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Influence of specially directed exercises on separate functions of sensor-based systems of pupils of junior classes

Abstract. ***Purpose:*** *to define dynamics of separate functions of sensor-based systems of children of primary school age as a result of specially directed physical exercises.* ***Material and Methods:*** *306 pupils of the 1st – 3rd classes of a comprehensive school of Kharkov took part in the research. The following methods were used: theoretical analysis of scientifically methodical literature, pedagogical experiment, pedagogical testing, methods of mathematical statistics, and methods of determination of separate parameters of touch functions (perimetry, acumetry, esthesiometry and others).* ***Results:*** *the assessment of a functional condition of visual, acoustical, vestibular, tactile analyzers and visual-motor reaction is carried out; the age distinctions in indicators are considered; the extent of influence of specially directed exercises on separate functions of the studied sensor-based systems is defined.* ***Conclusions:*** *the positive influence of specially directed exercises on a condition of separate functions of vestibular, acoustical, visual and tactile analyzers at pupils of junior classes is established.*
Keywords: *sensor-based systems, pupils of junior classes, physical education, specially directed exercises.*

Introduction. The problem of the increase of the level of motive preparedness and indirectly of a state of health of younger generation of Ukraine remains one of the priority as the deterioration of a state of health is observed in a third of children after the first year of a study at school which progresses during the entire period of a study in general education educational institutions [5]. Deteriorations of a state of health of children connect, mainly, with the decrease in the level of their physical preparedness, caused by the reduction of physical activity as a result of a study which is oversaturated by subject matters where a static component prevails [2; 4; 11; 15].

The leading role in the process of a study, the development of motive qualities, formations of the motive sphere of children play touch systems (visual, vestibular, acoustical, tactile) [1; 6; 12–14; 16].

A number of researchers note a considerable influence of analyzers on the manifestation of coordination abilities, speed, flexibility, force and endurance [1; 7–10; 14]. In their opinion, influencing a functional condition of touch systems act on the development of motive qualities becomes mediately. That is, the level of physical preparedness can be regulated due to the activity of the main touch systems.

A number of authors in the works indicate the increase of activity of separate analyzers at the investigated of different age as a result of special exercises: O. K. Moiseyenko [10] – at children of a preschool age, I. O. Kuzmenko, L. Y. Shesterova [3, 16] – at children of a middle school age; L. O. Magomedov [6] – at children of a school age with defects of sight and so forth. A question of a complex influence of specially directed exercises on a functional condition of touch systems of children of a younger school age remains insufficiently studied, that proves a relevance of our research.

Communication of the research with scientific programs, plans, subjects. The research is carried out according to the thematic plan of the research work of Kharkov state academy of physical culture for 2013-2015 by a subject 3.5.29. "Theoretical and applied bases of the creation of monitoring of physical development, physical preparedness and physical condition of different groups of the population".

The objective of the research: to define dynamics of separate functions of touch systems of children of a younger school age as a result of specially directed physical exercises.

Material and methods of the research. Research methods: the theoretical analysis and synthesis of data of scientifically methodical literature, pedagogical experiment, methods of mathematical statistics, methods of determination of separate parameters of touch functions which included: *in the visual analyzer* – a perimetry method where limits of achromatic were defined (colourless) field of sight of two main meridians – horizontal and vertical with the use of a perimeter of Forster; *in the acoustic analyzer* – a method of acumetry where bone and air conductivity of sound waves was investigated with the use of a tuning fork 140 Hz*;* a resistance of a *vestibular apparatus* to rotary loadings on the Barany chair (5 turns for 10 s) was determined by the following indicators *in the vestibular analyzer*: a deviation from a straight line in walking blindly on 5 m of a piece, speed of run, when performing a certain task and accuracy of creation of a movement in an elbow joint with the use of a kinematometr of N. M. Zhukovskyi; *in the tactile analyzer* – a method of esthesiometry where a tactile sensitivity on different sites of skin is defined) with the use of Weber's compass; *in visually motor reaction* which displays a condition of CNS, a simple motive reaction to a light signal was investigated by means of the device IPR-01.

The researches were conducted on the basis of GES No. 143 in Kharkov. 306 pupils of the 1-3rd classes took part in them from whom 3 experimental and 3 control groups were created. The first group – pupils of the 1st classes; the second – pupils of the 2nd classes; the third – pupils of the 3rd classes.

During the academic year pupils of the control groups were engaged on the standard state program of physical culture, and special exercises and outdoor games joined additionaly which are directed on the increase of a functional condition of separate analyzers and before the educational process of physical training of experimental groups, with the standard program. So, exercises with the determination of a distance between different subjects; exercises on the improving system of Huashan school of Dao and Hatha yoga; exercises at a performance of which movements by hands or feet were followed by eyes, with subjects where the direction of movements of subjects was fixed by eyes and others were used for *the visual analyzer*. The representation of orders with a change of a timbre and loudness; musical maintenance with a change of speed and a rhythm; exercises on attention with the use of sound irritations and hindrances; a performance of exercises

at a limitation of opportunities of the acoustical analyzer and others were applied to influence on *the acoustic analyzer*. For *the vestibular analyzer*: jumps with turns on 90°, 180° and 360° with different starting positions of a head; run and walking with unexpected stops; rotation round own axis; fast inclinations of a head and a trunk; a performance of the listed exercises in the absence of a visual control and others. For *the tactile analyzer:* movements by fingers of one hand or two hands at the same time; the use of the principle of opposition of fingers of hands; definitions of forms and sizes of different sports subjects, and also their difference, by character of a surface without a visual control but other, and also the modified outdoor games with the use of all listed exercises.

The special exercises were joined in preparatory, main and final parts of a lesson, in sports minutes at lessons on general education subjects, in the system of organized breaks and were given in the form of homeworks.

Results of the research and their discussion. The analysis of the data of the primitive research showed that results of measurement of volume of a peripheral sight are lower than norm (boys of the 1-3rd classes have the top limit 34,35 – 41,94°; the lower – 42,65–55,29°; the internal – 44,15–52,38°; the external – 61,65–74,94°, at girls of the 1-3rd classes – 38,06–41,76°; 41,06–55,18°; 44,09–51,79°; 65,18–73,71° respectively). In sexual and aged aspects the domination of these boys over indicators of girls is observed and with the age these results generally improve, however it is doubtful ($p>0,05$).

After carrying out the experiment the volume of peripheral sight authentically improved at pupils of the experimental groups ($p<0,05$-$0,001$) (at boys – the top limit became 42,65–48,03°; the lower – 56,0–62,56°; the internal – 52,79–57,76°; the external – 75,41–86,32°, at girls respectively 43,21–47,71°; 53,41–60,76°; 51,24–56,0°; 76,29–84,44°). The gain at boys of the I group makes – 20,9%; II – 12,6%; III – 16,4%, at girls is 15,7%; 11,7%; 14,2% respectively. The most substantial increase of indicators is defined at pupils of the I age group. The dynamics of results remained the same, as in the primitive research in sexual and aged aspects.

After carrying out the primitive researches the sound audibility duration indicators at air and bone conductivity were at a rather low level and made: the air conductivity – at boys 9,65–11,18 s (a right ear), 9,91–11,68 s (a left ear); at girls respectively – 8,97–9,53 s and 9–10 s; the bone conductivity – at boys 6,65–7,47 s, at girls was 6,59–7,32 s. Generally the reliable prevalence of results of the air conductivity of boys over the data of girls is observed in the sexual aspect. The exception is made by indicators of the I age group where differences are doubtful ($p>0,05$). The data of the bone conductivity have no reliable differences ($p>0,05$). These results improve with the age mainly.

After the experiment the sound audibility duration authentically improved at pupils of the experimental groups ($p<0,05<0,001$). So, at boys of the I age group the gain in indicators of the bone conductivity makes – 27,5%, the air conductivity of a right ear – 22%, a left ear – 21,3%; the II groups – 23,9%, 23,8%, 20,2% respectively, III – 31,7%, 26,8% and 24,6%. Girls of the I groups have – 21,5%, 19,9% and 22,8%; II – 16,5%, 25,6% and 23,1%; III – 26,3%, 30,5% and 25% respectively. The most considerable gain of duration of the audibility of a sound is noted at pupils of the III age group. Generally the more significant increase in indicators of the air conductivity is observed at girls of all age groups when comparing with boys. It isn't revealed in sexual and aged aspects of considerable changes when comparing with the output data.

The analysis of the initial indicators of vestibular firmness testifies to the insufficient development of the vestibular analyzer as all indicators which display its functional state, authentically worsened after rotary loadings ($p<0,05$–$0,001$). In direct walking a deviation size from a straight line varied: at boys – before a rotation from 35,24 to 58,24 sm, after – from 114,10 to 153,10 sm, at girls – before a rotation from 50,59 to 60,91 sm after – from 97,90 to 174,06 sm; in speed of a performance of a certain task: at boys – before a rotation from 6,31 to 7,20 s, after – from 6,92 to 7,75 s, at girls respectively – from 6,82 to 7,72 s and from 7,64 to 8,31 s; in the accuracy of acreation of the set movement amplitude: at boys before a rotation from 23,76 to 24,71°, after – from 20,18 to 20,56°, at girls respectively – from 22,88 to 27,47° and from 21,65 to 27,59°. The analysis of data in the aged aspect showed that in children improved indicators with age in speed of run, and in a direct walking and the accuracy of a creation of the set movement amplitude these changes have multidirectional character. On sex the prevalence of results of boys is revealed by data of a direct walking and speeds of a performance of a certain task, and on indicators of a creation of the set amplitude of the movement the opposite tendency is found (results of girls dominate over indicators of boys).

The analysis of the results received after the experiment showed a considerable improvement of firmness of the vestibular analyzer by all parameters of pupils of the experimental groups. So, the size of a deviation varied at boys in a direct walking– before a rotation from 19,94 to 26,4 sm, after – from 39,19 to 57,24 sm, at girls – beforea rotation from 22,65 to 29,03 sm, after – from 46,24 to 60,5 sm; in speed of a performance of a certain task: at boys before a rotation from 6,01 to 6,68 s, after – from 6,70 to 7,66 s, at girls respectively – from 6,46 to 7,11 s and from 6,68 to 7,45 s; in the accuracy of a creation of the set movement amplitude: at boys before a rotation from 24,2 to 24,5°, after – from 24,5 to 25,29°, at girls respectively – from 23,9 to 25,76° and from 24,38 to 25,5°. Comparing the data before and after the vestibular loading after the experiment, it is revealed that after a rotation, as well as before the experiment, results of pupils of all age groups worsen, however these changes are less essential and not always reliable (in a direct walking the deterioration of results after a rotation has a reliable character ($p<0,01$–$0,001$), and according to run speed when performing a certain task and kinematometry of reliable differences isn't observed in indicators ($p>0,05$)). Thus, comparing the received results before and after the experiment after the vestibular loading, it is revealed that after the application of special exercises indicators of all studied parameters significantly changed and these differences generally have a reliable character. So, after the vestibular irritation by the data of a direct walking at boys of the I group results improved for 64,4%; II – 55,1%; III – 74,1%, at girls – for 46,5%; 65,2% and 71,9% respectively. On indicators of speed of run when performing a task the gain of results makes: boys of the I groups have – 10,3%; II – 7,2%; III – 9,1%, at girls – 10,3; 10,0; 12,9% respectively. According to kinematometry, boys respectively have 19,9%; II – 15,6%; III – 23,0%, at girls were 13,0%; 11,4% and 6,7%. The most essential changes mainly took place at pupils of 9 years old, except for indicators of speed of a performance of a task at

boys and kinematometry at girls where the gain of results of pupils of 7 years old prevails. In the aged and sexual aspects the dynamics of results didn't change. It should be noted that differencees are insignificant and doubtful for the sex on the deviation of indicators in walking and accuracy of a creation of the movement ($p>0,05$), and according to speed of a performance of a certain task – reliable ($p<0,05–0,01$).

According to the primary measurements it is established that indicators of the tactile sensitivity on the middle of a palm and the 3rd phalanx of a finger are lower than norm and are in limits: at boys – from 1,41 to 1,50 sm, in girls – from 1,51 to 1,70 sm and in boys – from 0,61 to 0,80 sm, in girls – from 0,65 to 0,75 sm respectively. Indicators insignificantly are above norm and fluctuate in limits by the results of measurement of sensitivity on a back surface of a hand and a forearm: at boys – from 1,66 to 2,20 sm, in girls – from 2,06 to 2,28 sm and at boys – from 2,29 to 2,71 sm, in girls – from 2,54 to 2,89 sm respectively. Such difference in standard indicators can be explained to that the presented norms aren't graduated on an aged sign. On age and sex indicators don't differ authentically ($p>0,05$).

The data of tactile sensitivity at pupils of the experimental groups considerably improved and began to be in limits after introduction in the process of physical training of specially directed exercises: on the middle of a palm – at boys – from 0,95 to 1,15 sm, at girls – from 1,04 to 1,16 sm; to the 3rd phalanx of a finger – at boys – from 0,46 to 0,55 sm, at girls – from 0,44 to 0,50 sm; on a back surface of a hand – at boys – from 1,34 to 1,83 sm, at girls – from 1,49 to 1,87 sm and a forearm – at boys – from 1,72 to 2,33 sm, at girls – from 1,86 to 2,46 sm. Thus it should be noted that according to measurement of sensitivity on the 3rd phalanx of a finger and the middle of a palm of improvement has a reliable character in all age groups ($p<0,05–0,001$), by the results of measurement of a back surface of a hand changes are reliable at pupils of the III ($p<0,05–0,001$) and boys of the II age group ($p<0,05$), and forearm indicators authentically improved only at pupils of the III group ($p<0,05$). The gain of results on the data of measurement of sensitivity on the 3rd phalanx of a finger at boys of the I age group makes 31,2%; II – 30,3%, III – 23,8%, at girls – 33,3; 32,8 and 35,2% respectively. Behind results of measurement of sensitivity on the middle of a palm at children of the I group – 20,6%; II – 26%; III – 35,8%, at girls – 23,5; 29,2 and 31,1% respectively. On indicators of a back surface of a hand at boys respectively – 16,8; 18,3 and 22%, at girls – 13,4; 15 and 29,7%. According to the measurement of sensitivity of a forearm the gain at boys made 13,7; 13,2 and 24,8%, at girls – 14,2; 10,8 and 26,7%. The most considerable improvement of the results on all indicators of tactile sensitivity is defined generally at pupils of the III age group. The 3rd phalanxes of a finger of children make the exception of these measurements of sensitivity where the greatest shifts are observed in the I age group. Dynamics of indicators in sexual and aged aspects didn't change significantly.

During the primary research it was established that the time of visually motor reaction was in limits: at boys – from 0,78 to 0,88 s, at girls – from 0,67 to 1,07 s, with age these results improve, however it is doubtful ($p>0,05$). In the sexual aspect it is revealed that in the I and II age groups boys react to a signal, than girls, and in the III group quicker, opposite – girls own a faster visually motor reaction, and these differences have a reliable character ($p<0,05–0,001$).

After the application of the specially directed exercises the indicators of time of a motive reaction authentically improved at pupils of the experimental groups ($p<0,05–0,001$) and began to be in limits: at boys – from 0,67 to 0,74 s, at girls – from 0,6 to 0,91 s. The gain of results at boys of the I age group makes 14,9%; the II groups – 15,2%; III – 15,1%, at girls are 14,1%; 13,4% and 13% respectively. The greatest improvement of results is observed at boys of 8 years old and girls have at 7 years old, besides the more essential gain in indicators is noted at boys, than at girls. In sexual and aged aspects the tendency remained the same, as well as in the primitive research.

During the experiment some changes in a functional condition of separate functions of touch systems took place at pupils of the control groups, but these changes also, when comparing with results of pupils of the experimental groups,are less essential and doubtful ($p>0,05$).

Conclusions:

1. The data of the primitive researches allowed establishing the insufficient level of the development of vestibular, acoustical, visual and tactile analyzers at pupils of junior schools.

2. The application in the course of physical training of the specially directed exercises positively affected a functional condition of the studied touch systems.

Prospect of the subsequent research in this direction is the definition of the influence of specially directed exercises on a functional condition of touch systems of pupils of senior schools, vocational-technical schools and students of higher educational institutions.

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