

NATIONAL SPORTS ACADEMY "Vassil Levski"
Department of "Basketball, Volleyball, Handball"

Galimir Mitkov Tomov

**FEATURES OF SELECTION AND SPORT ORIENTATION IN
BASKETBALL**

ABSTRACT

**of a dissertation for awarding of the educational and scientific
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Scientific Supervisor:
Full Prof. Tsanko Tsankov, PhD

Scientific Reviewers:
Full Prof. Rossitza Tzarova, PhD
Assoc. Prof. Georgi Brestnichki, PhD

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The dissertation contains 171 standard pages, including 11 appendices. It is illustrated with 18 tables, 46 figures, 4 normative tables, and a list of references. The bibliography includes 131 sources (84 in Cyrillic and 6 in Latin), as well as 41 websites.

The dissertation has been discussed and directed for public defence before a scientific jury at an extended meeting of the Department of "Basketball, Volleyball, Handball" at the National Sports Academy "Vassil Levski," held on March 19, 2025.

The public defence of the dissertation for the award of the educational and scientific degree "*Doctor*" will take place on ***June 4, 2025***, at ***2:00 PM*** in ***Hall A-3*** of the ***National Sports Academy "Vassil Levski,"*** Studentski Grad, Sofia

INTRODUCTION

This dissertation aims to bring additional clarity to the issue of improving the system for early orientation, selection, and recruitment of young basketball players aged 10-12, which is characterized by specific and important features in the anatomical, morphological, and physiological development of the individual. Basketball is a dynamic system that is constantly being enriched and improved. It is a complex process that depends on many principles, rules, and patterns. A great help to coaches would be the creation of models, principles, and algorithms for sports orientation and better selection of children. The question of the comprehensive study of the individual characteristics of growing players and the creation of a rational selection system is the core organizational-methodological structure of youth basketball. The intensification of sports, combined with the increasing demands on the stage development of basketball, creates the need for finding more objective criteria for sports orientation and selection.

The goal of this study is to improve the system for sports orientation and selection. To achieve this goal, tasks are set related to establishing the current state of the researched problem through literary and documentary sources based on office research, which includes online research, and gathering information about the organization, results, and selection in basketball clubs in Bulgaria. The efforts are aimed at developing an improved model for the system of sports orientation and selection, based on collected empirical data about the physical development and specific performance capabilities of young (10-, 11-, and 12-years-old) basketball players, processed using appropriate mathematical-statistical approaches.

I. STATEMENT OF THE PROBLEM

I.1. Introduction to the Essence and Functions of Modern Sport: The Role of Sports Training and Sports Education

Sports training consists of a combination of specialized knowledge, skills, approaches, and organizational forms. It is essential to have optimal conditions that ensure full training and maximum expression of the potential abilities of athletes. Sports training is optimally conducted using a systemic approach in two aspects: broad, encompassing the components, activities, and conditions of sports training, and narrow or differentiated, referring to the process of sports improvement.

In turn, the problems of selection are concentrated on three areas:

1. Morpho-anthropometric characteristics combined with indicators of health status.
2. Motor characteristics for assessing the genetic capacity of motor and vegetative functions of the athlete.
3. Psychological characteristics, including intellectual and emotional manifestations for determining the mental state of the athlete.

D. Dasheva (2015) draws attention to the fact that the complex set of factors characterizing athletic talent is studied from various perspectives – pedagogical, psychological, medical-biological, and others. Knowledge about the influence of these factors is crucial in predicting athletic abilities, with the most commonly applied theoretical concepts being based on two approaches – the study of the stability of indicators and the determination of the influence of hereditary factors. In the approach for studying the stability of indicators, the resilience of human characteristics throughout childhood and adolescence is examined. Stability in results predetermines easily predictable development. However, if the results are mainly variable, then the selection is considered random due to the lack of justification for its predictability. One of the most

effective approaches for studying the stability of indicators is longitudinal monitoring in combination with subsequent definition and outlining of correlations (the degree of dependence) between juvenile and definitive values of these indicators.

The fundamental approach to determining the degree of influence of hereditary factors in predicting athletic abilities is crucial for selecting talents and predicting individual achievements in sports. It is based on the proven impact of genetic factors such as height, weight, structural proportions, etc., on an individual's sports performance. Less proven is the degree of inheritance of motor (locomotor and vegetative) abilities.

Phenotypic factors also influence the system of sports training in relation to the training process, competitive activity, and other additional elements of the sports environment, such as the social environment, motor regimen, and recovery.

Management factors reflect the operational interaction between different structures in the sports training system and are based on the principle of subordination and coordination of sports activities. The main elements of this subsystem are the regulatory framework and organization, scientific-informational support, and human resources.

Material and technical factors provide the necessary material conditions and prerequisites for the effective functioning of sports training in its entirety as a system of interconnected factors. The main components of this subsystem include sports facilities available for the needs of sports training, financial support for the athlete and their team, and the living conditions in which sports training and practice take place.

Sports education focuses on achieving maximum efficiency of motor abilities related to a specific sport discipline. Motor abilities, manifested through sports skills, can be defined as relatively stable sets of genetic prerequisites

necessary for performing locomotor activities. The expected performance of the athlete depends on the motor skills that are closely linked to the sport discipline.

The content of sports education consists of individual key areas organized as components with the following directions:

- Physical component aimed at developing motor abilities;
- Technical component focused on acquiring sports skills through motor training;
- Tactical component for acquiring and further developing different methods for conducting sports competitions;
- Psychological component for improving the personality of the athlete.

Sports training is a process of systematic development of each component depending on the duration of the training, leading to the achievement of maximum effectiveness in the senior age within the chosen sport discipline.

D. Dasheva (2015) summarizes that numerous studies unequivocally prove that there is no "ceiling" to the sports-technical and functional capabilities of the athlete. However, the training and competitive processes require new scientific approaches and methodologies for managing sports training to achieve even higher and more ambitious sports results.

In this context, the interest of sports specialists in the motor activity and sports training of the younger generation is growing, and their role contributes to the improvement of sports in general, as well as of individual disciplines. Attention to the anatomical-physiological characteristics of the growing children's organism forms the basis for rational planning of the training process. Narrow specialization requires an in-depth understanding of the main functions and structure of the human body. When selecting beginner athletes, it is necessary to include morphological control as a special criterion, since certain body proportions are of great importance for achieving rational technique and improving athletic skill (Toteva, M., 1992).

I.2. Age Development of Children and Adolescents as a Biological-Social Process

There is unanimous agreement in contemporary pedagogy that the early years of human growth – from birth to school entry – are unique and critical for human life development, as this is the period for laying the foundations of health, the learning process, behavioral models, and personality development (Unicef, 2023). The development of a child is a complex process consisting of a network of interactions between genes, the surrounding environment, and the child's first experiences.

M. Montessori (2017) concludes that in a child's development, there are particularly favorable periods for the formation of certain qualities and abilities, as well as periods during which mental abilities, emotional responsiveness to specific influences, sensitivity, and the sharpness of the senses are in optimal condition. The specific selective orientation of receptors is the foundation for defining periods in a child's life that are referred to as sensitive periods of development.

Sensitive periods set the potential opportunities for changes in the child's development, which, however, are highly dependent on specific social and individual living conditions. Defining the possible sensitive periods for children's development, using M. Montessori's (2017) approaches, undoubtedly adds theoretical value. However, from a practical standpoint, researchers like D. Ilieva and R. Dencheva (2017) challenge the usefulness of this methodology in the context of sports training.

Social determinants and heredity, according to L. S. Georgiev (2005), are also leading factors in the physical development of children during the early years of life.

Sports activities are a specific way of integrating adolescents into the social environment. They make them happy and favor their mental development

by stimulating attention, enriching memory, developing thinking, forming and enhancing creative imagination, and strengthening the will.

The advancement of mental and social intelligence in an age aspect allows for differentiation between chronological age (calculated by the time elapsed since birth) and social age, which characterizes the intellectual and mental progress of development. Thus, children of the same chronological age can have a greater or lesser social age. Social age is calculated through tests often used to measure intelligence (intelligence quotient), calculated as the ratio between mental and chronological age.

In the last decade, research has shifted from merely calculating intelligence quotients to analyzing the connections between physiology, biochemistry, and genetics, to identify and describe the morphological, anthropometric, physiological, and functional characteristics of athletes who have reached high levels in competitions in various sports disciplines. In elite sports codes, identifying and encouraging future athletes to follow specialized talent paths largely depends on objective physical, technical, and tactical characteristics in addition to subjective coach assessments. Despite the presence of numerous evaluations, the dependence on subjective forms of identification remains common in most sports codes (Drozdovska, S. B., Dosenko, V. E., Ahmetov, I. I., Ilyin, V. N., 2013).

I.3. Anatomical-Morphological and Physiological Characteristics in the Development of Adolescent Athletes

Anatomical-morphological and physiological development in humans passes through several periods and stages, characterized by different features, including accelerated or delayed growth (Dimitrova, P., 1999). These periods do not sharply differ from each other, but in each of them, significant changes are observed in the motor apparatus, height and body mass, and the functional state

of the motor and nervous systems. In periods of slowed growth, qualitative changes in the structure, composition, and functions of the body take place.

From a biological standpoint, sexual maturation is the most important for overall development, including physical education and sports. A characteristic feature of the puberty age is the development of secondary sexual characteristics.

The literature also mentions the concept of biological variability, which describes the individual deviations in the development of specific organs and systems in children of the same chronological age (Yordanova, T., 2019). This calls for a differentiated approach to the development and changes occurring in adolescents' bodies. Knowing the deep changes that occur during puberty allows coaches to properly adjust their training and improvement strategies for young athletes.

The concept of physical capability is broad and encompasses physical work capacity, preparedness, and fitness (Petkova, P., 2017). From a sports-pedagogical perspective, physical capability refers to the body's ability to perform physical work and achieve results in individual physical activities, where a series of motor qualities are expressed comprehensively (Peltekova, I., Peltekov, B., 2022). Structuring human physical capability through the identification of motor qualities is the most commonly used method to explore the problems related to its development and enhancement. The ability to perform movements quickly, exert significant effort, or maintain a necessary level of work capacity for a long time can be identified as qualitative characteristics of human motor function (Karabiberov, Y., 1994).

The concept of physical fitness takes on a new meaning, according to conditioning coach Y. Karabiberov (2009), which refers to stable health, a high degree of psycho-physical balance, excellent physical condition, and physical capability.

According to P. Slanchev et al. (1992), human physical development is the result of the interaction between the factors of the internal (biological) and external (natural) environment. The main biological factor is heredity, as well as the crucial role of endocrine function – the pituitary gland, sex hormones, thyroid and adrenal glands. Exogenous (external) factors include socio-economic living conditions, diet, physical activities, sports, physical labor, and recovery periods after exertion.

Physical development is a continuous but uneven process, i.e., different morphological, functional, and mental aspects of age-related maturity develop individually and reach maturity at different times. Physical development is not only a matter of muscle mass increase but also of qualitative functional changes, governed by certain biological laws, whose manifestation is most evident in adolescents when the athlete's body changes both structurally and functionally, albeit at varying rates. Some of the morphological indicators are largely hereditary, and for this reason, the selection for different sports should be aligned with this information (Tzarov, K., Djordjevic, B., 1997).

According to L. Georgiev (2003), during the initial school-age period (7-11 years), accelerated physical and mental development occurs, known as acceleration. This period is favorable for developing the physical and mental abilities of the child, as maturation of the body continues.

Puberty (12-15 years) is also known as the transitional age, as it marks the shift from childhood to early adolescence (Georgiev, L., 2003). This period is the most intense, with no equal pace and scale of the changes that occur. The most significant changes include:

- Overall and rapid increase in life forces;
- Profound restructuring of the body;
- Accelerated anatomical and functional maturation of the body and personality formation;
- Increased moral and intellectual strength;

- The height of the child almost reaches the adult level – the average growth in boys per year is between 4 and 7 cm, reaching 8-10 cm by 15 years. Girls experience the most intense growth around 13 years, where their height can increase by up to 20 cm in two years;
- The limbs grow more noticeably, while the development of the chest and pelvis lags behind. As a result, body proportions become unbalanced, accompanied by slower muscle development. When the proportions of the body are imbalanced, the movements of adolescents become sharp and uncoordinated. However, this age is sensitive for achievements in sports, including mastering complex practical skills;
- Growth is uneven, with fluctuations between 2 to 5 kg, but muscle strength gradually strengthens, especially in boys.

In our view, during the 10-12-year-old age period, specific methodological recommendations would be extremely beneficial for sports theory and practice, such as:

- Speed exercises should be short-term and alternated with rest periods (active rest);
- The favorable opportunity for building conditioned reflex connections in movements should be used, due to the high plasticity of the nervous system;
- The dynamics of growth, sexual maturation, and the development of all organs and systems require an individualized approach to training by coaches;
- Attention should be given to the fact that during this period, there is a faster increase in the strength of the upper limbs than the lower limbs;
- The development of motor qualities, skills, and habits should primarily be carried out through games and competitive methods;
- The 10-12 age range provides a foundation for developing the following qualities: speed (reaction time and running), strength

- (overall strengthening of all parts and muscles of the body), endurance, agility and coordination (increased levels of general and specialized coordination abilities), flexibility (general and special joint mobility);
- The training process should carefully plan the workload to avoid undesirable physical and psychological consequences.

I.4. Features of Motor Skills Development in Adolescent Athletes

In adolescence, the processes related to the growth and development of the body play a crucial role in improving motor skills. Understanding the age-related dynamics of these qualities allows sports professionals to plan and implement the training process effectively. According to K. Rachev and V. Margaritov (1994), the higher excitability and mobility of nervous processes in children between the ages of 7 and 10 make it easier to form conditioned reflexes and motor habits more quickly. In another work, K. Rachev (1999) highlights that the processes of forming various motor skills begin around the age of 11-12, when the development of the motor analyzer accelerates.

The age-specific characteristics of motor skills development require sports educators to consider the changes occurring in the adolescent's body and their potential abilities when developing motor qualities. For optimal development of motor skills in sports games, S. Bazelkov (2007) recommends the simultaneous development of qualities specific to the sport, while also focusing on mastering the techniques and tactics of the game.

Motor skills are developed in a specific way, taking into account the dynamics of neuromuscular effort and the structure of motor habits in the game (Yotov, I., Avramov, E., 2007). For example, when training a specific technique, the qualities required for its effective execution are also developed. Incorporating various exercises into the training process is necessary for the development of speed, explosive strength, flexibility, agility, and endurance.

During the initial stages of sports training, the main focus should be on the comprehensive development of motor qualities, using a variety of training tools. In practice, there are different approaches to the development of motor skills in sports games (Aladzhov, K., 2012). Some specialists insist on using game-based methods, while others believe that each training session should focus on either speed or strength. According to a third approach, training for motor qualities should be isolated from game preparation and performed without the ball.

In modern theory and practice, it is emphasized that motor skills should be developed comprehensively, taking into account the individual capabilities of the adolescents and providing priority to certain qualities depending on the development phase. Some authors (Petkova, P., 2019) argue that this is the most effective way to achieve balance between different motor qualities and their specific demands in sports games, including basketball.

Special attention should be paid to the development of qualities important for basketball, such as speed, endurance, and strength endurance. The development of these abilities and skills should be aligned with the requirements of the game so that young athletes can adapt to the rapidly changing game situations.

1.5. Basketball Technique as a Structural Element of Initial Sports Training

Mastering basketball technique is a process that requires both training time and motivation from young athletes. According to Hutchison (1992), the main technique during the initial training stage should be closely related to the development of motor skills. This close relationship is determined by biochemical and anatomical-physiological mechanisms that are essential for both mastering new motor skills and developing motor qualities (Kodim, M., 1979).

The primary goal of initial sports training is to achieve an optimal balance between the development of motor qualities and the mastery of technical skills. A high level of physical preparation is the foundation on which sports mastery is built (Wilkes, G., 1968). Sports technique is understood as a system of individual or interconnected movements aimed at achieving victory over the opposing team (Peltekov, V., 1986). It is not enough for an athlete to be strong, fast, or exceptionally enduring; it is crucial to manifest these abilities in a specific way according to the requirements of the game of basketball.

The period of initial training (10-12 years) should focus on forming basic motor habits and mastering the technique of the sport. This will provide the foundation for future development in professional basketball, while simultaneously developing qualities like speed and endurance (Smochevski, M., 2001). For the training process to be successful, it is necessary to use exercises that closely resemble the actual movements in the game.

According to D. Mihailov (1995), technical training should be based on model characteristics to achieve the most effective game technique. This includes an individual approach to athletes, taking into account their strengths. Mastery of basic technical skills to the level of automation is crucial for athletes to fully realize their game potential.

The key points for the successful sports preparation of adolescent basketball players include:

- Providing a rich arsenal of practical knowledge and skills;
- Achieving a high level of development of fundamental motor qualities;
- Coordinating motor abilities with the motor activity in the game;
- Achieving rational technique (also called situational technique), ensuring effectiveness in different game situations.

I.6. Sports orientation, selection, and recruitment of promising young basketball players

In the initial stage of sports training (usually covering children aged 7 to 13 years), the goal of training sessions is comprehensive physical development, focusing on the formation of basic motor skills and habits specific to the respective sport (Alexieva, M., 2008). A characteristic feature of the structural organization of teams is the decreasing age at which children start sports activities. This contemporary trend presents new challenges for sports specialists, including difficulties in selection and forecasting in sports due to various objective reasons, such as:

- Individual tempo of morphological and biological development of adolescents;
- Acceleration;
- Specificities of physiological changes in children's bodies;
- Development of motor qualities.

It is crucial that children are properly selected and recruited for basketball training sessions based on qualities that align with the specific motor skills required for the sport (Zvonarek, N., Ćurković, S., 2006). One of the main factors that should be closely monitored is the process related to the development of motor skills in young athletes. Often, differences in the rate of development of motor skills in adolescent athletes of the same age mislead coaches regarding their real motor potential (Valkov, V., 2011). In addition to the game potential, individual motor characteristics also play an important role, as they significantly affect the achievement of high sports results.

Applied scientific problems in the field of physical development and sports are closely related to the issues of initial sports selection, as some morphological traits are too conservative to change under the influence of the training process. In Bulgaria, several systems have been developed in this regard, including one by I. Popov and colleagues from 1994, which presents an

organization for selecting children in three stages (Popov, I. H., Mihaylova, S. P., Glushkova, M. K., 1990). The goal is for the coach to have a wide range of candidates and be able to make a genuine selection, rather than being forced to fill the team's open positions with available candidates, resulting in a fictitious selection process.

According to M. Borukova (2014), in Serbia, selection is primarily based on a whole system of tests, which are used from the earliest age in the selection of young basketball players. Specialized coaches search for talented players, and their main task is to identify physical and game potential by the age of 10-12. One of the most recent and widely used testing batteries was developed by basketball specialists M. Karaleich and S. Yakovlevich in 2007, consisting of 10 tests for specific basketball skills and qualities. Successful management of the training process allows coaches to select, recruit, and objectively assess the future basketball players' condition, as well as forecast their physical development and sports work capacity.

Identifying giftedness and potential in adolescents is a complex process that includes the child's genetic abilities, the characteristics of their nervous system, and their creative inclinations in all aspects of life (Smocevsky, M., 2001). While some coaches consider talent to be an innate factor and a rare ability, N. Popov (1999) argues that it is a personality trait with a higher level of development. Abilities could be seen as a psychological characteristic that, with the right knowledge, ensures success in a given activity. Talent, on the other hand, is a combination of predispositions that enable optimal development of abilities. In-depth studies on the psychological dimensions of sports talent, personality traits, and motivation in sports were conducted by T. Yancheva (2009).

The findings from D. Dasheva et al. (2015) indicate that the system of youth sports in Bulgaria does not foresee a specific, systematic, and modernized

selection of sports talents, nor does it manage to transform sports schools into modern, effective centers for training, recovery, research, and sports technology.

Recommendations from Ts. Zhelyazkov (according to Cholova, E., 2003) suggest applying scientific-methodological approaches to selection, which includes three areas:

- Selection based on morphological traits – anthropometric data, age, and health status;
- Selection based on motor (movement) traits – level of functional preparedness;
- Selection based on other personal characteristics – intellectual, emotional, etc.

Ts. Zhelyazkov also emphasizes that selection does not only apply to young athletes with their specific issues but extends to all levels of sports training.

K. Tzarov and B. Djordjevic (1997) recommend that, regardless of the methodology chosen for organizing the selection process, it should be based on biological age criteria. Initial selection is when groups are formed for training in basic basketball techniques. The final selection occurs when the main training process concludes and young basketball players are divided into groups based on the skills and qualities they have developed up to that point. The coach's ability to select, measure, and assess the objective condition of future basketball players, predict their development, and apply appropriate training methods is essential for the successful management of the training process (Slavcheva, I., 2014).

It has been established that within the same age group, alongside normally developing children, there are those who are accelerated (accelerates) or delayed (retarded) in their physical development. Many experienced teachers and coaches believe that children with normal or even delayed physical development are more promising, as the favorable impact of the training process on the

growing body is more prolonged. Often, children with lower initial indicators, after several months of preparation, surpass those who had higher anthropometric and functional parameters (Tzarov, K., 2016).

At all stages of selection, the coach aims to obtain a comprehensive and maximally complete picture of the candidate's current and predicted qualities, rather than superficial assessments of their speed, strength, endurance, height, etc.

When considering motor qualities in relation to age, their level of development is evaluated as a function of growth and development. This approach is dictated by the need to assess the qualities in the context of forecasts for their final characteristics. The evaluation of motor qualities is optimal only when it is an inseparable part of the forecast for the player's overall potential. To better understand this crucial part of the preparation of young athletes, each motor quality should be considered and evaluated not in isolation, but in the context of its correlation with other qualities (Portnov, Y., Kostikova, L., 1988).

From the conducted literature review, it is clear that, up to now, the issues of selecting adolescent basketball players in Bulgaria have been primarily addressed by K. Tzarov (2008, 2016), and regarding the control and optimization of physical development in age aspects, by R. Tzarova (2013) and M. Borukova (2014).

Preliminary selection should primarily be based on a sufficient number of informative and predictive tests that would stimulate progressive dynamics in the development of individual juvenile indicators until their definitive developmental phase. Currently, there is a need to rethink the tests used for selection so far, as well as to introduce new tests aimed at objectifying and improving the efficiency of the preliminary and initial selection process.

In this regard, the present dissertation focuses on assessing the current condition of young athletes and exploring alternative approaches that are more suitable for improving the efficiency of selection in basketball in the current

reality of the training and preparatory processes. The literature review identifies that the existing methodological approaches and systems of selection and control in Bulgaria, in light of the current understanding of development and changes in the bodies of young athletes, need to be reconsidered and updated.

Therefore, there is a significant need for optimizing and effectively improving the sports orientation, selection, and recruitment system. This cannot be achieved without in-depth scientific research, which is why the dissertation includes a comprehensive empirical study and uses the results obtained to make scientifically based recommendations for improving one of the crucial factors in sports preparation – selection.

The theoretical study of the researched issue allows for the formulation of the following **working hypothesis**: *A quality selection of children for basketball activities is one of the most important factors for success in basketball. However, we believe that the current system of sports orientation and selection needs to be updated in terms of developing a new regulatory framework for controlling and evaluating the specific physical development traits and work capacity in basketball, which is an extremely relevant task with high practical value.*

II. OBJECTIVE, TASKS, AND METHODOLOGY OF THE RESEARCH

II.1. Objective and Tasks of the Research

The aim of this research is to improve the system for sports orientation and selection in basketball.

Tasks of the research:

1. Investigating the current state of the researched issue through literary and documentary sources and analyzing information about the mechanisms applied in the organization, selection, and recruitment in basketball clubs in Bulgaria.
2. Determining the state of key indicators of physical development and specific preparedness of 10-, 11-, and 12-years-old boys who are organized in basketball training.
3. Testing the significance of the identified differences in physical development and specific preparedness of the researched basketball players in relation to their age.
4. Revealing the peculiarities in the factor structures of each of the observed groups.
5. Determining the contribution of each of the researched characteristics to the overall level of physical development and specific preparedness in the three age groups.
6. Developing an updated regulatory framework for sports orientation and selection in basketball.

II.2. Methodology of the Research

II.2.1. Organization of the Research

This research was conducted from April 2021 to May 2024.

The subject of the research is the system of sports orientation and selection in basketball.

The object of the research is the indicators of physical development and specific work capacity in 10-, 11-, and 12-years-old boys who are organized in basketball training at sports clubs in Bulgaria.

The research sample consists of 255 boys from 10 basketball clubs in Bulgaria. The selection of the test group is organized based on the athletes' age, dividing them into three age groups (85 from each group) – 10-years-old, 11-years-old, and 12-years-old, with the starting point being their birth year, rather than their actual age at the time of testing.

II.2.2. Research Methods and Indicators

To achieve the goal and tasks of the research, and given the object and subject of the analysis, the following *research methods* have been applied:

- *Logical and retrospective analysis of literary sources (including internet research);*
- *Anthropometry;*
- *Dynamometry (hand-held);*
- *Sports-pedagogical testing – the applied test battery includes two main groups of indicators: for special physical preparedness and for specific technical-tactical skills;*
- *Diagnostic psychological experiment.*

The total number of indicators included in the test battery is 24 (*Table 1*).

II.2.3. Approaches to Analyzing Quantitative Data

All results from the conducted sports-pedagogical tests were recorded in an Excel file and then processed using statistical analysis software – IBM SPSS.

The following types of *statistical analyses* were applied in the data processing:

- *Variance analysis;*
- *Hypothesis testing;*

- *Sigma method for assessment;*
- *Spearman's rank correlation;*
- *Factor analysis;*
- *Index method.*

Table 1. List of Indicators Included in the Test Battery

№	Indicators	Units of measurement	Measurement precision	Direction of increase
1.	<i>Height</i>	cm	1	+
2.	<i>Body mass (weight)</i>	kg	1	+/-
3.	<i>Height – stretched arm</i>	cm	1	+
4.	<i>Arm span</i>	cm	1	+
5.	<i>Foot size</i>	cm	1	+
6.	<i>Palm size</i>	cm	1	+
7.	<i>Length of lower limb</i>	cm	1	+
8.	<i>Length of upper limb</i>	cm	1	+
9.	<i>Chest circumference – breathing difference</i>	cm	1	+
10.	<i>Chest circumference – pause</i>	cm	1	+
11.	<i>Hand dynamometry</i>	kg	1.0	+
12.	<i>Long jump from standing</i>	cm	1.0	+
13.	<i>Vertical jump</i>	cm	1.0	+
14.	<i>Vertical jump after 2 steps</i>	cm	1.0	+
15.	<i>12 m sprint run</i>	s	0.01	-
16.	<i>Depth of bend</i>	cm	1.0	+
17.	<i>Running between cones</i>	s	0.01	-
18.	<i>Dribbling between cones</i>	s	0.01	-
19.	<i>T-test</i>	s	0.01	-
20.	<i>Shuttle run</i>	s	0.01	-
21.	<i>Coordination-motor test (t)</i>	s	0.01	-
22.	<i>Coordination-motor test – coefficient</i>	s	0.01	-
23.	<i>Shulze table</i>	min	0.01	-
24.	<i>Operational thinking test</i>	min	0.01	-

III. RESULTS OF THE EMPIRICAL STUDY AND ANALYSIS

III.1. Comparative analysis of the physical development indicators

To determine the average levels of all the indicators included in the test battery, as well as the degree of dispersion of individual cases around them, the collected extensive information for each of the three age groups was subjected to analysis using a method called variance analysis.

The results of processing the raw data for the 10-years-old boys, which contain information about their physical development levels, are presented in *Table 2*.

Table 2. Mean values and variability of the studied physical development indicators for 10-years-old boys

№	Indicators	Mean	S	V	min	max
1.	<i>Height</i>	149,84	7,20	4,81	131	162
2.	<i>Body Mass (Weight)</i>	43,19	8,25	19,10	25	61
3.	<i>Height – Extended Arm Length</i>	191,46	9,70	5,07	172	209
4.	<i>Arm Stretch</i>	147,53	8,92	6,05	130	176
5.	<i>Foot Size</i>	25,98	1,22	4,70	23	28,5
6.	<i>Palm Size</i>	18,42	0,62	3,39	17,5	20
7.	<i>Lower Limb Length</i>	88,45	4,22	4,77	78	97
8.	<i>Upper Limb Length</i>	65,05	5,47	8,29	57	93
9.	<i>Chest Circumference – Breath Difference</i>	6,51	1,91	29,30	2	12
10.	<i>Chest Circumference – Pause</i>	74,53	7,38	9,91	59	89
11.	<i>Hand Dynamom</i>	15,49	3,14	20,28	9	22

The table shows that the average height of the boys in this age group is 149.84 cm, while the average weight is 43.19 kg. Based on these values, the calculated Body Mass Index (BMI) is 19.24 kg/m². The evaluation of this index according to the norms adapted for this age group (Slanchev, P., 1992) indicates that, although it is at the upper limit, it can be concluded that the 10-years-old basketball players generally have a normal level of body fat. However, it should be noted that this relatively high BMI value is due to the presence of boys in the

group with overweight. Unfortunately, this is a serious problem for many modern students who wish to engage in sports. These children need to be subjected to continuous monitoring, and together with parents, coaches, and other sports specialists, measures should be taken to reduce their body weight. If this does not happen, the children who are already oriented towards basketball may be directed towards other sports, where they will have a better chance for successful development.

It is well-known that, in addition to height, other important morphological characteristics for basketball include the lengths of both the lower and upper limbs. These characteristics affect the player's reach (both horizontal and vertical), which is crucial for success in both offense and defense.

As seen in **Table 2**, the average length of the lower limbs of the 10-years-old boys is 88.45 cm, while the length of the upper limbs is 65.05 cm. At the same time, there are significant variations in the results among the young basketball players included in this group. For example, the maximum length of the lower limb is 97 cm, while the minimum is 78 cm. For the upper limbs, the measurements are 93 cm and 57 cm, respectively. Height varies between 162 cm and 131 cm, and so on. These differences affect the variability of the respective indicators and influence the degree of homogeneity of this group (**Figure 1**).

The analysis of the figure shows that for all the indicators characterizing the body lengths, the values of the variation coefficients (V) are below 10%, ranging from 3.39% for indicator 6 ("hand size") to 8.29% for indicator 8 ("length of the upper limb"). This provides a high probability ($P_t = 95\%$) that the examined group of 10-year-old basketball players is homogeneous in terms of all measured body lengths of the young players. Indicator 10 ("chest circumference – pause", $V_{10} = 9.91\%$) can also be included in this group.

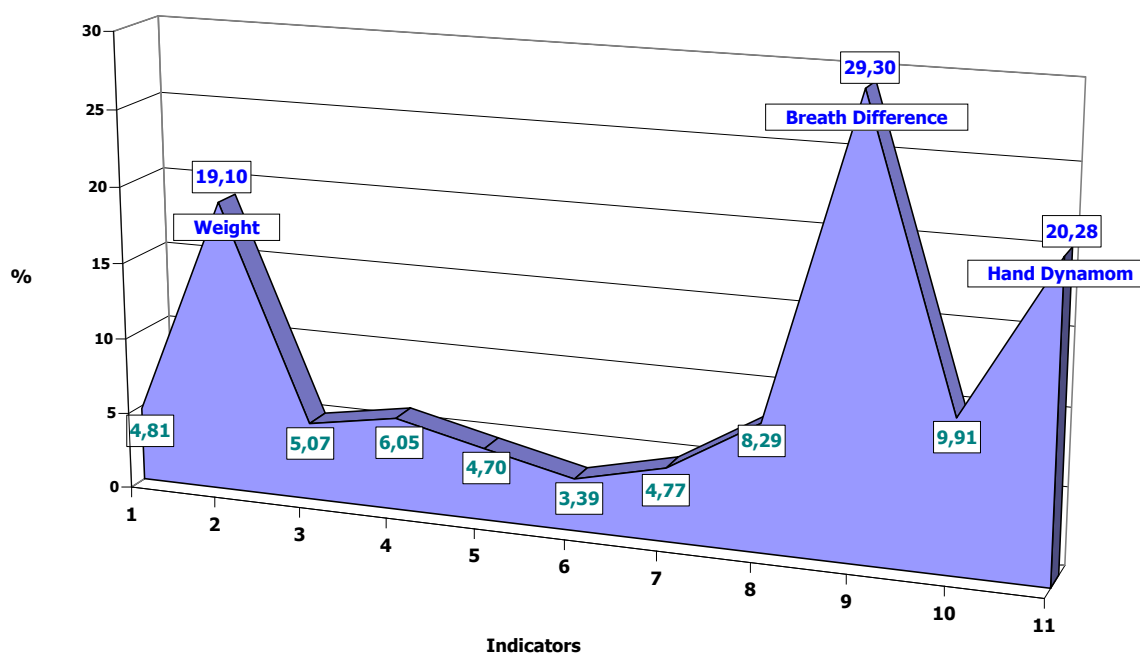


Figure 1. Dispersion of physical development indicators in 10-years-old basketball players

However, for the remaining three indicators related to the physical development of the boys, the values of V range between 10% and 30%. According to sports statistics norms, this means that the group is relatively homogeneous concerning the functional capacity of the chest (indicator 9 – $V_9 = 29.30\%$), grip strength (indicator 11 – $V_{11} = 20.28\%$), and body weight (indicator 2 – $V_2 = 19.10\%$) of the young basketball players included.

From **Table 3**, it is clear that the values of the measured morphological traits in the 11-year-old boys are very similar to those of the 10-years-old. It is interesting to note that, despite having nearly the same average height, the higher age group has a lower average weight, which results in a lower BMI ($BMI_{11\text{-years-old}} = 17.54 \text{ kg/m}^2$). This places the group in the middle of the normal body weight zone.

For the purpose of the study, the comparative Student's t-test was used to test the null hypothesis, which suggests that there are no significant differences between the established levels of physical development characteristics in 10-11-years-old boys.

Table 3. Mean values and variability of the examined physical development indicators in 11-years-old boys

№	Indicators	Mean	S	V	min	max
1.	Height	149,31	8,61	5,77	129	167
2.	Body mass (weight)	39,11	7,39	18,90	25,9	62
3.	Height – stretched arm	189,69	12,25	6,46	163	215
4.	Arm span	144,25	9,98	6,92	120	171
5.	Foot size	23,92	1,53	6,39	20	27
6.	Palm size	19,32	2,59	13,38	15,5	29
7.	Length of lower limb	82,08	5,61	6,83	69	92
8.	Length of upper limb	65,06	5,01	7,70	52	78
9.	Chest circumference – breathing difference	6,26	1,95	31,20	3	13
10.	Chest circumference – pause	75,07	6,58	9,13	57	90
11.	Hand dynamometry	16,82	3,71	22,06	4	24

The analysis of the lower part of **Figure 2** shows that the calculated values of the comparative t-test for 6 of the observed morphofunctional traits, where the columns in the figure are shaded, are higher than the critical t-value ($t_{\text{emp}} = 1.97$).

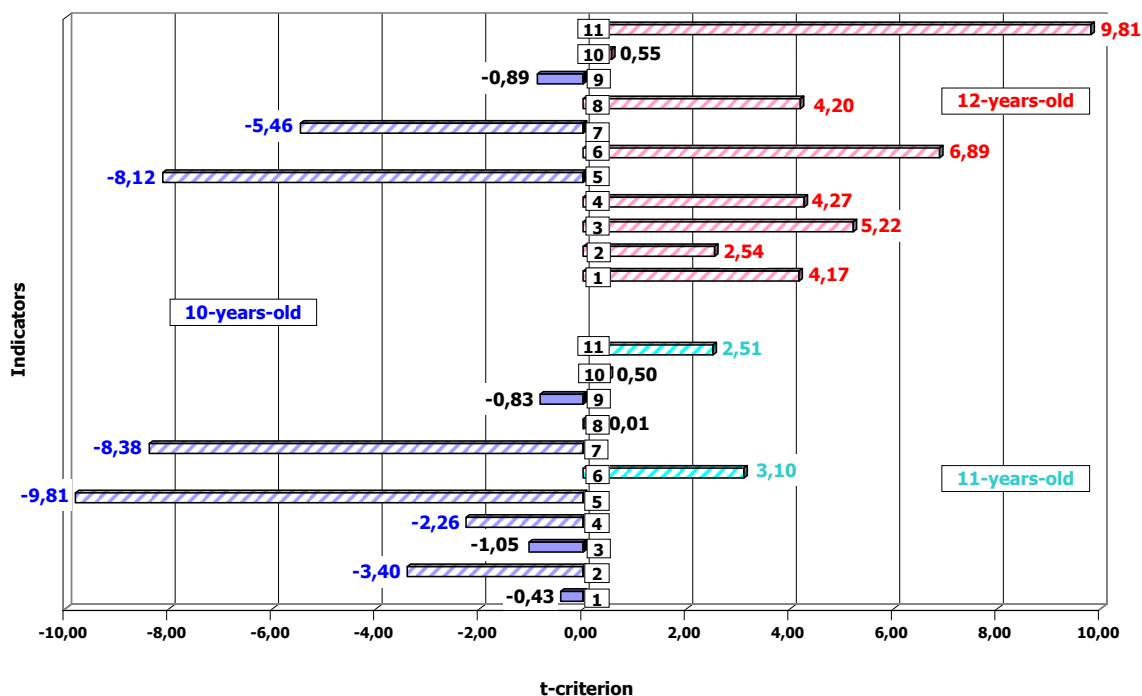


Figure 2. Statistical significance of differences in the mean values of physical development indicators between 10-years-old and the two older age groups ($t_{\text{tabl}} = 1.97$)

Additionally, for 4 of the traits (represented in blue), the advantage is in favor of the younger age group. This allows us, with a high level of confidence ($P_t \geq 95\%$), to reject the null hypothesis and accept the alternative hypothesis as true. According to this, 11-year-old basketball players (see the columns in green) have a significantly larger palm length (indicator 6, $t_6 = 3.10$) and better developed grip strength (indicator 11, $t_{11} = 2.51$) compared to the 10-years-old. At the same time, however, they show significantly smaller foot sizes, shorter lower limbs, smaller horizontal reach, and lower body weight. Evidence for this is provided by the values of the comparative t-test, which favor the younger age group (in blue and shaded), ranging from 2.26 to 9.81.

Although this fact may seem illogical, we believe that the better results of the 10-year-olds are likely due to a better initial selection of the most recent generation, which serves as a positive indicator for more successful future development in the sport.

For the remaining 5 physical development traits, the t-values are below the critical threshold. This means that the observed differences between the height (standing and with stretched arms – indicators 1 and 3), length of the upper limb (indicator 8), chest circumference at rest, and respiratory difference (indicators 9 and 10) in the two groups of boys are statistically insignificant and can be explained by random factors.

The results of the variance analysis of the 12-years-old basketball players are presented in **Table 4**.

For the purpose of the study, a comparative Student's t-test was conducted to test the null hypothesis, which states that there are no significant differences between the established levels of physical development traits of 10- and 11-years-old boys.

The analysis of the lower part of **Figure 2** shows that the calculated values of the comparative t-test for 6 of the observed morphofunctional traits,

where the columns in the figure are shaded, are higher than the critical t-values ($t_{\text{emp}} = 1.97$).

Table 4. Mean values and variability of the examined physical development indicators in 12-years-old boys

Nº	Indicators	Mean	S	V	min	Max
1.	<i>Height</i>	155,01	8,89	5,74	136	173
2.	<i>Body mass (weight)</i>	46,49	8,65	18,60	27,8	68,5
3.	<i>Height – stretched arm</i>	199,60	10,66	5,34	179	222
4.	<i>Arm span</i>	153,76	10,05	6,53	134	170
5.	<i>Foot size</i>	23,95	1,94	8,09	19,3	27
6.	<i>Palm size</i>	19,88	1,86	9,36	15,5	24
7.	<i>Length of lower limb</i>	84,30	5,57	6,61	72	96
8.	<i>Length of upper limb</i>	68,24	4,39	6,44	58	77
9.	<i>Chest circumference – breathing difference</i>	6,24	2,06	33,10	1	10
10.	<i>Chest circumference – pause</i>	75,14	7,08	9,42	60	94
11.	<i>Hand dynamometry</i>	20,20	3,14	15,56	14	28

Furthermore, for 4 (represented in blue), the advantage is in favor of the younger age group.

This provides grounds, with a high probability ($P_t \geq 95\%$), to reject the null hypothesis for these 6 traits and accept the alternative one. According to this, 11-years-old basketball players (see columns in green) have significantly greater palm length (indicator 6, $t_6 = 3.10$) and better grip strength (indicator 11, $t_{11} = 2.51$) than 10-years-old. At the same time, however, they have significantly smaller feet, shorter lower limbs, smaller horizontal reach, and lower body weight. Evidence of this can be found in the comparative t-test values, which are in favor of the younger age group (in blue and shaded) and range between 2.26 and 9.81.

Although the discussed fact may seem illogical, we believe that the better results of the 10-years-old are likely due to the better initial selection of the latest generation, and this serves as a good assessment for more successful future development in the sport.

For the remaining 5 physical development traits, t-values are lower than the critical value. This leads to the conclusion that the observed differences in height (standing and with extended arm – indicators 1 and 3), upper limb length (indicator 8), chest circumference in a resting state, as well as respiratory difference (indicators 9 and 10) of the boys in the two groups are statistically insignificant and can be explained by random factors.

The results of the variance analysis for the 12-years-old basketball players are presented in **Table 4**.

The table shows that the boys at this age group stand out with the highest height (155.01 cm) and the highest weight (46.9 kg). The calculated average body mass index (19.35 kg/m²), according to the standards of sports medicine for the studied age group, can be assessed as normal.

Upon analysis, the almost identical values for indicators 9 and 10, which provide indirect information about the functional capacity of the chest, are noteworthy. This, in our opinion, is an extremely important issue that coaches should pay special attention to. The higher respiratory difference is evidence of better-developed respiratory mechanisms and better capacity of the athletes to withstand higher training loads.

A good impression is made by the fact that the 12-years-old basketball players possess greater grip strength (indicator 11 – $X_{11} = 20.20$ kg), which is a prerequisite for better mastering of specific basketball techniques, especially those performed with the ball.

The check for the validity of the observed differences between the average levels of morphological traits for the 12-years-olds and 10-years-olds (*see the top part of Figure 2*) shows that for 7 of the indicators (represented by the shaded columns in red), the older age group naturally demonstrates an advantage. Therefore, it can be confidently stated that the alternative hypothesis holds for:

- Grip strength (indicator 11 – $t_{11} = 9.81$);

- Palm length and upper limb length (indicators 6 and 8 – $t_6 = 6.89$ and $t_8 = 4.20$);
- Height and reach (indicators 1, 3, and 4 – t values range from 4.17 to 5.22);
- Body weight (indicator 2 – $t_2 = 2.54$).

At the same time, however, the 12-years-old have significantly smaller feet and shorter lower limbs (indicators 5 and 7 – t values are 8.12 and 5.46, respectively). This is further evidence of the more successful anthropometric selection of the youngest participants in our study.

As seen from **Figure 2**, with regard to chest circumference and its associated respiratory difference, the null hypothesis holds because the t -test values are lower than the critical 1.97.

What is the significance of the differences observed between the average levels of anthropometric traits registered in the 11- and 12-years-old groups? **Figure 3** answers this. From it, it is evident that overall, the level of physical development of the 12-years-old basketball players is significantly higher.

Evidence for this is provided by the values of the Student's t -test, which for 7 of the indicators are higher than the critical value and range between 2.58 (for indicator 7 “lower limb length”) and 6.38 (for indicator 11 “hand dynamometry”).

It is also evident from the figure that for the other indicators, t -values are in a range that justifies, with a high probability, the confirmation of the null hypothesis, according to which there are no significant differences between 11- and 12-years-old regarding chest circumference and the associated respiratory difference, as well as foot and palm length (indicators 9, 10, 5, and 6).

Of interest for the study is the comparative analysis of the variability of morphological traits in the three observed groups, which naturally determines the degree of homogeneity of each group with respect to each trait.

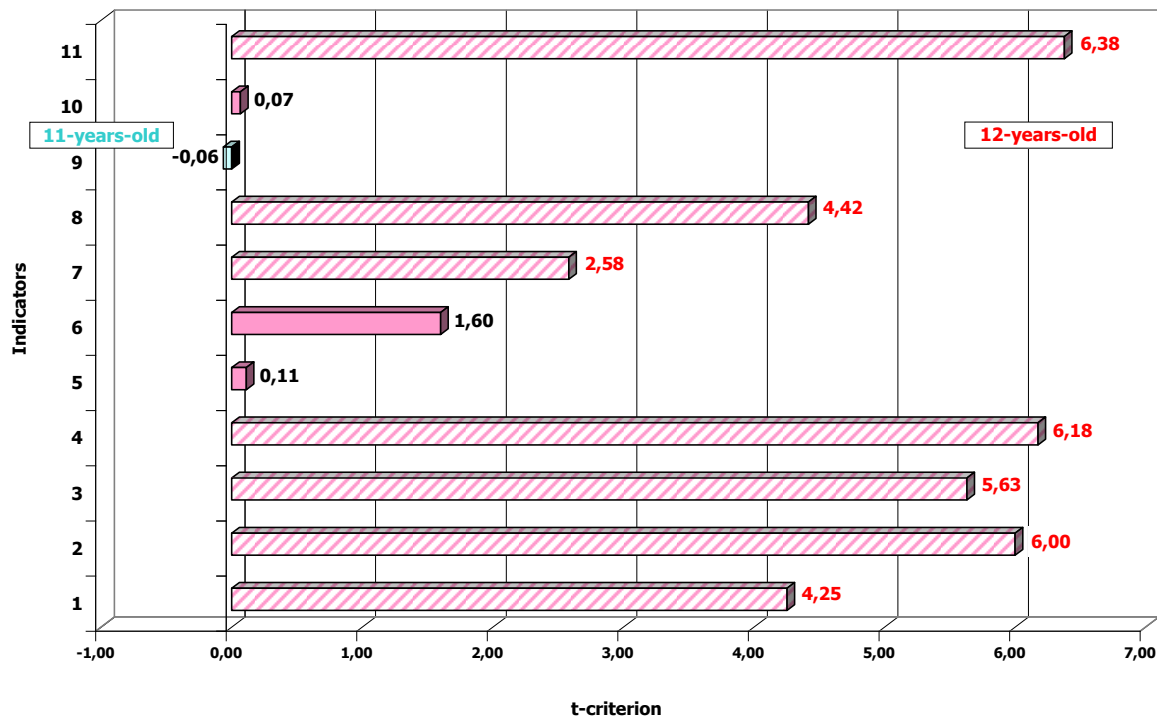


Figure 3. Statistical significance of differences in the mean levels of physical development indicators between 11-years-old and 12-years-old basketball players ($t_{tabl} = 1.97$)

The analysis of *Figure 4* shows that, overall, the dispersion zones for the three age groups are nearly identical.

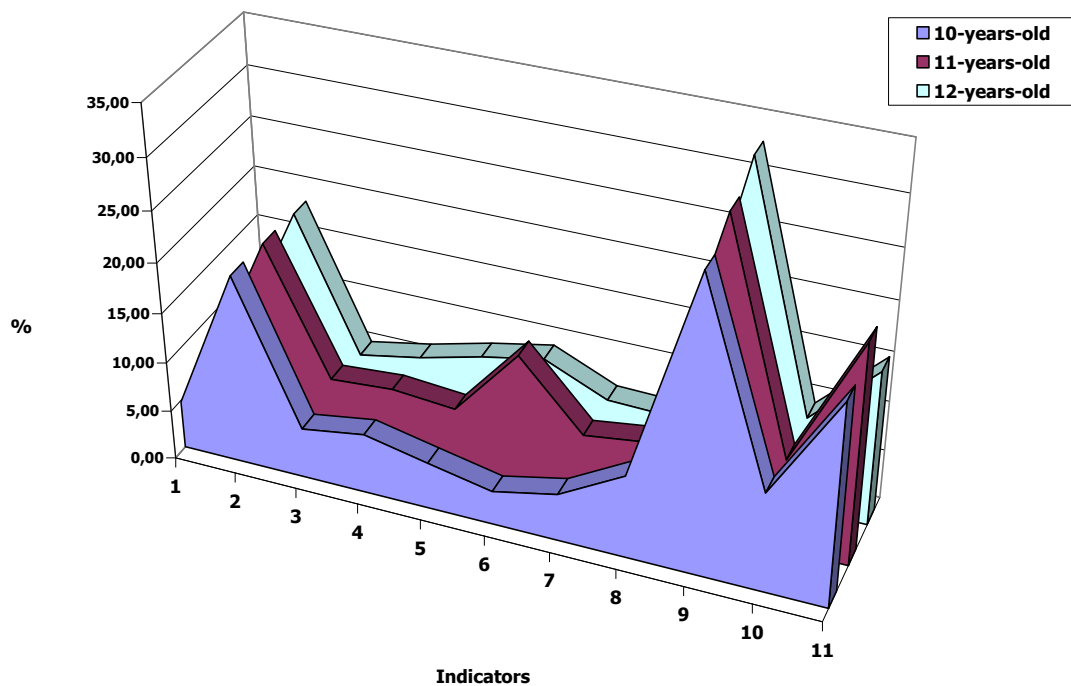


Figure 4. Comparative analysis of the variability of physical development indicators

As mentioned earlier in the analysis of the 10-years-old' results, it can be reasonably stated that all the observed groups are homogeneous with respect to the measured body lengths and chest circumference. The observed exceptions concern:

- the relative homogeneity of all groups in terms of grip strength and body weight of competitors (indicators 11 and 2) and of the 11-years-old group in terms of palm size (indicator 6);
- the heterogeneity of the groups in terms of chest functional capacity (indicator 9).

III.1.2. Comparative analysis of physical fitness signs

As stated in the Study Methodology, for the purposes of this study, 5 main indicators are included in the test battery, allowing to get an idea of the level of specific conditioning in boys from each age group – 10-, 11- and 12-years-old.

The analysis of **Table 5** allows us to reveal the average levels and variability of the studied signs of physical fitness in 10-years-old basketball players.

Table 5. Mean values and variability of the examined indicators of specific physical fitness in 10-years-old boys

Nº	Indicators	Mean	S	V	min	max
12.	<i>Long jump from standing</i>	132,81	21,45	16,15	96	223
13.	<i>Vertical jump</i>	23,88	6,99	29,27	8	38
14.	<i>Vertical jump after 2 steps</i>	27,04	8,9	32,92	9	43
15.	<i>12 m sprint run</i>	3,30	0,36	10,91	4,18	2,78
16.	<i>Depth of bend</i>	103,08	7,2	6,98	92	121

It is clear from the data that the boys in this age group have an average performance in the standing long jump of 132.81 cm. Within the group, there are children with an exceptionally high level of development in the explosive strength of the lower limbs during horizontal muscle efforts, and others where

the level is very low. Evidence of this are the maximum ($X_{\max} = 223$ cm) and minimum ($X_{\min} = 96$ cm) values, presented in the last two columns of the table.

The level of explosive strength development in the lower limbs during vertical muscle efforts was determined using two sports-pedagogical tests: “vertical jump from standing” and “vertical jump after 2 steps” (indicators 13 and 14). Again, significant differences are observed between the best and the least prepared basketball players (30 cm and 34 cm, respectively).

Body flexibility is a quality that is often underestimated by basketball coaches. This is clearly evident from our research – the difference between the measured values for forward bend in 10-year-olds is nearly 30 cm. The concerning fact is that some of the boys cannot touch the floor while bending forward, which in test 16 is marked as 100 cm. The lack of flexibility in the spine and hip joints not only affects the level of specific basketball skills but is often the main cause of injuries.

All of the above affects the homogeneity of the group (*Figure 5*).

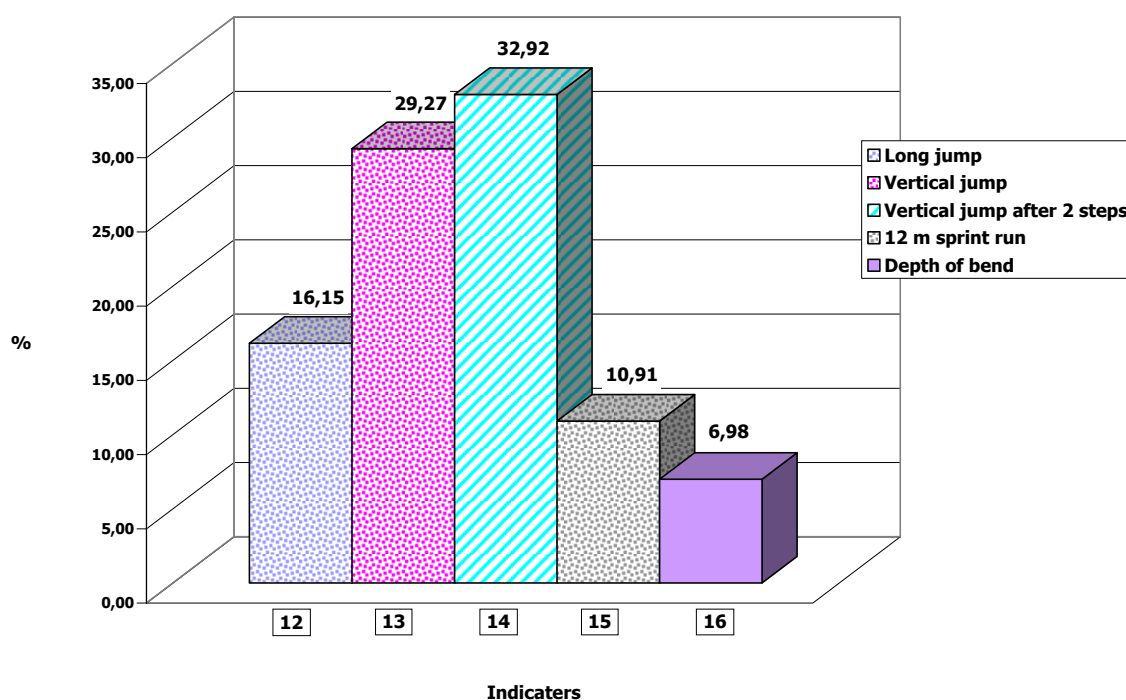


Figure 5. Dispersion of specific physical fitness indicators in 10-years-old basketball players

As can be seen, the coefficients of variation for indicators 13 and 14 are quite high, which gives grounds to consider that the group of 10-year-old basketball players is heterogeneous with respect to the level of development of explosive strength in the lower limbs during vertical muscle efforts. However, regarding the explosiveness of efforts in the horizontal plane and the sprinting abilities of the children, we can talk about relative homogeneity. Only with respect to flexibility, the low coefficient of variation ($V_{16} = 6.98\%$) allows the group to be considered homogeneous.

It is quite natural that in the following age groups (*Tables 6* and *7*), a higher level of development of specific motor qualities is to be expected.

The dynamics of the development of physical fitness traits in an age aspect are presented in *Figure 6*.

Table 6. Mean values and variability of the examined indicators of specific physical fitness in 11-years-old boys

№	Indicators	Mean	S	V	min	max
12.	<i>Long jump from standing</i>	155,47	24,15	15,53	96	192
13.	<i>Vertical jump</i>	30,08	4,9	16,29	17	51
14.	<i>Vertical jump after 2 steps</i>	35,62	8	22,46	19	57
15.	<i>12m sprint run</i>	2,98	0,35	11,74	3,87	2,38
16.	<i>Depth of bend</i>	105,20	9,97	9,48	86	126

Table 7. Mean values and variability of the examined indicators of specific physical fitness in 12-years-old boys

№	Indicators	Mean	S	V	min	max
12.	<i>Long jump from standing</i>	160,25	16,98	10,60	126	198
13.	<i>Vertical jump</i>	26,72	8,46	31,66	11	51
14.	<i>Vertical jump after 2 steps</i>	30,54	9,59	31,40	13	57
15.	<i>12m sprint run</i>	3,04	0,33	10,84	3,87	2,48
16.	<i>Depth of bend</i>	103,18	5,88	5,70	92	116

The figure shows that with regard to the explosive strength of the lower limbs in horizontal muscle efforts (indicator 12), a significant change is observed between 10- and 11-years-old — nearly 13 cm, after which the increase in 12-years-old is less than 5 cm. However, for the remaining

indicators, the development curves peak at 11 years old, followed by a decrease, and a drop in the average achievements is observed in 12-years-old.

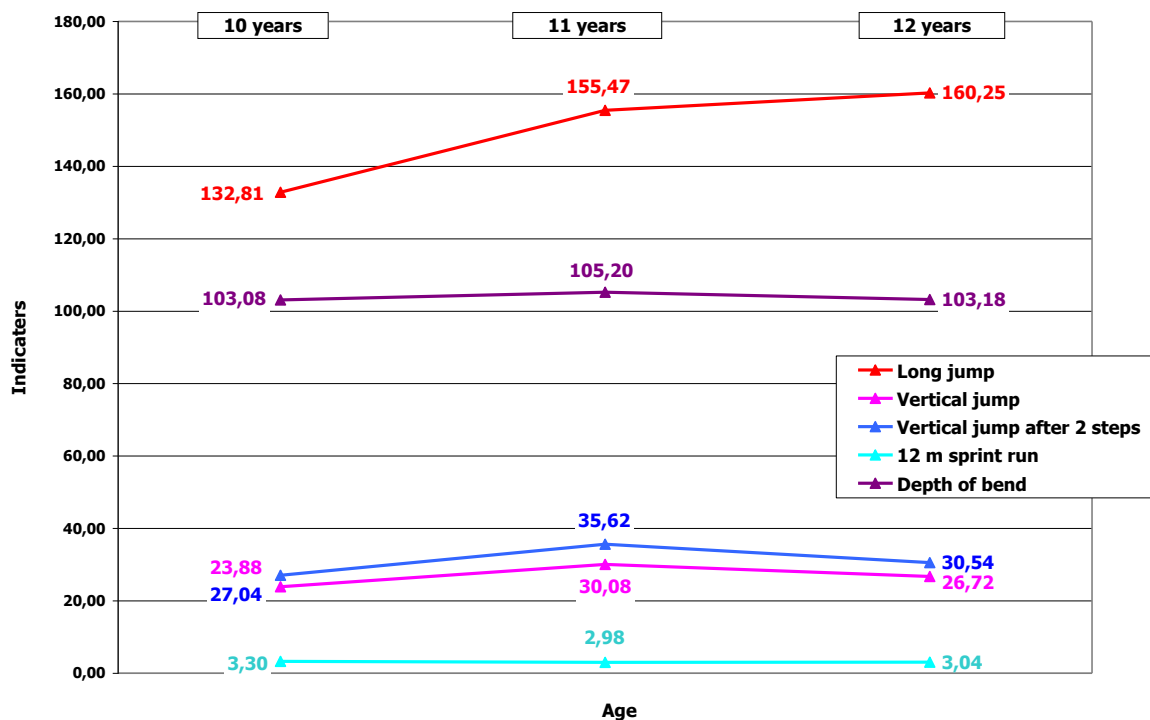


Figure 6. Dynamics of the development of *specific physical fitness indicators* from an age perspective

The check for the significance of the observed changes in the levels of development of physical fitness traits shows that with regard to body flexibility, the null hypothesis can reasonably be accepted. According to this hypothesis, the development levels of the three examined age groups for this important motor quality in basketball are very similar, and the differences between them are statistically insignificant and can be explained by random causes (**Figure 7**).

However, the same cannot be said for the other observed traits. In comparative terms with the 10-year-olds, the two subsequent age groups have achieved significantly better results, which means that the alternative hypothesis holds for the explosive strength of the lower limbs, both in horizontal and vertical muscle efforts, as well as for the sprinting abilities of the boys.

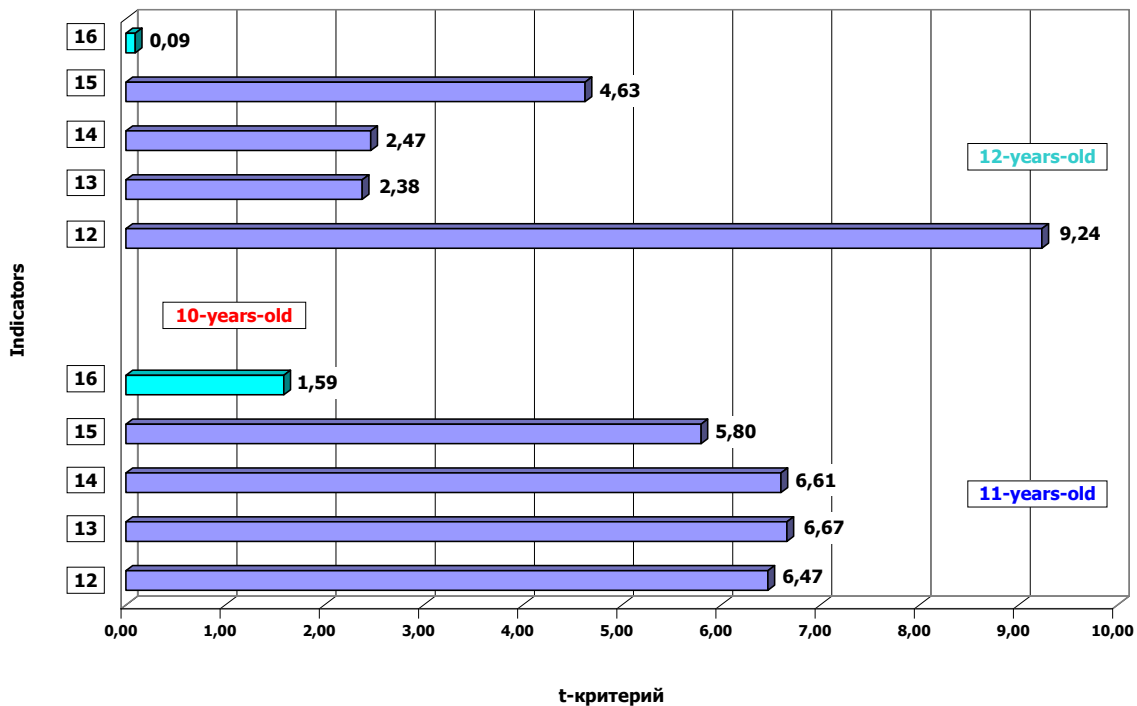


Figure 7. Statistical significance of the differences between the mean levels of specific physical fitness indicators in 10-year-olds and the other two groups from higher age categories ($t_{\text{tabl}} = 1.97$)

The comparative analysis of 11- and 12-years-old shows that the older age group demonstrated a higher level only in the explosive capabilities of the boys.

The comparative analysis of the homogeneity of the three age groups concerning physical fitness traits (**Figure 8**) shows that all of them are homogeneous only with respect to the body flexibility of the basketball players included in them.

III.1.3. Comparative analysis of traits characterizing the level of motor skills

The results of the variation analysis of the baseline data characterizing the motor skills level of the boys from the three studied groups are presented in **Table 8**.

In the dissertation, a detailed analysis of the mean levels and variability of the studied traits in this test group is provided. Therefore, only some key conclusions will be presented here.

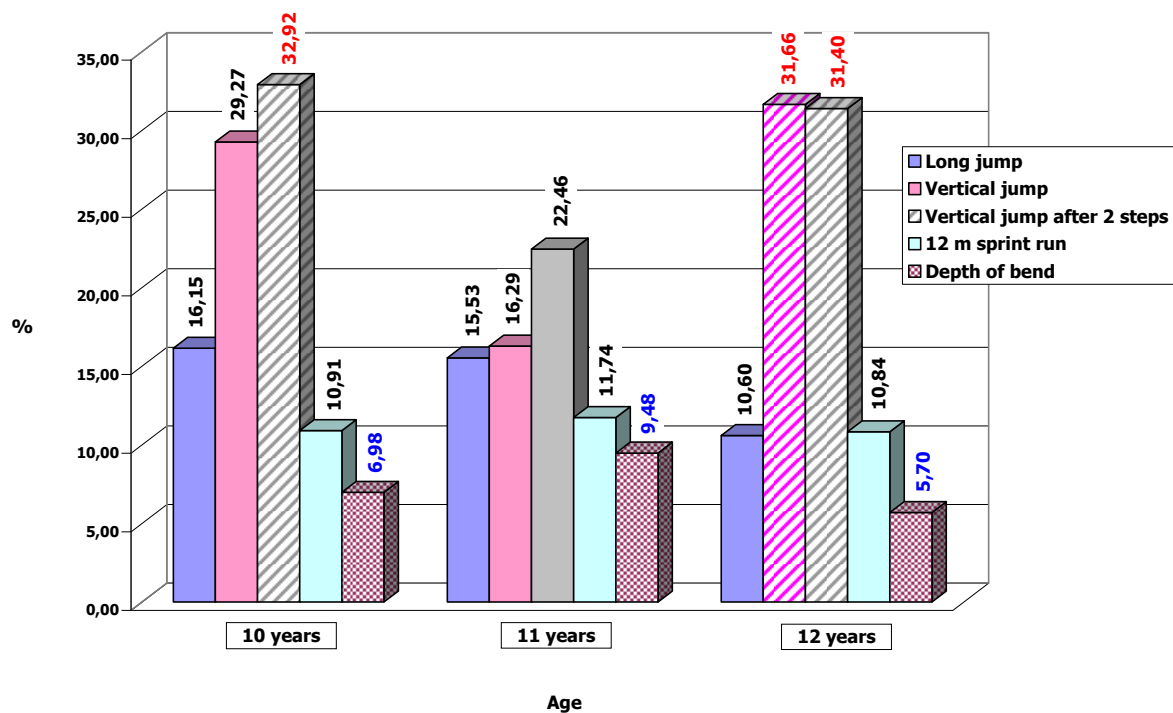


Figure 8. Comparative analysis of the homogeneity of the groups with respect to *specific physical fitness indicators*

Table 8. Mean values and variability of the examined indicators characterizing the level of *specific motor skills*

№	Indicators	Mean	S	V	min	Max
10-годишни						
17.	Running between cones	10,06	0,97	9,60	11,38	7,42
18.	Dribbling between cones	11,87	1,20	10,11	13,83	8,69
19.	T-test	13,00	1,71	13,15	15,57	10,89
20.	Shuttle run	24,87	1,11	4,46	26,86	22,29
11-годишни						
17.	Running between cones	8,95	0,88	9,78	11,30	7,39
18.	Dribbling between cones	10,46	1,30	12,40	13,51	8,64
19.	T-test	11,67	1,62	13,92	14,93	9,62
20.	Shuttle run	26,97	2,83	10,49	34,94	21,96
12-годишни						
17.	Running between cones	9,37	0,9	9,57	10,93	7,97
18.	Dribbling between cones	10,90	1,45	13,31	13,51	8,96
19.	T-test	11,04	1,96	17,76	12,98	9,54
20.	Shuttle run	29,29	3,98	13,57	37,48	24,36

The check of the significance of the differences between the mean levels of traits characterizing the level of specific motor skills of the 10-year-olds and

the two older age groups (*Figure 9*), for example, shows that the 11- and 12-years-old significantly outperform the youngest group in terms of their ability to move across the court in offense at high speed, both with and without the ball, and also in terms of their ability to quickly move in defense.

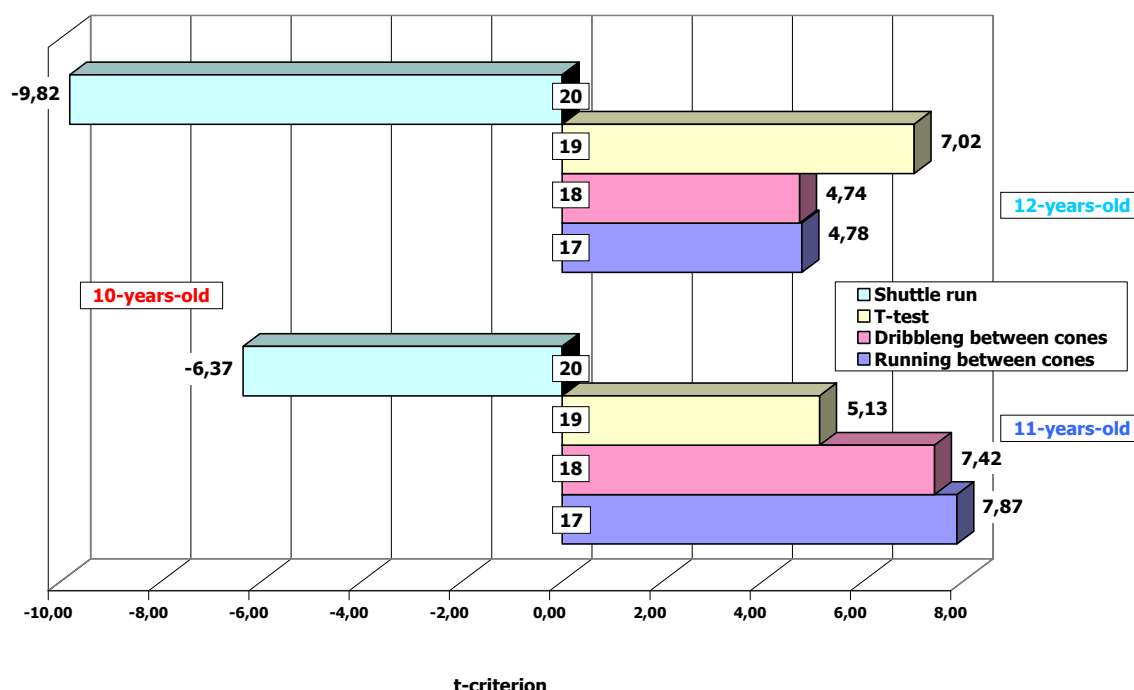


Figure 9. *Statistical significance of the differences between the mean levels of indicators characterizing the level of specific motor skills in 10-years-old and the other two groups from higher age categories ($t_{tabl} = 1.97$)*

This provides grounds for rejecting the null hypothesis and accepting the alternative one regarding the mentioned skills. At the same time, this hypothesis is valid for the ability to move across the court for extended periods with continuous changes in direction and rhythm, but here, the significant advantage is in favor of the 10-years-old. Meanwhile, the results also provide grounds to claim that 12-years-old have a significantly higher level of skill in fast defensive movements compared to 11-years-old, but significantly fall behind in the other examined traits characterizing the level of specific motor skills.

III.1.4. Comparative analysis of the studied traits characterizing some psychological features of the basketball players

The final part of the comparative analysis is focused on revealing the characteristics of the studied traits that define important psychological qualities and traits for basketball players in the three age groups.

The analysis shows that with increasing age, positive changes occur in the measured traits. The test of the significance of the observed differences between the average levels of these traits shows that the 11- and 12-years-old have a significant advantage over the youngest group.

The results presented in **Figure 10**, however, show much more variation. It can be seen that the significant advantage of the 12-years-old over the 11-years-old relates to their coordination-motor abilities ($t_{21} = 8.00$ and $t_{22} = 8.50$) and the level of operational thinking development ($t_{24} = 15.69$). However, in terms of attention parameters, the null hypothesis holds ($t_{23} = 0.10$).

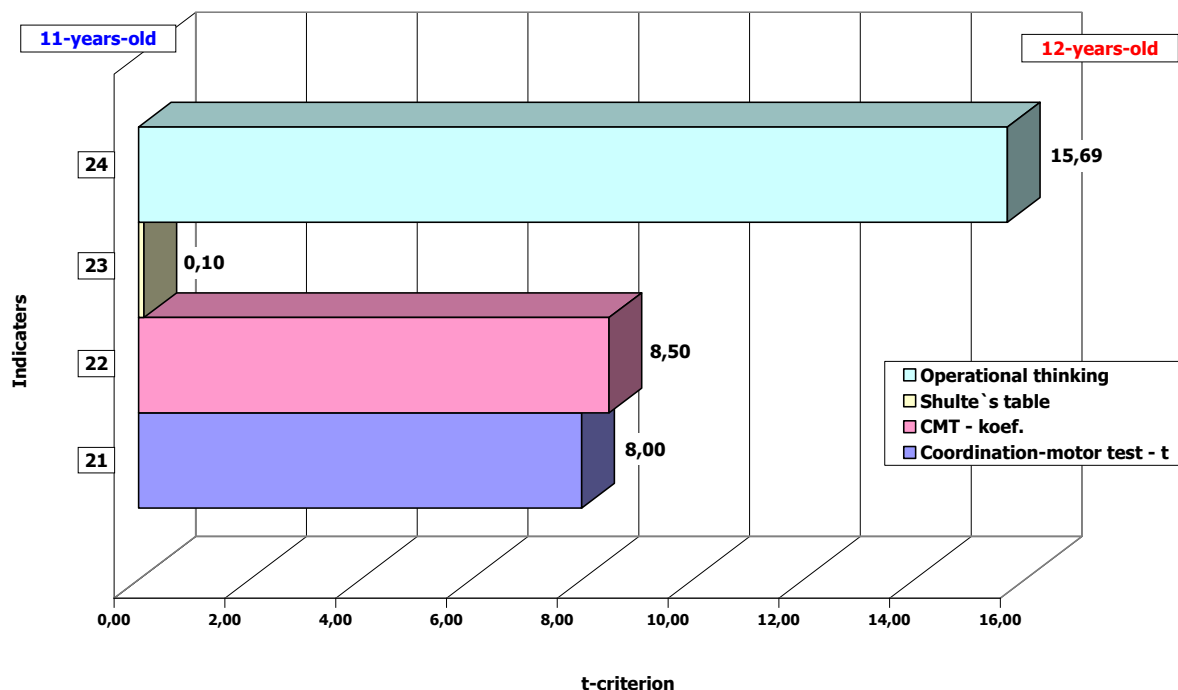


Figure 10. Statistical significance of the differences between the mean levels of indicators characterizing psychological traits in 11-year-old and 12-year-old basketball players ($t_{tabl} = 1.97$)

The comparative analysis of the homogeneity of the three groups regarding the traits that characterize the psychological features of the studied individuals shows that, in general, all three groups are relatively homogeneous.

III.2. Factorial structure of physical development and specific training

III.2.1. Factorial structure and key factors in 10-years-old

The analysis of *Table 9* shows that the factorial structure of 10-year-old boys engaged in organized basketball is determined by 7 main factors (*Figure 11*), which explain 77.21% of the total variance of the studied phenomenon (physical development and specific preparedness).

Table 9. Factorial structure of physical development and specific fitness in 10-year-old basketball players

N ₂	I	II	III	IV	V	VI	VII	h ²	1 - h ²
1.	0,589	0,645	-0,001	0,064	-0,015	0,093	-0,057	0,778	0,222
2.	0,793	0,218	0,011	0,032	-0,072	-0,187	0,185	0,751	0,249
3.	0,390	0,830	0,095	0,044	0,286	0,077	-0,042	0,942	0,058
4.	0,056	0,870	0,019	0,029	0,230	0,118	0,172	0,858	0,142
5.	0,370	0,180	0,493	0,144	0,653	-0,050	0,037	0,863	0,137
6.	-0,007	0,342	-0,065	0,022	0,847	-0,138	0,050	0,860	0,140
7.	0,546	0,676	0,239	0,075	0,034	0,119	-0,049	0,836	0,164
8.	0,224	0,854	0,056	0,015	0,068	0,226	-0,139	0,858	0,142
9.	-0,066	0,199	0,004	-0,036	-0,195	0,850	0,005	0,806	0,194
10.	0,735	0,283	-0,030	0,103	0,046	-0,262	0,244	0,761	0,239
11.	0,002	0,139	0,847	0,065	0,098	0,008	-0,140	0,771	0,229
12.	-0,480	0,113	0,458	0,401	-0,067	0,005	0,079	0,625	0,375
13.	-0,746	-0,130	-0,083	0,016	-0,423	-0,265	0,127	0,845	0,155
14.	-0,779	-0,159	-0,128	0,032	-0,434	-0,217	0,056	0,887	0,113
15.	0,847	0,162	-0,258	-0,047	0,009	0,150	0,033	0,836	0,164
16.	0,332	0,114	0,408	0,080	0,210	0,589	0,025	0,688	0,312
17.	0,129	0,472	-0,706	-0,104	0,079	-0,237	-0,156	0,835	0,165
18.	0,262	0,709	-0,368	-0,178	0,097	-0,316	-0,092	0,856	0,144
19.	0,716	0,278	0,272	-0,006	0,191	0,266	-0,184	0,804	0,196
20.	0,692	0,220	-0,089	-0,089	-0,111	-0,189	0,041	0,593	0,407
21.	-0,041	-0,045	0,080	0,931	-0,014	-0,004	0,040	0,879	0,121
22.	0,047	0,050	0,083	0,918	0,096	0,006	-0,136	0,883	0,117
23.	0,222	0,038	0,077	-0,053	-0,113	-0,189	0,723	0,631	0,369
24.	0,122	0,127	0,130	0,035	-0,189	-0,262	-0,641	0,565	0,435
%	23,01	18,14	9,39	8,28	7,82	7,48	5,10	79,22 %	

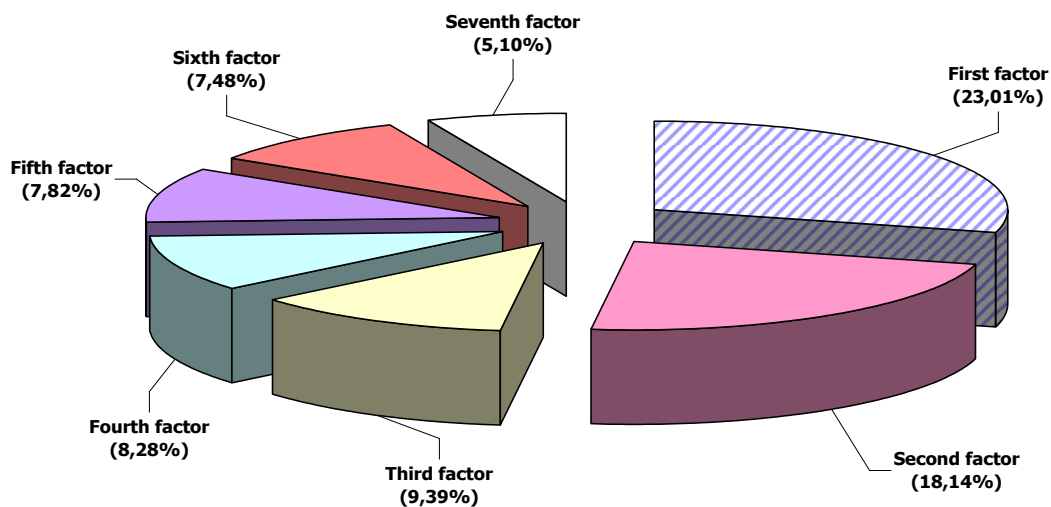


Figure 11. *Relative proportions of the variance in physical development and sports fitness explained by each factor – 10-years-old*

As seen in *Figure 12*, the *first factor* in 10-year-olds is extremely complex.

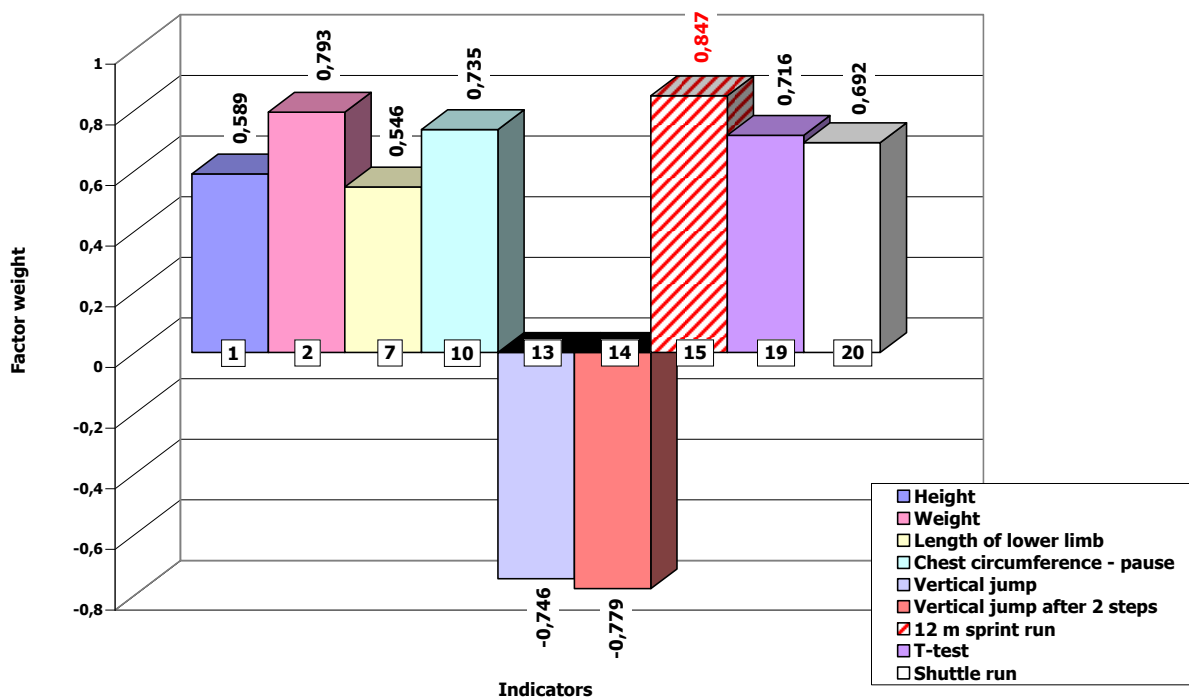


Figure 12. *Factorial structure of physical development and sports fitness in 10-years-old basketball players – First factor*

Nine of the traits included in the applied test battery have high factor loadings. The trait with the highest factor loading (0.847) is Indicator 15, which provides information about the sprinting capabilities of the basketball players. The factor can be identified as "*sprinting and explosive capabilities*", which positively influence the players' ability to move quickly across the court, both defensively and offensively without the ball.

The *second factor* for the 10-year-olds can be defined as "*morphological*", highlighting the importance of body lengths as a prerequisite for successful basketball development. At the same time, it is important to note that athletes with such physical attributes face difficulties when moving across the court while dribbling the ball.

The *third factor* (9.39%) can be identified as "*grip strength*." Although not entirely logical, it is important to include here the "specific skill for moving across the court at high speed with continuous direction changes."

The *fourth factor* reveals the significance of "*coordination-motor skills*" as an important element of young basketball players' talent, but their relative contribution is only 8.28%. The remaining factors explain a very low relative share of the total variance, so we will not go into detail on them.

III.2.2. Factor structure and main factors in 11-years-old

The factor structure of physical development and specific preparedness for 11-years-old is also defined by 7 main factors, which explain a relative share very close to that of 10-years-old (78.55%).

The most significant (*first*) *factor* for 11-years-old (22.45%) is also defined by 9 indicators. As seen in *Figure 13*, all of these are from the group of anthropometric traits. Therefore, it is quite natural to conclude that in this age group, "*good morphofunctional development*" should be prioritized at all stages of selection.

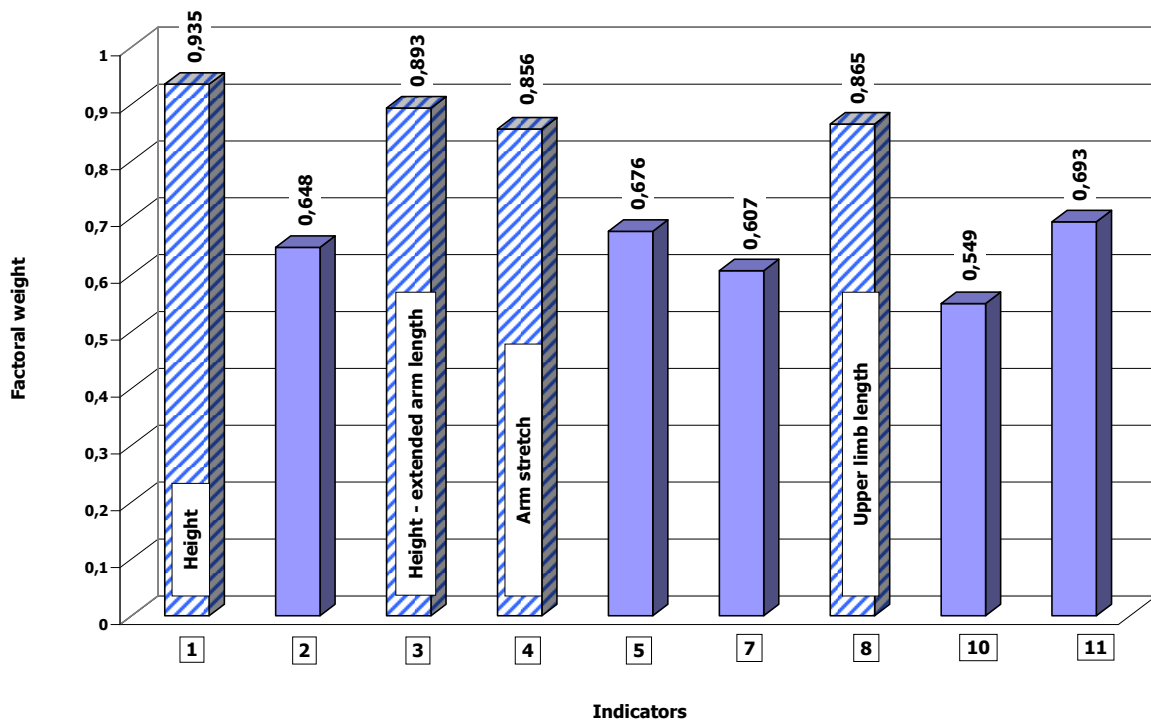


Figure 13. Factorial structure of physical development and sports fitness in 11-years-old basketball players – First factor

The *second factor* (18.22%) highlights the ability of young basketball players *to move effectively* both in offense, with or without the ball (indicators 17 and 18, with factor loadings of 0.941 and 0.871, respectively), as well as in defense (indicator 19).

The *third factor* (11.36%) can be identified as "*explosive strength of the lower limbs in vertical muscle efforts*". However, as the results show, this important basketball-related motor skill in 11-years-old is inversely proportional to body flexibility.

III.2.3. Factor structure and key factors for 12-years-old

In contrast to the two younger age groups, the relative share of the explained variance of the studied phenomenon is higher here – 81.84% (*Figure 14*).

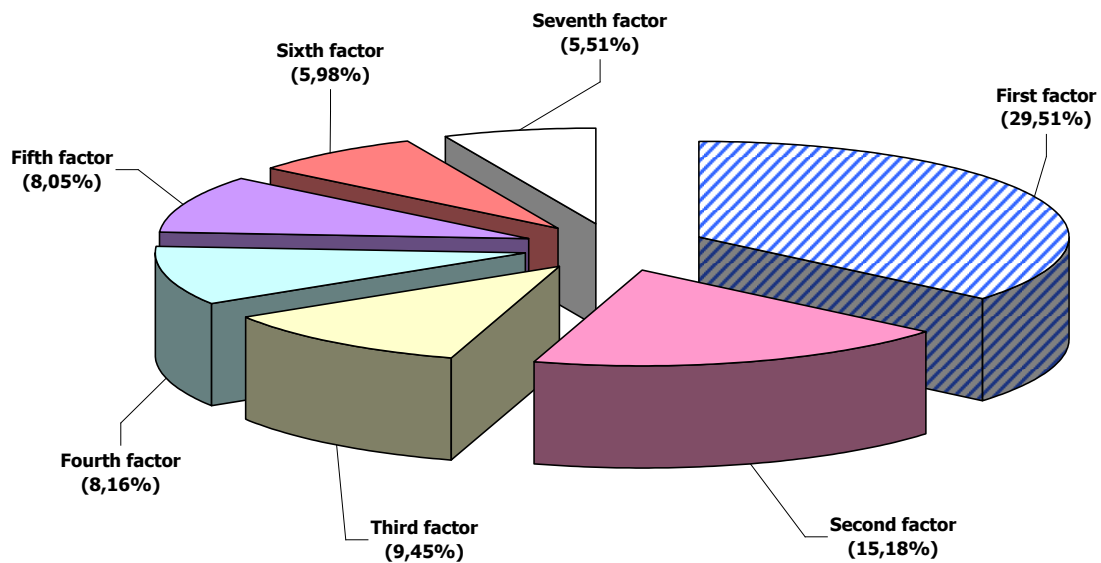


Figure 14. *Relative proportions of the variance in physical development and sports fitness explained by each factor – 12-years-old*

As in the case of the 11-years-old, the ***first factor*** here reveals the high importance of ***good physical development*** as a crucial prerequisite for progress in basketball.

The ***second factor*** (15.18%) is very similar to the second factor for 11-years-old and highlights ***the role of the ability to move*** in attack (both with and without the ball) and in defense, which is extremely important for the game.

The ***third factor*** (9.45%) is analogous to the third factor for 11-years-old and can also be identified as the "***explosive strength of the lower limbs during vertical muscle efforts***".

It is important to note that the attention parameters are only found at the end of the developed factor matrices, i.e., in the seventh factors for the 10- and 12-years-old. Furthermore, it is well known that concentration, distribution, and flexibility of attention are critical for a good basketball player. However, our study shows that during the period of sports orientation and selection, they are

not of significant importance. This fact is likely connected to the psychological characteristics of the studied age group.

III.3. Contribution of the studied traits to overall physical development and specific readiness

To achieve the goal and objectives of the study, the results of each boy for every observed trait were evaluated. Based on this, generalized individual scores, expressed as the average sum ΣT_{mean} , were calculated, providing information about the current overall state of each basketball player.

To uncover the contribution of each of the studied traits to the overall level of physical development and specific readiness, a Spearman rank correlation was performed based on individual scores across all indicators. The calculated rank coefficients (R) allow for the identification of the most important indicators for each age group. Based on this, models for effective selection of 10-, 11-, and 12-year-old Bulgarian basketball players can be developed.

The analysis of **Figure 15** shows that the most significant traits for 10-years-old, and consequently the most important for selection at this age, are:

- ***body lengths;***
- ***foot size;***
- ***flexibility;***
- ***grip strength.***

Evidence for this is provided by the values of the rank correlation coefficient, which for the mentioned traits range between 0.626 and 0.510. Statistically, this means that these traits have a significant impact on the generalized assessment of physical development and specific readiness in 10-year-old Bulgarian basketball players.

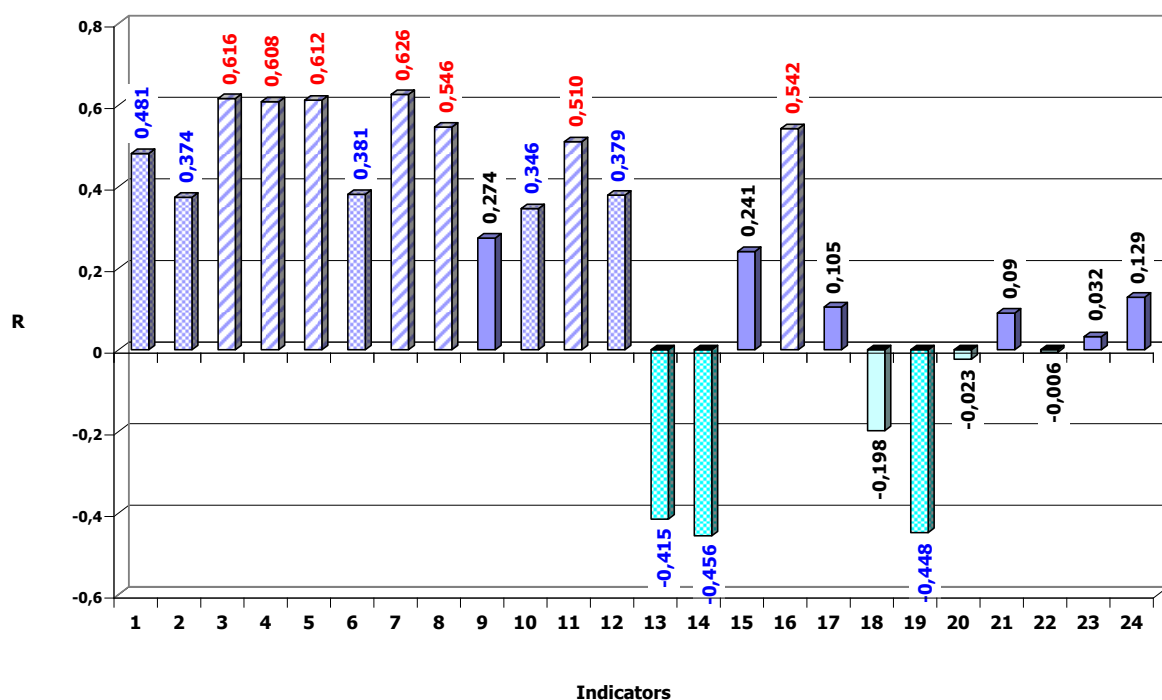


Figure 15. Contribution of the examined indicators to the overall fitness level of *10-years-old* basketball players

When analyzing the figure, it is also noticeable that in this age group, the focus should not be on the boys' height, but on the length of the limbs, which are key to greater horizontal and vertical reach.

The results for the next two age groups are quite different. As shown in **Figure 16**, for 11-years-old, height emerges as the most significant criterion for effective selection – for indicator 1, the rank correlation coefficient is the highest ($R_1 = 0.670$).

At this stage, the importance of longer upper limbs (indicator 8 – $R_8 = 0.662$) also increases, in contrast to the length of the lower limbs, where the value of R decreases from 0.626 in 10-year-olds to 0.277. There is also an increase in the influence of grip strength, while the significance of body flexibility decreases.

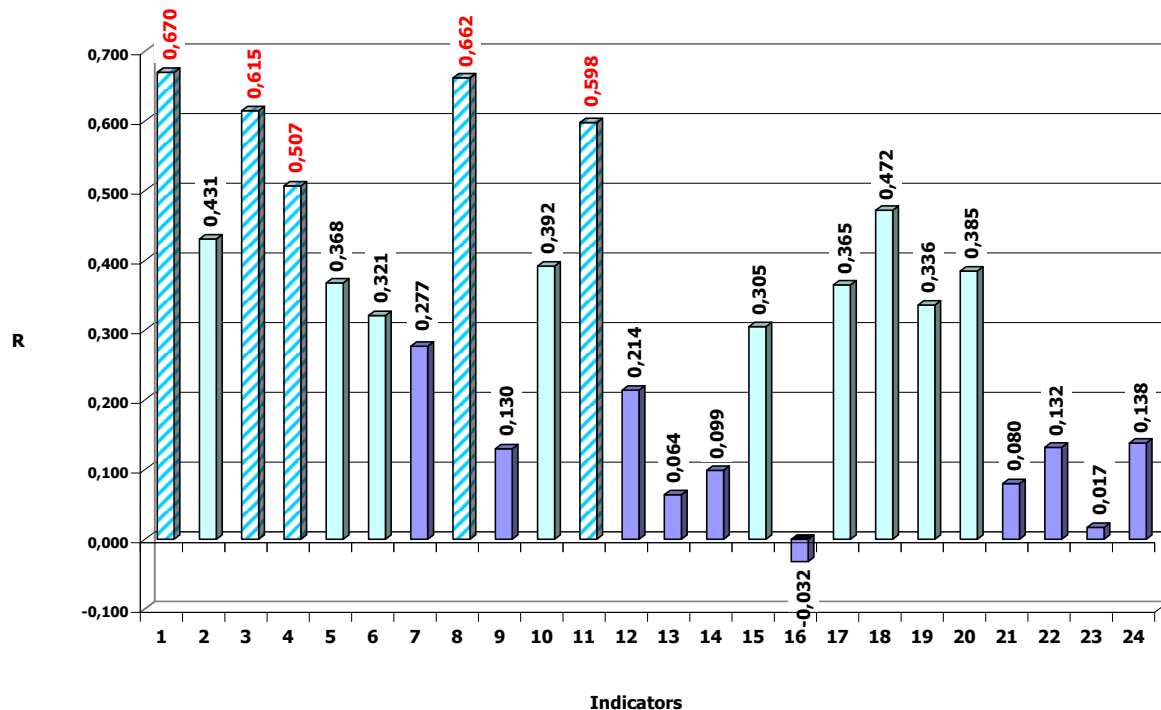


Figure 16. *Contribution of the examined indicators to the overall fitness level of 11-years-old basketball players*

All of this provides a foundation for determining the most important traits for the selection of 11-year-old basketball players:

- the height;
- the length of the upper limb;
- height with an upward arm stretched;
- grip strength, and
- the horizontal stretch.

In 12-year-olds, there is an even more pronounced increase in the importance of the morphofunctional development of boys. As the most important for the implementation of quality selection in them, can be defined:

- the height;
- the length of the lower limb;
- the horizontal stretch;
- the size of the palm, and
- the length of the upper limb.

In summary, it can be argued that at the age of 10-12 years, a high level of development of morphofunctional traits is the basis of the qualitative selection of basketball players.

The signs characterizing the level of development of special motor qualities, and especially those that reveal the peculiarities of some psychological characteristics, are not a significant part of the criteria for successful selection. Of course, we assume that there is a possibility that some of the indicators from these groups turned out to be insufficiently accessible for performance by basketball players of the studied ages. Therefore, this will be checked by us once again before the developed regulatory framework is proposed for wider use.

As for specific motor skills, the results show that they have a moderate effect on the overall readiness of young basketball players - their ranking coefficients are in the range between 0.3 and 0.5.

III.4. Regulatory framework for control and assessment of the physical development and special preparedness of 10-12-years-old bulgarian basketball players

In order to solve the purpose and objectives of the study, on the basis of the above analyses and generalizations, with the help of modern mathematical and statistical methods, a regulatory framework for control and assessment of the physical development and special fitness of 10-12-years-old Bulgarian basketball players has been developed.

To assess the state of each of the studied signs of physical development, special physical fitness, specific motor skills and some psychological features and qualities in 10-, 11- and 12-years-old boys playing basketball, normative tables have been developed that can be successfully used in the process of sports orientation and selection of basketball players.

The normative tables allow for easy and quick assessment of the condition of each of the signs included in the attached test battery.

The assessments are offered in a 50-point point system, which makes it possible to take into account even the slightest changes in the state of the studied signs both within short periods of the children's work and after a longer educational and training process.

It is recommended that in the selection process, the coaches keep the results of the control norms, which will allow them to track the development of each child for a long time. It should not be forgotten that talents are sometimes very difficult to find and the efforts on the part of managers are great, but this work is always rewarded.

IV. CONCLUSIONS AND RECOMMENDATIONS

The analyses and summaries made in the text provide grounds for formulating the following important conclusions:

1. Ten leading basketball schools can be identified in Bulgaria that support the targeted age group of boys aged 10 to 12 years. However, no specific standards have been implemented for selection and practices for recruiting athletes in these ten teams.

2. As expected, the physical development of 12-years-old basketball players is significantly higher compared to the other two age groups. At the same time, however, 10-year-olds have significantly larger feet and longer lower limbs.

3. Overall, the zones of variation for the physical development traits in the three age groups are almost identical, and all the studied groups are homogeneous and relatively homogeneous concerning the measured traits. Non-homogeneity is observed with regard to the functional capacity of the chest.

4. In a comparative analysis with the 10-year-olds, both the 11- and 12-years-old groups achieved significantly better results regarding the development of special physical qualities. Interestingly, 11-years-old have a significantly higher level of development in explosive strength during vertical muscle efforts compared to 12-years-old.

5. All the groups are homogeneous only with respect to the flexibility of the body in the included basketball players. The 10- and 12-years-old groups are non-homogeneous concerning the development of explosive strength during vertical muscle efforts.

6. The ability to move across the court for prolonged periods with continuous direction and rhythm changes is a priority for 10-years-old. The 12-years-old have a significantly higher level of defensive speed movement than

the 11-year-olds but significantly lag in other tested specific technical-tactical preparedness traits.

7. Both 11- and 12-years-old have significantly higher levels of development in mental characteristics compared to the youngest group. The significant advantage of the 12-years-old over the 11-years-old pertains to coordination-motor skills and the development of operational thinking. With regard to attention parameters, the null hypothesis holds.

8. The factor structure of physical development and special preparedness in all three age groups is determined by seven main factors, which explain a high percentage of the initial variance of the investigated phenomenon. The most important factor for 10-years-old can be identified as "sprint and explosive capabilities." For the next two age groups, the priority is good "morpho-functional development" as a key factor for success in basketball.

9. The foundation for quality selection of basketball players in the 10-12 year age period lies in the high level of development of morpho-functional traits. Traits characterizing the development of special motor skills, particularly those revealing mental characteristics, are not a significant part of the criteria for successful selection.

10. The developed normative framework for the control and evaluation of physical development and special preparedness will allow sports specialists to track the development of young basketball players through all phases of selection, which in turn will help identify and include the most talented Bulgarian boys for basketball training.

Recommendations:

1. A re-evaluation of the validity of the indicators used to track mental characteristics in the studied age group should be conducted once more.

2. The results obtained should be disseminated within basketball communities, especially among coaches of youth teams.

3. A methodological material for the Bulgarian Basketball Federation (BFBasketball) should be developed, including the methodology of the research and the proposed normative framework.