

Walking as the Factor of Diminishing Relative Risk of Arterial Hypertension in Teenagers

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Abstract— The ecological conditions of life of modern man are becoming less and less favorable. A lack of physical activity, largely associated with the progress of digital and other technologies, weakens the already reduced ability to withstand diseases. Many diseases, including hypertension, are becoming more and more “young”: earlier they were mainly diseases of adults and elderly people, now children, adolescents and youths suffer from hypertension. The matter of this article is using walking for teenagers aged 13-16 suffering from arterial hypertension (AH). High blood pressure in adolescence influences on the development of the organism and its dynamic stability. In this regard, the matter of the article is the optimization of teenagers AH, after using the aerobic walking accompanied by the vessel tone normalization and decrease of relative risk of hypertonic disease.

Keywords: *ecology, high blood pressure, physical activity, teenagers, aerobic workout*

I. INTRODUCTION

The ecological conditions of life of modern man are becoming less and less favorable. A lack of physical activity, largely associated with the progress of digital and other technologies, weakens the already reduced ability to withstand diseases. Many diseases, including hypertension, cardiovascular diseases are becoming more and more “young”: earlier they were mainly diseases of adults and elderly people, now children, adolescents and youths suffer from hypertension. Cardio-vascular diseases (CVD) are the leading cause of a death in the industrialized countries as Russia and developing countries. In recent years there have been some proofs about the atherosclerotic process resulting in (CVD) begins in childhood and adolescence and develops during the whole life influenced by the genetic and modifiable risk factors [1; 2; 3; 4; 5]. The researchers studied, long-term, prospective show the substantive risk factors of (CVD) frequently appearing in childhood have the relatively stable character having the risk factors is due to the repeated researchers executed in later life. [6; 7; 8; 9; 10;11]. That is why early prevention of cardiovascular diseases is needed at a time when there are no risk factors or they are just about to form, and its manifestations are intermittent, incapable, when there is no stereotype of painful behavior. A healthy lifestyle

is the most promising option for the prevention and limitation of risk factors for cardiovascular disorders. The non-drug method in adolescence is the most attractive method [12; 13; 14; 15; 16]. All the more, as regards health protection the Russian law of 21.11.2011 r. № 323-FL «On the foundations of protecting of Russian and other citizens health» illustrates prevention priority [9; 12; 13; 17; 18].

Adolescent arterial hypertension (AH) is a serious problem in modern life, prevalence of (ah) pre-exposure in schoolchildren varies between 1 and 18 per cents. 33-42 % of adolescents have high blood pressure during 3-7 years and 17–26% ones have unstable Arterial Hypertension transforming to hypertonic, it is exposed by 40% adult population [11; 12; 13]. 18.5% of men and 30.4% of women suffer from hypertension in childhood and adolescence. In this regard, consideration must be given to any risk factor for increased pressure and the development of arterial hypertension in schoolchildren. [19; 20; 21; 22; 23].

Children and adolescents are shown to have first and second normal Arterial Hypertension. Assessment of blood pressure levels is carried out using special tables.

Normal blood pressure is systolic blood pressure (SBP) and diastolic blood pressure (DBP), the level of which is \geq 10th and <90th percentile of the distribution curve of blood pressure in the population for the corresponding age, gender and height.

High normal blood pressure – SBP and / or DBP, the level of which is \geq 90th and <95th percentile of the distribution curve of blood pressure in the population for the corresponding age, gender and height, or \geq 120/80 mm Hg. Art. (even if this value is <90th percentile).

AH is defined as a condition in which the average level of SBP and / or DBP calculated on the basis of three separate measurements \geq the 95 percentile of the distribution curve of blood pressure in the population for the corresponding age, gender and height. If the levels of SBP and DBP fall into different categories, then the degree of hypertension is established by a higher value of one of these indicators. In

children and adolescents, 2 degrees of hypertension are distinguished:

1 degree – the average levels of SBP and / or DBP from three measurements equal to or higher than the 95th percentile established for this age group, provided that they exceed the 99th percentile by no more than 5 mm Hg. Art.

2 degree (severe) – average levels of SBP and / or DBP from three measurements, exceeding the 99th percentile by more than 5 mm Hg. Art. established for this age group.

Disease prevention is a system of measures aimed at preventing, reducing the risk of developing health disorders and diseases, preventing or slowing their progression, and reducing their adverse effects. Primary disease prevention is a system of measures common to the entire population: reducing the influence of harmful environmental (external) risk factors on the human body, creating a healthy lifestyle, preventing the development of the disease. It is believed that elimination of the main risk factors would avoid 80% of heart disease, myocardial infarction and type 2 diabetes. In Russia, the full elimination of the main risk factors can contribute to an increase in the expected healthy life expectancy of the population by at least 8–10 years [23; 24].

The prevention and non-medicamental treatment of CVD associated with hypertension was based on lifestyle changes that address the main risk factors for CVD (adequate physical activity, proper nutrition, weight loss).

II. RESEARCH OBJECTIVES

The objective of the investigation: to study the effect of a medium-intensity walking program on blood pressure in adolescents with hypertension.

Research Objectives:

- 1) To identify students with arterial hypertension in the studied groups.
- 2) Create an aerobic walking program to normalize blood pressure in students.
- 3) Conduct a pilot study to identify the effectiveness of the developed walking program.

Aerobic physical activity is a type of physical activity in which muscles rhythmically contract over a long period of time, accompanied by increased metabolism and increased heart rate. It is known that the easiest, but quite effective way to increase physical activity is walking, and the walking distance is not important, but the distance traveled, since one hour of walking burns 400 kcal, and jogging for 20-30 minutes only 250-375 kcal. Regular aerobic muscle activity with a depressant effect will also contribute to the training of CVS and respiratory systems.

In connection with the above, this problem is very relevant to the younger generation.

III. METHODS AND MATERIALS

The study was held in the Municipal budgetary educational institution of secondary school No. 90 of the city district of Togliatti.

TABLE I. WALKING PROGRAM FOR ADOLESCENTS 13-16 YEARS OLD WITH HIGH BLOOD PRESSURE

Week	Distance (km)	Time (min)	Class frequency a week
1	3,2	34	3
2	3,2	32	4
3	3,2	30	5
4	4,0	38	5
5	4,0	37	5
6	4,0	36	5
7	4,8	45	5
8	4,8	44	5
9	4,8	43	5
10	4,8	42	4

It was attended by 334 adolescents with previously identified hypertension at the age of 12-16 years. 2 groups were formed, the adolescents of which did not differ in physiological parameters, age and physical development. The adolescents of the main group (OG) were engaged in the school program of physical education, and outside school hours were engaged in walking according to the moderate intensity aerobic program. The training program used is presented in table 1.

Moderate intensity physical activity leads to increased heart rate, a feeling of warmth and slight shortness of breath. An example of such activity is brisk walking, cycling and dancing. The comparison group (HS) was engaged in a regular curriculum.

The boundaries of the permissible load were determined by heart rate (HR) (220 – age). The heart rate was maintained within 60-90% of the calculated one with the lower boundary of the training regime 50% of the calculated heart rate. The intensity of physical activity increased gradually. Due to the possibility of increasing blood pressure, all isometric loads, including weight lifting, were excluded.

It is known that the best results for health give such physical exertion, in which heart rate is in the target range. This heart rate value helps to maintain the level of intensity of physical activity between the upper and lower limits of heart rate. To establish the target heart rate range, the Karvonen method was used – a method for determining the heart rate reserve [1].

The target heart rate range used by us for moderate-intensity physical activity for adolescents 12-14 years old was from 130 to 154 beats per minute, and for adolescents 15-16 years old from 130 to 156 beats per minute.

Hardware-software complex "Varicard 2.51". To evaluate cardiointervalograms and analysis of heart rate variability (HRV), we used the varicard 2.51 hardware-software complex (AIC), which provides the implementation of all the main methods of HRV analysis [24; 25].

The research results were processed using mathematical statistics methods using Student's criteria and χ^2 Excel Windows software package. Relative risk was calculated as the odds ratio (OR) based on a four-field table. Relative risk indicates the strength of the relationship between exposure and disease, or between exposure and recovery in patients. The statistical significance of the "effect-effect" relationship was evaluated using a 95% confidence interval (95% CI)

indicating that the true value of the value lies within the calculated interval [25; 26; 27].

IV. RESULTS

According to our survey, 334 adolescents aged 12–16 years have high blood pressure. The average level of SBP and/or DBP calculated on the basis of three separate measurements ≥ 95 percentile of the distribution curve of blood pressure in the population for the corresponding age, gender and height. In digital values, the SBP ranged from 124 to 133 mm Hg. Art., and DBP from 81 to 84 mm RT. Art. There were no differences in blood pressure values in adolescents of exhaust gas and HS.

At the end of the study, the blood pressure in the HS was normalized in 9 out of 86 adolescents.

The use of a wellness walking program for 10 weeks in the exhaustive group led to normalization of blood pressure in 43 out of 81 adolescents.

The results of the assessment of blood pressure in adolescents at the beginning and end of the study are presented in table 2 and 3.

TABLE II. THE RESULTS OF THE ASSESSMENT OF BLOOD PRESSURE IN ADOLESCENTS AT THE BEGINNING OF THE STUDY

Indicators	Age	GS		AG	
		Quality of pupils	Number of students with normal blood pressure	Quality of pupils	Number of students with normal blood pressure
SBP	13	19	2	17	3
	14	23	2	22	3
	15	20	2	20	4
	16	24	1	22	2
DBP	13	19	3	17	2
	14	23	3	22	2
	15	20	3	20	3
	16	24	1	22	2
Indicators	The relative risk of normalizing blood pressure OR	Confidence interval 95% CI	χ^2	p	
SBP	1,82	0,27-12,47	0,02	0,893	
	1,66	0,25-11,02	0,0	0,958	
	2,25	0,36-13,97	0,2	0,658	
	2,3	0,19-27,3	0,01	0,938	
DBP	0,71	0,1-4,86	0,02	0,893	
	0,67	0,1-4,43	0,0	0,958	
	1,0	0,18-5,67	0,2	0,658	
	2,3	0,19-27,3	0,01	0,938	

For adolescents of 13 years of age, the relative risk (calculated as the odds ratio – OR) of normalization of the SBP compared to the HS was 9.56 with a 95% confidence interval (CI) of 1.67-54.89 ($\chi^2 = 5.74$, $p = 0.017$), and to normalize the DBP, it was 11.43 with a 95% confidence interval (CI) of 1.97-66.36 ($\chi^2 = 6.87$, $p = 0.09$).

For adolescents of 14 years of age, the EG relative risk (calculated as odds ratio - OR) of normalization of GARDEN as compared with HS was 9.63 with a 95% confidence interval (CI) of 2.19-42.37 ($\chi^2 = 8.49$, $p = 0.004$), and to normalize the DBP, it was 5.56 with a 95% confidence interval (CI) of 1.27-24.29 ($\chi^2 = 4.28$, $p = 0.039$).

For adolescents of 15 years of age, the relative risk (calculated as the odds ratio - OR) of normalization of the SBP compared to the HS was 7.36 with a 95% confidence interval (CI) of 1.34-40.55 ($\chi^2 = 4.51$, $p = 0.034$), and for the normalization of DBP, it was 8.5 with a 95% confidence interval (CI) of 1.86-38.82 ($\chi^2 = 6.83$, $p = 0.009$).

For adolescents of 16 years of age, the EG relative risk (calculated as odds ratio - OR) of normalization of GARDEN compared to HS was 13.2 with a 95% confidence interval (CI) of 2.48-70.35 ($\chi^2 = 9.50$, $p = 0.002$), and to normalize the DBP, it was 23 at a 95% confidence interval (CI) of 2.63-201.35 ($\chi^2 = 10.24$, $p = 0.001$).

It is known that in adolescents, in addition to the activation of the hypothalamic-pituitary-adrenal system, the pattern of regulation of blood circulation also reflects enhanced sympathetic influences and a decreased threshold of excitability of the autonomic nervous system [2].

TABLE III. THE RESULTS OF THE ASSESSMENT OF BLOOD PRESSURE IN ADOLESCENTS AT THE END OF THE STUDY

Indicators	Age	GS		AG	
		Quality of pupils	Number of students with normal blood pressure	Quality of pupils	Number of students with normal blood pressure
SBP	13	19	2	17	9
	14	23	3	22	13
	15	20	2	20	9
	16	24	2	22	12
DBP	13	19	2	17	10
	14	23	3	22	10
	15	20	3	20	12
	16	24	1	22	11
Indicators	The relative risk of normalizing blood pressure OR	Confidence interval 95% CI	χ^2	p	
SBP	9,56	1,67-54,89	5,74	0,017	
	9,63	2,19-42,37	8,49	0,004	
	7,36	1,34-40,55	4,51	0,034	
	13,2	2,48-70,35	9,50	0,002	
DBP	11,43	1,97-66,36	6,87	0,009	
	5,56	1,27-24,29	4,28	0,039	
	8,5	1,86-38,82	6,83	0,009	
	23	2,63-201,35	10,2	0,001	

The use of the program of recreational walking for 10 weeks in the exhaustive group led to the normalization of autonomic homeostasis, vasomotor vascular and cardiovascular centers of adolescents, however, the vasomotor vascular center is characterized by increased activity, which is possibly associated with a high academic load and an increased psychoemotional state of schoolchildren. Therefore, further studies are needed to study the effect of the proposed complex on the psycho-emotional state of adolescents (Table 4).

In GS, from the side of vegetative homeostasis, a pronounced predominance of the sympathetic nervous system

was observed, and from the side of the vasomotor vascular center, its marked increase in activity was observed (Table 5).

Thus, a high relative risk of normalizing SBP and DBP in adolescent exhaust gas was revealed in all age subgroups with respect to HS. A comparison of the number of adolescents in the EG (43 people – 53.1%) who had a normalization of blood pressure and the number of adolescents who had a normalization of blood pressure in the HS (9 people - 10.5%, $p < 0.0001$) indicates the importance of the walking program for normalization Blood pressure and reduce sympathetic effects on circulatory function in adolescents.

TABLE IV. GENERAL ASSESSMENT OF THE STATE OF REGULATORY SYSTEMS AT THE END OF THE STUDY IN MG

B.Vegetative homeostasis	Balance of the sympathetic and parasympathetic parts of the autonomic nervous system	0	0,33
G.Vasomotor center	Moderate increase in vasomotor center activity regulating the vascular center	1	0,13
D.Sympathetic cardiovascular	Normal activity of the subcortical cardiovascular center	0	1,29

TABLE V. GENERAL ASSESSMENT OF THE STATE OF REGULATORY SYSTEMS AT THE END OF THE STUDY IN THE CG

B.Vegetative homeostasis	Pronounced predominance of the sympathetic nervous system	2	3,98
G.Vasomotor center	Moderate increase in vasomotor center activity regulating the vascular center	2	1,96
D.Sympathetic cardiovascular	Moderate attenuation of activity of the sympathetic vascular center	-1	0,13

V. CONCLUSION

When choosing physical activity in adolescents with arterial hypertension, great attention should be paid to its aerobic focus [28; 29]. Systematic walking of medium intensity contributes to the normalization of vascular tone and a decrease in the relative risk of developing hypertension. It is necessary to timely detect school-age arterial hypertension and select appropriate aerobic exercise for them.

1. The use of medium-intensity aerobic fitness walking is a promising area in the adaptive physical education system.

2. In our study, it was found that the use of walking with arterial hypertension in hypertension significantly reduced the risk of developing hypertension in comparison with hypertension due to the fact that the corresponding aerobic program was used in hypertension.

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