Interrelations of Morphological Indicators with Hemodynamics in Young People Engaged in Various Sports

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Abstract

In the study, there were identified the features of interrelations of morphological indicators with hemodynamics in young people engaged in various sports and having the athletic skills from the 1st grade to sport master. Significant correlations were observed between hemodynamics characteristics and such morphological parameters as thickness of skinfold under shoulder blade, which had significant (p<0.05) negative correlations with stroke (r=-0.583) and end-diastolic blood index (r=-0.582), and positive correlations with the index of total peripheral vascular resistance (r=0.574), variability of the stroke volume (r=0.65) and filling rate (r=0.56). Hand circumference associated with diastolic (r=0.67) and mean arterial pressure (r=0.61). It is shown that the constitution of athletes is a significant factor in determining the characteristics of their hemodynamics.

Keywords: morphological features, somatotype, hemodynamics, athletes.
Introduction

Constitutional (morphological) characteristics of a person determine not only the body proportions, but also are associated with features of functional systems of organism [5,6,16], and are determined even at the biochemical level [9]. The most pronounced dependencies of functional possibilities on the constitutional features are marked in sport [7,12,14], where, depending on specifics of the discipline, it is required to demonstrate a number of physical characteristics or their combinations (speed, exercise tolerance, strength) [15,20]. Undoubtedly, athletic achievements are based on varying degrees of development of functional systems (respiratory, cardiovascular, musculoskeletal, etc.), where a hyper-function of one system can be combined with less functionality of other one, this is being determined by both specifics of training and innate morphological features. The specificity of response to physical exercise in patients with different somatotype was observed [10], for example, the smallest changes in response to exercises were observed in patients with hypersthenic (muscle) somatotype [8]. The features of manifestation of speed-strength characteristics provided by morphological features of athletes have been marked [2,19], as well as depending on qualifications [13] which can be used for sport selection at the stage of initial training [1]. Similar advantages of constitution features, when performing specific physical activity, can not be provided only by morphological foundations, and will be based on specific differences between functional systems, which, depending on the type of imposed loads will play a significant role [11].

To date, most studies of morphological features are based on the separation of the tested individuals on somatotypes [17,18,21], this limiting the analysis of interrelations of morphological characteristics with the studied indicators. This approach does not allow us to identify the functional heterogeneity of studied individuals, which can be observed even within a single body type. In particular, the use of analysis of morphological features without differentiation on somatotypes will reveal in more detail the interrelations of body parameters with hemodynamic parameters of the investigated individuals, this will help reveal the factors underlying the manifestations of different physical properties, as well as the reason of their conditionality by both morphologic and hemodynamic factors [12]. The aim of the study was determining the interrelations of morphological indicators and hemodynamic features in young athletes aged 17-20 years.

Materials and Methods

Subjects: Thirteen young male athletes aged 17-20 years with the sport skill level from the 1st grade to the sport master from national team of republic participated in the study. They were engaged in different kinds of sports: rowing (n = 5), badminton (n = 1), athletics (n = 2, sprint), volleyball (n = 2), arm sport (n = 1), tennis (n = 1) and football (n = 1). Period of sport training in all athletes was 5-8 year, training load per week was 12 hours per week. Selection of different sport types has been associated with the formation of non-uniform sampling in morphological terms for further correlation analysis. Measurement of studied subjects have been performed during preparation period. Written informed consent was obtained for participation in the study.

Anthropometric Parameters Measurements

Morphologic study of constitution of athletes has been performed by anthropometric method. According to anatomical points are identified body height, longitudinal dimensions of extremities (length of shoulders, forearms, hands, hips, calf, foots), width of bony structures (chest, pelvic, elbows, wrists, hands, knee-joints, ankle joints, foots), relative widths of chest and pelvic (in relation to the length of the body). Also there were measured girth of chest, pelvis, extremities and skinfold under shoulder blade, over pectoral muscle, on abdomen, upper arm, back of hand, thigh and lower leg [16].
Hemodynamic Parameters Measurements

The study of hem circulation was performed using the multifunctional complex of multi-parameter monitoring “MARG K 10-01” (Mikrolux, Russia). The following parameters of hemodynamics were recorded: stroke volume (SV) - according to the data of electro-cardiogram (ECG) and the first derivative of transthoracic rheogram (mph); blood volume per minute (BVM, l/min), stroke volume (SV, ml), end-diastolic volume (EDV, ml), end-diastolic index (EDI, ml/m2), index of total peripheral resistance (ITPR, dyn × s × cm × cm 5), stroke index (SI, ml/m2), diastolic blood pressure (DBP, mm Hg) and mean blood pressure (MBP, mm Hg), Ejection Fraction (EF) - calculation of the parameter according to ECG and the first derivative of transthoracic rheogram (%), Aortic Pulse Amplitude (APA, Om), micro-vessels of finger pulse amplitude (MPA, ohms), respiratory wave of aorta (RWA, ohms), respiratory wave of micro-vessels of finger (RWM, Om), blood pressure (BP, mm Hg) - according to speed of distribution of pulse wave (between tooth “R” of ECG and peak of the first derivative of pulse wave of micro-vessels of finger); Heart Rate (HR) - according to ECG data (in beats/min). In addition to traditional hemodynamic parameters, variability of filling rate (VFR) and variability of stroke volume (VSV) were recorded, which, in contrast to the traditional calculation, are measured in percents during the interval which is greater than or equal to the period of breathing by formula: Variability = (Max. value - Min. value) / Max. value * 100%. Respiratory rate was determined by rheographic method.

Totally, 44 indicators characterizing anthropometric features of the tested individuals and 33 indicators - activities of cardiovascular system were analyzed. All measurement has been done in resting condition.

Statistics

The data obtained were subjected to correlation analysis (method of Bravais-Pearson in case of parametric values or Spearman rank correlation method in case of non parametric values and depending on the character of distribution of the studied parameters) to identify correlations between the studied parameters.

Results

Correlations between anthropometric parameters and cardio-hemodynamic characteristics are presented in Table 1. Correlation analysis a number of morphological and hemodynamic parameters was identified which have different statistically significant correlations (p≤0.05). The study showed that the largest number of interrelations with hemodynamics was found with traditionally measured anthropometric index – subcutaneous skinfold under scapula, which had a correlation with such parameters as stroke (r=-0.583, p<0.05) and end-diastolic (r=-0.582, p<0.05) index of blood, index of total peripheral resistance (r=0.574, p<0.05). Girth of hand correlated positively (p<0.05) with DBP and MBP (r=0.674 and r=0.607, respectively). High correlation (p<0.05) between girth of hand DBP, MBP and HR was noted (r=0.648, r=0.716, r=0.708, respectively). Body height correlated positively (r=0.620, p<0.05) with EDV.

Discussion

Such a relation can be characterized as a reduction of blood flow indices that reflect perfusion (SI) and preload (EDI) due to increased afterload (ITRP) in individuals with large amounts of subcutaneous fat folds in this area. Also correlations with specific indicators of hemodynamics are marked, which have informational value, especially for patients with artificial respiration - variability in stroke volume (VSV) and variability in filling rate (VFR), which is possibly determined by specificity of vegetative support with morph functional features.

Girth of hands had high positive relations with diastolic and mean arterial pressure, which is probably due to correlations of hand girth with indicators reflecting the relative width of pelvic (in relation to the length of the body), which is also high positively correlated with blood pressure values DBP and MBP. The elevated BP values are more typical for hypersthene stature, this was noted by the authors in
the study of primary school children [3]. It may be noted the presence of positive relationships of relative width of pelvis with heartbeat rate (HR), which is consistent with researchers who have studied the hemodynamics of skiers, where there was increase in HR of skiers with normosthenic constitution in relation to the asthenic one [7].

The positive relationship of body length to the upper anterior axis of iliac spine (as well as the body length as a whole) with end-diastolic and stroke volume of blood \((r=0.62, p<0.05)\) was marked. There were no statistically significant correlations with BVM and HR, this indicates likely large amounts of individual hearts having a greater length of the body. No statistically significant correlations of inotropic function of the heart with anthropometric data were found. The negative correlation \((r=-0.62\) and \(r=-0.56, p<0.05)\) of shoulder girth (as in tense and in relaxed state) with SI seems to be interesting, but requires further investigation. Negative relationships of respiratory rate with circumference of the chest at rest \((r=-0.66, p<0.05)\), on exhale \((r=-0.62, p<0.05)\) and inspiration \((r=-0.67, p<0.05)\), as well as with sagittal (anteroposterior) diameter of the chest \((r=-0.75, p<0.001)\) shows a close relationship of respiratory function with girths of the chest, efficiency of functioning of which directly depends on its size.

**Conclusion**

In the present study significant correlations was noted between subcutaneous skinfold under scapula, girth of hand, width of pelvic, body height and hemodynamics features in young male athletes aged 17-20 years. Thus, it is shown that morphological parameters have medium and high correlations with hemodynamic characteristics, which, in our opinion, is one of the foundations for morph functional features of representatives of various kinds of sports. It can be concluded that few morphological characteristics are most specific for determining of hemodynamics in athletes of high level.

**References**


