Some indicators of the sensorimotor systems of students aged 7-10 at the beginning of a one-year educational cycle in a special (I-II type) correctional and general education schools

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Abstract

Objective of the study was to study some indicators of sensorimotor systems in students aged 7-10 at the beginning of a one-year educational cycle in a special correctional I-II type and general education schools.

Methods and structure of the study. The survey involved 311 healthy schoolchildren aged 7-10 years and 96 peers suffering from sensorineural hearing loss (III-IV degree). The Neurosoft-NS-Psychotest complex was used. In children, a simple visual-motor reaction (VMR) was studied; reaction to a moving object. We analyzed the results obtained in the methods of "reaction time of discrimination" and "reaction time of choice".

Results and conclusions. As we grow older, the period of the sensorimotor reaction decreases, which is associated with the process of maturation of the central structures of the brain and the improvement of the functional state of the neuromuscular apparatus. In children 9-10 years old, the degree of balance between the processes of excitation and inhibition is greater in strength, which indicates the balance of nervous processes and the stability of the functioning of the nervous system at this age. With increasing age in children, the mobility of nervous processes is optimized. The functioning of sensorimotor systems in children 7-10 years old with auditory deprivation, in comparison with practically healthy peers, showed that the development of the mechanisms of central regulation of movements is somewhat slow.

Keywords: *indicators of sensorimotor systems; children 7-10 years old; auditory deprivation.*

Introduction. The Ministry of Education of the Russian Federation, in order to organize the process of physical education in general educational institutions, recommends a number of exemplary programs. A comprehensive analysis of these programs allows us to conclude that they show the key components of physical education: the development of physical qualities, the improvement of the health of students, the formation of the motor base of children, etc. [10]. However, the issues of using sections of physical culture activities related to the emotional-volitional, cognitive, psychophysiological spheres of the development of the student's body remain practically unresolved [5].

The basic task of developmental physiology and school pedagogy is the explication of the functioning of the central and autonomic nervous and sensory systems that form the characterological qualities of children of the first and second childhood, since the "plasticity" of their nervous processes is at a relatively low "level". At the same time, there is an increased interest among researchers in acquiring scientific knowledge regarding the functioning of sensorimotor systems in younger schoolchildren, since, according to teachers and physiologists, the parameters characterizing these systems are the most objective and representative [1, 7, 9].

Nothing else than the disproportion of the training load to the compensatory capabilities of the student's body entails a disorder in the state of physical health [4]. In this regard, children with auditory deprivation deserve special attention, since they have functional "disorders" of a number of organs and body systems. At the same time, the parameters of the sensorimotor systems of children suffering from auditory deprivation are indicators of the health of students [11].

In a number of scientific studies [2, 3, 8], only fragmentary works have been published, devoted to the study of the impact of physical education classes on the functional state of sensorimotor systems in 7-10 year old students in special correctional and secondary schools.

Objective of the study was to study some indicators of sensorimotor systems in students aged 7-10 at the beginning of a one-year educational cycle in a special correctional I-II type and general education schools.

Methods and structure of the study. The scientific experiment was carried out on the bases: laboratories of the Department of Anatomy and Sports Medicine of the Kuban State University of Physical Culture, Sports and Tourism, gymnasium No. 18, school No. 63 and a special correctional boarding school in Krasnodar. The survey involved 311 healthy junior schoolchildren 8-10 years old (boys - 149, girls - 162) and 96 (boys - 49, girls - 47), peers suffering from sensorineural hearing loss (III-IV degree). The hardware-software complex "Neurosoft - NS-Psychotest" with an IBM-compatible computer was used in the work.

Since within the framework of one article it is technically difficult to show the full complex, reflecting the functional state of sensorimotor systems, a fragment of the study was taken. In children, a simple visual-motor reaction (VMR) was studied (the classical technique of chronoreflexometry, which determines lability in the functioning of nerve centers). A kind of complex sensorimotor reaction (in addition to the sensory and motor components, it also includes a period of complex signal processing (sensory) of the central nervous system) - a reaction to a moving object (RMO). Along with this, the results were analyzed in the "reaction time of discrimination" (RTD) and "reaction time of choice" (RTCh) methods.

The studies were carried out at the beginning of the annual educational cycle many times, with the registration of the protocol for each student. Participation in the observations was carried out on a voluntary basis, informed consent was obtained from parents.

The information obtained during the study was processed on IBM-compatible computers according to standard statistical methods [6].

Results of the study and their discussion. As the obtained data showed, in healthy boys of 7 years old, when studying VMR, significantly high reaction time parameters (324.1±10.4 ms) were recorded in comparison with schoolchildren aged 8-10 years (301.8±12.5 ms; 275.1± 9.7 ms, 264.3±11.4 ms, $p<0.01 – p<0.0001$).

At the same time, schoolchildren aged 9-10 were the most "fast", however, there were no significant differences between these groups ($p>0.05$). Differences were not registered in boys of 8-9 years old, although in comparison with schoolchildren of 8 and 10 years old they are noted ($p<0.05$).

In the analysis of the received data of VMR in healthy girls, a similar pattern is noted, as in boys. Along with this, unlike boys, there was no difference in the parameters of 7- and 8-year-old girls (321.5±10.6 ms; 298.4±13.3 ms).

Conducting a study in boys of a special correctional school showed the following. Significantly higher indicators in the test were in 7-year-olds (352.4±13.6 ms) in comparison with schoolchildren aged 9 and 10 (282.8±14.3 ms; 278.9±9.2 ms; $p<0 .01 – p<0.001$), while no difference was noted with 8-year-olds (318.2±15.4 ms) ($p>0.05$). In turn, 8-year-old boys demonstrated significantly higher values in the PVMR test relative to 10-year-old boys ($p<0.05$). Differences were not registered in boys aged 8-9 years and 9-10 years ($p>0.05$).

As for girls from a special correctional school, at the age of 7 years (351.2±14.6 ms) they showed significantly greater time spent in testing in relation to all the considered age groups (303.4±9.8 ms; 295 .9±11.6 ms; 289.3±10.5 ms; $p<0.01 – p<0.05$). Other indicators within the group of girls aged 8-10 did not differ ($p>0.05$).

When conducting the "reaction to a moving object" test, it was revealed that the indicators of boys 7 years old (92.3±5.1 ms) and 8 years old (80.8±7.3 ms) did not differ, while the obtained data in comparison with boys aged 9 and 10 (76.2±4.5 ms; 62.7±3.9 ms) showed an almost 20% significant difference ($p<0.01 – p<0.001$).

It should be noted that the values of this parameter did not differ among schoolchildren aged 9-10 ($p>0.05$). In other words, 10-year-old boys show a balanced type of nervous processes.

When analyzing the data revealed in girls in the test "reaction to a moving object" (RMJ), it was found that significant differences in time between the studied 7, 9 and 10 years (96.2±8.7 ms; 75.6±4.9 ms; 64.7±6.9 ms, $p<0.05$ – $p<0.001$). There were no differences between the obtained parameters in girls aged 7 and 8 (84.4±7.6 ms).

As shown by the data obtained in the RMO test in boys studying in a special correctional school, a similar pattern was noted as in practically healthy schoolchildren, that is, there were no differences in indicators between 7- and 8-year-olds (101.7 ± 4, 8 ms; 92.1±5.3 ms; $p>0.05$) and the parameters differed significantly between the studied 7, 9 and 10 years (83.3±7.4 ms; 74.8±3.9 ms). In turn, when comparing this indicator between schoolchildren of 8 and 9 years old, 9 and 10 years old, no difference was noted ($p>0.05$).

Analyzing the data obtained from girls studying in a special correctional school, it should be noted that between schoolgirls of 7 and 10 years old, significant different values were obtained (98.4±6.9 ms; 72.3±5.7 ms; $p<0.01$), in other cases, the parameters in the RMO test were not observed in the study population (8 and 9 years old - 87.5±8.2 ms; $p>0.05$).

When analyzing response strategies, both boys and girls from a correctional school, it should be noted that they more often showed a reaction to a moving object with a delay in the appearance of a signal.

In the observed children, studying the complex sensorimotor reactions "reaction time of discrimination" (RTD) and "reaction time of choice" (RTCh), the following data were established: the largest values of RTD in time (they practiced a reaction to one specific impulse out of several) were noted in boys 7 years (438.8±14.3 ms), low - in schoolchildren aged 9 and 10 (387.6±8.9 ms; 369.5±12.4 ms; $p<0.001$; $p<0.001$), the difference in indicators in this test were also registered between 8-year-old (411.2±11.6 ms) and 10-year-old observed ($p<0.01$).

When analyzing the results of RTD in girls, the following is noted: schoolgirls of 10 years (378.7±18.2 ms) showed less time during testing in relation to 7-year-olds (441.5±15.5 ms; $p<0.01$). When comparing other age groups (8-9 years old: 418.9±14.3 ms; 396.4±17.7 ms) there were no significant differences in the indicators.

During the RTCh test (several subjective reactions to the proposed impulses were used) as in boys (7 years old - 465.3±16.5 ms; 8 years old - 458.4±13.2 ms; 9 years old - 446.8±6 .7 ms; 10 years old - 431.3±9.2 ms) and in girls (7 years old - 471.3±17.1 ms; 8 years old - 449.4±12.6 ms; 9 years old - 451 .6 ± 9.7 ms; 10 years - 458.8 ± 14.7 ms) data were obtained that did not have significant differences in age groups.

When conducting a study in the RTD test in boys of a special correctional school, it was found that in children 7 (457.4 ± 10.2 ms) and 8 (436.2 ± 9.4 ms) years old, significantly lower values of indicators were recorded in relation to schoolchildren 10 years (398.3±8.9 ms; $p<0.001$ – $p<0.01$). The same pattern was observed in girls (472.7±13.6 ms; 446.5±11.9 ms; 398.4±18.2 ms; $p<0.01$).

In the study of RTCh in boys (7 years old - 479.6±17.3 ms; 8 years old - 461.2±14.7 ms; 9 years old - 449.7±9.5 ms; 10 years old - 430.8±15 .4 ms) and girls (7 years old - 470.5±12.8 ms; 8 years old - 450.7±14.3 ms; 9 years old - 449.8±19.2 ms; 10 years old - 448.2± 16.7 ms) of the considered age groups, no significant differences in the parameters were found.

The obtained indicators in the RTD and RTCh allow us to assert the mobility of the nervous processes, with increasing age in children there is a significant decrease in the number of delayed and advanced reactions, which is determined by the intensive development of the central structures.

Conclusions. The established parameters of a simple visual-motor reaction are determined by the anatomical properties of the analyzer, the characteristics of the nervous processes of the body and the motor-coordination capabilities of the subject. That is, as they grow older, the period of the sensorimotor reaction decreases, which is associated with the process of maturation of the central structures of the brain and the improvement of the functional state of the neuromuscular apparatus.

In children 9-10 years old, the degree of balance between the processes of excitation and inhibition is greater in strength, which indicates the balance of nervous processes and the stability of the functioning of the nervous system at this age.

With increasing age in children, the mobility of nervous processes is optimized. The functioning of sensorimotor systems in children 7-10 years old with auditory deprivation, in comparison with practically healthy peers, showed that the development of the mechanisms of central regulation of movements is somewhat slow. There was an increase in the time spent in the visual-motor reaction in girls and in the reaction to a moving object in boys of 10 years old, as well as low values of the reaction time of discrimination in boys of 9 years old ($p<0.05$), which is of considerable interest in the context of the study of adaptive reactions children with auditory deprivation.

The study of the features of the functioning of sensorimotor systems in children 7-10 years old with auditory deprivation in comparison with practically healthy peers showed that the development of the mechanisms of central regulation of movements is somewhat slow. The degree of deviations in the activity of sensorimotor systems corresponds to the level of auditory deprivation. There was an increase in the time spent in the VMR in girls and a reaction to a moving object in boys of 10 years, as well as low values of the reaction time of discrimination in boys of 9 years ($p<0.05$), which is of considerable interest in the context of studying the adaptive reactions of the body of children with auditory deprivation.

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References

1. Aleksanyants G.D., Medvedeva O.A., Selikhova E.G. Osobennosti adaptatsii sensomotornykh sistem detey perioda vtorogo detstva s razlichnoy stepenyu slukhovoy deprivatsii v usloviyakh obrazovatelnoy sredy [Peculiarities of adaptation of sensorimotor systems in children of the period of second childhood with varying degrees of auditory deprivation in the conditions of the educational environment]. Peredovyye issledovaniya Kubani [Advanced studies of the Kuban]. Proceedings annual reporting conference of grant holders of the Kuban Science Foundation. (Sochi, June 20–22, 2022). Krasnodar: Kubanskiy nauchnyy fond publ., 2022. 392 p.
2. Aleksanyants G.D., Medvedeva O.A., Topchiy T.G. et al. Osobennosti fizicheskoy podgotovlennosti detey mladshego shkolnogo vozrasta, obuchayushchikhsya v obshcheobrazovatelnoy i spetsialnoy korrektsionnoy (I-II vida) shkolakh, v nachale uchebnogo goda [Features of physical fitness of children of primary school age, studying in general education and special correctional (I-II types) schools, at the beginning of the academic year]. Pedagogiko-psikhologicheskiye i medko-biologicheskiye problemy fizicheskoy kultury i sporta. 2022. Vol. 17. No. 2. pp. 126-132.
3. Aleksanyants G.D., Selikhova E.G., Medvedeva O.A. Psikhofiziologicheskiye pokazateli koordinatsionometrii u detey [Psychophysiological indicators of coordinationometry in children]. Teoriya i praktika fizicheskoy kultury. 2020. No. 11. p. 17.
4. Vilenskaya T.E. Teoriya i tekhnologiya zdorovyesberezheniya v protsesse fizicheskogo vospitaniya detey mladshego shkolnogo vozrasta [Theory and technology of health saving in the process of physical education of children of primary school age]. PhD diss. abstract. Krasnodar, 2011. 19 p.
5. Glazun T.V. Funktsionalnoye sostoyaniye organizma uchashchikhsya 1-6 klassov v usloviyakh primeneniya variativnykh obrazovatelnykh i fizkulturno-ozdorovitelnykh tekhnologiy [The functional state of the body of students in grades 1-6 in the context of the use of variable educational and physical culture and health technologies]. PhD diss. abstract. Maykop, 2006. 204 p.
6. Denisova L.V., Khmelnitskaya I.V., Kharchenko L.A. Izmereniya i metody matematicheskoy statistiki v fizicheskom vospitanii i sporte: uchebnoye posobiye dlya vuzov [Measurements and methods of mathematical statistics in physical education and sports]. Textbook for universities. Kyiv: Olimpiyskaya literature publ., 2008. 127 p.
7. Chermit K.D., Begidova S.N., Bguashev A.B. et al. Didakticheskiye zakonomernosti i printsipy postroyeniya fizicheskogo vospitaniya i sportivnoy podgotovki detey i molodezhi [Didactic

patterns and principles of building physical education and sports training for children and youth]. Vestnik Adygeyskogo gosudarstvennogo universiteta. Seriya 3: Pedagogika i psikhologiya. 2014. No. 4 (146). pp. 146-154.
8. Dorontsev A.V. Otsenka urovnya razvitiya koordinatsionno-dvigatelnogo potentsiala u malchikov 12-13 let s neyrosensornoy tugoukhostyu I-II stepeni, zanimayushchikhsya adaptivnym basketbolom [Evaluation of the level of development of the coordination-motor potential in boys aged 12-13 with sensorineural hearing loss of I-II degree, involved in adaptive basketball]. Pedagogiko-psikhologicheskiye i mediko-biologicheskiye problemy fizicheskoy kultury i sporta. 2020. No.15 (4). pp. 109-114.
9. Kaigorodova N.Z. Issledovaniye psikhofiziologicheskikh morfofunktsionalnykh osobennostey uchashchikhsya, nakhodyashchikhsya na raznykh etapakh adaptatsii k nachalnoy i sredney shkole [The study of psychophysiological morphological and functional characteristics of students at different stages of adaptation to primary and secondary school]. Valeologiya. 2002. No. 3. pp. 97-101.
10. Litvinov E.V. Programma po fizicheskomu vospitaniyu [Physical education program]. Sport v shkole. 2006. No. 22. pp. 3-4.
11. Medvedev O.A., Aleksanyants G.D. Fiziologicheskiye pokazateli zritelno-motornogo vospriyatiya (chuvstva) uchashchikhsya obshcheobrazovatelnoy i korrektsionnoy shkol [Physiological indicators of visual-motor perception (feelings) of students of general education and correctional schools]. Sovremennyye naukoyemkiye tekhnologii. 2010. No. 9. pp. 90-91.