UDK 796.835/61.2+001.8

ISSN (English ed. Online) 2311-6374
2017, №3(59), pp. 72-76

An investigation of functional state of the kickboxing athlete respiratory system

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Purpose: *to study of the functional state of the respiratory system of kickboxing athletes.*

Material & Methods: *in study involved 17 athletes – members of the Kharkov region team, age (17,88±0,58) years. Anthropometric studies were carried out according to standard methods, determined: body weight, body length, vital capacity of the lungs. Assessment of physical development, the state of the respiratory system was made with the SPIROCOM program.*

Results: *the physical development of athletes is rated as average and harmonious. An increase in the vital capacity of the lungs was almost doubled in comparison with the standard. A significant increase in actual tidal volume and minute volume of respiration was established in comparison with the proper values. A significant increase in expiration time, a predominance of individuals with a large expiratory volume.*

Conclusion: *established increased functionality of the respiratory system, which is due to the specifics of training in this sport.*

Keywords: *kickboxing*, *respiratory system*, *physical development, adaptation.*

Introduction

The functional state of external respiration in sports has always been given great importance, as a factor reflecting the body's ability to prolonged, extensive muscular activity.

In the conditions of sport activity, extremely high demands are placed on the apparatus of external respiration, the realization of which ensures the effective functioning of the entire cardio-respiratory system. Pulmonary ventilation is the most important indicator of the functional state of the external respiration system [2].

V. A. Aikin, E. A. Reutskaya, E. A. Sukhachev [1] note the need to increase the attention of specialists not only to issues related to the assessment of the long-term adaptation of the athlete's body to the training loads carried out, but also to the problems of restoring and strengthening the respiratory system biathlete.

Traditionally, it is believed that the maximum development of the functional capabilities of the respiratory system is characteristic of cyclical sportsmen in sports, in which the predominant endurance develops. However, in acyclic forms, including martial arts, it is necessary to pay attention to the functional state of the respiratory system, as a factor that largely determines the success of athletes.

Taking into account the parameters of breathing during training makes it possible to significantly improve its effectiveness. S. N. Neupokoev, L. V. Kapilevich, A. V. Kabachkova and others [8] studied the performance of the external respiration system in improving hand strokes on sports equipment from boxers of various qualifications. It is noted that the use of means that limit the load on the brush in a collision with a sports projectile affects the type of execution of percussion actions that qualitatively affects the spirographic indices of athletes of different qualifications. It is noted that the blows performed by the ballistic type of muscle tension are the most economical. This is expressed in a slight decrease in the parameters of the respiratory system after the performance of shock actions in the experimental group of qualified athletes.

Thus, the study of the peculiarities of external breathing in athletes of martial arts will allow not only to assess their functional state, but will also contribute to the optimization of training.

Y. S. Vanyushin, E. S. Minnibaev [3] suggest using the coefficient of complex provision of the body with oxygen to evaluate the functional capabilities of the athlete's body which allowing to judge the compensatory and adaptive reactions of the organism when carrying out a load of increasing power.

N. A. Oleinik, V. I. Chibisov, Y. I. Reiderman and others [10] developed a technique for determining the current state of the cardiovascular and respiratory systems of athletes. The technique allows you to evaluate the functionality during training and physical training in on-line mode.

O. L. Nifontova, V. Z. Kon'kov [9] conducted a study of the cardiorespiratory system of skiers-racers and children not engaged in sports, at the age of 9–11 years. It is established that young athletes have more developed respiratory muscles and increased the limit capabilities of the respiratory system. Higher rates of hemodynamics in skiers-racers showed less economical activity of the heart and a narrow range of adaptive possibilities.

S. I. Petrenko [11] investigated the physical working capacity and function of the respiratory system of young football players with different variants of biological development. It has

been established that both the performance indicators (according to the PWC170 test) and the functional parameters of the respiratory system (number of respiratory cycles per minute, the retention of breath on inspiration and exhalation, and the maximum oxygen consumption) grew as young athletes grew up.

M. S. Terzi [17] studied the physiological features of the functional training of martial artists of different qualifications. The functional readiness of the taekwondo athletes of different qualifications for the cardio-respiratory system was studied in the training and competition process. With an increase in the level of sports qualification, the indicators of the functional state of taekwondo athletes by tests of the cardio-respiratory system significantly increased. The analysis of the indicators of the functional state of engaged in taekwondo an athlete testifies to the development of long-term adaptation to physical stress in taekwondo.

S. N. Neupokoev, L. V. Kapilevich, A. V. Kabachkova, E. V. Loson, O. V. Dostovalova [7] studied the parameters of the external respiration system in improving strokes with different types of muscle tension. It is shown that the use of means limiting the load on the brush (boxing gloves), helps to optimize the nature of muscle tension while improving accented strikes in the box. It is noted that ballistic-type attacks are the most economical. This is expressed in an increase in the electrical activity of the muscles directly involved in providing strength and speed of impact, and reducing the electrical activity of their antagonists, which contributes to a minimum reduction in the parameters of the respiratory system after the test load.

V. N. Chernaya, T. R. Abdumaminov, S. Y. Koval, O. V. Khomyakova, Y. I. Shramko [18] studied the effect of wushu gymnastics exercises on the indices of the functional state of the respiratory system of athletes. Gymnastics training wushu contributed to more effective action of aerobic exercise on the athlete's body and increased reserve capabilities of the respiratory and oxygen transportation system.

Y. N. Romanov, A. S. Aminov, L. A. Romanova [14] estimated the general and special performance of top-class kickboxers in two stages of preparation for the competition. In assessing the overall performance of kickboxers, significant reserves of anaerobic threshold, respiratory volume, respiratory rate, lung ventilation.

S. V. Kiprich, D. Y. Berincik [5] determined the specific characteristics of functional and metabolic support for the special endurance of qualified boxers. It is shown that the range of individual differences in performance indicators and functional maintenance of special endurance increased in each round under the influence of accumulation of fatigue.

N. V. Slivkina [16] notes that an important place in the adaptation of the body to physical activity is the state of the cardio-respiratory system. The conclusion is drawn that in sportsmen of oriental martial arts the phenomenon of economizing the activity of the cardio-respiratory system is not expressed.

O. A. Rivnaya, L. V. Podrigalo, S. S. Ermakov et al. [13] studied the morphological and functional features of athletes of synchronized swimming of high qualification, relationship between anthropometric indicators and functional characteristics of the external respiration system. Exceeding physiometric indicators in athletes in comparison with the standards of physical development. The parameters of external respiration illustrate the adaptation of the organism to specific loads. Correlations were established between the vital capacity of the lungs and the duration of inspiration, the respiratory rate with the duration of inspiration and expiration, illustrating the increase in functional reserves. The conclusion is drawn that according to morphological features athletes synchronous swimming do not differ from the standards, and physiometric and functional indicators of the external respiration system significantly exceed the contemporaries, which characterizes the range of functional reserves, and the resulting correlation links reflect the orientation of the adaptation process under specific conditions of synchronous swimming.

E. S. Shayakhmetova [20] analyzed the competitive activity of boxing from the standpoint of sports physiology and proved the possibility of using respiratory technologies in order to increase aerobic abilities of athletes.

The available data in the literature and determined the relevance of this study.

The purpose of the research

To study of the functional state of the respiratory system of kickboxing athletes

Material and Methods of the research

Under observation were 17 athletes – members of the Kharkiv region team, age was (17,88±0,58) years.

The design of the study involved the study of the main parameters characterizing the physical development and state of the respiratory system. Anthropometric studies were carried out according to standard methods, determined: body weight, kg; Body length, cm; vital capacity (VC, l).

A comprehensive study of the external respiration system was carried out using the SPIROCOM program, in which the main parameters of spirography were recorded. Determined reserve volume of inspiration (ROIn, ml) and expiration (ROEx, ml), their speed ($m \cdot s^{-1}$), the respiratory volume (RV, ml), the minute respiration volume (MRV, l min^{-1}) respiratory rate (RR, cycle min^{-1}). The proper indices of the respiratory system were calculated on the basis of anthropometric indices.

Statistical analysis of the obtained data was carried out using licensed packages Excel spreadsheets with the definition of parametric and nonparametric criteria [6].

Results of the research and their discussion

For the purpose of comparing the indicators of physical development, official standards are used [12; 15]. It is established that the mean lengths (176,47±1,60) cm and the body weight of the athletes (65,65±2,14) kg do not significantly differ from the standards, respectively 175,67 cm and 63,48 kg. This allows us to consider the physical development of the surveyed athletes as medium and harmonious.

At the same time, a comparison with the value set VC physical development standards (3,20±0,05) l proved that the examined athletes had a significant increase in this value is almost

twice. In our opinion, this should be interpreted as evidence of the best functional state of the external breathing system of kickboxing athletes in comparison with the average statistical level. The increase in the parameters of the VC suggests its significant contribution to the process of adaptation to physical loads during training in kickboxing.

To assess the adequacy of the actual data, a comparison was made of the external respiration rates, the results of which are shown in Fig. 1–4.

The analysis of individual indicators of the surveyed athletes made it possible to establish that the actual indicators are generally higher than those due. Thus, at 47,06% the value of RV significantly exceeded the proper value, in 41,18% – was within the norm (deviations did not exceed 10%) and only 11,76% were characterized by a value of RV significantly lagging behind the normative one (Fig. 1). A comparison of the proper and actual RR values with the Wilcoxon-Mann-Whitney test confirmed a significant excess of the actual values, U=96, p<0,05. A similar result was obtained using the Rosenbaum test, Q=11, p<0,05.

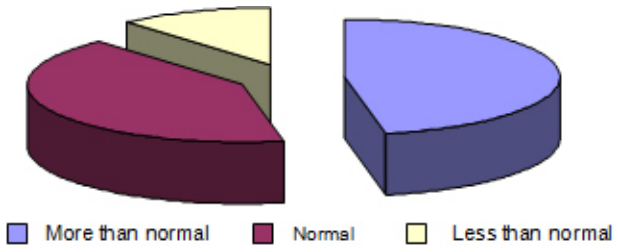

Fig. 1. Distribution of kickboxers according to the value of the respiratory volume

RV is a rather static indicator, depending on the basic anthropometric criteria (mass, body length, chest circumference) and, accordingly, inert in its dynamics. Therefore, the increase in the actual results compared with the calculated ones illustrates the expansion of the adaptive potential of the respiratory system of athletes. In addition, in many ways RV is determined by the strength of the respiratory musculature and, above all, the intercostals muscles and diaphragm. The increase in this indicator reflects an increase in the economy of the work of the respiratory system, that is, an increase in the strength of these muscles leads to an increase in the volume of respiratory movements.

The results of the MRV analysis are shown in Fig. 2.

When assessing the compliance of MRV, it was clarified that the overwhelming majority (64,71%) of the surveyed had a value greater than the normative, 23,53% were characterized by a deviation within the physiological norm and only 11,76% had a significant lag. Comparison of the proper and actual values of the MRV with the help of the Wilcoxon-Mann-Whitney test, and in this case, confirmed a significant excess of the actual values, U=86, p<0,05. The increase in MRV is possible due to the increase in respiratory rate and RR. From the point of view of long-term adaptation, the most effective way is to increase RR and stabilize the number of respiratory movements per unit time, which was observed in this case. In addition, the closed stand of an athlete in kickboxing reduces the possibility of carrying out respiratory movements. In this case, an increase in the MRV illustrates the high potential of the respiratory musculature. The obtained results allow to consider that adaptation to physical loads in kickboxing largely depends on the function of external respiration.

In the valuation of MBC it was found that 41,18% had an excess, 29,41% – a coincidence and 29,41% – a lag in relation to the proper values (Fig. 3).

The Wilcoxon-Mann-Whitney test confirmed the absence of

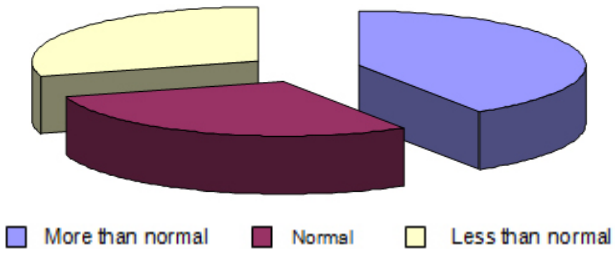

Fig. 3. Distribution of kickboxers in terms of maximum breathing capacity

significant differences between actual and proper values, U=125, p>0,05. Given the fact that MBC is largely dependent on breathing rate, an increase in this indicator is observed in athletes cyclic sports associated with long loads. In the case of martial arts, the maximum increase in the frequency of breathing will interfere with the technical implementation of strikes. In these sports there is coordination of motor phases with respiratory cycles. During training, attention is focused on the coincidence of shock movements with the act of exhalation. Excessive increase in the frequency of breathing will interfere with the implementation of strikes.

In the evaluation of the VC, the increase was established in 47,06%, the coincidence in 41,18% and the lagging in 11,76% relative to the proper values (Fig. 4).

The Wilcoxon-Mann-Whitney test in this case confirmed the

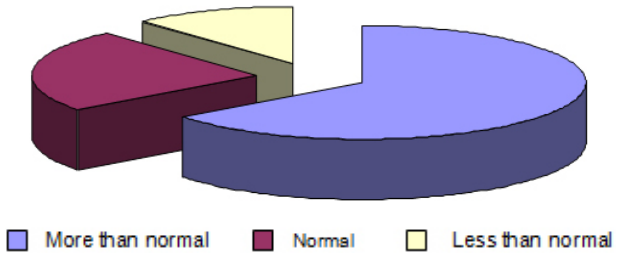

Fig. 2. Distribution of kickboxers according to the value of the minute respiration volume

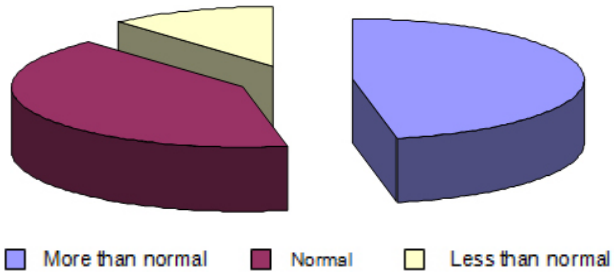

Fig. 4. Distribution of kickboxers in terms of the vital capacity of the lungs

absence of significant differences between actual and proper values, U=97, p>0,05. At the same time, the calculation of the vital index (VI) confirmed its significant increase in athletes. So, VI of the available age-sex standards was 50,16, and in athletes it was almost twice as large and amounted (90,55±4,47). This once again confirms the conclusions made earlier about the increase in the functional level of the respiratory system of athletes.

Thus, the obtained data indicate that the majority of the surveyed athletes were characterized by an excess or a coincidence of the actual values of the parameters of external respiration relative to the proper values, which makes it possible to consider the functional capabilities of the respiratory system to be increased.

When comparing the time of inspiration and expiration, which was respectively (1,36±0,12) s and (1,96±0,15) s, the value of the last (p<0,05). In our opinion, this is also a testimony in favor of the assumption of an increased functional state of the system under consideration. As you know, the inspiration is an active action performed with the help of the tension of the respiratory musculature (intercostals muscles, diaphragm), while the exhalation is carried out passively – by relaxing these muscles [4]. Therefore, physiologically, the expiration time is less than the inspiratory time. In the examined athletes, the ratio of inspiration to exhalation was (0,72±0,06). The change in this ratio to the opposite indicates that in the process of respiratory movements, the respiratory musculature actively participates, in addition, the exhalation from the passive process becomes active, which is caused, as already noted, by training in striking blows on the exhale.

Another fact in favor of the assumptions made is the study of the ratio of ROIn and ROEx. In 58,83% of the examined, this value is less than one, which indicates an excess of the expiratory volume. 11,76% of the athletes surveyed had a ratio of these respiratory volumes close to unity and only 29,41% had a significant excess of inspiratory volume over the exhalation. Such ratios of exhalation and inspiration suggest a high resistance of athletes to hypercapnia, which is also important for success in martial arts. The breathing system regulates homeostasis, protects the body from acidosis, for proper breathing, an exhalation is very important for normalizing the acid-base balance and pushing back the formation of fatigue.

The value of the reserve of respiration (RR), defined as the ratio of MBC to MRV, was (8,41±0,71). This is comparable to the data given by A. V. Chogovadze, L. A. Butchenko [19], for sportsmen of team sports: volleyball (7,80±0,70) and football (8,20±0,50), which also gives grounds for the conclusion about the increased functional capabilities and the impact of the specific organization of the training process in kickboxing on the state of breathing.

Conclusions

The conducted study of the physical development of kickboxing athletes confirmed the existence of an average harmonious development, while the magnitude of the VC significantly exceeded the normative values. A special study of the respiratory system makes it possible to draw a conclusion about the increased functional capabilities of this system, which is proved by the prevalence of actual indices in the majority of the surveyed in comparison with the calculated indices. In favor of this conclusion, the fact that the ratio of the time of respiratory movements due to exhalation of activity, the predominance of the reserve volume of exhalation over a similar volume of inspiration. Installed results suggest a high resistance athlete to hypercapnia, which is also important for success in the martial arts.

Conflict of interests. The author declares that there is no conflict of interests.
Financing sources. This article didn't get the financial support from the state, public or commercial organization.

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Received: 03.05.2017.
Published: 30.06.2017.

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