

MORPHOLOGICAL AND FUNCTIONAL FEATURES OF SYNCHRONOUS SWIMMING SPORTSWOMEN OF HIGH QUALIFICATION

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Annotation. *Purpose:* the studying of morphological and functional features of synchronous swimming sportswomen of high qualification, establishing of the interrelation between anthropometrical characteristics and functional characteristics of the external respiration system. *Material:* the research involved 12 sportswomen aged 17-18 years. *Results:* it is shown exceeding physiometric indicators (vital capacity of lungs by 64%, carpal dynamometry 21-22%) in synchronous swimming sportswomen have been compared to the standards of physical development. External breathing parameters illustrated adaptation of the organism to the specific loads: an increase in tidal volume by 40%, elongation of the duration of the expiration by 62.5%. A correlation between vital capacity of lungs and inspiratory duration ($r = 0,47$), with the frequency of breathing and duration of the inspiration ($r = -0,83$) and duration of the expiration ($r = -0,93$), is showing an increase in the functional reserves. *Conclusions:* have been found that morphological indicators of synchronous swimming sportswomen did not differ from the standards and indicators for physiometric and functional indices of the external respiratory system considerably exceed the same-age girls' indicators characterized the range of functional reserves and the resulting correlations reflected the direction of the adaptation process in specific environments of synchronous swimming.

Key words: *synchronous, swimming, morphofunctional, features, interrelation.*

Introduction

Synchronous swimming (SS) is rather young kind of spots, which was included in Olympic Games program only in 1980. However, works, devoted to its scientific and methodic foundation had appeared since 40-s of the last century [1]. Aesthetic and show character, health related and applied significance of this kind of sports conditioned specialists' interest to foundation of theory and methodic of training and mastering of main techniques and skills [2-4]. As a kind of physical functioning, connected with movements in water, SS has the same advantages as swimming for time [3, 4]. It facilitates perfect development of swimming skills, diving, orientation in water in different body positions, formation of highly developed coordination. Movements in water shall be expressive that requires form sportswomen not only perfect swimming skill and plasticity of movements but also creative attitude to choice of free programs, musical accompaniment [3, 4].

Research of morphological and functional characteristics of people, practicing sports, permits to estimate organism's adaptation potentials and in this connection it is an urgent task of modern sport physiology [5]. Studying of persons, who work with maximal tension of organism's functions permits to evaluate the range of adaptation that, in its turn, permits to mark out maximal points at scale "norm- pre-nosology – pathology" and to control duration and degree of factor's, meanwhile not causing pathology, influence. Besides, the obtained results can be used as criteria for selection of candidates to professional sport functioning and give base for determination of most important factors of functional system, strategy of its adaptation to certain conditions.

Specificities of SS as a kind of physical functioning, pre-condition interest to studying of respiratory system, morphological characteristics of physical condition and interconnections between them. The existing in literature information proved that in this kind of sports sportswomen had the best hypoxic tests and cardio-vascular indicators characterized higher adaptation potential [6, 14, 15].

Purpose, tasks of the work, material and methods

The purpose of the research was studying of morphological functional characteristics of synchronous swimmers of high qualification, determination of interconnections between anthropometric indicators and functional peculiarities of external respiratory system, which appear under specific loads of this kind of sports.

In the research 12 SS sportswomen took part; they were the members of combined team of Ukraine. Mean age was (17.17 ± 0.53) years, period of trainings not less than 6 years, level of sport qualification: master of sports or international master of sports.

Anthropometric examinations were conducted in compliance with commonly accepted methodic; there were measured: mass of body (kg); length of body (cm); vital capacity of lungs (VCL), (l); right and left hands dynamometry (HD) (kg). On the base of received data we calculated a number of commonly accepted indices of physical condition.

Complex study of external respiratory system was fulfilled with registration of spirometry parameters in program SPIROCOM with determination of reserve inhale volume (RIV, vl) and exhale volume (REV, ml), breathing volume (BV, mk), minute volume of breathing (MVB, ml), breathing rate (BR cycles per minute (cpm)), forced VCL (FVCL,l).

Static analysis of the received data was carried out with the help of licensed electronic tables Excel with determination of parametrical and non parametrical criteria [7].

Results of the research

The obtained anthropometric indicators of sportswomen and standards for physical condition of schoolchildren in Ukraine are given in table 1.

Table 1

Anthropometric indicators of SS sportswomen

Indicator	Synchronous swimmers	Standard of physical condition of Ukrainian schoolchildren [8]
Body length, cm	168.58 ±1.54	168.98 ±0.45
Body mass, kg	56.00 ±1.88	53.95 ±1.04
VCL, l	4.28 ±0.19	2.60±0.03*
Right hand dynamometry, kg	23.7±0.33	19.53±0.43*
Left hand dynamometry, kg	20.5±0.77	18.26±0.43*

* - differences are confident with ($p < 0.05$).

Comparison of SS sportswomen's body masses and body lengths with standards of physical condition of Ukrainian schoolchildren [8] showed confident differences from age standards that permitted to consider their level of fitness as middle. At the same time physiological metric indicators (VCL, HD) illustrated increasing of functional potentials, characteristic for higher physical fitness. In our opinion it reflects specificity of SS (movements under water, long intensive loads), conditioning reconstruction of organism.

Calculation of vital index and comparison of it with standards of 17 years old girls [9] showed confident increasing of this indicator: mean value corresponds to range (40.97-56.35) ml.p.kg, while the same range of sportswomen is (76.42±2.63) ml.p.kg. that shall be estimated as increasing of functional potential, characteristic for this kind of sports. Index of strength for right hand was 42.32% and 36.61% for left that corresponds to age-sex standards of 17 years old girls (28.36-44.46)% [9]. Thus, calculation of anthropometric indices permits to conclude that the most significant for SS is development and expansion of adaptation potential of respiratory system.

As it is known its development goes in heterochronic way and is closely connected with age morphological reconstruction and improvement of regulatory mechanisms [10]. Analysis of indicators, which characterize functional condition of external respiratory system also proved certain distinctions. It was found that HD with quiet breathing was (0.70±0.04) l and exceeds mean indicator (0.5l), rate of breathing in rest was (18.8±1.5) cycles and does not differ from functional norm [10]. Minute volume of breathing in rest was (12.9±1.1) l that also exceeds reference value, which is characteristic for healthy children [10]. In our opinion the presented data reflect adaptation changes in system of external breathing, which appear owing to increasing of inhale volume, illustrating increasing of function's efficiency in rest. Stability of BR in combination with significant increasing of HD results in expansion of system's adaptation potential, which manifests as increasing of MVB.

With measuring of time of breathing movements it was determined the following: inhale duration was (1.51±0.13) sec. And practically coincides with physiological standard (1.5 сек); exhale - (1.95±0.2) sec. That substantially exceeds standard parameter (1.2 sec) [11]. In our opinion it illustrates specificity of SS, connected with long pauses in breathing and need in regulation just of exhale, which in SS is transformed from passive act to mainly active.

The determined characteristics of external breathing reflect specificity of motion elements, used in SS, which often are fulfilled with full or partial submerging in water. It requires rather long pauses in breathing and excludes exhaling. Sportswomen's adaptation is realized owing to increasing of depth of breathing with insignificant increasing of its rate. For example, under load BV and REV are 2.8-3.0 l, i.e. more than 60% from VCL. The value of FVCL, which insignificantly differ from VCL, is also verification of respiratory function's reconstruction. Concerning people, who do not practice sports, FVCL, which is much lower than VCL, is connected with sharp and shortened periods of inhale and exhale and with increasing of breathing tracts' resistivity. FVCL to certain extent characterizes workability of breathing muscles, responsible for inhale. Thus, these indicators of SS sportswomen illustrate breathing muscles' adaptation to conditions, requiring deep inhales with little rate.

Level of morphological functional potentials of external breathing system shall be regarded as reserve of power. It characterizes physical limits of breathing system's potential and can be evaluated with VCL, MBV indices as well as with indices, reflecting their relation to body mass. For example vital index, received in our research, witnesses that in this kind of sports potentials of external breathing system are realized maximally under loads and can completely provide organism with oxygen in conditions of tensed muscular functioning.

Alongside with comparison of lung volumes and indicators of physical condition studying of correlation dependences between them permits to evaluate their adaptation characteristics [12,13]. For this purpose we built correlation matrix with determination of correlation coefficient by Pirson [7].

It was also interesting to know, which exactly indicators are characterized by most substantial connections with VCL, BR and BV as main criteria of breathing system's condition, reflecting its functioning and potential of functional reserves.

It was determined that there is strong dependence between VCL and RIV ($r=0.7$) that, in our opinion, one more proves earlier assumptions about adaptation reconstruction of breathing system under influence of loads, specific for SS. Connection between VCL and FVCL was practically functional ($r=0.93$) that is easily explained by the fact that the second indicator is function of the first. The determined dependence between VCL and value of Kettle's index ($r=0.7$), which illustrates dependence between main somatic indicators (length and mass of body) and main physiological criterion, is also interesting and can serve as verification of physical influence on potential of functional reserves.

We proved presence of middle level connections between VCL and age ($r=0.59$) that shall be interpreted as witness of adaptation potential's increasing with age under condition of normal organism's growing. The same conclusion, in our opinion, can be made from analysis of dependence between VCL and body mass ($r=0.67$). Connection between VCL and period of inhale ($r=0.47$), reflects influence of specific SS loads on functional state of breathing system and illustrates increasing of functional reserves.

We determined dependence between BR and age ($r=-0.43$) and it can be interpreted in two ways. On the one hand it is reflection of organism's growth processes (with age breathing rate reduces) and on the other hand it can be one more prove of SS influence on functional state, i.e. reduction of breathing rate with increasing of total period of SS trainings. Connection BR – MBV ($r=0.76$) reflects the fact that the first indicator is a component of the second. At the same time dependences BR wit inhale period ($r=-0.83$) and exhale period ($r=-0.93$), which are of reverse character, shall be estimated as one more prove of earlier assumptions about influence of SS specific loads on function of external breathing. Dependence BR – VCL ($r=-0.44$) was of the same character that, in our opinion, can be explained by increasing of sportswomen's breathing volumes with deep breathing at low rate. This assumption is also proved by determined dependence BR – FVCL ($r=-0.54$).

Breathing volume is in correlation dependence with period of exhale ($r=0.41$) and REV ($r=0.69$) that shall be interpreted as influence of time and volume of breathing movements on functional state of the system. In this connection stressing on just exhale can serve as prove of its significance in SS; its regulation in coordination with fulfilled movements can be understood as adaptation organism's reconstruction. Connection between BV and MBV ($r=0.46$) shall be appraised as witness of functional dependence, when first parameter is a component of the second.

The obtained dependences permit to verify assumptions, made during analyzing of anthropometrical and functional indicators of SS sportswomen. Besides, the determined interconnections permit to evaluate specificities of adaptation reconstructions of SS sportswomen's organisms, which happen under influence of specific loads of this kind of sports.

Conclusions:

Thus, the carried out researches permitted to determine that synchronous swimming sportswomen of highest qualification with absence of substantial differences in length and mass of body from age standards of physical condition are characterized by substantial increasing of physiological indicators. This principle is reflection of requirements, set by this kind of sports to sportswomen's organism. Studying and evaluation of VCL as well as calculation of physical condition indices can be recommended as methodic of current control, screening tests of sportswomen's condition. However, studying only of morphological characteristics is insufficient for evaluation and prognostication of functional state in this kind of sports. For fulfillment of this task it is necessary to supplement by functional, complex examination of respiratory system. The obtained data permitted to evaluate the level of synchronous swimming sportswomen's external breathing as high that can be noted as leading factor, which determines successfulness in this kind of sports. Expanded studying of external breathing function permits to receive information about functional reserves of sportswomen as well as to prognosticate successfulness of performances. The determined interconnections between analyzed indicators specify characteristics of adaptation reconstructions of organism of SS sportswomen.

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