INTRODUCTION

The continuous improvement of the physical education of children, their increased physical activity and systematic sports activity require studying the adaptation of a growing body to prolonged muscle activity [1–4]. In children five to seven years of age, the development of various physiological systems is accompanied by the first burst of physiological growth, i.e., by a rapid heterochromatic rearrangement of many functional systems, including the cardiovascular one. Children’s adaptation to increased physical activity under conditions of a physiological burst is likely to have a specific pattern. The hemodynamic organization in a child’s body is especially important to study, because it is the main pathway of the oxygen supply for the working muscles.

The age of “second childhood” is especially sensitive because, during this period, the maturation of the musculoskeletal and cardiovascular systems is activated. The abilities of children and their faculties of motor activity are manifested at this age and the motor human experience is difficult to overestimate [5].

The functionality of a child’s body is largely determined by the cardiovascular and respiratory systems [6, 7]; the body’s adaptive response to loads of various intensities depends on the activities of both systems [8]. The degree of deviation of a functional parameter from the baseline and the time of returning to it serve as a measure of assessing physiological systems [9].

The adaptive rearrangement during muscular activity depends on the individual constitution and has some specific characteristics. The differences in the fundamental properties (morphology, neurosomatic state) correlate with differences in the structure and function of the internal organs, in body composition and metabolism, in its endocrine system’s activity, energy potential, specific immunity characteristics, and physical efficiency. Therefore, individuals of different somatic types make different efforts to reach the same results in physical exercises. Note that the educational influence should be directed to the most developed physiological functions [2, 10, 11]. Analysis of the physical health of preschool children should be based on the concept of the multicomponent and multidirectional influence of motor activity and environmental factors of the body [12].

Studying the effects of motor activity on various body systems of preschool children and development of the optimal physical exercises and the principles of sports training are determined by their influence on the characteristics of the cardiac functional activity.

We studied the adaptation of the cardiovascular system of children five to seven years of age to increased physical activity, with their individual somatic characteristics taken into account.

METHODS

Healthy preschool children from Preschool Education Institutions nos. 22 and 74 of the city of Chita participated in our study. In total, 128 children five to seven years of age were examined (74 boys and 54 girls). Several subgroups were formed according to the children’s somatic characteristics (Fig. 1).

Children’s somatic types were determined on the basis of the dimensional variation of their somatic parameters. Macro-, meso- and microsomatic types were distinguished (MaS, MeS, and MiS, respectively) [13, 14]. The MeS type was the most frequent among both boys and girls ($n = 40$ and $n = 28$, respectively).
the group of boys, the numbers of MiS and MaS types were 18 and 16, respectively. In the group of girls, the numbers of both MiS and MaS types were $n = 13$.

In preschool educational institutions, the physical activity of children five to six years of age lasted for 495 min (8 h 25 min); in the preparatory group, it lasted for 570 min (9 h 30 min). The children were involved in sports and recreation activity, including swimming, and additional physical exercises in rhythmic, correction, and fitball gymnastics, hydroaerobics, etc.

During the one-year educational experiment, a type-specific method was used in physical education classes. That means that each type of body constitution received loads that were the best fit for the constitutional characteristics of each particular child. This is especially important for children’s training because of the influence on their health. The type-specific method imposes a high muscular load, which is, however, habitual and enjoyable for each constitutional type. This mechanism of physical adaptation is globally specific, because the impact is directed to the most advanced physiological functions and, at the same time, it leads to numerous positive changes in the development of physical ability [1, 14].

The exercises that mostly develop strength were offered to MaS-type children with a high level of aerobic abilities; exercises that predominantly develop quickness were offered to MeS-type children with a high level of anaerobic mechanisms of energy supply for muscular activity; and the exercises developing both quickness and strength, to MiS-type children, whose aerobic and anaerobic abilities were equally well-developed.

The state of the cardiovascular system was studied using rheography and the parameters of central hemodynamics, including stroke volume (SV) and cardiac output (Q) [5, 15].

During physical training, the response of the cardiovascular system of preschool children to a controlled physical load with a stepwise increase in power (from 1 to 1.5 W/kg) was measured with a Polar S610 pulsmeter. The loads were adjusted on a Tornio Pony children’s bicycle ergometer (Fig. 2).

The physical ($PWC_{170}$) was calculated according to Karpman (1988), with the heart rate (HR) taken into account. To determine the individual differences, the relative physical working capacity (per kilogram of body weight) was also calculated [16, 17].

The results were processed statistically using the Statistica 5.5 software package; statistically significant differences were determined using the Student’s test.

**RESULTS AND DISCUSSION**

The study of a child’s body’s response to muscular activity is impossible without determination of the basic patterns of the rearrangement of hemodynamics, which often limits the development of adaptive reactions, including those to physical exercise.

Comparative analysis of changes in the functional parameters of five- to seven-year-old children during the experiment showed that the method of grading physical load during fitness classes according to the specific somatic characteristics of each child promoted an increase in the functional efficiency of the cardiovascular system (Tables 1, 2, 3).

Before the experiment, the HRs of older preschool children were similar to the average parameters reported by many other authors [1, 6, 7, 18, etc.]. With age, a