.56	7.46	55.68	64.84	19.00
7	3.59	2.54	7.40	55.00	64.16	18.65
6	2.87	2.52	7.34	54.32	63.48	18.30
5	2.27	2.50	7.28	53.64	62.80	17.95
4	1.78	2.48	7.22	52.95	62.12	17.60
3	1.39	2.46	7.16	52.27	61.43	17.25
2	1.07	2.44	7.10	51.59	60.75	16.90
1	0.82	1.86	5.21	32.50	40.97	16.55

Table 4. Normative table (sample) for evaluation of the physical development and the specific performance of the 17-19-year-old Bulgarian handball players

Value T (points)	Value P (%)	Dribble around the stands	Dribble index	Throwing a handball ball - length	7-meter throw – % successful
		22.	23.	24.	25.
50	99.38	5.65	0.02	45.31	91.36
49	99.18	5.73	0.05	44.90	89.64
48	98.93	5.80	0.08	44.50	87.91
47	98.61	5.88	0.10	44.10	86.18
46	98.22	5.96	0.13	43.69	84.46
45	97.73	6.04	0.15	43.29	82.73
44	97.13	6.11	0.18	42.89	81.01
43	96.41	6.19	0.21	42.48	79.28
42	95.55	6.27	0.23	42.08	77.55
41	94.52	6.34	0.26	41.68	75.83
40	93.32	6.42	0.28	41.28	74.10
39	91.93	6.50	0.31	40.87	72.38
38	90.32	6.57	0.34	40.47	70.65
37	88.50	6.65	0.36	40.07	68.92
36	86.44	6.73	0.39	39.66	67.20
35	84.14	6.81	0.41	39.26	65.47
34	81.60	6.88	0.44	38.86	63.75
33	78.82	6.96	0.47	38.45	62.02
32	75.81	7.04	0.49	38.05	60.29
31	72.58	7.11	0.52	37.65	58.57
30	69.15	7.19	0.54	37.25	56.84
29	65.54	7.27	0.57	36.84	55.12
28	61.79	7.34	0.60	36.44	53.39
27	57.93	7.42	0.62	36.04	51.66
26	53.99	7.50	0.65	35.63	49.94
25	50.00	7.58	0.67	35.23	48.21
24	46.01	7.67	0.74	34.83	46.89
23	42.07	7.77	0.81	34.42	45.56
22	38.21	7.87	0.87	34.02	44.23
21	34.46	7.96	0.94	33.62	42.91
20	30.85	8.06	1.00	33.22	41.58
19	27.42	8.16	1.07	32.81	40.26
18	24.19	8.25	1.14	32.41	38.93
17	21.18	8.35	1.20	32.01	37.60
16	18.40	8.45	1.27	31.60	36.28
15	15.86	8.55	1.33	31.20	34.95
14	13.56	8.64	1.40	30.80	33.63
13	11.50	8.74	1.47	30.39	32.30
12	9.68	8.84	1.53	29.99	30.97
11	8.07	8.93	1.60	29.59	29.65
10	6.68	9.03	1.66	29.19	28.32
9	5.48	9.13	1.73	28.78	27.00
8	4.45	9.22	1.80	28.38	25.67

7	3.59	9.32	1.86	27.98	24.34
6	2.87	9.42	1.93	27.57	23.02
5	2.27	9.52	1.99	27.17	21.69
4	1.78	9.61	2.06	26.77	20.37
3	1.39	9.71	2.13	26.36	19.04
2	1.07	9.81	2.19	25.96	17.71
1	0.82	9.90	2.26	25.56	16.39

The developed normative tables help the assessment of the current level of development of each of the observed variables, for each part of sports training of the young handball players competing in the age group up to 19 years. Based on the calculated evaluation, the so-called per-

sonal optimization models can be developed.

As an example, here are two custom optimization models developed by us.

The first is a personal optimization model of the specific physical fitness of 17-year-old handball player T. K. (Figure 7).

Figure 7. *Personal optimization model of the special physical preparation of T. K. (17-year-old)*

The figure shows the marks that the competitor received for the level of development of his specific physical qualities - between 11 and 42 points. It is quite clear that this young handball player had uneven development of the basic signs of physical fitness.

At a more detailed analysis of the optimization, the model shows, that T. K.

demonstrated a high level of development of the:

- explosive strength of the abdominal muscles (indicator 20, $T_{20} = 42$ points);
- special speed of movement on the terrain without a ball (indicator 15, $T_{15} = 39$ points) and
- sprinting abilities (indicator 14, $T_{14} = 30$ points).

At the same time, however, this competitor received very low marks for the level of development of upper limb strength, respectively 11 points for the comfortable and 14 points for the uncomfortable hand. Problems were also observed regarding the level of development of speed endurance (indicator 21, $T_{21} = 23$ points). The remaining signs of special physi-

cal fitness for T. K. were developed at the average and slightly above it for Bulgaria in the studied population (T takes values between 25 and 28 points).

The second example model (Figure 8) is the personal optimization model of the specific technical and tactical preparation of the same competitor (T. K. – 17-years-old).

Figure 8. *Personal optimization model of the specific technical-tactical preparation of T. K. (17-year-old)*

The analysis of the model shows that here the estimates of T. K. were higher than those obtained for his special fitness. The young handball player had a very high level of:

- the effectiveness of throwing the ball with a rebound of length (indicator 26, $T_{26} = 40$ points);
- the ability to move around the terrain with dribbling at high speed (indicators 22 and 23, $T_{22} = 36$ points and $T_{23} = 32$ points).

Relatively high (29 points) is also the assessment of the T. K. by indicator 27. This is proof for the high level of development of

this player's ability to move in defense, which is extremely important for success in modern handball.

The calculated summaries (the average sum of the scores on all indicators from the side of sports training) of T. K. showed, that during our study, this young competitor showed a little above the average for Bulgaria level for his special fitness ($\Sigma T_{\text{physical preparedness}} = 26.50$ points) and a relatively high level of his specific technical and tactical preparation ($\Sigma T_{\text{technical and tactical preparedness}} = 29.33$ points).

In summary, it can be argued that the em-

phasis of the future training work with T. K. should be aimed primarily at developing the strength of the upper limbs and the speed endurance. To improve his general physical condition, it is necessary to increase the volume of the training work to develop the explosive strength of the lower limbs in muscular efforts in both horizontal and vertical plane. The efforts made to develop the signs on which the assessments are highest will not lead to the same training effect.

DISCUSSION

The problem with the overweight of the players is very serious. The observation on the individual values of the Body Mass Index showed that 16,5% of the surveyed Bulgarian handball players competing in the age group up to 19 years were overweight or obese. This problem could be solved only with the joint efforts of both the athletes and the coaching staff of the teams, by applying an appropriate diet and increasing the volume and intensity of the training loads, which will lead to a reduction in the body weight and build a quality musculoskeletal system (Tzarova, Tzarov, 2012; Nestorov, 2019).

The results for the physical development of the players of our group are very close and coincide with the results of Krastev and Varbanov (2014), Avramov (2007).

In the studied group there were handball players with ability to move on the field at high speed developed at very high level. At the same time, however, there were players who experienced serious difficulties in dribbling the ball (Tzarova, Miladinov, Chanev et al., 2012).

We also think that the average level for the group 24.95 lifts sit-up (for 30 seconds) is relatively small for the studied age group, and this due to the fact, that in the group there are boys with very low level of development of the explosive power of abdominal muscles –

they completed only 16-18 successful attempts with a maximum achievement of 32 lifts.

It is necessary to increase the effectiveness of shots at goal (Yankelich, 1973; Stochenski, 1984; Evtushenko, 1985; Shibila, Pori, Bon, 2002; Chanev, 2019), mainly from the 7-meter line, which will make a positive impact on the level of competitive realization of young handball players.

The development of the coordination-motor abilities is very important for increasing the level of the technical skills and speed and power qualities of the adolescent handball players (Tiriaki, 2015). It's a positive fact, that more than half of the surveyed 17-19-year-old Bulgarian players have a good level of development of coordination skills and one-fifth - very good and high level, but overall, the population studied is heterogeneity in terms of the studied coordination-motor features.

The short-term memory is extremely important for sports games, as it provides the players opportunity to navigate in game situations and make the right tactical decisions. The analysis of the results from our research shows that almost three-quarters of the surveyed Bulgarian handball players have a good level of development of their short-term memory and the relative share of young players who have a high level of short-term memory development is 11.30%. However, we think that the low level of development of short-term memory in 15% of athletes can have a negative impact on their successful development along the path of high sportsmanship.

The competitors from the observed age groups participate together in the championships of the Bulgarian Handball Federation which gave us a reason to set up this population (17-19 years) and to develop the normative assessment framework (Chanev, 2018). The developed normative framework for control makes it possible quickly and

easily to evaluate the basic signs of physical development and the specific working capacity (Borukova, 2018) of the 17-19-year-old handball players at every moment of their preparation.

Based on the calculated evaluation, the so-called personal optimization models can be developed (Trarova, 2013), which allows coaches to understand both the best developed and the low developed qualities and skills at every moment of the preparation of young players and find adequate measures to optimize the future training process with each of them.

CONCLUSION

For the first time our study offers a legal basis for control and optimization of the physical development, the specific physical fitness, the technical-tactical preparedness, as well as the mental qualities of Bulgarian handball players from the age group 17-19 years. The best athletes from the indicated age group took part in the research. Their relative share is very high (86%), which is a guarantee that the representative sample have the characteristics of the general population. This, in turn, is evidence of the high informational value of the developed norm framework for assessment of the physical development, special physical and specific technical and tactical preparedness, as well as the observed psychological abilities and qualities of Bulgarian handball players competing in teams up to 19 years.

LIMITATIONS

This research was limited in Bulgaria as a specific geographic region. The findings provided valuable information about the physical development and specific working capacity of the 17-19-year-old Bulgarian handball players (men) and the results can be confirmed by a larger sample groups

from other handball sports clubs of different locations. In addition, the research population can be expanded to include curriculum (both girls in the study age group practicing handball and adolescent handball players in the lower age group).

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