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The Dynamics of Heart Rate and the Strength of Wrist Muscles in the Course of Many Days Wheel Chair Marathon.

Evgeney V. Shestopalov*, Olga V. Andreeva, Elena V. Suvorova, and Liliya S. Polyakova.

Nosov Magnitogorsk State Technical University, Lenin str., 38, Magnitogorsk, Russia,

ABSTRACT

The aim of the research is to understand the physical limitations of disabled athletes on the example of the correlation of functional parameters of the cardiovascular system and the muscles of the upper limbs in people having a locomotor system dysfunction in the course of many days wheel chair marathon. For this reason an experiment with physical loads of athletes was carried out. In the course of the experiment to control the adaptation to the physical loads, the subjects were regularly screened by means of an electrocardiogram and, then, the received data were analyzed to see the dynamics. During the taken periods of time the dynamics of the strength parameters was evaluated by hand dynamometry, which was a comprehensive indicator of the upper limbs strength. All the subjects had a gradual decline in the heart rate and it took them more than a month to get used to the physical loads. The variations of the relative weights of the heart rate observed in the course of the experiment don't have a statistically valid character and can be considered only as a tendency. In the comparative analysis the initial and final cross-sections validate the difference in the heart rate that is reflected in the value of the Student criterion. The dynamics of the relative weights of the wrist dynamometry compared with the reference values for each subject tells about some stable level of the strength in the upper limbs. In the course of the long wheelchair marathon the gradual decline in the heart rate can be observed, provided the daily distance of mileage remains unchanged. At the same, the variability of hand dynamometry only tends to occur that can be explained by the approximately constant value of the physical activity that doesn't require the shift to the anaerobic energy supply.

Keywords*:* a disabled person, wheelchair marathon, heart rate, adaptation

Corresponding author

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INTRODUCTION

Despite the great amount of scientific work that has been done in the field of exercise science over the past three decades, relatively little attention has been paid to physical activity of people with a disability. The problem was barely mentioned, as disabled people were not considered as a separate group and, consequently, their specific needs were not taken into account. So, in 1995 in the study, sponsored by the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM), R. R. Pate, M. Pratt, S. Blair et al grouped disabled people along with older adults, the socioeconomically disadvantaged, and the less educated people. Categorizing by gender, race, education, etc. people not engaged in physical activity, the researchers did not include persons with disabilities in their report [11].

One of the first mentioning of the necessity of the physical activity of disabled people appeared in 2007. In their report CDC mentioned that twice as many adults with a disability (25,6%) were physically inactive during the preceding week, compared to adults without a disability (12,8%). The data were consistent with other studies from the U.S. [8]. As for the Russian Federation and Eastern Europe it should be noted that in 1969 in Prague there was a meeting of ministers of health and social services from the countries of the former Eastern block at which the word rehabilitation was defined and included as one of the points in the program of state social policy. In 1999-2004 the blueprint of the state policy of the Russian Federation in the sphere of physical rehabilitation and social adaptation of disabled people said about the necessity of engaging disabled people in physical activity by means of physical culture and sport. The innovations reflected in researches focused on the correlation between health, physical activity behavior and physical disability [7].

Nowadays in Russia, as well as in the majority of the European states, there are programs of rehabilitation of disabled people. The aim of the programs is popularization of leisure time physical activity that implies fitness accompanied by relaxation, entertainment, communication, etc.[10] Nevertheless, in spite of the successful solution of the problem of rehabilitation of disabled people, there is still lack of programs focused at the disabled athletes. The lack of study is mainly connected with the little scope of the problem and its peculiarities. As a consequence, the training guidelines for athletes with different disabilities are small in number and sometimes ineffective due to the race of sports technologies. There are studies identifying some correlates in relation to a type of disability and functioning, such as environmental factors (e.g. costs, accessibility, built environment, information and social support) [3; 13] and personal factors (e.g. age, exercise self-efficiency, depression, and mental health) [2]. Some researchers focus on the peculiarities of physical activity for disabled athletes engaged in different sports [14; 15], others develop training guidelines with regard to various disabilities of athletes [5; 6; 9; 12; 16].

The present study is one of the researches aimed at revealing the peculiarities of intensive physical activity for disabled athletes having a locomotor system dysfunction. The number of the articles investigating into the problem of physical activity of athletes with a spinal cord injury accounts for 21% out of the whole amount of studies devoted to the disabled athletes [8]. In some of the researches an emphasis is made on the low activity level of people with a spinal cord injury compared to able bodied [18], the others concretize the peculiarities of physical state of athletes under intensive dynamic exercise (the central command, the arterial baroreflex and chemoreflex, and the exercise pressure reflex), the third ones identify the barriers preventing the individuals with SCI from taking part in the physical activity (lack of motivation, lack of energy and lack of interest [17]. The purpose of this article is to analyze and compare the results of intensive long-time physical activity with the quality of functioning of cardiovascular system in the course of many days wheel chair marathons. The practical use of the research can be found in the sphere of physical preparation of disabled athletes for the participation in significant sporting events.

MATERIALS AND METHODS

The research problem can be summarized as follows. The holding of the significant public sporting events with the participation of people having a locomotor system dysfunction allows collecting data to specify the characteristics of their physical activity. With regard to the World Health Organization there are a great number of definitions of the concept “human health”. P.I. Kalio considers that the dynamic balance with the environment is one of the main aspects of human health [3]. According to the approach, a disabled person can be conventionally assigned to the group of healthy people with regard to the available for him/her physical

activity. The determination of the special features of the people's body functioning makes possible to tell the range of some separate parameters of their physical capabilities.

The aim of the study is to determine the correlation of functional parameters of the cardiovascular system and the muscles of the upper limbs in people having a locomotor system dysfunction in the course of many days wheel chair marathon. The both investigated parameters make possible to give a complete evaluation of the physical activity of a human being under various training conditions. It should be minded that when putting a disabled person in the situation of heavy physical loads, the body reactions of a disabled athlete are different from those of a healthy human being.

The expenditure of the adaptation resources of a disabled person is heterochronic in different directions, that's why it's the long-term analysis of the heart rate variations and the upper limbs strength that is of great interest. To provide the control over the adaptation to the physical loads the subjects are regularly screened by means of an electrocardiogram and, then, the received data are analyzed to see the dynamics. Before the marathon started the subjects are subjected to the ambulatory examination to check their initial state, indicated in the table as "Examination 1". The parameters of the heart rate, received at that moment are taken for the initial ones. All the rest data of the examinations are compared to the initial parameters. It should be minded that when going through a grueling physical experience, repeated for several weeks, there is a danger of overexertion of an athlete's organism that cannot be necessarily diagnosed due to the slight variable correlation in the stable parameters. In this case the simultaneous monitoring of several integrative parameters, such as the heart rate and the muscle strength, allow detecting the heterochronics of the fluctuation that can serve as an indicator of the overexertion.

The dates of the next examinations are the following: II – in 10 days, III – in a month, IV – in three months, V – in six months after the start of the marathon. In all the cases the heart rate is screened by an electrocardiogram and the integer value is rounded. All the heart rate investigations are done during the day off after waking up and before sitting in a wheelchair.

The dynamics of the strength parameters during the taken periods of time is evaluated by hand dynamometry, which can be a comprehensive indicator of the upper limbs strength. Special attention is paid to the differences in the parameters for the left and the right hands.

RESULTS AND DISCUSSION

There is a decrease in heart rate for all the surveyed under the second examination, but this parameter also increases for everybody with the third survey. Only for N. quantity the heart rate during the first examination proved to be the highest, for the rest of the group the maximum is observed with the third section from the beginning of the study (See Table 1). The average values of the considered parameter in relation to the group of respondents are changed in the same way. The growth of heart rate in the third survey can be explained by the change in the average amount of mechanical work of the movement of a wheelchair. The value of this work for the fifth-seventh day of the movement comprised of approximately 2 MJ, and on the fourth week it increased approximately by 60%, that resulted in the higher heart rate in the morning after the training load.

Moreover, considering the high variability of wind direction relative to the course of the athletes, the influence of aerodynamic airflow resistance on the energy cost of mechanical work is conditionally excluded. The given values indicate that the adaptation of the participants of the marathon to the loads did not occur during the first month to the full extent.

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Table 1: The value of relative characteristics of exercise heart rate of Super Marathon's wheelchair participants

Sportsman	Age	The examined number				
		I	II	III	IV	V
A	27	1,000	0,921	1,079	1,000	0,974
B	33	1,000	0,907	1,040	1,040	0,960
C	57	1,000	0,929	0,954	0,948	0,961
D	38	1,000	0,974	1,180	1,026	0,974
E	29	1,000	0,971	1,077	1,043	1,014
F		1,000	0,994	1,009	0,956	0,910
		1,000	0,636	0,781	0,809	0,850

Table 2: The value of the relative characteristics of right and left wrist dynamometry of the Marathon wheelchair contestants

Sportsman	Age	The examined number									
		I		II		III		IV		V	
		R.	L.	R.	L.	R.	L.	R.	L.	R.	L.
A.	27	1	0,94	1,07	1,01	1,06	1,00	1,07	0,99	1,08	1,01
B.	33	1	0,96	1,04	0,98	1,05	0,96	1,08	0,96	1,09	0,99
C.	57	1	0,87	1,06	0,91	1,07	0,92	1,11	0,93	1,11	0,93
D.	38	1	0,92	1,04	0,95	1,05	0,97	1,08	0,98	1,13	0,97
E.	29	1,04	0,99	1,08	0,98	1,07	0,98	1,03	0,98	1,06	1,04
F.		0,946	1,04	0,986	1,042	0,984	1,064	0,978	1,078	0,992	0,946
		0,0623	0,0308	0,0643	0,0356	0,0559	0,0493	0,0370	0,0581	0,0482	0,0623

A further slow decrease of heart rate is observed for all the athletes participating in the race. Apparently, the reason for the slow heart rate decrease lies in the occurred adaptation to the given training loads. As the loads, proposed in the race, were mostly performed in the area of predominantly aerobic power, during the period under review, provided steady traffic management, the sustainable adaptation of cardiorespiratory system to work on endurance was expected.

In the course of the experiment the observed variations of relative values of heart rate in the sample are not statistically reliable and can be considered only at a trend level. When examining the samples as associated with the comparative analysis of the first and last segments, the presence of significant differences in the number of heart rate, considering the Student criterion — the declining of parameter values for each of the respondents, is revealed and showed that for the whole group t = 2,693.

At the same time after the experiment on the functioning of cardiovascular system was carried out, the current level of strength opportunities was determined (Table 2).

The dynamics of wrist dynamometry relative values brought to the original values for each of the respondents, suggests an approximately stable level of manifestations of power quality of upper limbs. Thus, the presence of differences of the evaluated parameter for right and left hands is of a particular interest.

The analysis of the received results explains the differences between the parallel sections for the right and left limbs at the level of syntropy for all the cases except cut IV, but this case, more likely, can be considered

as the emission caused by the external impacts. The dynamics of the differences in statistical characteristics of the dynamometry of right and left cuts in the neighboring sections does not give reliable values, but when comparing the cuts I and V for the right hand, which is a leading one for the majority of the respondents, they were significantly different from each other. Value of Student criterion is equal to t = 2,996.

CONCLUSION

In the course of the long-time super marathon wheelchair race, provided approximately stable values of a daily travelled distance, the consistent decrease of heart rate is observed. At the same time, the variability of wrist dynamometry is set mainly as a trend that is explained by the approximately constantly performed muscle work that did not require in the notable quantities the transition to the anaerobic energy supply of the performed work.

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