EFFECT OF LEVEL OF SKELETAL MUSCULAR DEVELOPMENT ON POTENTIAL LABILITY OF THE CARDIOVASCULAR SYSTEM IN CHILDREN

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Changes in the heart rate, pulse pressure, and stroke and minute volumes of the circulation (calculated by Starr's formula) were studied in 85 children with muscular and asthenic types of build in a resting state and after functional loads. In children of muscular type of build, the indices of potential lability of the cardiovascular system were significantly higher than in asthenics. The criterion characterizing potential lability most fully is the increase in cardiac output.

In children with a more powerfully developed skeletal musculature, higher indices of the potential lability of the cardiovascular system have been obtained on the basis of the increase in cardiac output.

Work in the author's laboratory has demonstrated the role of the degree of development of the skeletal musculature in determining the potential lability of the heart, a term applied to the range between the initial and the highest possible value of the heart rate [1, 5, 7]. It was subsequently concluded [2] that the potential lability is characterized most fully by the change in systolic output of the heart and the increase in the minute volume.

The object of the present investigation was to study the potential lability of the cardiovascular system in children with different types of body build and characterized by different levels of skeletal muscular development.

EXPERIMENTAL METHOD

Tests were carried out on 85 children selected from 480 healthy schoolchildren aged 10 years after a thorough clinical, physiological, and anthropometric investigation by the usual methods [4, 8]. The type of body build was determined by means of Shtefko's scheme [9]. The subjects chosen consisted of two groups: those with a predominantly muscular and those with a predominantly asthenic type of build. Tests involving functional loads on the cardiovascular system were carried out in which the subject sat down and stood up 25 times in 30 sec, a load of submaximal power for children of this age [3]. The heart rate was determined from the R-R interval of the ECG and the arterial pressure was measured by Korotkow's method in a resting state in the sitting position before the load test and in the first 10 sec thereafter. Continuous recordings were then made until the initial values were restored. The minute volume in a resting state and after the function tests were determined by Starr's formula [10] in the modification of Pugina and Bomash [6] for children: $SV = 40.0 + 0.5\ PP - 0.6\ DP + 3.2 \times age$, where SV is the stroke volume, PP the pulse pressure, and DP the diastolic pressure.

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TABLE 1. Heart Rate (HT), Arterial Pressure (A), Stroke Volume (SV), and Minute Volume (MV) for Children before and after Physical Exertion (m ± M)

No. of tests	HR	Increase in HR	Systolic AP	Diastolic AP	Pulse AP	Increase in pulse AP	SV (in ml)	MV	Increase in MV
	beats/min		mm Hg					liters/min	
				Boys of muscular build					
25	71,3± 1,30 130,2± 1,31	58,4± 1,3	103,1± 1,01 126,9± 1,42	51,8± 0,90 45,0± 1,10	53,5± 0,76 81,5± 1,04	29,1± 1,0	67,5± 0,59 85,0± 0,60	4,8± 0,16 11,7± 0,10	6,9± 0,14
				Boys of asthenic build					
16	81,6± 2,35 129,6± 1,90	47,0± 1,6	91,6± 1,50 105,4± 1,65	51,1± 1,00 47,8± 1,55	41,2± 0,85 57,0± 1,70	16,6± 1,6	61,9± 0,70 71,8± 0,80	5,0± 0,23 9,4± 0,20	4,4± 0,18
				Girls of muscular build					
21	72,9± 1,90 120,6± 1,32	48,0± 1,4	99,8± 1,09 122,5± 1,40	49,7± 0,91 47,5± 1,10	50,4± 0,87 75,2± 1,00	25,0± 1,4	67,4± 0,63 81,0± 0,71	4,8± 0,10 9,7± 0,16	4,9± 0,16
				Girls of asthenic build					
23	83,2± 1,33 124,8± 2,04	41,5± 1,5	94,9± 0,85 108,8± 1,00	54,0± 0,79 49,2± 1,10	42,0± 0,67 59,4± 0,90	17,4± 1,2	60,6± 0,55 71,4± 0,60	5,0± 0,26 8,9± 0,18	3,9± 0,16

Note. Upper figures give initial values, lower figures values after physical exertion.

EXPERIMENTAL RESULTS

In children with a muscular type of build, higher pulse pressures were obtained in a resting state, mainly because of a higher systolic pressure, and the heart rate was lower than in the asthenic children (Table 1). The increase in heart rate after physical exertion in children of muscular build was higher than in the asthenic children, and its degree was greater in boys than in girls. This is mainly due to differences in the heart rate in the initial state. The time taken for recovery of the initial heart rate and arterial pressure was shorter in children of muscular build (1 min 40 sec) than in asthenics (3 min 10 sec). The increase in pulse pressure occurred through an increase in the systolic and a decrease in the diastolic pressure. In children of muscular build, the increase in pulse pressure after physical work was greater (Table 1).

In boys and girls of muscular build the stroke volume in a resting state was higher, and the minute volume lower, than in asthenics (Table 1). After physical exertion their stroke and minute volumes were increased, the latter reaching much higher values than in the asthenics, especially in boys. When the increase in MV was expressed per kg body weight, the following results were obtained: in boys of muscular build 0.192, in asthenics 0.132; in girls of muscular build 0.142, in asthenic girls 0.110. The higher values of the stroke volume, combined with relatively low values of the heart rate, reflect the more economical activity of the cardiovascular system in children of muscular build. This is due to the higher tone of their vagus regulation than in children with a poorly developed skeletal musculature.

After physical exertion the minute volume of children with muscular build was increased to a much greater degree than in the asthenics. For example, boys of muscular build showed an increase in heart rate of 81.2%, an increase in stroke volume of 24.7%, and an increase in minute volume of 140%; the corresponding figures for the asthenics were 57.7, 16, and 86%. This comparison indicates that the increase in minute volume is the criterion characterizing the potential lability of the cardiovascular system most fully. It was concluded from the analysis of the results that higher values of the potential lability of the cardiovascular system are obtained in children with a well developed skeletal musculature.

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