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FUNCTIONAL CHANGES IN THE ORGANISM OF CHILDREN UNDER SYSTEMATIC MARTIAL ARTS TRAINING SESSIONS

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Abstract:

This paper deals with the study of changes in the parameters of the cardiac pump function (CPF) of young athletes in the course of systematic martial arts training. It was revealed that during long-term sports training the heart rate in young karatekas changes unevenly. The most significant decrease in heart rate is observed at the stage of special training. In the process of eight/nine years of systematic muscular training, the total decrease in heart rate of young athletes is 22.0±1.4 bpm (P<0.05). During the same period of natural growth and development, the heart rate in children not engaged in sports decreases only by 16.0±1.5 bpm (P<0.05).

*Practicing martial arts contributes to the increase in stroke volume. The SV growth rate in young karatekas is significantly expressed during initial and specialized training. At the same time, the increase in SV in young karate students is approximately the same at the first two stages of sports training. The total increase in SV in young karatekas for eight/nine years of systematic muscular training was 47.4±2.2 ml (P<0.05). The children not engaged in sports had increase in their stroke volume by only 39.0±2.5 ml (P<0.05) during the same period of natural growth and development. The rate of increase in cardiac output (CO) **among young karatekas is pronounced than at the stage of special training.***

Analyzing the cardiac pump function response to the orthostatic test, it was revealed that in young karatekas the response of the heart rate to an orthostatic test decreases as their training level increases. At the same time, the resistance of the heart rate to the orthostatic test is more pronounced at the initial stage of sports training.

Young karatekas, during active change of the supine position to the sitting position, had reliable decrease in their stroke volume in comparison with the initial data only at the initial training stage. Starting with the stage of special training, the stroke volume in young karatekas did not change significantly at active change of the supine to sitting position.

Children systematically practicing karate showed unreliable response of the cardiac output to a change in body position at all stages of sport training, whereas those not engaged in sports, on the contrary, had their cardiac output maintained at a high level.

Keywords: *muscle training, young sportsmen, martial arts, heart rate, stroke volume.*

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INTRODUCTION:

One of the basic physiological systems of the body the physical working capacity of a person depends on, is the cardiovascular system. The works [1-10] are devoted to the study of the cardiac pump function at rest, during exercises, and also after the performance of the muscular load in the recovery period. As is known, the heart is extremely responsive to the impact of various factors. Therefore, numerous studies are devoted to the study of heart function in various physiological situations. Motor activity is an important factor in the functional improvement of the heart in ontogenesis [2, 3].

It is known that the frequency of cardiac contractions in children with trained muscles increases less strongly during graduated exercise, and decreases during the recovery period faster than in children less adapted to muscle loads.

During competitive activity, athletes take different poses typical for this sport, staying in which causes a certain response of the cardiac pump function. It is known that actively changing from lying position to sitting position causes an increase in the frequency of cardiac contractions and simultaneous decrease in stroke volume [2]. At the same time, it is of considerable interest to study the response of the parameters of the cardiac pump function of young athletes systematically engaged in martial arts to the change of their body position in space.

A significant number of works have been devoted to the study of the cardiac pump function of athletes practicing in endurance sports. Changes in the parameters of the cardiac pump function during systematic training are associated with the manifestation of speed-strength qualities and, in our opinion, remain completely unidentified.

Objective: to study the indicators of the cardiac pump function of children systematically engaged in martial arts.

Tasks:

- Study the parameters of the cardiac pump function at rest in young karatekas;
- Analyze the features of the changes in the cardiac pump function of children having been practicing martial arts for a long time;
- Study the HR and SV resopnse in young karatekas to an orthostatic test.

RESEARCH METHODS:

To study the parameters of the cardiac pump function of children, we examined young sportsmen practicing martial arts in the children's center "Azino" in Kazan. The total number of subjects was 57 children.

All the young athletes studied and children of the control group for health reasons were referred to the main medical group.

Rheogram recording technique

Among the rheographic methods of determining the heart rate, the most widely used one was tetrapolar thoracic rheography according to Kubichek [4] in various modifications.

OWN RESEARCH RESULTS AND THEIR ANALYSIS

The children aged 6-7 years not engaged in sports had their heart rate at a level of 98.7±2.3 bpm. Their peers practicing karate for 1-2 years (initial training group – ITG) had their heart rate at a level of 95.5±2.4 bpm. This value was 3.2±1.2 bpm less than in children of the same age not engage in sports. Young athletes experienced a decrease in heart rate during the second-third year of systematic karate training (training group 1) up to 93.7±1.7 bpm. The difference in heart rate between karatekas of ITG and TG-1 was 1.8± bpm. However, this difference, as well as in the previous stage of muscle training, does not reach reliable values in comparison with the values of the ITG athletes. Thus, during the first two-three years of systematic training of karate, i.e. at the stage of initial training, the heart rate of young karatekas tends steadily to decline.

During the fourth and fifth years of karate, the heart rate of young athletes decreased by 6.0±1.7 bpm as compared with the HR of the children of the previous group and amounted to 87.7±1.5 bpm ($P<0.05$). Consequently, a significant decrease in heart rate in young karatekas occurs only during the fourth-fifth year of muscle training. In the course of the year 5-6 of systematic muscle training, young karatekas again show only a stable tendency to decrease in their heart rate. During the seventh-eighth year of systematic karate training, that is, at the stage of athletic perfection, the heart rate in young athletes decreased by a significant value in comparison with the previous values and amounted to 76.7±3.1 bpm.

Thus, the young athletes systematically engaged in karate, showed only a steady tendency to decrease in their heart rate at the initial training stage. At the stage of special training, the heart rate of young karatekas decreased significantly. At the stage of athletic perfection, the heart rate of young athletes also decreased significantly as compared with the previous stage of sports training. The heart rate of young karatekas with eight to nine years of systematic muscle training decreased by 22.0 bpm ($P<0.05$) as compared to the initial data. During the same period of natural growth and development the

heart rate in children not engaged in sports decreased by about 16.0 bpm (P<0.05).

Table 1: Changes in the heart rate of children of different experimental groups.

Age group	Heart rate at rest (bpm)
6-7 years (control group)	98.7±2.3
6-7 years (year 1-2 of karate practicing)	95.5±2.4
7-8 years (year 2-3 of karate practicing)	93.7±1.7
9-10 years (year 4-5 of karate practicing)	87.7±1.5*
10-11 years (year 5-6 of karate practicing)	84.5±3.1
12-13 years (year 7-8 of karate practicing)	76.7±3.1*
12-13 years (not engaged in sports)	82.7±3.1*

* – significant difference as compared with the previous values (P≤0.05)

We also analyzed changes in stroke volume of young athletes. The stroke volume in children aged 6-7 years not engaged in sports was 28.4±3.0 ml. Children of the same age engaged in karate for one-two years had their stroke volume slightly higher, amounting to 31.7±2.4 ml. The difference in SV values of young karatekas of the initial training group and children not engaged in sports was 3.3±1.4 ml. However, this difference was not significant.

During the second-third year of systematic muscle training, the stroke volume of young karatekas increased significantly as compared with the previous stage of muscle training and reached 47.9±2.3 ml. This value proved to be significantly higher in comparison with the SV values of both children of the same age not engage in sports and the athletes of the previous group by 19.9±1.4 and 16.2±1.7 ml, respectively (P<0.05). Thus, at the stage of initial training, i.e. during the first two or three years of systematic muscle training, the stroke volume of young karatekas increased in comparison with the initial data by 19.9 ml (P<0.05).

During 4-5 years of systematic muscle training, young karatekas show only a stable tendency to increase in their stroke volume. During year 5-6 of systematic karate training, the stroke volume of young athletes increased significantly from 51.7±2.3 to 69.9±1.7 ml, i.e. increment in stroke volume was 18.2±1.4 ml (P<0.05).

At the stage of athletic perfection, i.e. during year 7-8 of systematic muscle training, the rate of increase in stroke volume of young karatekas was significantly lower than during the previous two stages of sports training.

Thus, the stroke volume of young athletes systematically engaged in karate increased at the stage of initial training increased by 19.5±1.3 ml (P<0.05) in comparison with the initial data. At the stage of special training, the stroke volume of young athletes increased by 22.0±1.7 ml (P<0.05) as compared to the previous stage of muscle training. However, at the stage of athletic perfection, the increase in SV in young athletes was slight, as compared to the previous stage of sports training, and amounted to only 5.9±1.4 ml (P<0.05). Consequently, the SV growth rate in young karatekas is significantly expressed during initial and specialized training. At the same time, we should note that the increase in SV in young karate students is more pronounced at the second stage of sports training. The total increase in SV in young karatekas for eight/nine years of systematic muscular training was 47.4±2.2 ml (P<0.05). The children not engaged in sports had increase in their stroke volume by only 33.0±2.5 ml (P<0.05) during the same period of natural growth and development.

Table 2: Changes in stroke volume of children of different experimental groups.

Age group	**Stroke volume (ml)**
6-7 years (not engaged in sports)	28.4±3.0
6-7 years (year 1-2 of karate practicing)	31.7±2.4
7-8 years (year 2-3 of karate practicing)	47.9±2.3*
9-10 years (year 4-5 of karate practicing)	51.7±2.3
10-11 years (year 5-6 of karate practicing)	69.9±1.7*
12-13 years (year 7-8 of karate practicing)	75.8±1.4
12-13 years (not engaged in sports)	67.4±2.5*

* – significant difference as compared with the previous values (P≤0.05)

Table 4: Orthostatic test heart rate response

Group	Heart rate test response (bpm)
6-7 years (not engaged in sports)	27.2±2.0*
6-7 years (year 1-2 of karate practicing)	18.1±1.9*
8-9 years (not engaged in sports)	21.4±2.1*
8-9 years (year 2-3 of karate practicing)	10.7±2.0*
10-11 years (not engaged in sports)	17.7±2.0*
10-11 years (year 4-5 of karate practicing)	8.4±2.1*
12-13 years (year 5-6 of karate practicing)	6.7±1.2*

* – significant difference as compared with the previous values (P≤0.05)

Table 5. Orthostatic test stroke volume response.

Group	Heart rate test response (bpm)
6-7 years (not engaged in sports)	14.7±2.7
6-7 years (year 1-2 of karate practicing)	12.4±2.8
8-9 years (not engaged in sports)	16.3±2.4
8-9 years (year 2-3 of karate practicing)	10.1±2.5
10-11 years (not engaged in sports)	11.7±2.0*
10-11 years (year 4-5 of karate practicing)	8.4±2.1*
12-13 years (year 5-6 of karate practicing)	6.7±1.2*

* – significant difference as compared with the previous values (P≤0.05)

CARDIAC PUMP FUNCTION IMMEDIATE RESPONSE OF THE YOUNG KARATEKAS AT ACTIVE CHANGE FROM LYING TO SITTING POSITION

As our studies showed the heart rate in young karatekas decreases in response to an active change in body position as their fitness level increases. At the same time, a more significant decrease in the response of the heart rate to a change in body position in young karatekas by 16.5±1.7 bpm (P<0.05) occurs at the initial training stage. At the stage of special training the response of the heart rate to the change in body position in young karatekas decreased by 4.0±1.5 bpm (P<0.05). At the stage of athletic perfection, the response of the heart rate to an orthostatic test in young karatekas did not change significantly as compared with the response of the heart rate recorded at the previous stage of muscle training.

The children practicing karate for one or two years had decrease in their stroke volume at active change from lying to sitting position by 12.4±2.8 ml, which does not differ significantly from the stroke volume response of children of the same age not engage in sports. Stroke volume of 8-9-year-old children not engaged in sports decreased by 16.3±2.4 ml (P <0.05) when changing from lying to sitting position. The response of stroke volume to an active change in body position in young karatekas of the same age was 10.1±2.5 ml (P<0.05). Consequently, at the stage of initial training the children systematically practicing karate had a tendency to decrease in the response of their stroke volume to an orthostatic test.

At the stage of special training and athletic perfection, the response of stroke volume in young karatekas at an active change from lying to sitting position was insignificant. The response of stroke volume to an orthostatic test in children not engaged in sports did not change significantly as compared with the values recorded at previous ages.

CONCLUSION:

Our research is devoted to the study of the cardiac pump function of young athletes systematically practicing martial arts. Having analyzed changes in the cardiac pump function of young athletes in the process of long-term sports training, we found that

- Heart rate and stroke volume undergo different changes, i.e. vary in different directions. Heart rate decreases, while stroke volume increases;
- Decrease in heart rate and increase in stroke volume occurs at different times, i.e. heterochronically. The most pronounced decrease in heart rate is observed during year 4-5 and 7-8 of systematic muscle training. The pronounced increase in stroke volume occurs, on the contrary, during year 2-3 and 5-6 of long-term sports training;
- During the systematic practicing of martial arts, the total change in stroke volume is more expressed than the values of stroke volume.

Having studied the response of the cardiac pump function in young athletes to an orthostatic test we revealed that young karatekas, during active change of the supine position to the sitting position, had reliable decrease in their stroke volume in comparison with the initial data only at the initial training stage. Starting with the stage of special training, the stroke volume in young karatekas did not change significantly at active change of the supine to sitting position.

SUMMARY:

1. Indicators of the cardiac pump function of young karatekas vary asynchronically in the process of long-term muscle training.
2. The most significant decrease in heart rate occurs during year 4-5 and 7-8 of systematic muscle training, while a significant increase in stroke volume is observed during year 2-3 and 5-6 of practicing martial arts.
3. As the level of training of young karatekas increases, the response of their cardiac pump function to an orthostatic test decreases.
4. The most significant decrease in the response of the cardiac pump function of young karatekas to an orthostatic test occurs at the initial stages of muscle training.

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