Relationship of motor development of children and adolescents with body type and morphofunctional features

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Abstract

Objective of the study was to evaluate the relationship between the motor development of children and adolescents and the body type and their morphofunctional features.

Methods and structure of the study. The experiment involved 1415 children aged 4-7, 25 schoolchildren aged 7(8) to 10 years and 45 teenagers aged 11-16 playing handball. The work used: anthropometry according to P.N. Bashkirov and somatotyping according to R.N. Dorokhov, tapping test and RMO, assessment of morphometric parameters of the muscles of the lower extremities "MORFOMETR", digital dermatoglyphics according to the method of T.F. Abramova, bioimpedance analysis and a battery of motor tests.

Results and conclusions. A correlation was established between the development of the physical qualities of children of different ages and their body types. In addition, the dependence of somatotypes and morphometric parameters of the muscles of the upper and lower extremities, the speed of muscle contraction and indicators of digital dermatoglyphics, as well as hereditary predisposition, has been established.

Keywords: *somatotype, children and adolescents, morphofunctional features, motor development, motor qualities, muscle morphometry.*

Introduction. Motor loads are a powerful external environmental factor that affects the age-related processes in the younger generation, while the “dose effect” is manifested - the optimal number of movements stimulates, and insufficient and excessive ones inhibit growth processes almost equally [7].

The current actual demands of the time require socially oriented results of activity from physical culture, moving away from the formal expectation of normative results of schoolchildren. This is justified by the need to maintain a healthy lifestyle and level of physical activity at later stages of life. The solution of this problem is the most rational at the stage of school education, since it is at this age that sensitive periods of development of basic motor abilities are noted [6].

One of the solutions offered by specialists is a humanistic approach to the education and upbringing of children and adolescents within the framework of physical education and sports training. But this is only possible taking into account the individual heterochronous development, namely the morphofunctional, physical and mental characteristics of the student. Body type (somatotype) has a high prognostic and practical significance, determines the rate of human ontogenesis, is widely used in sports practice and physical education of children, adolescents and adults [2, 4, 5].

Modern educational technologies recommend optimizing the physical education of children and adolescents in accordance with their genetic, morphological and psychophysiological characteristics. Accounting for morphofunctional typology in physical education and sports formed the basis for the development of several recent concepts of an individual approach and

training regimes, taking into account these characteristics of schoolchildren [5].

Objective of the study was to evaluate the relationship between the motor development of children and adolescents and the body type and their morphofunctional features.

Methods and structure of the study. The experiment involved 1415 preschool children, 25 children of primary school age and 45 adolescent boys involved in handball.

All examined patients underwent anthropometry according to P.N. Bashkirov and the somatotyping method according to R.N. Dorokhov [3]. It was determined that the examined children belong to three main body types (somatotype): microsomatic (MiS), mesosomatic (MeS) and macrosomatic (MaS) and transitional micromesosomatic type (MiMeS).

In children of preschool age, on the basis of generally accepted pedagogical tests, an assessment of their motor development was carried out, neurodynamic indicators were studied (tapping test and RMO).

In school-age children, the method of genetic markers was used - digital dermatoglyphics. The qualitative sign of skin patterns of the distal phalanges of the fingers was evaluated with the calculation of the frequency of occurrence (%) of a particular skin pattern, and the delta index (DL10) was calculated. Basic steps were filmed at a frequency of 25 frames per second. An assessment of the morphometric parameters of the muscles of the lower extremities was carried out using the MORFOMETR program [9].

In the examined adolescents, digital dermatoglyphics was studied according to the method of T.F. Abramova [1]: delta index (DL10), total ridge count (TRC), ratio of TRC and DL10 (TRC/DL10); conducted clinical and physiological testing, as well as applied bioimpedance analysis to determine the composition of body weight (diamond-AIST body structure analyzer) and pedagogical testing (motor test battery).

The obtained results were processed using Microsoft Excel 7.0 software, morphometric synthesis method and factor analysis procedure using SPSS 15.0 for Windows.

Results of the study and their discussion. In girls of the MiS type, at the age of 5, the quality of speed begins to actively develop, and from the age of 6 - dexterity. The quality of speed is closely associated with the dominant of excitation processes (r=0.62), and the development of dexterity is associated with the processes of excitation and endurance of the nervous system (r=0.6) (P≤0.05). In boys of the MiS type, a significant increase in motor maturity is associated with the strength characteristics of the muscles of the trunk and lower extremities. An average correlation was noted between the indicators of dexterity and the dominant effect of excitation processes r=0.5, as well as the endurance of the nervous system, the quality of speed is associated with the amount of the muscle component of body mass r=0.62 (P≤0.05). The high motor development of boys and girls with the MeS type primarily depends on the dynamic strength of the muscles of the trunk and both limbs; at the age of 5–7 years, children showed an intensive development of motor qualities of dexterity and speed. These qualities are associated with neurodynamic parameters and dynamic strength of the muscles of the lower extremities (r=0.73), as well as an increase in muscle mass (r=0.7) (P≤0.05). Girls and boys of the MaS type have low motor development throughout the entire period of the first childhood, and only by the end of this period at 6-7 years old, they demonstrate significantly high values of motor qualities of dexterity, dynamic strength of the muscles of the lower extremities and torso (r=0.75) (P≤0.05). Thus, the motor development of preschool children is closely related to the body type and proceeds heterochronously.

As part of the calculation of the morphometric characteristics of the muscles of the lower extremities when performing basic steps in the overcoming mode in the complex of children's recreational aerobics, the computer program "MORFOMERT" was used [9]. We analyzed the features of the morphometric parameters of the muscles of the lower limb, namely the gluteus maximus, rectus femoris, biceps femoris and calf muscle of the leg. In junior schoolchildren of the MiS- and MeS type, the largest range of the length of the rectus femoris was found. A high maximum speed of muscle contraction was noted in those engaged in the MeS type, children of the MaS- and MiS types have the same values of this morphometric indicator. Schoolchildren with the MaS type are characterized by extremely low range of variations in the length of the biceps femoris muscle and the time between max and min muscle length during contraction compared to children of the MeS- and MiS types. It has been established that children with the MiS type have a high range of variations in the length of the gastrocnemius muscle.

An analysis of the image of the phase trajectories of the muscles of the lower extremities prompted the

search for conjugation with indicators of body type, digital dermatoglyphics and morphometric indicators of muscles using factor analysis. For the gluteus maximus and rectus femoris, the first factor (43% and 39%) combined the predictors of DL10, body type, and contraction rate of these muscles (r=0.48, P≤0.05). The first factor (41%) contains predictors of body type, contraction speed and range of variation in the length of the head of the biceps femoris muscle (r=0.43; P≤0.05). For the gastrocnemius muscle, factor analysis revealed two factors: the first (36%) combined predictors of body type, range of muscle length variation, and muscle length change; the second (25%) - the values of DL10 and the speed of contraction of the gastrocnemius muscle (r=0.45; p≤0.05). The results obtained are consistent with the data of B.A. Nikityuk, V.I. Filippov [8] and T.F. Abramova [1].

Thus, in children of primary school age, the body type, skin finger patterns, are closely related to the morphometric characteristics of the muscles of the lower extremities.

Boys handball players are conditionally divided into two groups: extreme players and players of the central zone. Somatotyping according to the method of R.N. Dorohova [3] revealed that the players of the central zone have MaS and MeS types in the period of 11-16 years, the outer players have representatives of three types: MaS, MeS and MiMeS. Factor analysis (values of the first and second factors 40%-45.1%) in the extreme players combined indicators of complex coordination actions, speed-strength qualities, dynamic strength of the lower limbs, which are interconnected with a genetic marker (TRC/DL10), somatotype, explosive strength of the nervous system and energy potential (r= r=0.51-0.85).

In the players of the central zone, the development of speed and agility was found to be associated with the dynamic strength of the upper and lower extremities (r=0.51-0.79), as well as with their hereditary predisposition (TRC/ DL10, TRC/DL10) to these qualities, functionality nervous system (r=0.48-0.84), body type, content of active cell mass (r=0.42-0.67).

Thus, the formation of motor qualities in young handball players is closely related to morphological features, functional capabilities of the nervous system and the implementation of the hereditarily given potential.

Conclusions. The examined children belong to three main body types (somatotype): microsomatic (MiS), mesosomatic (MeS) and macrosomatic (MaS) and transitional micromesosomatic type (MiMeS).

A correlation was established between the development of the physical qualities of children of different ages and their body types. Also, the dependence of somatotypes and morphometric parameters of the muscles of the upper and lower extremities, the speed of muscle contraction and indicators of digital dermatoglyphics, as well as with hereditary predisposition, was established.

Thus, we can draw the following conclusion: the motor development of preschool children is closely related to the body type and proceeds heterochronously; in children of primary school age, body type, skin finger patterns are closely related to the morphometric characteristics of the muscles of the lower extremities; and the formation of motor qualities in young handball players is in close relationship with morphological features, functional capabilities of the nervous system and the implementation of the hereditarily given potential.

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