THE INFLUENCE OF SPECIALLY DIRECTED EXERCISES ON THE FUNCTIONAL STATE OF THE TACTILE ANALYSER AND PHYSICAL FITNESS OF 7-15 YEAR OLD PUPILS

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ABSTRACT

Purpose: to determine the level of influence of specially directed exercises on the functional state of the tactile analyser and the level of physical fitness in 7-15 year old pupils. Material: research was conducted on the basis of comprehensive schools of Kharkov. More than 800 pupils, of whom 6 experimental and 6 control groups were made, took part in it. Results: the pupils' level of motive preparedness is determined; the functional state of the tactile analyser is investigated; differences of the studied indicators in age and sexual aspects are considered; interrelation between parameters of the functional state of the tactile sensory system and the pupils' motive abilities development level is defined; the extent of influence of specially directed exercises on the functional state of the tactile analyser and motive preparedness of the investigated subjects is revealed. Conclusions: 1. The analysis of initial research allowed to establish that the pupils' tactile sensitivity indicators of the middle of the palm and the 3rd phalanx are lower than the norm, and the results related to the back surface of the hand and the forearm are a little higher than the norm. 2. The correlation analysis showed the existence of a rather close interrelation between the tactile analyser and the development level of physical qualities. 3. The use of specially selected exercises positively influenced the functioning of the tactile analyser and, indirectly, affected the examinees' development of physical qualities.

Keywords: Physical education, school-age children, tactile analyser, motive qualities, special exercises.

INTRODUCTION

One of the most acute social issues is the health of the younger generation. The tendency to number reduction of the physically healthy youth is observed worldwide in recent years (Haskell, Lee, Pate, et al., 2007; Krivoruchko, et al., 2013; Maslyak, Mameshina, Zhuk, 2014; Bala, 2015; Aghyppo, Tkachov, Orlenko, 2016; Kuzmenko, 2017).

One of the main reasons for the negative dynamics of indicators related to the health status of the younger generation in Ukraine is sedentary lifestyle (Mameshina, 2016; Masliak, Bala, Krivoruchko, et al., 2018). Experts in the field of physical education and sport offer various solutions for the problem that has arisen (Filenko, Filenko, Martirosyan, 2013; Bala, 2012; Maslyak & Kryvoruchko, 2016). Special significance in physical education and sport belongs to sensory systems (visual, acoustic, vestibular, tactile) without whose involvement execution of any physical action is impossible (Aghyppo & Kuzmenko, 2015; Maslyak, Shesterova, et al., 2016; Podrigalo, Iermakov, Potop, et al., 2017; Pomeshchikova, 2010; Magomedova & Shesterova, 2013). A number of authors mark a special role of the tactile analyser in forming an integral

perception of the world around the person. In the case of loss of sight and hearing, the person can "hear" and "read" by means of the tactile analyser through the use of training and different technical devices, that is, work and be useful to the society. The tactile analyser plays a special role in the perception of movements, as execution of movements is accompanied by stretching skin and putting pressure upon its separate sections. Great demands in the case of executing physical actions, difficult on coordination, are imposed to the tactile sensory system; it gives information on the amplitude of movements and contact of the body with apparatuses and equipment (Smirnov & Budylina, 2003; Solodkov & Sologub, 2005).

An insignificant number of works is devoted to studying the question of the influence related to special exercises on the functional state of the tactile analyser and, indirectly, on the manifestation of some motive qualities at different contingents. So, Vasylenko & Mitova, 2011, claim about defining the influence of the tactile sensory system on the basketball players' technical training at the stage of specialized basic preparation.

It is established that the special exercises, which are aimed at the development of the tactile analyser, promote an increase in motive abilities of blind children (Mihaylik, 2001). Maslyak, 2006, 2008, 2015, found out that, as a result of carrying out his research, improving the indices of tactile sensitivity and, as a result, of motive preparedness of pupils attending elementary grades is under the influence of specially directed exercises.

Kuzmenko, 2011, defined a positive influence of specially directed exercises on the tactile analyser and the development level of coordination abilities in 10-14 year old children. However, the question of the influence of the tactile analyser activity on motive preparedness of school-age children remains relevant and requires further research.

The purpose of the research is to define the level of influence of specially directed exercises on the functional state of the tactile analyser and the development level pertaining to physical qualities in 7-15 year old pupils.

MATERIALS AND METHODS

Research was conducted on the basis of general education institutions of Kharkov. More than 800 pupils, of whom experimental and control groups were made, took part in the research: the I age group – 7-year-old pupils, the II age group – 8-year-old pupils, III age group – 9-year-old pupils (pupils of elementary grades), IV age group– 10-11 year old pupils, V age group – 12-13 year old pupils, VI age group – 14-15 year old pupils (middle-school pupils). All the children, who participated in the research, belonged to main and preparatory medical groups, and were under observation of the school doctor. During the academic year, the contents of physical education classes for pupils belonging to experimental groups were complemented with specially selected physical exercises, which are directed to activate the tactile analyser: finger movements of one or both hands at the same time, exercises using the principle of finger-to-thumb opposition, fingers of one hand to fingers of the other, exercises with the use of palm contact of hands, definition of forms and sizes of various sports objects, and also their distinction of the surface character (rubber, wood, plastic, iron, leather, etc.) without visual control.

Special exercises were included in the preparatory, main and final parts of lessons; sports minutes were practiced during lessons of general education subjects, and, in the system of organized changes, exercises were also given in the form of homework. Besides, the main and final parts of lessons were complemented with the modified outdoor games, which joined the above listed exercises. Research methods: analysis of scientific and methodical literature, pedagogical testing, aesthesiometry method, stating and forming a pedagogical experiment, methods of statistical analysis.
The analysis of scientific and methodical literature was carried out with the purpose of stating the studied question. Experts' opinions on the significance of the tactile analyser in physical education and sport were considered.

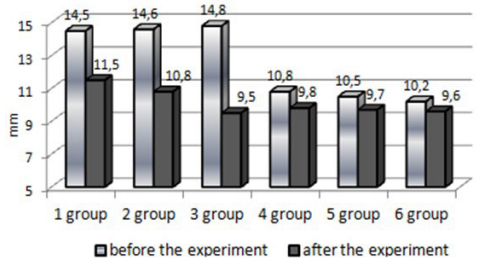
Pedagogical testing assumed the use of motive tests for determining the development level of the main physical qualities. So, the extent of speed development was determined by performance indicators of a 30 m run for 7-9 year old pupils and 60 m for 10-15 year old pupils (s); the coordination of movement (dexterity) for performance indicators was determined by a 4x9 m (s) shuttle run; flexibility was determined with the trunk bending forward from a sitting position (cm); the force by a bending extension of arms in a lying position (number of times) and torso lifting from a back-lying position (number of times); the endurance by a 500 m run for 7-9 year old pupils and 1000 m for 10-15 year old pupils (min., s). The aesthesiometry method, which assumed the definitions of tactile sensitivity by means of the Weber's compass on various skin sites, was used for researching the level of functioning related to the tactile sensory system: middle of the palm, the 3rd phalanx, the back surface of a hand and forearm.

Statistical analysis: research materials were processed with the use of the Excel programme. We calculated: the arithmetic average ( ) – for the characteristics of the set in separate parameters; standard error of the average (m) – for the definition of the arithmetic average deviation from the corresponding parameters of general totality; reliability of distinctions (p) – was calculated with the purpose to establish the extent of changes in average sizes of the studied signs after the experiment conducted by means of the student's parametrical criterion (t) at the significance level not lower than 0.05; correlation analysis (r) - was used to define the extent of communication between the studied signs.

Research results

Data from the initial research on separate parameters of the functional state of the tactile analyser allowed to establish the lack of reliable differences in indicators of experimental and control groups' pupils ($p>0.05$). By analysing the received results in the age aspect, it is established that tactile sensitivity in pupils tends to improve with age for all indicators. However, these distinctions do not generally have a reliable character ($p>0.05$). The insignificant prevalence of results for boys over the data for girls is revealed when it comes to the sexual aspect, except for the 3rd phalanx sensitivity results where the data on girls generally prevails over those for boys. However, these distinctions are unreliable in most cases ($p>0.05$).

A comparison of the received results with the norms, which are presented by Smirnov & Budylina, 2003, showed that tactile sensitivity according to the measurements of the middle of the palm and the 3rd phalanx is lower than the norm, while in accordance with the results related to the measurement of the back surface of the hand and the forearm, it is a little higher than the norm. In our opinion, it is illustrated that the presented norms aren't graduated on the age sign. By analysing the received results after the experiment, presented in Fig. 1, it should be noted that the improvement has a reliable character in all age groups according to the measurements of the 3rd phalanx and the middle of the palm ($p<0.05–0.001$).



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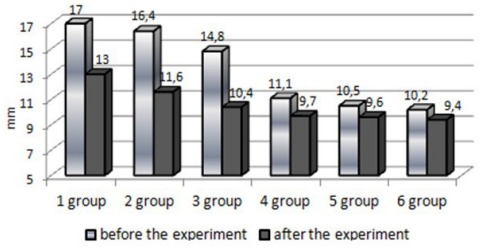

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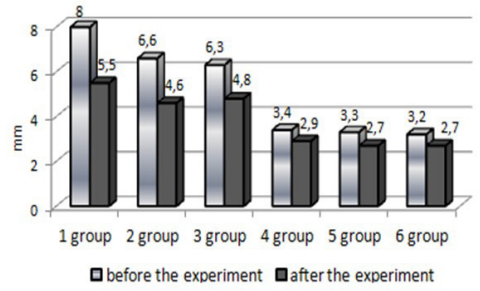

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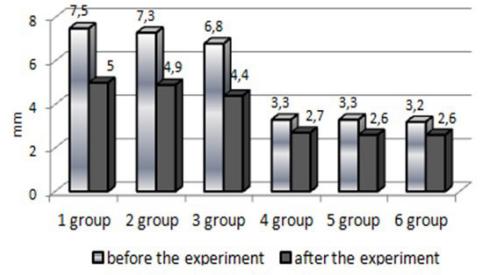

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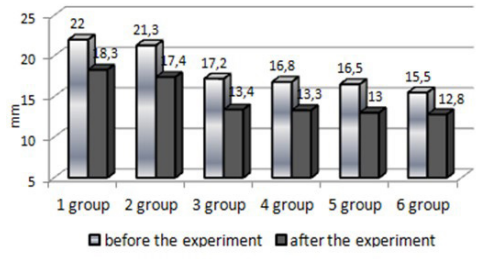

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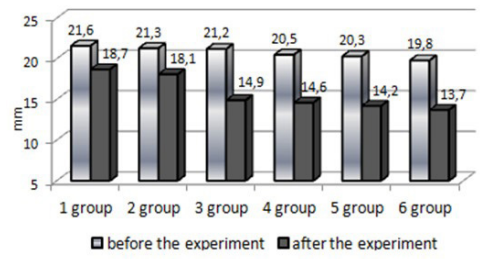

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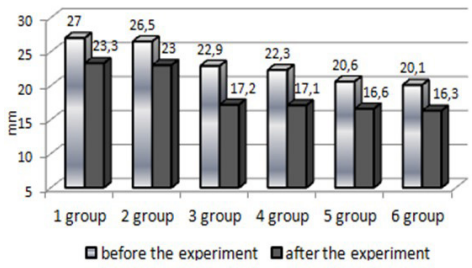

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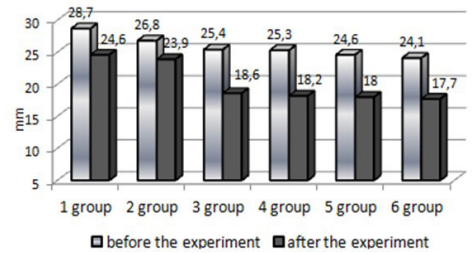

h)

Figure 1: Tactile sensitivity indicators for pupils belonging to the I - VI experimental groups before and after the experiment: a) the boys' middle of the palm; b) the girls' middle of the palm; c) boys' 3rd phalanx; d) girls' 3rd phalanx; e) the boys' back surface of the hand; f) the girls' back surface of the hand; g) boys' forearms; h) girls' forearms.

Changes are reliable in pupils of the III group ($p<0.05$, 0.001) and in boys of the II age group according to the results of measurements for the back surface of the hand ($p<0.05$), while the indicators of the forearm authentically improved only in pupils of the III age group ($p<0.05$).
The gain of results on data related to measuring the sensitivity of the 3rd phalanx in boys belonging to the I age group was 31.2%, in boys of the II group, it was 30.3%, the III group had a gain of results amounting to 23.8%, the IV had a 17.2% gain, the V had a 15.1%, and the VI had a 13.3% gain, while for girls it was 33.3%; 32.8%, 35.2%, 18%, 13.7% and 16.3%, respectively.

The gain related to the results of measuring the sensitivity of the middle of the palm in boys belonging the I group was 20.6%, the II group had a 26%, the III group 35.8%, the IV had 9.3%, the V 6.8%, and the VI had a gain of 3.9%, while the girls had 23.5%, 29.2%, 31.1%, 11.8%, 7.1% and 7.9%, respectively. When it comes to indicators of measuring the sensitivity of the back surface of the hand in boys, the gain was 16.8%, 18.3%, 22%, 15.3%, 13.7% and 14.2%, respectively, while the girls had 13.4%, 15%, 29.7%, 16.2%, 14.6% and 12.9%. According to the measurement of forearm sensitivity in boys, the gain of results was 13.7%, 13.2%, 24.8%, 15.1%, 14.6% and 13.2%, while the girls had 14.2%; 10.8%, 26.7%, 14.6%, 13.8% and 12.5%. The most considerable improvement of results for all indicators of tactile sensitivity is generally noted in pupils of the III age group. During the experiment, indicators of pupils from the control groups are also a little improved, however, these changes are not essential, and they are unreliable ($p>0.05$).

The analysis of differences in age and sexual aspects did not reveal essential differences in comparison with the basic data. Comparing the studied indicators to the relevant standards, it should be noted that a positive tendency for the improvement of tactile sensitivity for pupils belonging to experimental groups was not significantly reflected in a rating scale. Thus, the use of specially directed exercises positively affected the pupils' tactile sensitivity of various parts of the body. It was especially clear for 9-year-old pupils. The most significantly improved tactile sensitivity was for the 3rd phalanx and the middle of the palm.

We carried out the correlation analysis for the purpose of defining the degree of interrelation between indicators related to the state of the tactile analyser and the development level of physical qualities for 7-15 year old pupils. The obtained data confirm the existence of interrelation between the tactile analyser functional state parameters and the pupils' motive abilities development level which is generally reflected as "weak" and "average" in the degree size of interrelation (the correlation coefficient varied ranging from 0.21 to 0.88 at $p<0.05$-0.01).

So, the correlation coefficient varied, ranging from 0.21 to 0.62 at $p<0.05$-0.01 between indicators of the tactile analyser and the level of speed development; for dexterity, it varied from 0.21 to 0.69 at $p<0.05$-0.01; for endurance, it varied from 0.20 to 0.51 at $p<0.05$-0.01; for force, it varied from 0.20 to 0.52 at $p<0.05$-0.01; for flexibility, it varied from 0.20 to 0.88 at $p<0.05$-0.01.

The most significant interrelation is noted between parameters of tactile sensitivity and the development level of flexibility and dexterity. The tendency of interrelation also remained at the repeated experiment level, and in certain cases, an even increase in the degree of dependence is noted. An essential increase in interrelation is noted between parameters of the tactile sensory system and the development levels of speed, dexterity and flexibility. It was revealed that interference of the studied parameters depends on age and in some cases on gender. Thus, the revealed interrelation, as a result of the correlation analysis between the studied parameters, confirms the existence of a sufficient extent of tactile analyser interference on the development level of separate physical qualities.

Our previous research showed a positive influence of special exercises on the functional state of separate analysers (visual, acoustic, vestibular) in pupils (Azhippo, A.Yu., Shesterova, L.Ye., Maslyak I. P., Kuzmenko, I.A., Bala, T.M., Krivoruchko, N.V., Mameshina, M.A., Sannikova, M.V., 2016, 2017). The use of special exercises which influence the sensory systems, and, in particular, the tactile one, led to an improvement of their functional state and, indirectly, to an improvement of the level of physical fitness in the studied contingent.

So, indicators related to the development level of speed ($p<0.001$), coordination abilities ($p<0.05$ - 0.001) and force ($p<0.05$-0.001) authentically improved in pupils belonging to experimental groups, except for the results obtained for 7-year-old pupils, where the changes are statistically unreliable ($p>0.05$), endurance in pupils belonging to the IV-VI group ($p<0.001$). Endurance development has a natural character in pupils of the I – III age groups. Indicators of pupils from the control groups also underwent changes, however, these changes are less essential, and they are unreliable ($p>0.05$). By analysing the improvement of indicators concerning age, it is established that the most essential changes are recorded in speed indicators for 7-year-old boys and in abdominal tension muscle force indicators for girls of similar age. At the age of 8 years, the most considerable changes happened in the boys' flexibility indicators and in the results of speed manifestations and abdominal tension muscle force for girls. At the age of 9 years, the most essential changes are recorded in indicators of speed, dexterity, muscle force of hands and abdominal tension for boys, and in flexibility indicators for girls. The most significant changes in indicators of high-speed abilities, endurance, dexterity, and muscle force of hands were present in 11-year-old boys. Indicators of endurance, dexterity, flexibility, muscle force of hands and abdominal tension most significantly improved in girls of this age. The substantial increase of indicators related to abdominal tension muscle force and flexibility was observed in 12-13 year old boys, while high-speed abilities were observed in girls. The less significant rates of gain for motive preparedness indicators were noted both in boys and girls at the age of 14-15.

DISCUSSION

Certain authors emphasize the significance of the tactile sensory system in physical education and sport. It plays an important role in spatial orientation of the person, helps to precisely determine the run speed, and to carry out difficult movements of coordination, etc. (Parham & Mailloux, 2010). The use of special exercises promotes an increase in its functionality (Kuzmenko, 2011). The analysis of tactile sensitivity indicators, received after the experiment, demonstrates that they improved, and the differences generally have a reliable character in most pupils belonging to experimental groups ($p<0.5$-0.001). These data will agree with the opinion of Solodkov & Sologub, 2005, who consider that tactile sensitivity increases with the growth of the child's physical activity.

The most noticeable changes of tactile sensitivity indicators were observed in pupils of the III age group. The system of specially developed physical exercises and outdoor games, which are directed to improve the functional state of the tactile analyser, was approved for the first time in the course of physical education for pupils attending a comprehensive school. The optimum age periods for increasing the sensitivity are revealed.

It should be noted that the girls' tactile sensitivity of the 3rd phalanx is slightly higher than boys'. According to certain experts in the field of physiology, physical education and sport (Solodkov & Sologub, 2005), women have a larger number of receptors on their fingers than men, which is why finger sensitivity is higher for them.

Reliable differences in tactile sensitivity indicators, received after the experiment, weren't observed in pupils belonging to control groups ($p>0.05$). Thus, the research we conducted confirm and supplement the results of research conducted by Mihaylik, 2001, Kuzmenko, 2011, Maslyak, 2015, about the use efficiency of the exercises in the educational process, which are directed to increase the functional state of the tactile analyser.

The result analysis of the repeated research, received after using the special exercises, which are in a complex, positively influencing the functional state of sensory systems, and, in particular, the tactile one, allowed revealing that some changes also took place indirectly in the development level indicators of motive qualities. So, in pupils participating in the experiment, indicators of speed manifestation, high-speed and power qualities improved in 97% of cases, while, in 93% of cases, they improved in the dexterity manifestation, and, in 95% of cases, they improved in the flexibility manifestation.

The smallest gain was observed in the results reflecting the development level for the muscle force of hands and abdominal tension, 79% and 87% respectively. It is necessary to focus our attention to various changes in indicators of the endurance development level in elementary and middle-school pupils. So, the indicators improved in 95% of cases for the middle-school

aged examinees, and the results of endurance manifestation did not practically change for younger pupils. It is confirmed by the opinion of a number of authors (Shiyan, Papusha, 2000; Volkov, 2002) who note that endurance develops poorly at a younger school age because cardiovascular and respiratory systems are insufficiently developed in this age period that interferes with the development of this physical quality. Changes in indicators related to the level of physical fitness were observed in 45-50% of cases for pupils engaged in the standard programme, which is connected, in our opinion, with age features of their development.

In our opinion, the gain of indicators related to the development levels of flexibility, dexterity and speed is explained by the existence of a rather close interrelation between the manifestation of these physical qualities and the functional state of sensory systems, in particular, the tactile one. Improvement in indicators related to the development level of force and endurance is explained by our correlation dependence between separate indicators of the studied parameters.

It is also explained by the existence of a rather close interrelation between the manifestation of physical qualities (Volkov, 2002; Shesterova, 2003), i.e. the gain of indicators related to the development of dexterity and speed causes an increase in the development levels of force and endurance, and vice versa.

As a result of the conducted research, data (Pomeshchikova, Iermakov et al., 2016; Podrigalo, Iermakov, Rovnaya et al., 2016; Maslyak, Shesterova, Kuzmenko et al., 2016) about the interrelation of sensory systems with a manifestation of physical qualities were expanded.

The data of Shesterova, Kuzmenko, Maslyak, 2011, 2015, 2017, about the influence of specially directed exercises on the activity of various analysers in pupils are expanded.

CONCLUSIONS

1. The analysis of initial research allowed to establish that the pupils' tactile sensitivity indicators of the middle of the palm and the 3rd phalanx are lower than the norm, and the results related to the back surface of the hand and the forearm are a little higher than the norm.
2. The use of specially directed exercises, that we developed, in the course of physical education positively influenced the functioning of the tactile sensory system in pupils belonging to experimental groups ($p<0.05$-0.001). The most susceptible period for training the tactile analyser is the age of 9. The results of pupils belonging to control groups did not significantly change.
3. The research on the level of physical fitness after using the system of specially directed exercises demonstrate a reliable improvement in the development of all main physical qualities ($p<0.05$-0.01) in pupils belonging to experimental groups. 7-9 year old pupils' endurance indicators, which practically did not change, are an exception. Data on pupils belonging to control groups did not undergo considerable changes.
4. The correlation analysis of the tactile analyser functional state indicators and the development level of motive qualities confirms the existence of a rather close interrelation between them ($r = 0.20$-0.88), which gives the grounds to speak about the considerable extent of interference of these parameters.

Further research in this direction can be conducted by defining the extent of influence related to the tactile sensory system activity level on motive preparedness of sportsmen.

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UTICAJ POSEBNO USMJERENIH VJEŽBI NA FUNKCIONALNO STANJE OSJETNOG ANALIZATORA I FIZČKU SPREMNOST UČENIKA U DOBI OD 7 DO 15 GODINA

Svrha: odrediti nivo uticaja posebno usmjerenih vježbi na funkcionalno stanje osjetnog analizatora i nivo fizičke spremnosti učenika u dobi od 7 do 15 godina. Materijal: istraživanja su provedena na osnovu srednjih škola u Harkovu. Više od 800 učenika, koji su činili 6 eksperimentalnih i 6 kontrolnih grupa, je učestvovalo u istraživanjima. Rezultati: utvrđen je nivo motoričke spremnosti učenika; ispitano je funkcionalno stanje osjetnog analizatora; razlike proučavanih indikatora po pitanju dobi i pola su uzete u obzir; definisan je međusobni odnos parametara funkcionalnog stanja osjetilnog sistema za dodir i nivoa razvoja motoričkih sposobnosti učenika; otkriven je opseg uticaja posebno usmjerenih vježbi na funkcionalno stanje osjetnog analizatora i nivo motoričke spremnosti ispitanika. Zaključci: 1. Analiza početnog istraživanja nam je omogućila da ustanovimo da su indikatori osjetljivosti na dodir sredine dlana i treće falange kod učenika niži od norme, te da su rezultati dobiveni za nadlanicu i podlakticu nešto viši od norme. 2. Korelacijska analiza je ukazala na postojanje dosta bliskih međusobnih odnosa između osjetnog analizatora i nivoa fizičkih osobina. 3. Korištenje posebno odabranih vježbi je pozitivno uticalo na funkcionisanje osjetnog analizatora i, indirektno, na razvoj fizičkih osobina ispitanika.

Ključne riječi: Fizičko obrazovanje, djeca školskog uzrasta, osjetni analizator, motoričke osobine, posebne vježbe.

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