eISSN: 2349-5715 pISSN: 2349-5707

Volume: 11, Issue 04, April-2024 SJIF 2019: 4.702 2020: 4.737 2021: 5.071 2022: 4.919 2023: 6.980 2024: 7,662

IMPORTANCE OF MODERN INFORMATIVE METHODS AND BODY COMPOSITION INDICATORS

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Abstract: In various ages athletes we should examine the characteristics of shifts in the labile components of body weight through the research of body composition according to age. In the prepubertal period, there is a gradual and low increase in muscle mass, as well as a change in the volume of fat along the main border. A significant increase in muscle mass during puberty (especially in boys), a decrease in fat mass is characterized by a slight increase in boys and girls. This article, devoted to a review of the literature, is intended to study the significance of body composition indicators in junior and cadet athletes and currently informative methods for studying it.

Key words:body composition, junior and cadet athletes, informative methods for determining the compositional composition.

The study of the body's compositional structure is one of the relatively young and actively evolving fields of morphology today, and it is crucial to both sports and medical practice. The study of body shape in sports enables efficient management and regulation of the training process, as well as the tracking of athletes' physical and mental well-being. However, the examination of the aforementioned traits in sports necessitates accounting for the athlete's age and ability levels, the unique nature of the sport, model attributes, physical characteristics, and functional indicators [1, 4, 6, 7]. When evaluating the prospects of athletes, special attention is paid to determining their morphological, functional and constitutional characteristics. Unlike adults, children's bodies are characterized by rapid growth and development, active formation of organs and systems.

In some sports, height can serve as a sufficiently reliable prognostic indicator even when the increase in body mass is not large. It is worth noting that the performance results of a tall athlete with a relatively large body mass have a better perspective than short and medium-sized athletes. In many sports, despite the small body mass, height is of great importance. These physical characteristics are taken into account when building the model of the ideal athlete. Height-body weight index, indicators of neurofunctional and physical development level are important for achieving high results [2, 3].

The recruitment of relatively similar groups of athletes is based on large similarities in body structure, which indirectly affects the technical result. When an athlete's body structure is suitable for a certain sport, he has high potential, and vice versa, that is, athletes with a weak body structure can achieve high results when they improve their movement characteristics and technique. When engaging teenagers in sports, it is necessary to take into account the growth potential of their height and body weight. A sharp increase in body length has been found in boys from the age of 12, and an increase in body weight from the age of 13. During adolescence and young adulthood, high growth rates of body length, body weight and muscle mass are observed. Intensive growth of body length is observed in the period from 13 to 14 years (9-10 cm) and from 14 to 15 years (7-8 cm). The decrease in the growth rate corresponds to the age of 16-17: from 15 to 16 years - by 5-6 cm per year; From 16 to 17 years old - grows only 2-3 cm, and the growth of body length mostly ends at 18 years old. The reason for significant changes in the skeletal system and skeletal apparatus under the influence of physical activity is that their development is not yet complete in teenagers aged 16-18. The bone epiphyseal discs along with the vertebral body are fully grown at the age of 24; the growth of the nuclei of the superior bones continues from 16 to 25 years, and the growth of the pelvic bones

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continues from 14 to 20 years. The ossification of the fingers occurs in teenagers at the age of 16-22, while the ossification of the toes is completed 1-2 years earlier. From the age of 15-17, the growth of body length slows down, especially the longitudinal growth dominates. The bones will be thicker and stronger, but taking into account that the ossification process is not yet complete, it is necessary to be careful to engage in sports that involve lifting very heavy loads. The development of the adolescent's body is closely related to the growth of the cat's mass. With increasing age, its change occurs: at 7-8 years of age, the total mass of skeletal muscles is up to 28%, and at 12 years of age, it is 29.4% of the total body weight. By the age of 15, the muscle mass increases by 32.6%, and by the age of 18 - by 44.2%. By the age of 20, muscle mass is 40-45% of total body weight. As noted, changes in muscle mass indicators occur after the age of 17 due to external influences (nutrition, physical exertion), as well as genetic characteristics. At the age of 16-17, the increase in muscle mass is 3.8 kg (16.1%); 17-18 years old - 11.4 kg (5.6%); 18-19 years old - 11.0 kg (4.1%); 19-20 years - 10.3 kg (1.2%) [7].

During the research carried out by Rylova and Jolinskyi, it was found that the morphofunctional characteristics of young athletes, the body fat percentage of boys and girls who play sports is less than that of adolescent girls and boys who do not play sports, and the amount of muscle shedding in boys who do not play sports is less than that of young sportsmen. Based on the conducted research and dispensary data, as well as the results of retrospective studies, significant differences in the characteristics of groups of children and adolescents, as well as the presence of individual background conditions for each type of sport, were determined [15].

The impact of physical training on the musculoskeletal system is determined by their strength (volume, intensity) and the nature of stress (static, dynamic, force-related, high-speed, etc.). According to a number of authors, the same amount of dynamic exercises affects the active part of the body (muscles) and less on the passive parts (bones, tendons, ligaments). When evaluating age-related changes, it is necessary to take into account not only the magnitude of muscle tension, but also its qualitative characteristics (local or general, dynamic or static), as well as energy characteristics (light, medium, large, maximal, submaximal work capacity). From the point of view of age, the ability of the muscles to show the maximum working capacity is very different [12].

Dynamic studies of body mass components have been conducted by many scientists in different directions. It is known that body composition changes under the influence of different composition of dietary proteins, fats and carbohydrates [8]. An increase in the level of fat mass is observed when the proportion of carbohydrate-fat complex in the diet increases, and when the amount of fatty and carbohydrate-containing food is limited, the opposite changes in body composition are noted [2]. The use of various pharmacological drugs also affects the composition of the body: the use of anabolic agents increases muscle mass, efficiency and endurance [9].

Body composition indices have been found to be directly related to the level of physical activity [9]. Vigorous physical activity leads to a decrease in fat content and an increase in muscle mass [1, 11]. The specificity of the values of the components of body mass is determined by the type of sport and skill of the athletes. Skilled athletes with a high level of fitness have higher muscle mass and fat volume than athletes with low level of skill and level. The maximum values of muscle mass in athletes who engage in power-demanding sports, in sports requiring high endurance - the muscle volume is less compared to the power-demanding type of sports, as well as the minimum amount of fat volume. The values of muscle and fat mass in those who play sports differ depending on the intensity of the game. Thus, a specific morphological model of athletes is formed in each sport, and compliance with it is the main pillar of success in sports and "professional longevity". Today, the demands on athletes are steadily growing, they must meet the increasingly complex

eISSN: 2349-5715 pISSN: 2349-5707
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criteria of the morphological model, change their physical data from the general morphological norms and turn to more specialized training methods in order to ensure the optimal implementation of the biomechanical stereotype of sports.

One of the current problems for athletes is maintaining optimal body weight, which encourages athletes to use extreme methods to reduce body weight or keep it low, especially in heavy sports. Deliberately maintaining a low body weight or short-term weight loss can lead to serious medical problems. All this becomes one of the common problems in many sports [13, 14].

Calculation of fat mass, which serves to ensure metabolic activity, is important in sports [10]. Likewise, knowing the amount and distribution of bone and muscle is another essential metric in determining athletic performance. A decrease in the percentage of fat mass in an athlete's body up to 5-6% and the volume of the musculoskeletal system up to 46% due to excessive physical exertion indicates that the body is working excessively hard [2]. In addition, changes in muscle and fat components under the influence of training loads reflect a change in flexibility, tension and energy supply in the athlete's body at the structural level. In the same way, it is important to control the water balance in the body of athletes, because intense physical activity is accompanied by the loss of elements, primarily sodium and potassium, due to sweating, which negatively affects the functional state of the cardiovascular system and neuromuscular regulation. Studies have proven the need to monitor the total amount of water in the athlete's body and the amount of intracellular fluid in order to correct the body weight before the start of the competition in order to prevent the athlete from losing strength [12, 15].

Over the past century, many methods have been proposed to determine the composition of the human body, and today modern approaches allow studying this indicator at all levels of the biological system - elementary, molecular, cellular, organ tissue and the whole organism level [4]. However, they all have their own shortcomings, and currently there is no "gold standard" or universally acceptable criteria for body composition determination methodology [2]. All technical tools used are divided into the following categories: simple method, laboratory test and standard methods.

Common methods include anthropometry, bioimpedancemetry, body mass index determination. Laboratory examination methods include densitometry, hydrometry, ultrasound examinations, three-dimensional scanning, two-energy X-ray absorptiometry, and reference methods include multicomponent models, computer tomography, magnetic resonance examination methods [6].

Anthropometric, caliperometric methods of determining body composition have shown their effectiveness in sports and medical practice. It is one of the cheapest, simplest and most portable methods for determining body composition. However, conducting anthropometric measurements requires high qualification of the examiner and strict adherence to the examination protocol [4, 6]. Among the simple methods of studying body composition, body mass indices occupy a certain place. Unfortunately, the use of body-weight indices does not provide reliable information about body composition at the individual level. This method is a less informative method for determining fat mass in people whose activity is physical labor or regular physical exercise, and physical exercises associated with increasing muscle mass [3, 4].

One of the widely used methods for determining the composition of the body is the bioimpedancemetry method, which is based on significant differences in the electrical conductivity of fat tissue and lean body mass. This method is characterized by acceptable accuracy, portability, relatively low cost of equipment and testing, convenience of the research method, and the possibility of automatic data processing [1]. The disadvantage of the method is the lack of uniform standards of

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equipment and measurement methods, which makes it difficult to compare and analyze the results. The advantage of individual models of this method is that it is possible to simultaneously evaluate clinically important parameters such as active cell mass and basic metabolism, as well as to study parameters of not only integral, but also local body composition [5].

Another way to study body composition is plethysmography, based on the assessment of body density, in which the density of the body is determined in a hermetic chamber filled with ordinary air. An alternative method of determining body density is hydrostatic densitometry. For this, body weight is measured in water and under normal conditions. This method, which requires full body submersion to measure body weight, is less likely to be used in children, as well as in the elderly and sick. In general, hydrostatic densitometry and air plethysmography methods are technically challenging and must be performed in a hospital setting. In addition, due to individual differences, it is difficult to obtain accurate and complete information through these methods. Another way to determine body composition using body models is to estimate the total amount of water in the body.

The standard method of measuring water in the body is the isotope mixing method using tritium and deuterium. Unlike the methods of hydrostatic densitometry and air plethysmography, this method is very convenient to use and can be used in any setting, but the analysis is sent to the laboratory and checked there for several days. In addition, another disadvantage of this method is related to the effect of a small amount of radiation on the body (in the case of tritium) and the high cost of the examination (when N2 18O is used). A further shortcoming of this study is the assumption that the relative water content of the body mass is constant, the main source of deviation from the somewhat accurate figure. Therefore, it is not recommended to use this method in people suspected of dehydration.

In the study of the composition of the body, ultrasound is one of the most accurate methods of determining fat, muscle and other tissues today. Portable ultrasound devices allow measurements to be taken in any conditions [6].

Another of the most common methods for diagnosing body composition is dual-energy X-ray absorptiometry. Initially, this method was successfully used in medical practice for the diagnosis of osteopenia and osteoporosis. Currently, in addition to mineral density and bone mineral mass assessment, dual-energy X-ray absorptiometry is used to determine body fat and lean body mass. The dual-energy x-ray absorptiometry method allows studying both peripheral and axial parts of the skeleton. The built-in program automatically corrects the measurement results, taking into account the density of soft tissues. This method is a minimally invasive and relatively inexpensive method that does not require active participation of patients. Comparison of the results of the two-energy X-ray absorptiometry method with neutron activation analysis, hydrostatic densitometry methods showed the possibility of sufficiently accurate assessment of fat and lean body mass. On this basis, the dual-energy X-ray absorptiometry method is used as information to verify predictive formulas based on body mass indices, as well as caliperometry and bioimpedancemetry [4, 5].

Determination of total body protein is done by determination of nitrogen content using neutron activation analysis, which is available only in a few laboratories around the world. When using this four-component model, the ratio of body protein to body mass should be constant, but even when observing short-term changes in body fat under the influence of physical activity, or changes in diet, changes in cellular and protein mass in the body can cause deviations in the exact figure. . Different models have specific application specifications. For example, the two-component model for determining body composition is not suitable for monitoring changes in the individual composition of the body due to significant changes in body mass composition and density, except for the initial

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diagnosis and evaluation of the effectiveness of treatment of obvious levels of thinness or obesity. This model can be used to describe group averages. The three-component model can be used to characterize the healthy population of adults and adolescents, which allows for a slight improvement in the accuracy of body fat measurements, whereas in patients with body fluid imbalance or mineral changes in body volume, the three-component models lead to significant percentages of errors in accurate measurements of body fat. may come[4].

Traditional, two-, three-, four-component and five-level multicomponent models are used. However, component models for estimating body composition (body density, body water content, body mineral mass, total body protein, cell mass) require a lot of time to measure parameters, as well as the use of expensive and special technologies.

One of the benchmark methods for determining body composition at the tissue level is magnetic resonance imaging and computer tomography. X-ray computed tomography allows to separately monitor the amount of subcutaneous and internal fat, as well as the mass of skeletal muscles and internal organs. Magnetic resonance imaging, like computed tomography, can be used as a reference method for determining skeletal muscle mass. The advantage of the methods is their high level of accuracy. Disadvantages are the high cost of the examination, the use of a radioactive source, the lack of regulatory criteria, and the need for the method to be performed in stationary conditions [6].

Thus, to a large extent, the choice of technique for determining body composition depends on the intended purpose of the study and the availability of technology. Compared with the dual-energy X-ray absorptiometry (DXA) method, ultrasound and anthropometric measurements have been shown to be the most informative method for determining body fat percentage. Compared with DXA, bioimpedancemetry, and air plethysmography methods, it is not possible to accurately measure body fat percentage in young male athletes. In addition, the total fat percentage is significantly higher in bioimpedance measurements. When taken individually, bioimpedancemetry and DXA are less accurate in predicting total body fat than air plethysmography in young athletes.

Undoubtedly, relatively simple, portable and inexpensive methods - anthropometry, calliperometry, bioimpedance analysis - are preferred in population studies and ambulatory practice of sports medicine. In scientific and clinical research, the demand for high accuracy of the method is of great importance.

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