Fitness of athletes with musculoskeletal disabilities as an element of sustainable behaviour psychology

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Abstract. At present, both from the point of view of individual sciences and, above all, from the point of view of the emerging interdisciplinary approaches, the problems of the correlation between the physical and the mental in human development are a very relevant area of scientific research. Each science in the interdisciplinary approach has its own traditions, methods and research methodology, the use of which largely depends on the particular scientist and the scientific school he or she has passed through. The problem of sports training of disabled people touches a powerful layer of anthropological problems, ranging from anthropometry to social, cultural and philosophical anthropology, aimed at understanding the nature and essence of man. Within the problem field of cultural anthropology at the intersection with cognitive science, the problems of cognitive anthropology are considered. Modern cognitive science insists on the inclusion of an inner plan, a plan of mental intentions, in order to understand the essence of any kind of human activity. In sport, the inseparability of mental and physiological, mental and physical, feeling and action is an indispensable condition of this kind of human practice. A special role is played by sport for the disabled. The article deals with the methods of assessing the level of physical development of persons with lesions of the locomotor system who are engaged in powerlifting. The positive influence of powerlifting on the physical condition of athletes of this category is proven, which leads to a more stable mental state and greater psychological well-being.

1 Introduction

The study of the physical development of all populations is based on anthropometry. Anthropometric characteristics include a variety of total and partial body dimensions that are somehow related to the development of the musculoskeletal system and, in particular, the human skeleton. The problem of selecting the most informative characteristics for assessing physical development has been pointed out by many specialists. One of the most important indicators of human health is physical development [1-19]. Physical development

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is a process of change of morphological and functional indicators of human organism under the influence of heredity, environment and level of motor activity. Physical development of a person is influenced by many factors: heredity, ethnicity, environmental influences (natural and climatic conditions of residence), peculiarities of nutrition and its balance, professional activity and, of course, motor activity [2, 3, 7, 11].

2 Materials and methods

Anthropologist, Doctor of Biological Sciences Bashkirov P.N. under physical development of a person understands "that complex of morpho-functional properties of an organism, which ultimately determines the stock of its physical strength. The basis for the study of physical development of all population groups is anthropometry: military, preschool, school, professional and physical culture" [2]. Anthropometry is the simplest, most cost-effective and most widespread method of obtaining information that allows us to assess the characteristics of a person's physical development. In age anthropology and anthropometry, the main criteria of physical development are the rate and quality of growth and development [15]. Two groups of indicators are used to assess the level of physical development: physique and indicators of the functioning of various body systems [17].

The problem of choosing the most meaningful indicators in the assessment of physical development is pointed out by many specialists [10, 11, 18]. The main indicators necessary for the assessment of physical development of children and adolescents are also discussed. Many results of measurements, such as: lung volume, chest excursion, dynamometry and a number of other signs are influenced by the will and emotional state of the researcher, which in some cases is reflected in the research results [2, 3].

In their research, A.I. Kozlov and G.G. Vershubskaya point out the problems in the choice of methods for assessing anthropometric indices. The authors distinguish two important directions - the establishment of the boundaries of norm (standards) based on the data on local (population) variability of relevant characteristics and - the definition of uniform (reference) parameters suitable for use in most regions of the country or the world [7]. However, in the rapid assessment of physical development of children and adolescents, the World Health Organization (WHO) proposed to use simple available basic indicators: age, weight and body length (height), and to consider all other measurements as additional. Additional anthropometric indicators include sitting height, neck, abdomen, waist, hip and shin circumference, shoulder size, sagittal and frontal diameters of the chest, arm length, etc. [8]. For children and adolescents aged 5 to 19 years, the level of physical development is assessed by height, weight and BMI. By comparing specific values with the norms established for a given age-sex group, a specialist can make an initial conclusion about the status of an individual or a group, confirm or reject the assumption about the presence of certain deviations [7]. In Russia, research into the physical development of children is regulated by the Order of the Ministry of Health of the Russian Federation dated 10 August 2017. N 514n "On the Procedure for preventive medical examinations of minors". For the purpose of a unified approach to the assessment of children's physical development, the procedure and norms for assessing the physical development of children from 0 to 19 years of age have been approved in the subjects of the Russian Federation [13].

"Norm" is a varying concept, but where is the limit of its variation - this is a question that essentially remains unresolved to date. P.N. Bashkirov wrote the following about this concept: "the "norm" cannot be canonized neither in the direction of its form, nor in the direction of its magnitude; "norms" are multiple, they are as many as it is possible to distinguish separate groups of population by age, sex, territorial, epochal and other features" [2].

At present, special anthropometric standards and nomograms have not yet been developed for persons with disabilities. Due to the great variety of types of lesions, in this context, the use of the concept of "norms" of physical development is hardly appropriate. But still, medical institutions, up to now, assess the level of physical development of this category of population (persons) using the same standards and reference values of anthropometric indicators, which are used for persons without disabilities.

In most scientific domestic research, authors use both the results of the main indicators and the results of additional measurements in determining the physical development of disabled people with musculoskeletal disorders (MSD) [8]. Krasnoperova T.V. and Emelyanov V.D. consider the centile method to be the most objective in assessing the physical development of schoolchildren with MSD, since this method is based on the identification of differences between the average statistical results of measurements and actual data in subjects of the same age and sex, taking into account the geographical area of residence [8].

Due to the fact that persons with musculoskeletal disabilities have a great variety of different types and degrees of lesions, reliable measurements of body length in persons with MSD cause great difficulty. Height measurements are carried out both in the standing position, if possible, and in the sitting and lying positions. These growth indicators of such category of disabled people are not always reliable and informative. Analyses of literature and scientific sources have shown that there is currently no universal method for measuring the height of persons with diseases of the musculoskeletal system. Depending on the method used, these values may differ significantly from each other. In the supine position, physiological curvatures of the spine are smoothed out and height increases by 14-55 mm compared to the standing position. In the supine position, these measurements can be significantly higher than in the standing position. But despite this, when it is not possible to measure standing height, measuring the body length of a disabled person with MSD is carried out by all currently available methods.

Researchers have noted that in persons with MSD, when joint contractures, muscle weakness, scoliosis and involuntary movements are present, it is difficult or even impossible to measure height by conventional methods (standing and lying down). A number of common disorders and pathological processes make accurate measurement of standing height difficult in many patients. As an alternative, segmental lengths such as knee height, tibial length or forearm length are often used. The determination of height from skeletal bones is based on the fact that there are certain regular relationships between the size of the long tubular bones and the height of a person. On the basis of these ratios, it is possible to determine human growth by size of separate, mainly long tubular bones Ratios of lengths of tubular bones and growth of men and women change in periods of growth and slightly differ from each other. There are several methods for determining human height from the size of the tubular bones. Calculations can be made both with application of special tables, in which the ratio of lengths of tubular bones to human height is specified, and the growth can be calculated with the help of formulas and the method of percentage ratio [1]. Measurement of the tubular bones has been recommended for inclusion in the routine growth assessment of this group when accurate or reliable direct measurements of height or length in the supine position are difficult or impossible [14]. The same opinion is held by S.F. Kurdybaylo et al. that most of the available (used) methods are of little or no use for assessing the physical development of disabled people with musculoskeletal system damage [9]. The author notes the difficulties in determining height in disabled persons with complete amputation of the lower limbs and in persons with severe deformity and contracture of the legs.

In addition to the main signs of physical development in disabled people with MSD, the most informative are the determination of functional capabilities of the musculoskeletal

system, which are characterized by the volume of movements in joints, the state of the musculotendinous apparatus, and compensatory and adaptive reactions [9].

In this research of methods to assess the physical development of disabled people with MSD, we focused only on those types of lesions in which athletes with lesions of body parts or functions are allowed to compete in Paralympic powerlifting, these are people with such lesions as: with spinal cord injury, cerebral palsy (MSD), amputation of limbs. The height of the athletes was measured in the supine position, in addition the weight of the athletes was measured and the body mass index (BMI) was calculated.

Determining body weight at the weigh-in of disabled athletes with MSD participating in powerlifting competitions is not a problem, as the weigh-in is performed on special floor electronic medical scales with a wide anti-slip platform. The design of the scales allows weighing disabled people standing with bearing, sitting in a wheelchair, sitting on the platform. When weighing in a chair, the weight of the chair is not taken into account [5]. For athletes with lower limb amputation participating in competitions, there are additions to the result of body weight, which can be from 1 to 3 kg depending on the amputation [12].

Weight is influenced by muscular activity, which generally leads to a decrease in total body fat; an increase in net and total body mass, which is characteristic of boys [19, p. 385]. This opinion is also supported by our research [16]. Powerlifters with MSD, who systematically attend training sessions for many years regardless of the type of lesion, have indicators of physical development at the level of norms of standards proposed by WHO for persons of different age groups who do not have disabilities. When assessing physical development, it is necessary to take into account not only its basic indicators, but also some functional features of the organism. Physical development, in particular its basic indicators do not always demonstrate physical health of a person, but are an indicator of body density and physique. BMI does not take into account such factors as muscle atrophy or limb loss, or the difficulty in measuring height in people with limb contractures or severe scoliosis. Self-reported measurements of weight and height, often used to calculate BMI in research on people with disabilities, may be erroneous [4].

An important specific task of medical supervision is to assess the influence of disabling factors on the state of the organism, as well as the dynamics of vital signs under the influence of systematic physical training sessions [9].

Clearly, much remains unclear about how to optimize the level of physical activity in individuals with HIA. At the same time, it is important to emphasize that the extensive knowledge of the processes underlying high performance training is and will continue to be used to understand the health-promoting effects of exercise. The process of physical training, both in high-performance and mass sports, should be based on a clear understanding of the human physical condition and its changes associated with physical exertion [6].

We present the results of research into the physical development of powerlifters with musculoskeletal system lesions in the Far East region of different age groups. The first research involved a group of young men aged 13 to 17 years, 12 diagnosed with MSD and 2 athletes with spinal cord injury. Body weight measurements of body length (height) and standing and sitting positions and body mass were performed. Based on the measurements, the body mass index (BMI) of each athlete was determined. All athletes of this group were divided into subgroups according to age: group 1 - 13 years old, group 2 - 14-15 years old and group 3 - 16-17 years old (Table 1).

Table 1. BMI of young men with MSD engaged in powerlifting of different age groups

Age (years)	Body length (cm)	Body weight (kg)	BMI	
			powerlifters with MSD	Norm
20-30	174	56.0	18.5	18.5-24.9
31-40	168.8	65.4	23.0	
41-47	180	78.0	24.1	

Athletes who were 13 years old and had little experience in adaptive powerlifting had an average BMI of 15.8, which is slightly lower than the corresponding norm of their non-disabled peers. According to WHO standards for this age group, this BMI=15.8 indicates severe body fatigue. In the following groups of athletes 14-15 and 16-17 years old, second and third years of study, the average BMI=19.21 and 21.62, which corresponds to the norm of WHO standards.

If we compare BMI with the indicators of powerlifters with MSD of other age groups, we can note the following (Table 2).

Table 2. Physical development indicators of powerlifters with MSD of different age groups

Age (years)	Experience (years)	Body length (cm)	Body weight (kg)	BMI	
		powerlifters with MSD	powerlifters with MSD	powerlifters with MSD	Norm
13	>1	162.4	41.60	15.80	19.1
14-15	2	165.8	52.80	19.21	19.8-20.2
16-17	3	166.3	59.75	21.62	20.3-20.5

Weight-bearing indices of powerlifters with musculoskeletal system lesions regardless of age group are within the norm of a non-disabled person. BMI of the athletes did not indicate obesity and emaciation, but within the normal range, which is very important for persons with mobility disability. Athletes in the groups presented were mostly diagnosed with MSD, (with spinal cord injury - 1 person). Coaches' observations show that it is very difficult for athletes with MSD to "gain" weight, as well as to lose weight. There is research that BMI is significantly higher in men over the age of 30.

Research on BMI in young powerlifters with musculoskeletal disorders, mainly athletes with MSD living in Khabarovsk Krai, has shown that when exercising for two or more years, BMI corresponds to the norms developed by WHO for people without HIA. This research suggests a positive effect of powerlifting on physical development indicators in MSDs, which in turn has a beneficial effect on physical health in general.

Long-term observations of the coaching staff of athletes with musculoskeletal system defects have shown that the changes occurring in the athlete's body, namely strengthening of the muscular corset, changes in posture and gait, natural development of moral and volitional qualities in the process of achieving a sports result, the sports result itself are the most powerful factors of socialization, identification and individualization of the disabled athlete, causing an increase in the level of mental well-being of athletes.

3 Conclusions

1. At present, special methods of assessing the level of physical development, anthropometric standards and nomograms have not yet been developed for persons with disabilities. Naturally, in general, they should be oriented towards norm typical people, but the accumulation of research material on this problem will make it possible to study the measure of limitation and, consequently, to differentiate more clearly the methods of

rehabilitation and sports training. To assess the level of physical development of disabled people, unified standards and reference values of anthropometric indicators are used, which are used for people who do not have disabilities. The analysis of scientific and methodological sources has shown that currently there is no universal method of measuring body length of persons with diseases of the musculoskeletal system.

2. To assess the physical development of a disabled person with MSD, an individual approach is necessary in each specific case, taking into account the type and degree of the lesion. Complex observations in the dynamics of physical development of a disabled person is a more informative research method. It is necessary to take into account the place of residence, natural and climatic conditions, belonging to an ethnic group, financial status, peculiarities of nutrition, physical activity.

3. The positive influence of powerlifting on the physical condition of young athletes with musculoskeletal system lesions has been proved. Accurate measurement of body length of such athletes allows, first of all, to estimate body mass index more accurately, as well as to analyze in more detail not only the dynamics of sports results, but also the process of physical rehabilitation of disabled people, in addition to assess the current state depending on the period of training. The research of body mass index (BMI) in young powerlifters with musculoskeletal disorders (MSD) living in Khabarovsk Krai showed the following. In athletes at the age of 13 years, who started adaptive powerlifting not so long ago, the average BMI is 15.8, which is slightly lower than the WHO norms. For the age of 13, this 15.8 indicates severe exhaustion. In the other two groups of athletes 14-15 years old and 16-17 years old, second and third years of training, BMI values of 19.21 and 21.43, which correspond to the norm of this age according to WHO. These indicators indicate a positive effect of powerlifting on the physical development indicators of disabled people with MSD, which in due time has a favorable effect on physical health in general. In young athletes engaged in powerlifting no signs of obesity and exhaustion were revealed.

4. The average BMI in three age groups of powerlifter athletes with musculoskeletal system lesions (20-30 years, 31-40 years and 41-47 years) correspond to normal body weight. But at the same time, a slight increase in these indices in persons systematically engaged in strength exercises may indicate not only obesity, but also an increase in net and total mass of the athlete, which in powerlifting significantly affects the result.

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