

Influence of functional condition of visual sensory system on motive preparedness of school-age children

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Abstract. *Purpose:* to define the extent of influence of specially oriented exercises on functional condition of visual analyzer and the level of physical fitness of pupils of 7-15 years old. *Material:* the researches were conducted on the basis of comprehensive educational institutions of Kharkov, more than 800 pupils, of whom 6 experimental and 6 control groups were made, took part in them. *Results:* the level of motive preparedness of pupils is determined; the functional condition of visual sensory system is investigated; distinctions of the studied indicators in age and gender aspects are considered; the interrelation between parameters of functional condition of visual sensory system and the level of development of motor abilities of pupil is defined; the extent of influence of specially oriented exercises on functional condition of the visual analyzer and motive preparedness of examinees is revealed. *Conclusions:* 1. Data of initial researches allowed to establish that borders of achromatic (colorless) field of vision of pupils of 7-15 years old are fewer norms. 2. The correlation analysis showed the existence of rather close interrelation between visual analyzer and level of development of physical qualities. 3. Application of specially selected exercises positively influenced functioning of visual analyzer and indirectly on motive preparedness of examinees.

Key words: physical education, children of school age, visual sensory system, motor abilities.

Introduction.

The existence of tendencies of aggravation of symptoms of health of younger generation, and also the decrease in level of their physical fitness demands the search of new evidence-based ways of improvement of the organization of physical education in comprehensive educational institutions (Kryvoruchko, Masliak, Zhuravlyova, 2013; Maslyak, Mameshina, Zhuk, 2014; Bala, 2015; Aghyppo, Tkachov, Orlenko, 2016).

One of the perspective directions, according to number of authors, is the search of effective innovative teaching of movements and education of physical qualities (Filenko, Martirosyan, 2013; Bala, 2015; Maslyak, Kryvoruchko, 2015, 2016).

Experts in the field of physiology, physical culture and sport note the important role of sensory systems (visual, acoustical, vestibular, tactile) in formation of motive skills, development of physical qualities (Andreassi, 2000; Riemann, Lephart, 2002; Heekeren, Marrett, Bandettini, Ungerleider, 2004; Gold, Shadlen, 2007; Aghyppo, Kuzmenko, 2015). The special place in the course of formation of the motive sphere is allocated to the visual analyzer (Bundy, Lane, Murray, 2002; Geppert, Mailloux, Smith-Roley, 2004; Bear, Connors, Paradiso, 2007; Uchiyama, Demura, 2009; Zimmerman, Kimberly, Bullimore, 2011). It is caused by the fact that the most part of the whole information on the world around (about 90%) comes to brain via visual channels. Control and self-regulation of movements is exercised by means of sight. Sight registers any changes when performing physical exercises, provides the conditions, allowing expecting further actions, and considerably promotes the increase in accuracy of muscular feelings (Downar, Crawley, Mikulis, Davis, 2001; Lavie, Hirst, Viding, 2004; Berencsi, Ishihara, Imanaka, 2005; Noordzij, Zuldhoek, Postma, 2008; Mulder, Hochstenbach, Van Heuvelen, Den otter, 2008; Gaerlan, 2010).

Many authors dealt with issues of interrelation of physical fitness with functional condition of analyzers (Katukov, 2000; Rovnii, 2001; Smirnov, 2002; Maslyak, Shesterova, Terenteva, 2004; Kuzmenko, 2014)

Number of works is devoted to studying of influence of special physical exercises on separate functions of sensory systems and indirectly on the level of development of motive qualities at various contingent: Moiseenko, 2013 – at children of preschool age, Maslyak, 2015 - at children of younger school age; Shesterova, 1998; Ivanova, 2001; Kuzmenko, 2014 – at children of middle school age; Pomeschikova, 2010 – at children with violations of musculoskeletal apparatus; Magomedova, Shesterova, 2013 – at visually impaired children. At

the same time the question of influence of activity of the visual analyzer on the level of motive preparedness of children of school age remains insufficiently studied.

Purpose, work tasks, material and methods of the research.

The work purpose – to define the extent of influence of specially oriented exercises on functional condition of visual analyzer and, as a result, on the level of physical fitness of pupils of 7-15 years old.

Research methods: analysis of scientific-methodical literature, pedagogical testing, methods of definition of indicators of separate functions of visual sensory system, stating and forming pedagogical experiment, methods of the statistical analysis.

The pedagogical testing assumed use of motive tests for determination of the level of development of the main physical qualities. So, the level of development of speed was determined by results of run on 30 m for pupils of 7-9 years old, 60 m – for pupils of 10-15 years old (s); co-ordination of the movement (dexterity) - by results of shuttle run 4×9 m (s); flexibility – by results of trunk bending forward from sitting position (sm); force – by results of bending of extension of hands in lying support (number of times), lifting of trunk in sitting position from back-lying position (number of times); endurance – by results of run on 500 m for pupils of 7-9 years old and 1000 m for pupils of 10-15 years old (min, s).

The method of perimetry with use of perimeter of Forster was applied to the research of functions of visual sensory system (degree). Borders of achromatic (colorless) field of vision of two main meridian – horizontal (dermad, inside) and vertical were defined (up, downwards).

The researches were conducted on the basis of comprehensive educational institutions of Kharkov. More than 800 pupils, of whom experimental and control groups were made, took part in them: the I age group – pupils of 7 years old, the II age group – 8 years; III – 9 years (pupils of elementary grades); IV – 10-11 years; V – 12-13 years old; VI – 14-15 years old (pupils of middle classes).

All children, who participated in the research, treated the main and preparatory medical groups and were under observation of the school doctor.

Pupils of control groups were engaged according to the standard state program for comprehensive educational institutions during the academic year, and specially selected physical exercises and outdoor games, which are oriented to activation of the visual analyzer, in addition joined in the maintenance of physical education classes of pupils of experimental groups: exercises with determination of distance between various objects, definition and comparison of form, sizes, colors of the objects, which are located at different distances (from minimum to maximum possible in relation to the pupil); exercises from the improving system of Huashan school of Dao and Hatha-yoga; exercises, at performance of which by movements of arms, legs or trunk, it is necessary to accompany with eyes, and also exercises with objects with fixing by eyes of the direction of movement of objects. Special exercises joined in preparatory, main and final parts of lesson; sports minutes at lessons of general education objects; in system of organized changes and were offered pupils in the form of home works. Besides, the main and final parts of lesson were supplemented with the modified outdoor games which content joined the above listed exercises.

Results of the research.

Data of initial researches of separate parameters of functional condition of the visual analyzer allowed to establish the lack of reliable distinctions in indicators of pupils of experimental and control groups ($p>0,05$).

Considering the indicators of volume of peripheral sight, reflecting functional condition of visual sensory system in age aspect, it is established that borders of field of vision extend with age in all age groups, both at boys, and at girls. Comparing indicators of peripheral sight in sexual aspect, absence at the studied statistically reliable distinctions with the general tendency to the prevalence of results of boys is revealed ($p>0,05$). As a result of the analysis of data, the insignificant distinctions in indicators of volume of peripheral sight by right and left eyes are revealed. As a rule, the borders of field of vision by the right eye are wider, than the left eye. Comparing the received indicators to standard, it is revealed that the volume of peripheral field of vision is lower than norm in all studied groups. Analyzing the results, which were received after the experiment, are presented in fig. 1, it is revealed that the volume of peripheral sight authentically improved at pupils of experimental groups ($p<0,05-0,001$). So, the gain of results of boys of the I group makes – 20,9%; II – 12,6%; III – 16,4%, IV – 10,5%, V – 12,1%, VI – 10,8%; girls – 15,7%, 11,7%, 14,2%, 10,7%, 11,5%, 9% respectively. The most substantial increase of results in the group of younger pupils is noted at children of 7 years old, in the group of the pupils of middle classes – at children of 12-13 years old.

Indicators of pupils of control groups also improved a little during the experiment, however, these changes are not essential and are not reliable ($p>0,05$).

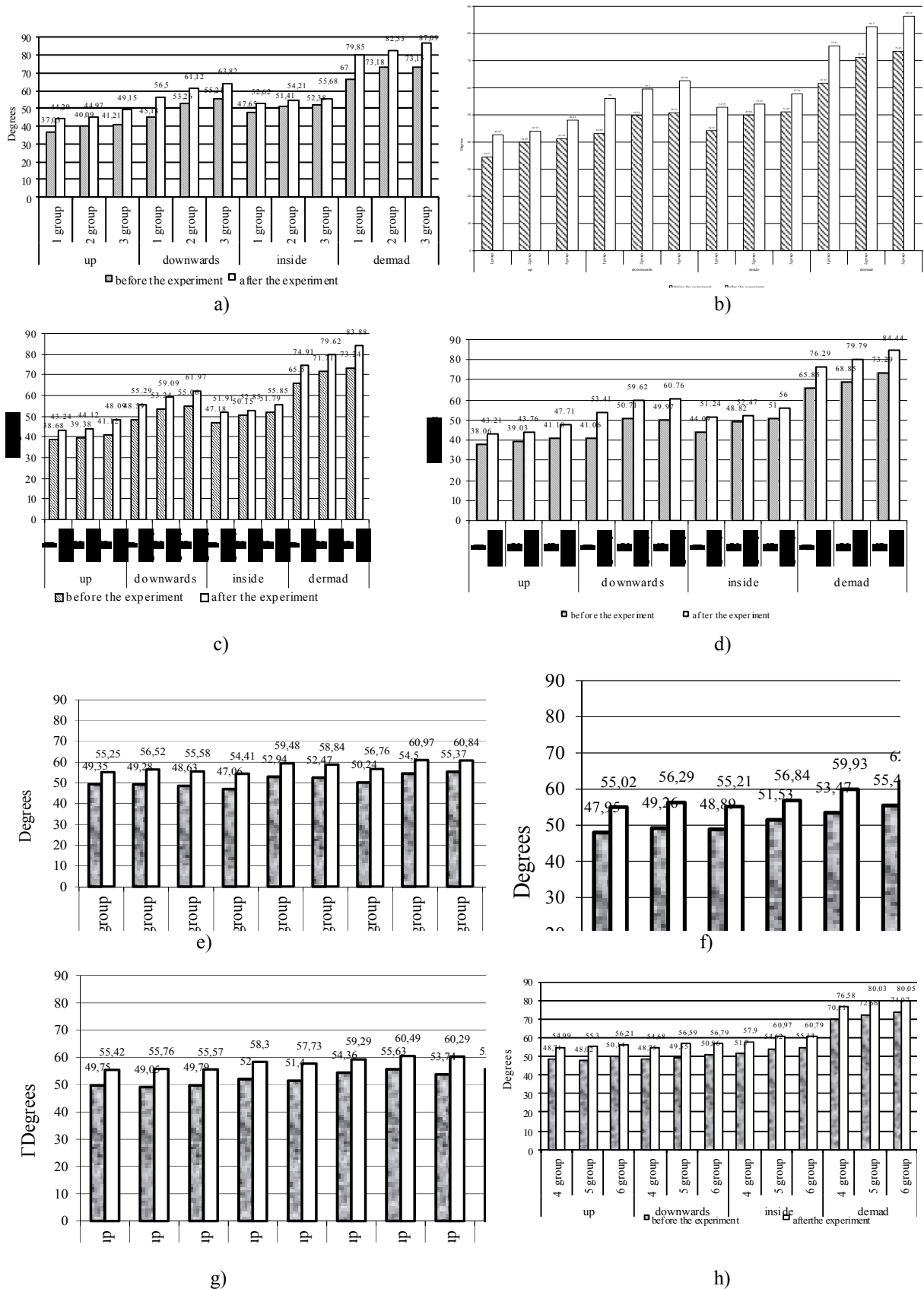


Fig. 1. Indicators of volume of peripheral field of vision of pupils of I - VI experimental groups before and after the experiment: a) by the right eye of boys of I - III groups; b) by the left eye of boys of I - III groups; c) by the right eye of girls of I - III groups; d) by the left eye of girls of I - III groups; e) by the right eye of boys of IV-VI groups; e) by the left eye of boys of IV-VI groups; g) by the right eye of girls of IV-VI groups; h) by the left eye of girls of IV-VI groups

The analysis of distinctions in age and sexual aspects didn't reveal the essential differences when comparing with the basic data. Thus, application of specially oriented exercises positively influenced expansion of borders of field of vision of pupils of all age groups. It was shown especially brightly at boys and girls of 7 and 12-13 years old. Use of the exercises, which were offered by us, positively affected not only functional condition of visual sensory system, but also motive preparedness of examinees. So, indicators of manifestation of speed and high-speed and power qualities improved at the pupils, who participated in the experiment in 97% of cases, in 93% of cases – in dexterity manifestation, in 95% of cases – in flexibility manifestation. The smallest gain was observed in the results, which reflect the level of development of muscular strength of hands and prelum abdominale – 79% and 87% respectively. It is necessary to focus attention to various changes of indicators of the level of development of endurance at pupils of elementary and middle classes. So, indicators improved in 95% of cases at examinees of middle school age, and results of manifestation of endurance didn't practically change at younger pupils.

Changes of indicators of the level of motive preparedness were observed in 45-50% of cases at the pupils, who were engaged according to the standard program that is connected, in our opinion, with age features of their development.

Analyzing the improvement of indicators concerning age, it is established that the most essential changes are recorded in speed indicators at boys of 7 years old, at girls of similar age – in prelum abdominale muscular strength indicators. The most significant changes happened in indicators of flexibility at boys of 8 years old, at girls – in indicators of speed and muscular strength of prelum abdominale. The most essential changes are recorded in indicators of speed, dexterity, muscular strength of hands and prelum abdominale at boys at the age of 9 years and in flexibility indicators at girls. The most significant changes were observed in indicators of high-speed abilities, endurance, dexterity and muscular strength of hands at boys of 11 years old. Indicators of endurance, dexterity, flexibility, muscular strength of hands and prelum abdominale most significantly improved at girls of this age. The substantial increase of indicators of muscular strength of prelum abdominale and flexibility at boys at the age of 12-13 years, high-speed abilities - was observed at girls. Less significant rates of gain of indicators of motive preparedness were noted at the age of 14-15 years old, both at boys, and at girls. Comparison of results of boys and girls allows saying that girls in all age groups are more susceptible to impact of specially oriented exercises, at higher absolute measures of development of motor abilities in boys. The correlation analysis was carried out for the purpose of definition of the extent of influence of separate parameters of the visual analyzer on the level of motive preparedness of pupils of 7-15 years old.

Data of the correlation analysis confirm the existence of interrelation degree, "average" in size, between the above specified indicators (the coefficient of correlation varied ranging from 0,21 to 0,74 at $p < 0,05-0,01$). So, the coefficient of correlation varied ranging from 0,33 to 0,74 at $p < 0,05-0,01$ between indicators of the visual analyzer and the level of development of speed; dexterity – from 0,33 to 0,43 at $p < 0,01$; endurance – from 0,21 to 0,62 at $p < 0,05-0,01$; power – from 0,20-0,34 at $p < 0,05$; flexibility from 0,20 to 0,60 at $p < 0,05-0,01$.

The tendency of interrelation remained when processing the repeated results. It is necessary to point to the increase in degree of dependence to "strong" in size between parameters of visual sensory system and the level of development of speed and dexterity. It is revealed that interference of the studied parameters depends on age and in some cases on sex. Thus, the correlation analysis of the data, which are obtained as a result of the experiment, demonstrates that the extent of interference of indicators of condition of the visual analyzer and the level of development of separate physical qualities considerably improves after application of specially oriented exercises. It should be noted that the extent of interference of the studied parameter increases with age.

Discussion.

The visual analyzer is one of the most important sense organs of the person. The visual system gives brain more than 90% of sensory information. One of the most important characteristic of functioning of visual system is the volume of field of vision on which, according to number of authors (Ivanova, 2001; Shesterova, 2003; Prolomova, Aleshin, Glibko, 2008; Kuzmenko, 2014; Maslyak, 2015) it is possible to influence special exercises.

The conducted by us researches as a result of which the reliable improvement of indicators of functioning of visual sensory system (peripheral field of vision) under the influence of specially oriented physical exercises is established ($p < 0,05-0,001$), confirm and supplement opinions of number of authors, who were engaged in training of the visual analyzer by means of special exercises and established, that various outdoor games and relays, and also sports with ball, increase excitability of peripheral elements of retina, improve the oculomotor system that promotes the increase in volume of peripheral field of vision (Prolomova, Aleshin, Glibko, 2008).

The most essential changes of indicators of field of vision were noted at pupils of 7 years old that confirms the opinion of Obreimova, Petruhin, 2000, who note the significant increase in borders of field of vision in the age period from 6 to 8 years. It is established during the research that borders of volume of peripheral sight extend with age both at boys and at girls. It will be coordinated with data of Solodkov, Sologub, 2001; Smirnov, Dubrovskii, 2002, according to which the field of vision at children is considerable worse, than at adults, but with age it quickly increases and continues to extend up to 20-25 years old.

Thus, the conducted by us researches confirm and supplement results of the researches of Katukov, Proloмова, 2000; Shesteroва, 2003; Kuzmenko, 2014; Maslyak, 2015 about efficiency of application in educational process of the exercises, which are oriented to the increase in functional condition of the visual analyzer. The analysis of results of the repeated researches, which are received after application of the special exercises, which have positively affected functional condition of visual sensory system, allowed revealing that some changes also occurred in indicators of the level of development of motive qualities.

So, the level of development of speed authentically improved at pupils of experimental groups on all indicators in all age groups ($p < 0,001$). The most significant improvement of results was noted at pupils of 9 years old. It confirms the opinion of Volkov, 2002, who observed the active gain of high-speed abilities, right from the age of 9 years. Only the tendency to the improvement of the level of development of speed is noted, considering data of the pupils of control groups ($p > 0,05$). In our opinion, the gain of indicators of the level of development of speed is explained by the existence of rather close interrelation between its manifestation and functional condition of the visual analyzer (Ermolaev, 2001; Rovnii, 2001). Analyzing the indicators of the level of development of coordination abilities, which were received after the experiment, it is revealed that they have considerably and authentically improved at pupils of experimental groups, both at boys, and at girls of all age ($p < 0,05 - 0,001$). Indicators of pupils of control groups, also underwent changes, however these changes are less essential and are not reliable ($p > 0,05$). In our opinion, the gain in indicators of the level of development of coordination abilities is explained by the intensive development of the visual analyzer in this age period (Nazarenko, 2003), and also rather high degree of dependence of their manifestation on functionality of the studied sensory system (Krucevich, 2012).

Indicators of flexibility authentically improved at pupils of experimental groups of all age owing to the experiment ($p < 0,05-0,001$). The most essential positive change of results was observed, generally at pupils of 9 years old. Indicators of pupils of control groups also underwent changes, however they are not essential and are not reliable ($p > 0,05$). In our opinion, the gain in indicators of the level of development of flexibility is explained by the existence of certain correlation interrelation between separate parameters of visual sensory system and indicators of flexibility.

Analyzing change of the level of development of force, owing to application of specially oriented exercises which are positively influencing indicators of functional condition of the studied analyzer, it is revealed that indicators of the level of development of force improved at pupils of experimental groups, and these changes have a reliable character ($p < 0,05-0,001$). The exception is made by indicators of pupils of 7 years old, where changes are statistically not reliable ($p > 0,05$). In our opinion, the gain of indicators of the level of development of force is explained by the correlation dependence which was revealed by us between separate parameters of visual sensory system and indicators of force, and also existence of rather close interrelation between manifestation of power, coordination and high-speed abilities (Volkov, 2002; Nazarenko, 2003; Krucevich, 2012), i.e. the gain of indicators of development of dexterity and speed causes the increase in the level of development of force and vice versa.

Considering the indicators of the level of development of endurance, which were received after applications of the special exercises, which are positively influencing functional condition of the studied sensory system, it is defined that data improved at pupils of experimental groups of all age. However, the recorded changes have a reliable character only in indicators of pupils of IV-VI groups ($p < 0,001$). Changes of volume of peripheral field of vision significantly do not influence the level of development of endurance at pupils of I – III age groups. It is confirmed by the opinion of number of authors (Shiyan, Papusha, 2000; Volkov, 2002) who note that endurance develops poorly at younger school age because of the underdevelopment of cardiovascular and respiratory systems that interferes with the development of this physical quality.

Conclusions.

1. Data of initial researches allowed establishing that borders of achromatic (colorless) field of vision of pupils of 7-15 years old are fewer norms.

2. Application in the course of physical education of the developed by us specially oriented exercises positively influenced functioning of visual sensory system of pupils of experimental groups ($p < 0,05-0,001$). The optimum period for training of visual analyzer is the age of 7 years.

Results of pupils of control groups practically didn't change.

3. Researches of the level of physical fitness after use of the system of specially oriented exercises demonstrate the reliable improvement at pupils of experimental groups of the level of development of the main physical qualities ($p < 0,05-0,01$). The exception is made by indicators of endurance of pupils of 7-9 years old which practically didn't change.

Data of pupils of control groups didn't undergo considerable changes.

4. The correlation analysis of indicators of functional condition of visual analyzer and the level of development of motive qualities confirms the existence of rather close interrelation between them ($r = 0,21-0,74$) that gives the grounds to speak about the considerable extent of interference of these parameters.

Further researches in this direction can be conducted by definition of the extent of influence of the level of activity of other sensory systems on motive preparedness of pupils.

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Conflict of interests. Authors declare that there is no conflict of interests.

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