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Original Article

Characteristics of biogeometric profile of posture and quality of life of students during the process of physical education

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Abstract
The purpose of this study was to determine the biogeometric profile of posture, quality of life and mental fitness of students during the process of physical education on the basis of extracts from medical records and somatometric research. Research data: To address the tasks at hand, the following methods were used: theoretical analysis and synthesis of data from special scientific and methodological literature, pedagogical observations, pedagogical testing, anthropometry, video recording and analysis of the biogeometric profile of students' posture using the Torso software, visual screening, and methods of mathematical statistics. The study involved 182 first-year students from the Yuriy Fedkovych Chernivtsi National University. Findings: The following types of postural disorders were observed in students: scoliotic posture was identified in 47.3% of the tested students; round-shouldered back was identified in 19.1% of the tested students; and rounded back was identified in 16.4% of the tested students. Physical fitness in students was identified according to their posture type. Quality of life of the students was determined based on the physical fitness and posture type. The study demonstrated that physical activity significantly contributes to improving the quality of life of student population.
Keywords: posture, physical fitness, quality of life, students

Introduction

Currently, the educational process at higher education institutions is associated with information flow and significant psychophysical loads. This imposes heavy demands on the medical condition and physical fitness of students. The latter is the major contributor to ensuring the comprehensive and harmonious development of the students (Andrejeva Julija et al., 2015, Andrieieva, O. et al., 2017, Bothmer, M. et al. 2005, Yarmak, O. et al., 2017). Most experts (Andrieieva O. et al., 2018, Cavalheri V. et al., 2010, Kashuba, V.A., et al., 2014, Kozina, Z. et al., 2017, Nosova, N. L. et al. 2015, Sergiy Drachuk et al., 2018, Zukowska H. et al., 2014) associate this with unfavorable social and economic living conditions and poor ecology, significant decrease in students' interest in physical education and sports, as well as degradation of the physical education system at higher educational institutions. Numerous studies (Abou Hassan, J. et al. 2010, Andrews, D.M. et al., 2012, Erdenko, D.V. et al., 2014, Iakovenko, D.V. et al., 2015, Iedynak, G., et al., 2017, Kashuba, V.A. et al., 2013-2015, Litvinenko, Y.V. et al., 2015, Zabalueva, T.V. et al., 2017, Torlakovic, A. et al., 2014) indicate that the massive nature of postural disorders is one of the most pressing problems of the modern society. Functional disorders of posture are some of the most common musculoskeletal abnormalities in modern students (Belikova, Zh.A. et al., 2012, Dudko, M.V., 2014, Gorelov, A.A. et al., 2013, Kolos, M.A. et al., 2010, Mani, R. et al., 2015, Retivykh, Iu.I. et al., 2009). Postural disorders adversely affect the functionality of internal organs, cardiovascular, respiratory and digestive systems. They have a negative impact on the level of physical and mental performance and the quality of human life (Boak, A. et al., 2014). Currently, there are many scientific publications (Hong, Y, et al., 2011, Martyniuk, O. A. et al., 2011, Cavalheri, V. et al., 2010, Kashuba, V.A. et al., 2014, Kozina, Z. et al., 2017, Nosova, N. L. et al., 2015) devoted to postural disorders in students, including methods and approaches for posture correction during physical education. However, some issues remain unresolved. By summarizing the professional perspective, it can be stated that the problem of correcting the impaired biogeometric profile of posture in students is described by multiple publications. However, the issues of prevention of postural disorders in conjunction with the quality of life have not yet been comprehensively studied.

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According to the World Health Organization (WHO), quality of life is a person's perception of themselves and their place in life in the context of the existing culture and value system, their attitude to the contents of their own life, expectations and problems. Therefore, quality of life is a subjective feeling, which is similar to happiness and personal well-being. J. Zivanni et al. distinguish the emotional component (happiness) and the cognitive and perceptive component (satisfaction with life) in the quality of life. To date, most studies describe the problems of determining the quality of life in adults and seniors or in children and young people suffering from acute or chronic diseases. Only some scientific works (Mani R., et al., 2015, Mani, R., 2015, Retivykh, Iu.I. et al., 2009) deal with the quality of life in schoolchildren and students who are apparently healthy and do not have any pathologies. In addition, domestic scientific literature does not provide clear algorithms and research reports. This makes it difficult to objectively evaluate the influence of a particular factor on the students' quality of life. Students are a special social group whose axiological attitudes are associated with studying at a higher educational institution and with the desire to gain knowledge that is necessary for a future profession. Education, success and performance of students is closely connected with health, which, in turn, is based on the lifestyle (Belikova, Zh.A. et al., 2012, Gorelov, A.A. et al., 2013, Mani, R. et al., 2015, Retivykh, Iu.I. et al., 2009). It is known that insufficient physical activity during this period results in detraining of various body systems, which causes a decrease in resistance to diseases and deterioration of physical performance (Andrieieva, O. et al., 2017, Yarmak, O. et al., 2017). It has been repeatedly noted at scientific conferences that physical education, physical activity and sport are vital for improving the quality of life. These factors contribute to improving health, increasing material income, respecting basic human freedoms, as well as increasing the education level. However, the influence of physical activity on the quality of life of the educational process participants was dealt with only by individual studies (Andrejeva Julija et al., 2015, Andrieieva, O. et al., 2017, Iedynak, G. et al., 2017,).

Methods

To address the proposed objectives, the following methods were used: theoretical analysis and synthesis of data from special scientific and methodological literature, pedagogical observations, pedagogical testing, anthropometry, video recording and analysis of biogeometric profiles of student postures using the TORSO software, visual screening and methods of mathematical statistics. The study involved 182 first-year students from the Yuriy Fedkovych Chernivtsi National University. According to students' medical records and methodological documents from the Department of Physical Education, all students represented the physical education class with full load and regular attendance of physical training classes in accordance with the established schedule - 2 classes per week (one class according to the schedule, and another is an optional mental fitness class). The period of observation and application of physical education and mental fitness methods was 9 months, followed by comparative studies. At the beginning and at the end of the study, the students had their biogeometric profile of posture and level of physical fitness determined using three test exercises: sit-ups, times per minute; forward inclination of body in sitting position, cm; raising and holding the shoulder girdle in prone position; s) and quality of life. Quality of life was assessed using the WHOQOL-BREF questionnaire (Fleck et al., 2000). This questionnaire was developed and approved by the World Health Organization group for quality of life assessment (WHOQOL). WHOQOL-BREF comprises 26 questions related to four domains: physical health, psychological health, social relations and environment, which are characterized as a brief extension tool applicable to various populations and have good internal consistency and content richness. To classify the percentage of subjects with average values above the 90th percentile for quality of life, we used standard values for various areas of quality of life tested for this population. The research data analysis was performed using the Shapiro-Wilk normality test and Levene's test for homogeneity of variances.

Results

The extracts from students' medical records were prepared with the direct involvement of the vertebroneurologist. Visual screening and use of the Torso software (Dudko, M.V., 2014) allowed to determine that at the beginning of the study only 16.9% of the students had normal posture. The types of postural disorders were as follows: scoliotic posture, round-shouldered back and rounded back were identified in 47.3%, 19.1%, and 16.4% of the tested students, respectively. Simple informative indicators are required to obtain urgent information on the biogeometric profile of students' posture. These indicators should be accessible to the physical education teacher and require no diagnostic equipment and heavy time expenditures. In this case, an improved control chart for the biogeometric profile of posture was used (Dudko, M.V., 2014,).

The following indicators were used to assess the biogeometric profile of posture:

• For sagittal plane - the position of the head and torso relative to the vertical axis, the condition of the thoracic kyphosis and lumbar lordosis, the shape of the abdomen, the angle between the thigh and shin;

• For frontal plane - the position of the head relative to the horizontal axis, the position of the shoulders, inferior angles of scapulae and pelvic bones, waist triangles, the position of the feet.

A three-point scale was used to assess each indicator. In addition, we used the method of individual comparison of posture on a photogram and on a graphical view of the sample. Score "1" was "poor", "2" -

"satisfactory", and "3" - "good". All 182 students were tested using the visual screening map of the biogeometric profile of posture. This allowed us to classify students by levels for each type of posture (i.e., "low", "medium", and "high") at the beginning and at the end of the study (see Table 1).

Table 1. Classification of students by biogeometric profile of posture (n=182), %

Type of posture	Level of biogeometric profile of posture					
	Low		Medium		High	
	At the beginning of the study	At the end of the study	At the beginning of the study	At the end of the study	At the beginning of the study	At the end of the study
Normal posture	-	4.3	7.6	8.2	9.3	2.6
Scoliotic posture	13.2	9.9	19.8	19.2	14.3	10.4
Rounded back	5.5	1.6	6.0	3.8	4.9	4.4
Round-shouldered back	12.6	10.4	3.8	2.2	2.7	2.7

These indicators have statistically significant differences ($p<0.05$).

Table 1 shows that during our study, students, who followed the training program proposed by us, experienced correction of posture. Thus, it should be noted that the number of students with normal posture increased from 0% to 4.3% for the low level and from 7.6% to 8.2% for the medium level, with a decrease from 9.3% to 2.6 % observed only for the high level of posture.

At the beginning of the study, we identified the features of physical fitness in students with different types of posture (see Table 2). The results of the sit-up exercise test in respondents with scoliotic posture were closest to the results in persons with normal posture.

For the forward inclination of body in sitting position test, the students with scoliotic posture and rounded back demonstrated the results that are closest to the normal posture.

The results of testing with raising and holding the shoulder girdle in prone position were low in people with abnormalities (50.83 – 68.01 seconds compared to 88 seconds). Students with rounded back demonstrated results that are closest to the normal posture.

Table 2. Indicators of physical fitness in students with various postural disorders at the beginning of the study (n=182)

Test physical exercise	Type of posture							
	Normal posture (n=31)		Scoliotic posture (n=86)		Rounded back (n=30)		Round-shouldered back (n=35)	
	$\bar{x}$	S	$\bar{x}$	S	$\bar{x}$	S	$\bar{x}$	S
Sit-ups, times per minute	50.02	5.14	45.31*	6.23	37.97*	3.11	40.34*	6.08
Forward inclination of body in sitting position, cm	3.83	0.56	3.31*	0.51	2.22*	0.33	3.31*	0.46
Raising and holding the shoulder girdle in prone position, seconds	88.08	9.03	60.21*	10.01	50.83*	3.96	68.01*	11.93

Note: * - $p<0.05$ compared with students with normal posture.

At the end of the study, we repeatedly determined students' physical fitness. As a result, the ratio between the indicators of physical fitness and the types of posture remained unchanged. However, the number of test subjects with posture types changed (see Table 3).

Table 3. Indicators of physical fitness in students with various postural disorders at the end of the study (n=182)

Test physical exercise	Type of posture							
	Normal posture (n=64)		Scoliotic posture (n=72)		Rounded back (n=18)		Round-shouldered back (n=28)	
	$\bar{x}$	S	$\bar{x}$	S	$\bar{x}$	S	$\bar{x}$	S
Sit-ups, times per minute	52.78	7.35	46.11*	7.12	39.14*	8.11	42.24*	7.42
Forward inclination of body in sitting position, cm	7.12	6.17	4.31*	0.64	3.23*	1.25	4.02*	3.26
Raising and holding the shoulder girdle in prone position, seconds	118.42	12.04	73.5*	8.25	67.32*	7.6	72.01*	5.31

During the study, we identified quality of life in students with different types of posture. The findings showed that quality of life in students decreases as a function of the type of posture. This trend is especially prominent in the physical and environmental spheres of life. It should be noted that at the beginning and at the end of the study, the number of students changed in terms of the fullness of the number of students with different types of posture. However, the quality of students' life has improved as a result of physical training and mental fitness classes. At the same time, the respondents with postural disorders have significantly lower indicators in all spheres of life and lower quality of life compared with students with normal posture (see Table 4).

Table 4 Assessment of quality of life in students based on their type of biometric profile of posture (n=182), points

Spheres of life	At the beginning of the study			At the end of the study		
	Type of posture	$\bar{x}$	S	Type of posture	$\bar{x}$	S
Physical	Normal posture (n=31)	62.58	12.4	Normal posture (n=64)	68.23	14.2
	Scoliotic posture (n=86)	42.68*	9.3	Scoliotic posture (n=72)	53.26	7.1
	Rounded back (n=30)	41.11*	10.1	Rounded back (n=18)	44.81	10.3
	Round-shouldered back (n=35)	40.33*	9.7	Round-shouldered back (n=28)	51.11	7.7
Psychological	Normal posture (n=31)	57.03	11.93	Normal posture (n=64)	63.47	10.3
	Scoliotic posture (n=86)	53.04*	7.54	Scoliotic posture (n=72)	55.36	6.4
	Rounded back (n=30)	48.73*	6.17	Rounded back (n=18)	49.03	8.77
	Round-shouldered back (n=35)	45.51*	9.42	Round-shouldered back (n=28)	49.58	10.22
Social	Normal posture (n=31)	60.79	7.89	Normal posture (n=64)	65.49	8.9
	Scoliotic posture (n=86)	57.83*	6.17	Scoliotic posture (n=72)	61.23	7.13
	Rounded back (n=30)	60.94*	7.53	Rounded back (n=18)	64.13	9.3
	Round-shouldered back (n=35)	43.04*	13.38	Round-shouldered back (n=28)	48.26	10.38
Environmental	Normal posture (n=31)	48.37	3.94	Normal posture (n=64)	52.61	13.4
	Scoliotic posture (n=86)	42.51*	15.04	Scoliotic posture (n=72)	43.74	14.44
	Rounded back (n=30)	38.63*	10.1	Rounded back (n=18)	44.09	12.3
	Round-shouldered back (n=35)	45.04*	9.3	Round-shouldered back (n=28)	46.66	9.3
Quality of life	Normal posture (n=31)	63.66	14.93	Normal posture (n=64)	90.26	9.93
	Scoliotic posture (n=86)	49.12*	8.57	Scoliotic posture (n=72)	58.36	9.7
	Rounded back (n=30)	52.11*	9.46	Rounded back (n=18)	57.11	10.16
	Round-shouldered back (n=35)	35.37*	4.28	Round-shouldered back (n=28)	56.17	6.18

Note: * - $p<0.05$ compared with students with normal posture.

Discussion

Apart from some positive changes, the transformation processes that take place in Ukrainian society adversely affect people's daily living activities, resulting in reduced life expectancy, reduced physical activity, increased rate of non-communicable chronic diseases, significant decrease in financial security, loss of guidance on a healthy lifestyle, and lack of physical training in children, adolescents and adults [5].

The analysis of the data found in special scientific and methodical literature and information sources indicates that posture is one of the main and objective characteristics of the physical well-being and health of modern young people. This is especially true for students because the intensity of the training process, the development of social and economic and everyday living and training conditions affect the level of students' physical activity, morphological state of their body and physical performance. This ultimately determines the state of biogeometric profile of posture and manifestation of a certain level of physical health.

In our opinion, the abovementioned statement correctly reflects the urgent need to conduct constant monitoring and to determine the dynamic pattern of not only morphological and physical fitness indicators in students but also indicators of their spatial body organization, which determine their biogeometric profile of posture.

The findings were supplemented by data from other experts (Kashuba VA, Dudko MV., 2015). The concept of Kashuba V.A. et al. () on preventive approaches in physical training of students was also confirmed. The findings show that the indicators of dynamic strength endurance of the abdominal muscles in students with normal posture correspond to 52.78 times per minute. This is statistically significantly higher than the value in students with rounded back (39.14 times per minute, S = 8.11) and in students with scoliotic posture (46.11 times per minute, S = 7.12). In students with rounded back and scoliotic posture, the strength endurance of the muscles of the shoulder girdle and the back was noted at an average level ($p<0.05$). Of great importance are also the statistically significant differences between the indicators of the level of development of static strength endurance in students with normal posture (118.42 seconds, S = 12.04), scoliotic posture (73.05 seconds, S = 8.25), rounded back (67.32 seconds, S = 7.6), and round-shouldered back (72.01 seconds, S = 5.31) ($p<0.05$). The "forward inclination of body in sitting position" test was used to assess the flexibility of the spinal column, the mobility of the hip joints and the elasticity of the hamstrings. The analysis of indicators for this test showed a low level of development of this indicator in students of all types of posture. Thus, the average indicator in students with normal posture was 7.12 cm (S = 6.17), in students with scoliotic posture - 4.31 cm (S = 0.64), in students with round-shouldered back - 4.02 cm (S = 3.26). However, it should be noted that these indicators did not have any statistically significant differences ($p>0.05$). At the same time, students with rounded back demonstrated the lowest result of 3.23 cm (S = 1.25 cm) ($p<0.05$).

In areas related to quality of life, there was a statistically significant difference with previous studies (). Therefore, we can argue that physical training and mental fitness exercises contribute significantly to improving the quality of life. These results are consistent with the previous study () because they show that regular physical training can be an indicator of improved quality of life, provided that other important and major factors such as autonomy, activity, security, etc., are preserved. If students exercise and participate in physical activity programs, they will achieve and complement themselves as a harmonious personality, not only physically, but also psychologically and emotionally, personally and socially. This shows that for students, physical activities can be a means of improving and obtaining socialization and even improving their quality of life.

Conclusion

The last decade in Ukraine has seen a decrease in the level of health in students due to a number of objective and subjective reasons: low social and economic standard of living in the majority of students, poor educational activities, and lack of physical activity in students. This results in an increased number of students with functional musculoskeletal disorders.

The following types of postural disorders were found in students: scoliotic posture was identified in 47.3% of the tested students; round-shouldered back was identified in 19.1% of the tested students; and rounded back was identified in 16.4% of the tested students. Only 16.9% of the students had normal posture. The increased number of students with functional musculoskeletal disorders creates a problematic situation, which later develops into a functional degradation of the body in certain students.

The level of flexibility of the spinal column, the mobility of the hip joints and the elasticity of the hamstrings was determined as low. The average indicator in students with normal posture was 7.12 cm (S = 6.17), in students with scoliotic posture - 4.31 cm (S = 0.64), in students with round-shouldered back - 4.02 cm (S = 3.26). However, it should be noted, that the abovementioned indicators did not have statistically significant differences ($p>0.05$).

Of great importance are the statistically significant differences between the indicators of the level of development of static strength endurance in students with normal posture (118.42 seconds, S = 12.04), scoliotic posture (73.05 seconds, S = 8.25), rounded back (67.32 seconds, S = 7.6), and round-shouldered back (72.01 seconds, S = 5.31) ($p <0.05$).

The quality of life of students was determined based on the physical fitness and type of posture. Our study showed that for students, during their academic years, physical activity contributes significantly to improving their quality of life.

Conflict of interest. The authors declare that there are no conflicts of interest.

References

Andrejeva Julija, Mockiene Asta, Zukauskiene Milda. Fatigue and faulty posture connection among children, diagnosed with dysarthria. Pedagogics, psychology, medical-biological problems of physical training and sports. 2015;8:75-81. http://dx.doi.org/10.15561/18189172.2015.0810

Andrews DM, Fiedler KM, Weir PL, Callaghan JP. The effect of posture category salience on decision times and errors when using observation-based posture assessment methods. Ergonomics. 2012; 55(12):1548–58.

Andrieieva O., Hakman A. Health status and morbidity of children 11-14 years of age during school. *Journal of Physical Education and Sport*, 2018 Supplement issue 2, 1231 – 1236. (SNIP) : 0.904. (SJR) : 0.429.

Andrieieva O., Hakman A., Balatska L., Moseychuk Y., Vaskan I. & Kljus O. (2017). Peculiarities of physical activity regimen of 11-14-year-old children during curricular and extracurricular hours. *Journal of Physical Education and Spor*t, 17(4), 2422 – 2427. doi:10.7752/jpes.2017.04269

Belikova ZhA. Uprazhneniia khatkha-jogi kak sredstvo korrekcii deformacii pozvonochnika studentov special'nykh medicinskikh grupp s narusheniiami osanki. Cand. Diss. [Hatha yoga exercises as mean of backbone deformation's correction of special health groups' students with posture abnormalities. Cand. Diss.], Belgorod, 2012. (in Russian)

Boak A, Hamilton HA, Adlaf EM, Beitchman JH, Wolfe D, Mann RE. The mental health and well-being of Ontario students. CAMH Research Document. 2014;38:213—244.

Bothmer M, Fridlund B. Gender differences in health habits and in motivation for a healthy lifestyle among Swedish university students. Nursing and Health Sciences. 2005;7:107—110.

Cavalheri V, Camillo CA, Brunetto AF, Probst VS, Cipulo Ramos EM, Pitta F. Effects of arm bracing posture on respiratory muscle strength and pulmonary function in patients with chronic obstructive pulmonary disease. Revista Portuguesa de Pneumologia (English Edition). 2010;16(6):887–91.

Dudko M.V. Characteristic of biogeometric profile of students' posture and physical fitness in process of physical education. Physical education of students, 2015;4:1016.

Futornyi S. Actual issues of improving the process of student`s physical education through the application of modern health-saving technologies. Molodizhnij naukovij visnik nacional'nogo universitetu imeni Lesi Ukrainki. 2014;14:26–30.

Gorelov A.A., Kondakov V.L., Belikova Zh.A. About necessity of use of Hatha Yoga exercises for correction of deformation of students' spine of special medical groups with violations of posture. Physical education of students, 2013, vol.2, pp. 35-44. http://dx.doi.org/10.6084/m9.figshare.156378

Hong Y, Fong DT-P,Li JX. The effectof school bag design and load on spinal posture during stair use by children. Ergonomics. 2011;54(12):1207–13.

Iedynak G., Galamandjuk L., Kyselytsia O., Nakonechnyi I., Hakman A. & Chopik O. (2017). Special aspects of changes in physical readiness indicators of young men with different somatotypes between 15 and 17 years of age. *Journal of Physical Education and Sport*, 17(4), 2690 – 2696. doi:10.7752/jpes.2017.04311

Kalinichenko IO, Dyachenko YL. State changes in posture and arch of the foot in children aged 4 - 6 years with hypermobility of the joints under the influence of rehabilitation activities in schools. Pedagogics, psychology, medical-biological problems of physical training and sports, 2013;8:26-30.

Kashuba VA, Dudko MV. Sovremennye podkhody, metodiki i tekhnologii k formirovaniiu zdorovogo obraza zhizni studentov v processe fizicheskogo vospitaniia [Modern approaches to, methodic and technologies of students' healthy life style formation in process of physical education]. Fizichne vikhovannia, sport i kul'tura zdorov'ia u suchasnomu suspil'stvi. 2015;1:52 - 57. (in Russian)

Kashuba VA, Martyniuk OA. K voprosu ispol'zovaniia korekcionno-profilakticheskikh programm v processe fizicheskogo vospitaniia studentok s razlichnymi narusheniiami prostranstvennoj organizacii tela [On the question of usage of correction-prevention programs in physical education of girl students with different disorders of body space organization]. Naukovij chasopis NPU im. M.P. Dragomanova, 2013;1(27):28-35. (in Russian)

Kashuba VA, Ivchatova T, Sergienko K. K voprosu izmeneniia prostranstvennoj organizacii tela cheloveka v processe fizicheskogo vospitaniia s ispol'zovaniem komp'iuternykh tekhnologij [On the question of change of human body space organization in physical education with the help of computer technologies]. Sportivnij visnik Pridniprov'ia. 2014;1:42-45. (in Russian)

Kolos MA. Korekciia funkcional'nikh porushen' opornorukhovogo aparatu studentov v procesi fizichnogo vikhovannia. Cand. Diss. [Correction of functional disorders of students' muscular skeletal apparatus in process of physical education. Cand. Diss.], Dnipropenrovsk, 2010. (in Ukrainian)

Kozina, Z., Shepelenko, T., Osiptsov, A., Kostiukevych V., Stasiuk, I., Mulik, K. Factor structure of the integral readiness of aerobics athletes (women) Journal of Physical Education and Sport. 2017;17 Supplement issue 5: 2188 - 2196.

Litvinenko Y.V., Niznikowski Tomasz, Boloban V.N. Evaluation of the kinematic structure of indicators key elements of sports equipment exercise by postural orientation movements. Physical education of students, 2014;6:29-36.

Mani R, Milosavljevic S, Sullivan SJ. Control of posture during tasks representing common work related postures – a reliability study. Ergonomics. 2015;3;58(6):980–989.

Martyniuk OA. Korrekciia narushenij prostranstvennoj organizacii tela studentok v processe fizicheskogo vospitaniia. Cand. Diss. [Correction of disorders of girl students' body space organization in process of physical education. Cand. Diss.], Kiev, 2011. (in Russian)

Milosavljevic S, Carman A. Can postural modification reduce kinetic and kinematic loading during the bowing postures of Islamic prayer? Ergonomics. 2010;53(12):1446–1454.

Nosova NL. Kontrol' prostorovoi organizacii tila shkoliariv u procesi fizichnogo vikhovannia. Cand. Diss. [Control of schoolchildren's body space organization in process of physical education. Cand. Diss.], Kiev, 2008. (in Ukrainian)

Nosova, N. L. & Dudko, M. V.(2015). [Estimation of the state of carriage of students in the process of physical education on the basis of visual skrine] Sportivna nauka Ukraini [Sport science of Ukraine]. Lviv, pp. 30–35.

Retivykh IuI. Metodika korrekcii narushenij osanki studentov sredstvami ozdorovitel'noj fizicheskoj kul'tury na osnove ucheta vidov i stepeni deformacij pozvonochnika. Cand. Diss. [Methodic of correction of students' postures by means of health related physical culture on the base of registration of kinds and degree of backbone deformatio n. Cand. Diss.], Volgograd, 2009. (in Russian)

Sergiy Drachuk ,Viktoriia Bohuslavska, Maryan Pityn, Yuriy Furman, Viktor Kostiukevych, Nataliia Gavrylova, Svitlana Salnykova, Tetiana Didyk (2018). Energy supply capacity when using different exercise modes for young 17-19-year-old men. Journal of Physical Education and Sport ® (JPES), 18 (1), Art 33, pp. 246 - 254,

Temchenko VA, Burko VL, Konik GA. Organizaciia upravleniia fizicheskoj kul'turoj i sportom v vysshem uchebnom zavedenii [Organization of management of physical culture and sports in higher educational establishment]. II regional'na naukova konferenciia "Strategichne upravlinnia rozvitkom galuzi Fizichna kul'tura i sport", 14 grudnia 2013 r., Kharkiv [II regional scientific conference "Strategic management of development of Physical culture and sports' branch". December 14th, 2013, Kharkiv], Kharkiv, HDAFK; 2014. p. 16—18. (in Russian)

Torlakovic A, Muftic M, Radjo I, Talovic M, Mahmutovic I. Evolution of Sports-medical Team Management in the Program of Posture Correction in Children. Materia Socio Medica. 2014;26(2):104.

Yarmak, O., Galan, Y., Hakman, A., Dotsyuk, L., Blagii, O. & Teslitskyi, Yu. (2017). The Use of Modern Means of Health Improving Fitness during the Process of Physical Education of Student Youth. Journal of Physical Education and Sport, 17 (3). 1935-1940. doi:10.7752/jpes.2017.03189

Yarmak, O., Galan, Y., Nakonechnyi, I., Hakman, A., Filak, Y. & Blahii, O. (2017). Screening System of the Physical Condition of Boys Aged 15-17 Years in the Process of Physical Education. Journal of Physical Education and Sport, 17 Supplement Issue 3, 1017-1023. doi:10.7752/jpes.2017.s3156 Halyna Bezverkhnia, Tetiana Fedirchyk, Viktoria Tsybulska, Mykola Maievskyi, Tetiana Osadchenko, Serhii Ilchenko, Anna Hakman (2019). Formation of motivation for professional and applied physical training in future elementary teachers. Journal of Physical Education and Sport, Vol 19 (Supplement issue 2), pp 299 – 304. DOI:10.7752/jpes.2019.s2045

Zabalueva TV. Pedagogicheskie aspekty formirovaniia vozrastnoj osanki cheloveka [Pedagogic aspects Zukowska H, Szark-Eckardt M, Muszkieta R, Iermakova T. Characteristics of body posture in the sagittal plane and fitness of first-form pupils from rural areas. Pedagogics, psychology, medical-biological problems of physical training and sports. 2014;7:50–60. http://dx.doi.org/10.6084/m9.figshare.1015583