Global Scientific Review
A Peer Reviewed, Open Access, International Journal
www.scienticreview.com
Volume 24, February 2024
ISSN (E): 2795-4951

Biomechanical Characteristics of Human Motors

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Abstract: The work provides detailed information about changes in the morphological characteristics of a person's stature, motility and morphofunctional indicators, biomechanical parameters of natural locomotion during ontogenesis. Studied the sickle structure of dynamogram types and types of natural human locomotion.
Key words: morphology, motility, morphofunctional, ontogenesis, locomotion, dynamogram.

The word "Motricity" from Latin to Uzbek, it means movement, and its qualities include strength, speed, endurance, resilience and agility. Human movements, that is, motor skills, depend on the structure of their body in many ways. The structure of the human body includes:

a) total body size. This includes body length, weight, chest circumference, waist size, etc.;
b) body proportions - the ratio of body parts (limbs, etc.) to each other;
c) constitutional (proper development) characteristics of the body.

The morphological status of a person in many cases determines his functional capabilities, which, in the end, reflect different types of activity. Individuals with a certain height are adapted to achieve success in specific types of sports compared to other individuals. This is determined by the fact that most of the individual characteristics of sports equipment depend to large extent on the characteristics of stature (the distribution of MIT in the body, the length of individual links of a person, height, mass, etc.).

The following morphological features are distinguished in human stature:

-total dimensions of the body - the main dimensions describing its size (weight - body mass; spatial (volumetric) - body volume; superficial - body surface, cross-sectional area; linear - body length and chest perimeter);

- body proportions - proportions of separate parts of the body. First of all, they depend on the ratio of skeletal sizes, and only the thickness of subcutaneous fat cells and the level of muscle development show a less significant effect on them;

- constitution - interrelationships of forms and functions.

The total dimensions of the human body are different, which leads to the difference in motility, and therefore - in most biomechanical indicators. We will show it in an example.

We denote the linear sizes of the body by the size then, surface sizes, in particular cross-sectional area, are proportional to l^2. In this case, the physiological cross-section of the muscles will also be proportional to l2. This means that muscle strength will also increase proportionally, because it is determined by the physiological cross-section.

Another example: the magnitude of mechanical work is calculated as the force multiplied by the distance traveled under the influence of this force. The force is proportional to l^2, the path ~ l, so the mechanical work is ~ l^2 l ~ I^3.

The change of human motility and morphofunctional indicators during the increase in the total size (I) of the body (according to D.D. Donskoy, V.M. Zatsiorsky, 1979) is as follows:

Absolute power... .... l^2
Time of individual actions............................. l
Frequency of actions... ... l^{-1}
Running speed... .... l^0
Mechanical work... .... l^3
Mechanical power.. .... l^2
The living capacity of the lungs.. l^3
Maximum oxygen consumption................................. l^2
Maximum pulmonary ventilation................................ l^2

It is important to understand that the above correlations are not considered ideal. As the total sizes increase, people with different l will not be geometrically similar. Specific physiological processes occurring in the body can affect body size and, therefore, body weight (for example, different activity of the pituitary gland can be the reason for a large difference in body size). But, despite this, the general laws are fair.

Body proportions and constitutional peculiarities, like total sizes, affect the choice of a sport, a narrow specialization within this type, the used option of sports equipment, and the tactics of actions in competitions.

The success of a nuclear launcher depends on the launch height of the projectile, the higher the length of the body, the higher it will be. In disc throwers, arms and legs are elongated, which is explained by the fact that the linear velocity of the projectile at launch depends on the length of the arm that launches the disc, that is, the higher the initial speed of the disc, the greater the distance it flies. . The following tradition is observed in running athletes: the shorter the distance, the taller the athlete, except for sprinters, who have tall (V. Borzov) and short (A. Komelyuk) athletes also participated. The regularity of the relative length of the runners' legs is also visible: the legs of the steerer are shorter than those of the sprinter; A hurdler has the longest legs.

But there are many examples in sports practice: runners competing in the same distance have different relative leg lengths. Athletes with long legs are considered to run with longer strides. The uniqueness of their technique is that they maintain balance by naturally bending their body forward. Runners with shorter legs are forced to lean back for this purpose. These examples taken from athletics show that in some athletes (depending on their specialization) the decisive factor of performance is the total size of the body, in others - its shape, that is, the proportions of its individual parts, and in others - muscle and fat. The degree of development and specification of the masses, the relative weight of the body, etc. are considered.

Ontogeny of motor skills. Changes in biomechanical parameters of natural locomotion during ontogenesis: Ontogeny of motor skills refers to changes in a person's actions and movement capabilities throughout his life.

Man's actions are a necessary condition for his existence. Such an emphasis is justified even in the case where it is discussed whether it serves as a purposeful action and supports the normal functioning of a biological organism. It is known that activities in early childhood are not only a condition for physical and functional development, but also a condition for a child's mental development. According to N.A. Bemstein (1961), movements live and develop.

It is necessary to distinguish between the natural laws of the development of a person's movement potential and the laws of his development during purposefully organized physical activity (sports, healing, health-giving, adaptive physical culture). The first type of human natural locomotor movement is walking. It can be divided into two stages. By analyzing the first stage of walking ontogeny as a whole, V.K. Balsevich (2000) distinguished three main groups with specific differences in a number of parameters: the first - from 5 to 10 years, the second - from 11 to 14 years, the third - from 15 to 19 years old. The oscillating character of the age-related change of walking parameters is characteristic for the first stage, and each stage of this process is within the limits of one of the above-mentioned age groups.

In the second stage of gait development (from 25-29 to 55-65 years), the spread of parameters becomes smaller during the general trend of increasing step length.

Walking speed, calculated as an inverse function of step duration, also has a tradition of uneven decline at the age of 5-20 years and a more stable decline at the age range of 20-29 to 60-65 years. N.A. Bemstein concluded that the formation of the basic coordination mechanisms of a child's gait is completed by the age of five, and at the same time, he said that the final formation of the "adult" structure of gait occurs much later than the age of 10 years. V. K. Balsevich believes that walking parameters reach the values characteristic of adults at the end of the second decade of life. The sufficiently late final formation of walking is explained by the following: in addition to coordination mechanisms, it is necessary to develop the strength and quick-power qualities of the locomotor apparatus, which ensures the realization of the coordination ratio against the background of changing morphofunctional local indicators of the growing organism.

The dynamo gram of the basic reaction during walking can observe the development and realization of the quick-power potential of the locomotor apparatus.

V.K. Balsevich (2000) noted three types of vertical components of support reactions in both males and females (Fig. 1).

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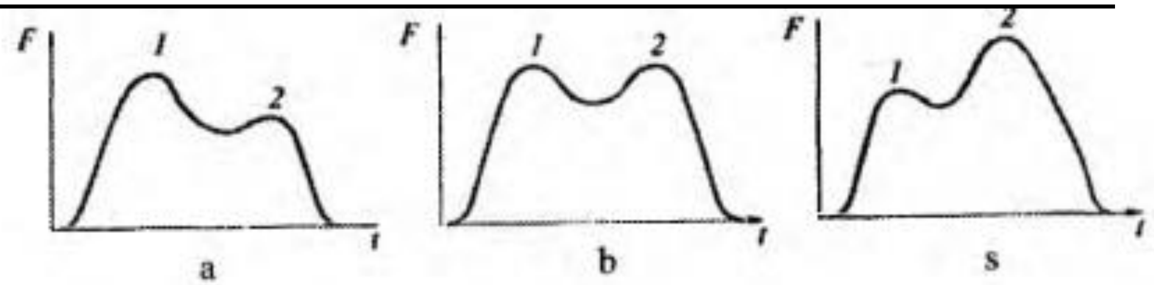

Fig. 1. The nature of the vertical component stresses of the support reaction in normal walking: a - type I of walking; b - II type of walking; s - type III of walking; 1 - the first maximum; 2 is the second maximum.

All types of dynamograms are characterized by a two-scythe structure, the first maximum of which corresponds to the shock stress during the foot placement on the support surface in the damping phase, and the second one - to the active depression from the surface in the depression phase.

Type I is characterized by a sharp increase in the magnitude of the vertical component of the force when placing the foot on the support. In this case, it is observed that the first maximum of amplification is higher than the second.

For support reactions of type II, the values of the first and second maxima are approximately the same, and a fairly smooth increase in the shock maximum when putting the foot on the support is characteristic.

Dynamograms of type III are distinguished by the fact that the second maximum is significantly higher than the first, that is, it is characterized by active depressing of the sole of the foot from the base surface.

In boys from 5 to 10 years of age, in most cases, I type of support reactions are observed when walking, II type of depsining is characteristic of children of 11-12 years of age, and especially of 13-15 years of age. Then, a stable tradition of the share of the total amount of depressing recorded in the course of the III-type base reaction is observed.

The known stabilization in the distribution of the type of basic reactions observed in girls from 7 to 10 years old is replaced by a sharp increase in the percentage of type III basic reactions in the next age groups. In girls and young girls in the period of 11-19 years, as in men, the dynamics of percentage distribution has an oscillating character. Later, a stable tradition of a gradual increase in the proportion of type III base reactions in women during walking was observed.

Changing the walking speed does not change the character of the dynamograms, but the magnitude of the maximum increases with increasing speed.

The second type of natural human locomotion is running. Running differs from walking in that the flight phase occurs.

It is considered that the transition of the child to running takes place at the age of 2 years. As in the development of walking, the phase parameters of the running step have characteristic signs of age-related fluctuations in the period from 5 to 20 years. Relative stabilization of the time structure of running begins after 20-29 years of age.

Dynamic characteristics of the base reaction in running can be divided into three types of force curves in the vertical components of the dynamogram (Fig. 2).

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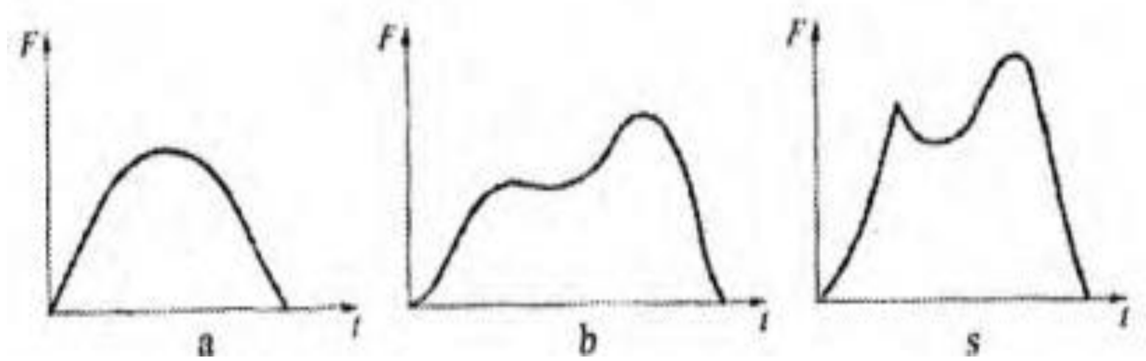

Fig. 2. The character of the vertical composition of the stress of the base reaction in slow running is a - 1 type; b - type 2; s - type 3

During type II of the vertical component of the base reaction, insufficient elastic loading of the support is manifested, as a result of which a plateau of stresses is observed in the damping phase, and only at the end of it, the stresses increase again to the maximum.

During type III of the vertical component, a considerable shock pulse occurs at the beginning of the damping phase of the base reaction. Then, in the base reaction, there is a pronounced decrease, alternating with a fairly smooth increase in voltage, which reaches a maximum by the end of the damping phase. Such a less efficient way of performing the running step - support interaction is often due to errors during the execution of the foot on the support (with a hard placement of the heel, with a forward strike of the calf, with a pin) and amortization work during the support reactions. determined by the weakness of the performing muscles.

Significant fluctuations in the magnitude and character of the basal reaction are observed in individuals of both sexes from 11 to 19 years of age. Before and after this stage of ontogenesis, the character of the basic reaction stabilizes until the age of 55-65 years, in which type I reactions remain dominant in individuals of both sexes. It should also be said that type I basic reactions in women prevail in all periods of their life.

Type I dynamograms are characterized by an increase in the vertical component of the tension at the front and a uniform decrease of this level during the phase of active subsidence. During this type of foundation reactions, the duration of the amortization and active subsidence phases is, as a rule, the same.

Electromyographic information about the work of the leg muscles during running indicates the observation of a variety of antagonistic muscle relations, as during walking. In the phase of lowering the foot to the support, clear reciprocal relationships have been identified. In the amortization phase, on the contrary, simultaneous electrical activity of the antagonist muscles is observed.

The indicated characteristics are common to all studied groups. As the age increases, the specific relationship between the working nature of the quadriceps muscle is determined at the base stage. This muscle, in the amortization phase of the support reaction in all age groups, develops a high level of activity at the same time as its antagonist, the biceps muscle. However, when the amortization ends, the electrical activity of the quadriceps muscle disappears immediately before the foot leaves the ground in all older age groups. Biocurrents of the quadriceps muscle are recorded during all phases of the basic reaction in 5-6 and 11-12-year-old children.

If, in the early stages of the development of locomotor function, the ability to run develops against the background of increased integration of the activities of antagonistic muscles, then during adolescence, muscle tensions are more clearly differentiated.

Asymmetry of movement and movement preferences: During the performance of movement actions, in most people, the preferential use of one of the arms and legs (clap, ungakay) is manifested in basic reciprocal movements (stepping, swinging). In wrestling, the opponent's throws are made to the "own" side, and in throws, rotations are made in such a way that the leader is the dominant side of the body. Such priorities in movement lead to asymmetry of movement in sports and everyday activities.

Asymmetry is manifested in sports in different ways: it is a difference in the general strength characteristics of the limbs, the strength, coordination capabilities and specific movements of the same muscle group in different limbs. The following are considered as its reasons: firstly, differences in different levels of participation or role of the right and left hemispheres of the brain in controlling the movements of the arms and legs; secondly, the conditions of human activity. Of course, the training process affects the level of asymmetry in terms of strength and coordination. However, dominant manifestations always remain significant and almost unchanging. This allows us to talk about the existence of special reasons and physiological mechanisms responsible for the formation of the specified difference.

G.P. Ivanova, D.V. Spiridonov, E.N. According to Sautinalaming (2003), one of the reasons for dominance is the asymmetry of the distribution of mass on the frontal surface of the human body in relation to its longitudinal axis. This means that the center of mass of the body is shifted towards one leg during the vertical posture and the symmetrical placement of the legs. The symmetric distribution of my problem should be considered as a special case of asymmetry. According to some estimates, the asymmetry of the center of mass in the frontal plane is 3-6 percent.

The asymmetry of the work of muscle groups of the same name is manifested in practice, in particular, in asymmetric movements. For example, a very high tone of the antagonist-muscles of the supporting leg, during braking, ensures a large interaction of the muscle system associated with it. During turns around the vertical axis, the joint tension of the muscles of the supporting leg and the half of the body associated with it causes the axis of rotation to shift from a symmetrical position to the side of the more strengthened part of the body, that is, the supporting leg, which causes the turning relieves. In this case, rotation around the non-supporting leg is difficult due to the need to first shift the body's center of mass to it and the complexity of creating a "strong muscle vertical" through the non-supporting leg.

The asymmetry of the tone of the antagonistic muscles of different halves of the body also plays an important role in the dynamics of hand movements. By taking into account the effectiveness of the ballistic and shock components of the arm movement associated with the less-strengthened half of the torso, it will, at the same time, capture or suppress the movements of the arm associated with the more-strengthened half of the body. brakes to some extent.

The asymmetry of the muscle bundles of the antagonistic muscles of different sides of the body, which is manifested not only in the performance of the main elements of the movement, but also in less noticeable, but important details, significantly complements the concept of the functional asymmetry profile during dynamic consideration. In this case, a separate system - the asymmetry of movement of the arms, legs and body is connected to a single dynamic system, the characteristics of which determine the individual character of the sports technique.