INFLUENCE OF EXERCISES AND GAMES WITH BALL ON VESTIBULAR STABILITY OF STUDENTS WITH MUSCULAR-SKELETAL APPARATUS DISORDERS

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Abstract

Purpose: to work out approaches to increase of vestibular stability of students with muscular skeletal apparatus disorders by means of outdoor games and exercises with ball.

Material: in the research students with disorders of muscular-skeletal apparatus (n=63, age 16 – 19 years, boys and girls) participated. The research was being fulfilled during 1.5 years (three academic semesters). The students had disablement with mild or average disorders. All students were under medical observation and had no counter indications to physical education. Testing of vestibular stability was conducted by indicators of vegetative, somatic and sensor reactions to standard vestibular analyzer's irritations in Barany's armchair (5 rotations per 10 seconds).

Results: we determined directions of students' vestibular stability improvement and ways to acquiring confidence in own actions and higher adaptation to every day conditions. Characteristic features of cardio-vascular system's reaction to vestibular apparatus irritation have been found. We have registered reduction of systolic blood pressure with multidirectional changes of diastolic B.P. and heart beats rate. When assessing space orientation with closed eyes under vestibular load we registered deviation to the side opposite to affected limb. During rotation in Barany's armchair we registered rather long dizziness; with it girls' indicators were significantly worse.

Conclusions: application of specially oriented exercises and games with ball weakened stress, caused by irritation of vestibular analyzer. We have worked out a system of specially selected exercises and games with ball for improvement of organism's resistance to vestibular load. Such exercises facilitate strengthening of belief in own forces, result in relaxedness in movements, improve adaptation to external conditions.

Keywords: *Students, muscular-skeletal apparatus, vestibular, ball, outdoor games.*

Introduction

Disorders of muscular-skeletal apparatus are rather widespread in society's life. That is why demand in young people's adaptation to future professional functioning requires targeted development of specific motor abilities; perfection of motor actions skills. In this aspect there is an opportunity of formation of motor actions' technique, development of moral-will sphere of disabled people (Phelan & Kinsella, 2014; Baril, 2015). Besides, with such approach favorable pre-conditions for life quality improvement of disabled people are created (Bolach & Prystupa, 2014; Makarova, 2014; Kozina, 2015).

During studying at school and in colleges such contingent of youth undergo changes of motor stereotypes. It results in de-stabilization of their life activity and social orientation (Druz, Klimenko, & Pomeschikova, 2010). That is why creation of proper conditions in educational medium acquires special importance. Such approach brings good opportunities for realization of equal rights and opportunities, formation of personal significance feeling of disabled youth (Makarova, 2012). Problem of physical activity's formation, considering youth's psychic and physical condition is of special importance for future professional functioning (Leyfa, 2013; Podrigalo, Iermakov, Galashko et al., 2015; Podrigalo, Iermakov, Nosko, et al., 2015). That is why adaptation of disabled people to life in society is closely connected with effectiveness of educational process in educational establishments (Eide et al., 2011; Soffer & Chew, 2015; Ilnytska, 2015).

Solution of different problems, connected with adaptation of people with muscular skeletal apparatus disorders is shown in: programs of rehabilitation and recreational trainings (Zhen, 2015), in sportsmen's trainings (Derkach & Yedinak, 2014), physical rehabilitation (Ilmatov, 2015; Lobko, 2015). The authors showed potentials of social rehabilitation and increase of comfort level of people with muscular skeletal apparatus disorders with the help of physical exercises of different orientation. Active participation in sports and health related measures, practicing of different kinds of sports restore psychic balance of disabled people and permit them to participate in active life (Bartík & Bolach, 2015; Sobko, 2015).

One of acute problems of social adaptation to future professional functioning is possibility of receiving of secondary and professional education for children and youth with disablement. It also permits to acquire skills in self-servicing; to prepare for labor activity, for family life. In this context physical exercises'

practicing at special educational establishments shall be oriented on development of important for students with muscular skeletal apparatus disorders physical skills (Pomeshchikova et al., 2016). In the first turn it is development of coordination: space orientation and vestibular stability. In such cases space accuracy of movements is of great importance (Liu, 2014; Singh & Agashe, 2015) as well as motivation for physical exercises' practicing (Kozina, Iermakov et al., 2016).

It is known that functioning of vestibular apparatus plays significant role in space orientation of both: healthy people and those, having health problems (Syshko, 2012; Voropay & Buryanovatiy, 2014). In other work (Strelec, 1996) it is noted that in human natural functioning main role is played by motor activity. Its effectiveness is determined by accuracy of space orientation. Orientation in space depends on effectiveness of vestibular analyzer functioning and complex system of vestibular reflexes. Therefore, development of vestibular somatic reactions is critically important for a person and can serve as specific indicator of differences in dynamic of physical exercises' influence on development of healthy and not healthy people's motor functioning.

Study of connections between vestibular and cardio-vascular systems is one of important methods of assessment of organism's general condition (Syshko, 2009; Savina, 2010). Under influence of vestibular irritations indicators, characterizing organism's vegetative functions change. Types of vestibular-vegetative reactions are determined by morphological-functional characteristics, which formed owing to correlations between vestibular, motor and vegetative systems (Syshko, 2009). For stabilization and strengthening of vestibular stability in children with imbalance of muscular system many authors (Sharov & Andreeva, 1997; Sharov, 2001) offer to use autonomous dynamic stand. However, there is an opinion (Liakh & Sokolkina, 1997) that in inter-individual variable ability to keep vestibular stability important role is played by additive, genetic factors. As per the data of other authors indicators of cardio-vascular, respiratory and nervous systems after vestibular irritations depend on type of responding to such loads (Syshko, 2009). It witnesses about rather high conservatism of this ability, which reflect level of human motor potentials, depending on vestibular analyzer's fitness.

In natural and everyday life one of main roles is played by motor functioning, effectiveness of which is determined by accuracy of space orientation (Ilyin, 2003). Therefore, development and perfection of vestibular-somatic functions is principally significant for provisioning of human motor functioning.

Many works are devoted to study and assessment of vestibular somatic reactions (Syshko, 2009; Moiseenko, 2012). The authors used different means of physical education: exercises on specially worked out simulators (Bruder, Blessing, & Wandke, 2014; Hagberg et al., 2015), health swimming (Lee, Sanders, & Payton, 2014; Rovira-Beleta et al., 2015), massage (Henoch et al., 2010), power-lifting (Zhen, 2015), hippotherapy (Shurtleff, & Engsberg, 2010) and etc. Selection of adequate tests for physical fitness is rather important in such cases Ivashchenko, Yermakova, Cieslicka, & Muszkieta, 2015; Ivashchenko, Yermakova, Cieslicka, & Zukowska, 2015; Khudolii, Iermakov, & Ananchenko, 2015; Khudolii, Iermakov, & Prusik, 2015). Usage of individual approach to students' training to different motor actions can be considered correct (Zhanneta et al., 2015; Kozina, Repko, Ionova et al., 2016). However, exercises and games with ball have not been widely spread yet in trainings of students with muscular skeletal apparatus problems.

In our researches it was found that students' variable motor activity in game with ball is accompanied by positive emotions (Pomeschikova, 2010; Pomeschikova, Yevtushenko, & Yevtushenko, 2012). Besides, we determined dependence between indicators of different space orientation manifestations (Pomeschikova et al., 2012). Application of different exercises with ball permits to develop all motor qualities. In such trainings consideration of kind of disease is compulsory as well as degree of muscular skeletal apparatus disorder and individual ability to endure physical load (Druz et al., 2010). We found that application of system of exercises and games with ball increased indicators of movements' frequency in tapping test. We determined indicators of time of simple reaction to sound, to visual signal; complex reaction of choice. It is noted that changes of vestibular-sensor reactions' indicators, considering the character of disorders, have positive tendency with all kinds of disorders. We found that application of specially selected exercises reduced period of dizziness of boys and girls (Pomeschikova & Lozuchenko, 2011; Pomeshchikova et al., 2016). In the course of our research we determined that outdoor games are a key element for students' motivation for regular physical functioning (Adamčá, Bartík, & Nemec, 2014). In other our researches we found that control of physical load is very important in structure of physical exercises' practicing (Ivashchenko, Khudolii et al., 2015; Zaporozhanov, Borachinski, & Nosko, 2015) as well as recreational measures (Pupiš, Sližik, & Bartík, 2013; Iermakov, Arziutov, & Jagiełło, 2016).

Vestibular apparatus is an important sensor system, which permits for a person to keep balance. It points at position in space, realizes body coordination in motor functioning. Stability of vestibular apparatus is important in everyday life, even in fulfillment of the simplest forms of behavior. For students with muscular-skeletal apparatus disorders development of its sensor tools is an important function of their social adaptation. Training of sensor-motor functioning of students with muscular skeletal apparatus disorders is reflects most effectively in indicators of vestibular stability. It points at demand in assessment of vestibular stability level under influence of the worked out system of special exercises and games with ball.

As a hypothesis we can assume that application of specially selected exercises and games with ball at trainings can increase vestibular stability of students with muscular skeletal apparatus disorders. The purpose of the research is to work out approaches to increase vestibular stability of students with muscular-skeletal apparatus disorders under influence of outdoor games and exercises with ball.

Methods

Sample

In the research students with disorders of muscular-skeletal apparatus (n=63, age 16 – 19 years, boys and girls) participated, who studied in Account and economic residential college (Kharkov, Ukraine). Main group consisted of 40 students (19 boys and 21 girls); control group – 23 students (10 boys and 13 girls) with the same disorders of muscular skeletal apparatus. The research was being fulfilled during 1.5 years (three academic semesters). In the college, boys and girls with disablement of 1st and 2nd group and disabled children skilled in self-servicing study.

The research was fulfilled in compliance with WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects. 2013.

Procedure

Analysis of medical records showed that students had disablement with mild or average degree of disease. All students were under medical observation and had no counter indications for physical education.

Functional state of vestibular apparatus was assessed by value and duration of vegetative, somatic and sensor reactions, appearing in response to vestibular irritation – rotational test by Voyachek V.I. (Gandelsman, 1973). The test was fulfilled in Barany's armchair with open eyes and forward head bent by 90°. In such position of the tested armchair rotated 5 times per 10 seconds. After 5 rotations armchair was stopped and pause of 5 seconds was kept. Then the tested took vertical position of head.

By results before and after rotational test we registered:

1. Vestibular-vegetative stability by methodic of Lozanov-Baychenko (Gandelsman, 1973), in which vegetative reflexes (heart beats rate and blood pressure) to rotational test were registered in points. By combinations of heart beats rate and B.P. changes by special table of Lozanov-Baychenko (Gandelsman, 1973) vestibular stability was assessed;

2. Vestibular-somatic stability was determined at 5 meters' segment by deviation from straight line (walking with closed eyes) before and after standard irritation (5 rotations per 10 sec.). Deviation was registered in centimeters;

3. Vestibular-sensor stability was assessed in seconds of dizziness period after standard vestibular irritation. Students registered duration of dizziness by pressing stopwatch button.

The trainings of main groups included the offered by us special exercises and outdoor games with ball, oriented on strengthening of vestibular stability (Pomeschikova, 2010, 2011; Pomeshchikova et al., 2016).

Statistical analysis

Generalization of the studied characteristics was assessed by mean arithmetic value, standard deviation and error of mean arithmetic. Confidence of differences between mean values was stated by Student's t-criterion. Assessment of statistical hypothesizes based on 5% significance level. For statistical processing of data we used licensed program Microsoft Excel (2010). Statistical analysis of the received results was conducted, considering recommendations on Microsoft Excel tables' usage for computer data analysis. For determination of correlations between indicators we calculated correlation coefficient by Pearson.

Results

Analysis of vestibular-vegetative stability indicators showed that vestibular irritation in Barany's armchair caused insignificant changes of blood pressure. Systolic pressure mainly reduced. Change of boys' systolic pressure after rotation was 4.68 mm merc. col. (3,9%). Girls' indicator was 6.19 mm merc. col. (5.6%). Changes of boys' and girls' systolic pressure after rotation were not confident ($p>0.05$). At the same time, under influence of vestibular irritation we found multidirectional change of diastolic pressure. Variations of boys' diastolic pressure indicators were within from increase by 3.26 mm merc. col. to reduction by 6.3 mm merc. col. Reaction of girls' diastolic pressure to vestibular irritation expressed in insignificant reduction from 0.46 to 2.86 mm merc. col. With it, changes of boys' and girls' diastolic pressure were not confident ($p>0.05$).

Analysis of boys' and girls' vestibular stability indicators before and after vestibular irritation showed that boys had higher indicators of diastolic pressure. After rotation we observed confident differences between girls' and boys' systolic pressure indicators ($t=2.06$; $p<0.05$). Comparison of boys' and girls' diastolic pressure indicators before and after rotation did no show any confident differences ($p>0.05$). Different orientation of systolic and diastolic pressure reactions to vestibular irritation characterizes the type of reaction, which is assessed by orientation of changes in blood pressure indicators. Analysis of reaction type permitted to find the following: boys have prevalence of pulse hypotension; girls have prevalence of pulse and general hypotension (see fig. 1).

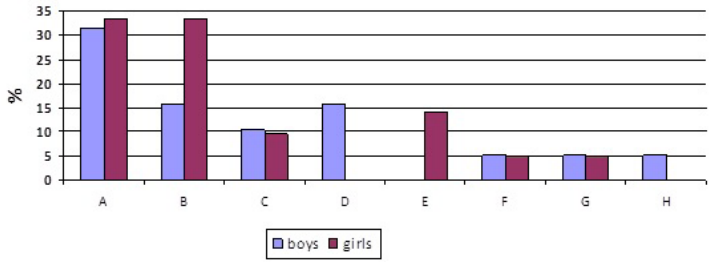

Figure 1. Distribution of students by orientation of blood pressure under influence of vestibular irritation: A – by type of pulse hypertension; B – by type of general hypotension; C – by type of systolic hypotension; D – by type of pulse hypertension; E – by type of general hypertension; G – by type of systolic hypertension; H – without changes.

Heart beats rate before and after rotations was determined in 10 seconds' segment of time. After rotation boys' and girls' heart beats rate changed insignificantly (p>0.05). These changes were multidirectional. For example, boys' heart beats rate changed from increase by 0.68 bpm per 10 sec. to slowing by 0.7 bpm per 10 sec. Girls' heart beats rate insignificantly increased in response to vestibular irritation, in average by 0.05–0.7 bpm per 10 sec.

Changes of boys' and girls' heart beats rate before and after vestibular irritation were not confident (p>0.05). By shifts of blood pressure and heart beats rate under influence of vestibular irritation (table of Lozanov-Boychenko was used) (Gandelsman, 1973) we made conclusion about level of vestibular stability of students. With primary study vestibular stability indicator of students was at level of 2.40–3.47 points (from 5 possible). It says about deficit of vestibular analyzer's stability (see table 1).

Table 1. Indicators of vestibular-vegetative stability of students before and after experiment (in points)) (±m)

Contingent	Before experiment	After experiment	t	p
Boys (n=19)	*3.22±0.24*	*3.99±0.16*	*2.64*	*<0.05*
Girls (n=21)	*3.17±0.17*	*4.00±0.15*	*3.67*	*<0.001*
t	*0.19*	*0.06*		
p	*>0.05*	*>0.05*		

It was found that in indicators of boys' and girls' vestibular stability there were no confident differences (p>0.05). Vestibular-motor reactions of students with muscular-skeletal apparatus disorders were studied by indicators of deviation, when walking with closed eyes before and after vestibular irritation. Analysis of deviation values after irritation of vestibular apparatus (see table 2) permitted to determine confident worsening of boys' and girls' results (p<0.05). Comparison of boys' and girls' indicators before and after vestibular irritation showed no confidence differences (p>0.05).

Table 2. Indicators of vestibular-somatic and vestibular-sensor stability of students before and after experiment (±m)

Contingent	Conditions	Before experiment	After experiment	t	p
		Walking along straight line with closed eyes (cm)			
Boys (n=19)	*Before rotation*	*59.21±8.00*	*49.84±7.57*	*0.85*	*>0.05*
	After rotation	*152.95±17.24*	*100.11±13.68*	*2.40*	*<0.05*
	t	*4.93*	*3.21*		
	p	*<0.001*	*<0.01*		
Girls (n=21)	*Before rotation*	*61.05±8.10*	*43.86±7.52*	*1.55*	*>0.05*
	After rotation	*140.14±14.97*	*82.05±10.51*	*3.18*	*<0.01*
	t	*4.65*	*2.95*		
	p	*<0.001*	*<0.01*		
		Period of dizziness (sec.)			
Boys (n=19)	*17.00±2.24*	*12.32±1.90*	*1.59*	*>0.05*	
Girls (n=21)	*23.95±2.01*	*18.86±1.52*	*2.02*	*<0.05*	
t		*2.31*	*2.68*		
p		*<0.05*	*<0.05*		

In primary studies of vestibular-sensor reactions to rotation in Barany's armchair we registered noticeable time of students' dizziness (see table 2). It should be noted that girls' indicators were worse than boys' (p<0.05). Correlation analysis of vestibular stability indicators of main group students showed that between girls' vestibular-vegetative, vestibular-somatic and vestibular-sensor stability there was no correlation (see table 3). In boys we found weak correlation between vestibular-vegetative and vestibular-somatic stability (r=-0,483).

Table 3. Indicators of correlation analysis of students' vestibular stability

Stability	***Vestibular –vegetative***	***Vestibular-somatic***	***Vestibular-sensor***
Boys (n=19)			
Vestibular –vegetative	*1*		
Vestibular-somatic	*-0.483*	*1*	
Vestibular-sensor	*-0.076*	*0.124*	*1*
Girls (n=21)			
Vestibular –vegetative	*1*		
Vestibular-somatic	*0.307*	*1*	
Vestibular-sensor	*-0.117*	*-0.118*	*1*

After application of specially selected exercises and games with ball, in main groups systolic blood pressure indicators in rest reduced insignificantly (p>0.05) (fig.2). Irritation of vestibular apparatus after experiment resulted in insignificant change of systolic pressure (p>0.05).

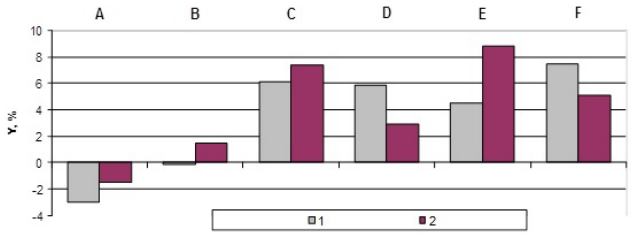

Figure 2. Change of blood pressure and heart beats rate indicators of main groups' students after experiment (%): Y - change of blood pressure and heart beats rate indicators (%); 1 – before rotation; 2 – after rotation A – boys' systolic pressure; B – girls' systolic pressure; C – boys' diastolic pressure; D – girls' diastolic pressure; E – boys heart beats rate; F – girls' heart beats rate.

After experiment, diastolic pressure in rest indicators of main groups' students reduced. With it, these changes were not confident (p>0.05) Irritation of vestibular apparatus resulted in insignificant change of diastolic pressure, which was not confident (p>0.05). Change of diastolic pressure after experiment was, practically, always less than in primary testing. Variations of girls' diastolic pressure after experiment were less than boys'. Thus, change of boys' diastolic pressure after experiment before and after rotation was a little higher than girls' (see fig.2). After experiment, heart beats rate in rest (in main groups) reduced. However, confident changes of heart beats rate in rest took place only in girls (p<0.001).

Irritation of vestibular apparatus before and after experiment resulted in insignificant variations of heart beats rate and were not confident (p>0.05). Heart beats rate indicators after vestibular irritation (after experiment) reduced in all groups, but these changes were not confident (p>0.05). It should be noted that after experiment heart beats rate under influence of rotation reduced practically in all cases, comparing with primary testing results (see fig.2).

Both: boys' and girls' heart beats rate indicators after experiment, before and after rotation, hand no confident differences (p>0.05). Thus, insignificant increasing was found in girls before rotation and in boys after rotation. Boys' resistance of heart beats rate to vestibular irritation increased, in average, by 80.7%. Analysis of girls' resistance of heart beats rate to vestibular irritation did not show any improvement.

Study of blood pressure and heart beats rate indicators' change under influence of vestibular irritation in main groups after experiment showed confident improvement of vestibular stability in points (boys, p<0.05; girls, p<0.001). So, boys' vestibular-vegetative stability increased by 23.9%, girls' – by 26.2% (see fig. 3.).

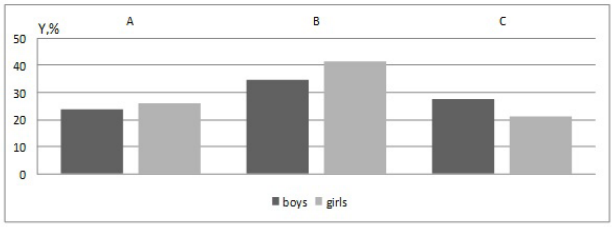

Figure 3. Changes of vestibular stability indicators of main groups' students after experiment (%): Y – changes of vestibular stability indicators (%); A – vestibular vegetative stability; B – vestibular-somatic stability; C – vestibular-sensor stability.

Analysis of main group students' straight-line walking results before and after vestibular load showed confident increment of somatic indicators after rotation: in boys - (p<0.05); in girls - (p<0.001) (see table 3). Analysis of these data showed that increment of indicators of deviation from straight line (walking with closed eyes) in main groups was: boys' (before rotation) – 15.8%; girls' (before rotation) – 28.1%; after vestibular load – 34.6% and 41.4%, accordingly (see fig. 3).

Analysis of vestibular-sensor indicators of main groups' students before and after experiment (see table 3) showed that confident increment was observed only in girls (p<0.05). By results of feeling dizziness period after rotation, increment of results in main groups was: boys' – 27.5%, girls' – 21.3% (see fig.3). Analysis of vestibular stability indicators by vegetative, somatic and sensor reactions in control groups after experiment showed that there were also some changes, though they were not significant (p>0.05).

Discussion

Our work has been fulfilled in direction of already existing researches of specialists, who study problems of physical fitness support and increase in youth with muscular skeletal apparatus disorders, for socialization of these people. In physical rehabilitation of this contingent, for improvement space orientation and vestibular stability authors offer to use autonomous dynamic stands (Sharov & Andreeva, 1997), suspended swing (Mittal & Narkeesh, 2012).

Results of our research continue a number of works devoted to perfection of disabled people's vestibular stability (Sharov & Andreeva, 1997; Mittal & Narkeesh, 2012). The tests for vestibular stability of different age physically healthy people are presented in a number of works (Voropay & Buryanovatiy, 2014; Syshko, 2009; Moiseenko, 2012). Analysis of motor fitness initial data of students with muscular skeletal apparatus disorders and their comparison with healthy youth's indicators permitted to conclude that they are rather lower. All authors note that vestibular irritation significantly worsened motor potentials of the tested. Reduction of results after rotation was confident. It complied with results, received in contingent of students with

muscular skeletal apparatus disorders. Application of special exercises for vestibular apparatus irritation by the authors rendered training influence on it. It facilitated improvement of vestibular stability.

Solution of most of motor tasks to large extent is influenced by vestibular analyzer. In our research initial data of vestibular stability study by change of blood pressure and heart beats rate were: boys' 3.22±0.24; girls' – 3.17±0.17 points.

In other researches it was determined that vestibular irritators increase systolic pressure (Gruzhevskaia, 1978; Liashchuk, 1979). The data of our observations point at reduction of systolic pressure under influence of rotation loads and completely coincide with results of other research, received on healthy schoolchildren of 10–15 years' age (Malka, 1979).

Our results coincide with opinion that vestibular irritations cause significant worsening of space orientation. Results of vestibular-somatic reactions showed that standard vestibular irritation confidently worsens indicators of straight-line walking (before rotation boys' indicators was 59.21±8.00 cm and after rotation – 152.95±17.24 cm; girls'– 61.05±8.10 cm and 140.14±14.97 cm, accordingly) It was found that the least deviations from straight line before and after rotation were observed in students, who had disorders of shoulder girdle (paresis hands, amputation, abnormality of development). The highest deviations were observed in cases of lower limbs diseases (hemi paresis, lower paraparesis, dislocation of hip joint). In other cases and muscular skeletal apparatus disorders (chondro-dystrophy, muscular dystrophy, rheumatoid arthritis, arthrogryposis) we observed indicators, bordering with minimal and maximal deviations from straight line. In separate cases students with disorders of lower limbs demonstrated rather high results. In straight-line walking with closed eyes students with muscular skeletal apparatus disorders (connected with lower limbs) deviated to the side opposite to affected limb. For example disabled with right side paraparesis deviated to the left. In cases of other disorders we found no dependences.

In studies of vestibular-sensor reactions of different age children (Syshko, 2009) significant variability in feeling of dizziness is noted. The same we also observed in students with muscular skeletal apparatus disorders. Under influence of special training the author registered shortening of dizziness period. The data of dizziness feeling in our research were: boys' – 17.00±2.24 and girls' – 23.95±2.01 sec.

Vestibular stability indicators in gender aspect differed confidently only in results of vestibular sensor reactions ($p<0.05$). Our results comply with opinion that training of vestibular analyzer influences on reduction of vestibular-sensor reaction time.

Our research showed that exercises and games with ball substantially influence on development of vestibular stability. Application of such exercises resulted in significant perfection of general space orientation and correction of movements, according to situations' changes and different conditions of game. Regular exercises with ball and outdoor games (with turns, rotations, and head bents to different sides) facilitate training of vestibular analyzer.

After application of system of specially oriented exercises and games with ball we observed weakening of vestibular irritator influence on organism. After experiment we registered confidently improved indicators of vestibular-vegetative and vestibular-somatic reactions of boys and girls ($p<0.05–0.001$). Results of vestibular-sensor reactions showed shortening of dizziness period feeling. However, confident improvement of this indicator was registered only in girls ($p<0.05$). Results of control groups' students remained approximately at the level of primary measurements. Improvement of vestibular stability facilitates increase of students' motor experience and mastering of required life skills.

Conclusions

1. The worked out system of special exercises and games with ball improved vestibular stability of students with muscular skeletal apparatus disorders. It expressed in weakened influence of vestibular loads on vegetative indicators of cardio-vascular system, straight-line walking indicators and dizziness feeling time in this contingent of students.

2. The fulfilled research witnesses about positive influence of exercises and games with ball on vestibular stability of students with muscular skeletal apparatus disorders. We worked out system of specially selected exercises and games with ball for improvement of organism's resistance to vestibular load. As a result such system of exercises increase level of confidence in actions, causes relaxedness of movements, improves adaptation to external conditions.

Conflict of interests

The authors declare that there is no conflict of interests.

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UTJECAJ VJEŽBI I IGARA SA LOPTOM NA VESTIBULARNU STABILNOSTI UČENIKA S POREMEĆAJEM MIŠIĆNO-SKELETNOG SUSTAVA

Sažetak

Svrha rada: vježbati pristupe povećanju vestibularne stabilnosti učenika s poremećajima mišićno-skeletnog aparata pomoću igara na otvorenom i vježbi s loptom.

Metode: u istraživanju su učestvovali učenici s poremećajima mišićne-skeletnog aparata (n = 63, dob 16-19 godina, dječaci i djevojčice).

Istraživanje je realizirano tijekom 1,5 godine (tri akademska semestra). Učenici su imali nesposobnosti od blagih do prosječnih poremećaja. Svi studenti su imali liječnički nadzor i nisu imali kontraindikacije za bavljenje tjelesnim odgojem. Ispitivanje vestibularne stabilnosti sprovedeno je pomoću pokazatelja vegetativnih, somatskih i senzora reakcije na standardne analizatore vestibularnih iritacija u Bárány-jevoj fotelji (5 okretaja u 10 sekundi).

Rezultati: utvrdili smo pravce vestibularnog poboljšanja stabilnosti studenata i načine za stjecanje povjerenja u vlastite postupke i veću prilagodbu na svakodnevne uvjete. Pronađene su karakteristične reakcije kardio-vaskularnog sustava ka iritaciji vestibularnog aparata.

Zabilježili smo smanjenje sistoličkog krvnog tlaka s višesmjernim promjenama dijastoličkog krvnog tlaka i srčanog ritma. Pri ocjeni orijentacije u prostoru zatvorenih očiju pod vestibularnim opterećenjem, registrirali smo odstupanje na suprotnoj strani od zahvaćenog ekstremiteta. Tijekom rotacije u Bárány-jevoj fotelji zabilježili smo dugotrajnu vrtoglavicu, s pokazateljima koji su kod djevojčica bili su znatno slabiji.

Zaključak: primjena posebno orijentiranih vježbi i igara s loptom slabi stres uzrokovan iritacijom vestibularnog analizatora. Razradili smo sustav posebno odabranih vježbi i igara s loptom za poboljšanje otpornosti organizma na vestibularna opterećenja. Takve vježbe jačaju samopouzdanje u vlastite snage, dovode do opuštenosti u pokretima, poboljšavaju adaptaciju na vanjske uvjete.

Ključne riječi: *Učenici, mišićno-skeletni sustav, vestibularni, lopta, igre na otvorenom.*

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