Original research article

DIFFERENCES IN POSTURAL STATUS OF PRIMARY SCHOOL STUDENTS WHO ENGAGE IN DIFFERENT SPORTS AND THEIR PEERS WHO DO NOT ENGAGE IN SPORTS

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Abstract. *Puberty is a critical period for the possibility of development of postural disorders. Proper physical activity makes it possible to correct postural disorders and develop positive motor habits. The aim of this study was to analyze the postural status of primary school pupils in Novi Sad and to determine whether there are any statistically significant differences in relation to the sport in which the participants are engage in. The sample consisted of 197 students aged between 11 and 12. Postural status was determined by the clinical method. The data were analyzed by the SPSS statistical software, version 20, and the differences were determined by the χ2 test at the p≤0.05 significance level. The results show that the most common postural disorders are flat feet (62.9%), winged scapula (53.3%), knock knees (29.9%), left thoracic scoliosis (28.9%) and lordosis (23.9%). Significant differences in the postural disorders winged scapula (p=0.050), left thoracic scoliosis (p=0.000) and knock knees(p=0.000) were identified between participants who were not engaged in sports and those who were engaged in different sports. Coaches and physical education teachers should insist on their students and athletes performing the exercises properly, and include corrective exercises in their work programs.*

Key words: *postural disorders, posture, physical activity.*

INTRODUCTION

Proper postural status has a significant impact on the state of health and working ability (Đokić & Stojanović, 2010), while the modern way of life has a bad influence on psychosomatic status, especially in the period of growth and development. Unfortunately,

postural disorders, more pronounced hypokinesia and mental instability, are accompanying phenomena of the urban lifestyle. Good posture is essential not only for the physical, but also for the proper spiritual development of children (Całka-Lysis, Jankowicz-Szymańska, & Adamczyk, 2008).

Proper posture is all the rarer in children's daily activities. It is therefore necessary to involve children in organized, professionally guided, everyday variety of physical activities that contribute to strengthening postural muscles responsible for creating a good posture pattern even during early childhood (Protić-Gava & Krneta, 2010). Various factors such as prolonged improper sitting and standing, inadequate school furniture, overweight schoolbags, reduced physical activity, and others that influence the spine and lower extremities causing loads that exceed the tolerance zone leading to the appearance of muscle imbalance, are the main cause for the occurrence of postural disorders (Đokić & Stojanović, 2010).

The incidence of postural disorder is most common in children during critical periods of growth and development, and the latest in the series is the period of adolescence in which rapid growth ensues due to excessive secretion of reproductive glands and the closure of some cartilage epiphysis of the long bones of the skeleton (Demeši-Drljan & Mikov, 2012).

As a result of the previous growth and development, body posture is also caused by the dominant physical activity, but also by the sport in which the child is engaged (Shumway-Cook & Woollacott, 2000). Postural disorders and asymmetry of the musculoskeletal system occur in people who are not involved in sports, and in athletes (Vařeková, Vařeka, Janura, Svoboda, & Elfmark, 2011). Large loads to which young athletes are exposed can cause the appearance of deformities of the locomotor system (Sławińska, Rożek, & Ignasiak, 2006), but properly dosed appropriate activity positively affects the development process, correcting postural disorders and developing positive motor habits (Grabara & Hadzik, 2009).

METHOD

The sample of participants

The sample consisted of 197 primary school students from Novi Sad, aged 11 and 12, of male (104) and female (93) gender. The schools included in the survey were primary school "Prva Vojvođanska Brigada", primary school "Žarko Zrenjanin" and primary school "Đorđe Natošević".

The students were divided into groups in relation to the sport they practiced, but one group consisted of students who were not involved in sports. The first group consisted of 43 students who were engaged in football, the second consisted of 25 students who were engaged in basketball, the third consisted of 29 students who were engaged in gymnastics, rhythmic gymnastics, jazz ballet, ballet and dance, the fourth group consisted of 32 students who were engaged in volleyball, and the fifth group consisted of 68 students who are not involved in sports.

Measures and procedures

With a view to determining postural status, a modified Napoleon Wolanski method, according to Radisavljević, was used, which meant observing all segments of the body in the frontal and sagittal plane (Radisavljević, 2001). During the examination the students

were barefoot and wore minimal clothes. The observation was carried out at a distance of about 2 meters and the position of the body segments in the frontal and sagittal plane was analyzed. According to this method, the posture of all body segments was evaluated with 0, 1 and 2 - good posture was evaluated with 0, minor deviation with 1 and major deviation with 2 (Živković, 2000).

With the purpose of determining the students' engagement in sports, a questionnaire was used, which was drawn up for the purpose of this survey and by means of which data were obtained on whether the students were involved in sports, which sport and for how long.

Methods of data processing

The results were processed in the SPSS software version 20 for determining differences in postural status of the participants who were engaged in some sport or not, namely the nonparametric method χ^2 was used - at a significance level of $p \leq 0.05$.

RESULTS

Table 1 shows the numerical and percentage representation of the participants who are involved in various sports and students who are not involved in sports.

Table 1 Numerical and percentage of representation of respondents who are engaged in different sports and respondents who are not engaged in sports

Sports	Number of respondents	%
Football	43	21.8
Basketball	25	12.7
Gymnastics, rhythmic gymnastics, jazz ballet, ballet and dance	29	14.7
Volleyball	32	16.2
Non-athletes	68	34.5
Total	197	100.0

The results in Table 1 show that out of a total number of participants, 43 (21.8%) participants are engaged in football, 25 (12.7%) participants are engaged in basketball, 29 (14.7%) participants are engaged in gymnastics, rhythmic gymnastics, jazz ballet, ballet and dance, 32 (16.2%) participants are engaged in volleyball and 68 (34.5%) participants are not engaged in sports.

Table 2 shows the numerical and percentage representation of postural disorders of the spinal cord of the total sample of participants.

The results show that most participants have good posture of certain segments of the spinal cord. Most postural disorders occur in the sagittal plane of the spinal cord (poor and extremely poor posture). Taking into account all segments of posture, most of the participants had poor posture of the winged scapula (53.3%), followed by lordotic poor posture (23.9%) and kyphotic poor posture (18.3%). In the group of participants who have extremely poor posture, most participants had extremely poor posture of the winged scapula (12.7%).

Table 2 Numerical and percentage representation of postural disorders of the spinal cord
of the total sample of respondents

| Postural disorders | Evaluation of postural disorders | | | | | | Total | |
| | Good posture | | Poor posture | | Extremely poor posture | | | |
	Number	%	Number	%	Number	%	Number	%
Kyphosis	158	80.2%	36	18.3%	3	1.5%	197	100%
Lordosis	141	71.6%	47	23.9%	9	4.6%	197	100%
Kypholordosis	177	89.8%	16	8.1%	4	2.0%	197	100%
Flat back	173	87.8%	24	12.2%	0	0.0%	197	100%
Winged scapula	67	34.0%	105	53.3%	25	12.7%	197	100%
Left thoracic scoliosis	165	83.8%	32	16.2%	0	0.0%	197	100%
Right thoracic scoliosis	171	86.8%	25	12.7%	1	0.5%	197	100%
Left lumbar scoliosis	190	96.4%	7	3.6%	0	0.0%	197	100%
Right lumbar scoliosis	191	97.0%	6	3.0%	0	0.0%	197	100%
Left thoracic – lumbar scoliosis	194	98.5%	3	1.5%	0	0.0%	197	100%
Right thoracic – lumbar scoliosis	192	97.5%	5	2.5%	0	0.0%	197	100%
Compensatoryleft/rightscoliosis	193	98.0%	2	1.0%	2	1.0%	197	100%
Compensatoryright/leftscoliosis	195	99.0%	10	2.0%	0	0.0%	197	100%

Table 3 shows the numerical and percentage representation of deformities of the chest
and lower extremities of the total sample of participants.

Table 3 Numerical and percentage representation of deformities of the chest and lower
extremities of the total sample of respondents

| Postural disorders | Evaluation of postural disorders | | | | | | | |
| | Good posture | | Poor posture | | Extremely poor posture | | Total | |
	Number	%	Number	%	Number	%	Number	%
Pectus excavatum	176	89.3%	21	10.7%	0	0.0%	197	100%
Pectus carrinatum	181	92.3%	14	7.1%	0	0.5%	197	100%
Flat chest	191	97.0%	5	2.5%	1	0.5%	197	100%
Knock knees	126	64.0%	59	29.9%	12	6.1%	197	100%
Bow legs	175	88.8%	21	10.7%	1	0.5%	197	100%
Hyperextension of legs	191	97.0%	6	3.0%	0	0.0%	197	100%
Flat foot	46	23.4%	124	62.9%	27	13.7%	197	100%
Concave foot	194	98.5%	2	1.0%	1	0.5%	197	100%

Based on the results shown in Table 3, it can be concluded that the majority of the
participants have poor posture, knock knees (29.9%) and flat feet (62.9%), but when it
comes to extremely poor posture, most participants have an extremely poor posture of the
foot arch (13.7%).

Figure 1 shows the numerical and percentage representation of the winged scapula
posture of the participants who are engaged in various sports and those who are not. The
results show a statistically significant difference between the groups of participants
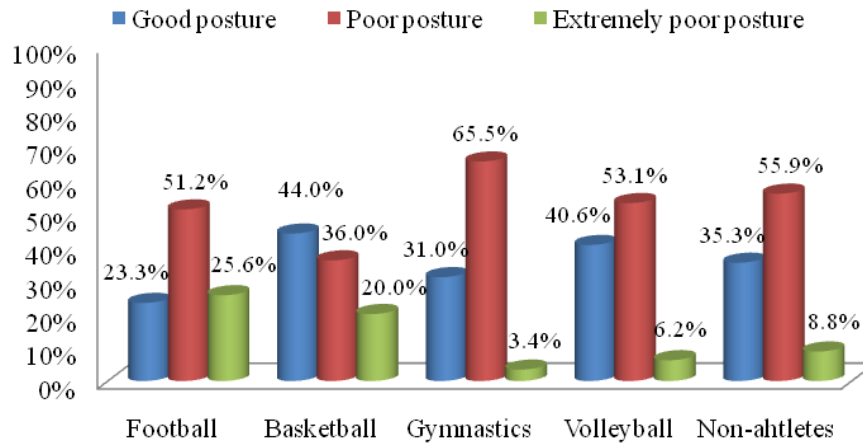(χ^2=15.537, p=0.050, N=197, df=8) at a p≤0.05 significance level.

Fig. 1 Numerical and percentage representation of winged scapula posture of respondents in relation to the sport respondents are engaged in and non-athletes

Figure 2 shows the numerical and percentage representation of the left thoracic scoliosis of the participants who are engaged in various sports and those who do not do sports. Significant differences between the groups of participants (χ^2=21.472, p=0.000, N=197, df=4) have been determined, at the p≤0.05 significance level.
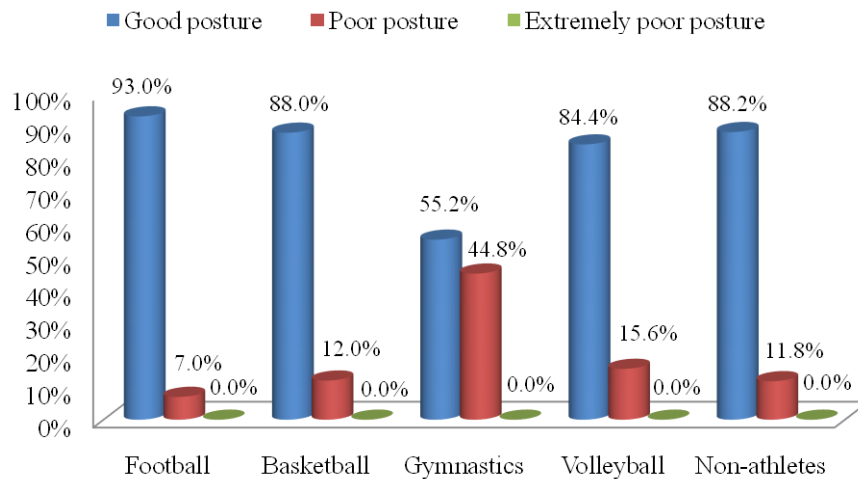

Fig. 2 Numerical and percentage representation of left thoracic scoliosis in relation to the sport in which the participants engage and nonathletes

Figure 3 shows the numerical and percentage representation of knock knees in the participants engaged in various sports and those who do not do sports. According to the obtained values χ^2=29.038, p=0.000, N=197, df=8, and at the p≤0.05 level of significance, we can conclude that there are statistically significant differences in the knock knees postural disorder between groups of participants.
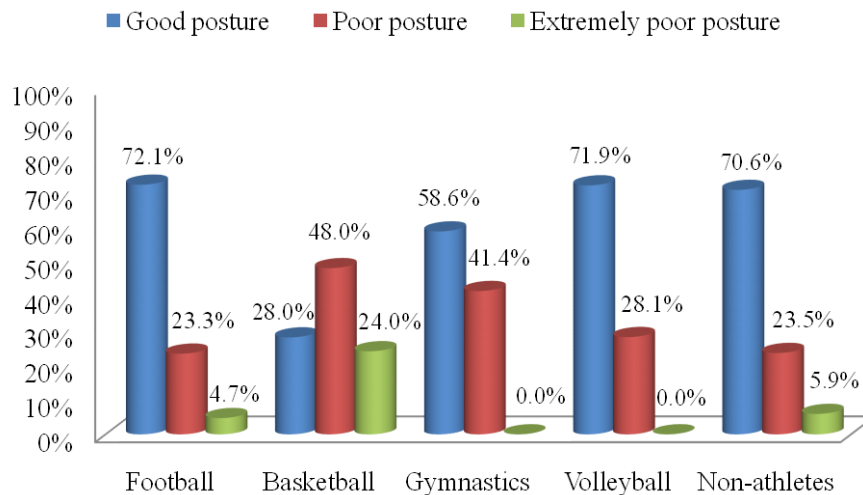
Fig. 3 Numerical and percentage representation of postural disorder knock knees in relation to the sport in which the respondents are engaged and non-athletes

DISCUSSION

The degree of the curvature of the spinal cord depends on many factors such as gender, lifestyle, physical activity, etc. Physical activity affects the process of ossification and muscle strength, so it is one of the important factors affecting postural status (Kutzner-Kozinska, 2001; according to Lichota, Plandowska, & Patrycjusy, 2011).

Postural disorders that occur in most sports are scoliosis and kyphosis, while lordosis occurs in a slightly smaller percentage (Asghar & Imanzadeh, 2009). The results obtained in this study partially coincide with the above statement. In this study, differences were found in the postural disorder scoliosis, but also in the postural disorder winged scapula which is very often associated with the postural disorder kyphosis.

In their study, Wojtys, Ashton-Miller, Huston, & Moga (2000) observed the existence of an increased curvature in the sagittal plane, i.e. increased thoracic kyphosis and lumbar lordosis in children engaged in sports in which strength is the dominant factor. Intense physical training combined with a still underdeveloped spinal cord in children leads to the formation of postural disorders of the spinal cord. Children involved in gymnastics, soccer, hockey, swimming and wrestling are under this negative influence the most, which may be associated with early specialization in these sports.

The highest percentage of postural disorders of the winged scapula in this study was found in participants who practice gymnastics and football. The participants who are engaged in gymnastics had 69.0% of the winged scapula postural disorder, and the participants who play football 76.8% of the same postural disorder. Based on these results, we can conclude that this research partly coincides with the research of Wojtys, Ashton-Miller, Huston, & Moga (2000), regarding the existence of a large percentage of poor posture in kyphotic gymnasts and football players, while there is no similarity in terms of lordotic poor posture.

In his study, Grabara (2010) concluded that gymnastics training in early childhood can lead to postural changes, where these changes reflect the asymmetry in the frontal plane of the spinal cord in relation to persons who are not involved in sports. Lumbar lordosis is less pronounced in gymnasts aged 7 – 10 compared to their peers who are not involved in sports, while in gymnasts aged 11 lumbar lordosis is very pronounced compared to their peers who are not involved in sports. Also, Kumsa, Ereline, Gapayeva, Pääsuke, & Vain (2007) found in their study that rhythmic gymnasts have a reduced angle of kyphotic and lordotic curvature than the group of participants who do not do sports.

The analysis of the postural status of gymnasts in this study shows that gymnasts have statistically significant differences and a large percentage of the winged scapula postural disorder (69.0%), thoracic scoliosis (44.8%) and knock knees(41.4%). Also, the results of this study show a pronounced lumbar lordosis in gymnasts, that as many as27.6% of the gymnasts had the postural disorders lordosis, while 30.9% of the non-athletes had this postural disorder.

The research conducted by Tanchev, Dzherov, Parushev, Dikov, & Todorov (2000) was aimed at determining the prevalence of scoliosis in rhythmic gymnastics, analyzing its specific characteristics and trying to present some etiological explanations of some specific forms of scoliosis. Of the total sample, scoliotic curvature over 10° was present in 12% gymnasts, which represents a large share compared to 1.1% of children of the same age who do not do sports. In this study, the authors speak of three major factors that separate rhythmic gymnasts from their peers who are not involved in sports, and these factors are likely to contribute to an increased incidence of scoliosis. These factors are laxity in the joints as well as hereditary factors, slow growth and maturation as a result of physical, dietary and psychological stress and continuous asymmetric loading of the spinal cord. Also, it can be seen that gymnasts have a higher percentage of scoliotic poor posture (44.8%) compared to non-athletes (11.8%). On the basis of these results, overlaps between the two studies are evident.

By analyzing the shape of the leg in young volleyball players compared to those participants of the same age who are not involved in sports, the authors concluded that there is a small percentage of leg shape deviations from the normal status and that differences between these two groups are not significant (Krneta, Protić-Gava, Vuković, & Šćepanović, 2012). Similar results in terms of deviation of the leg shape were obtained in this study, where 28.1% of the participants who were engaged in volleyball had the postural disorder knock knees, which is a lower percentage compared to other groups of sports.

In their study, Modi et al. (2008) compared the frequency, type and size of scoliotic curvature in participants who played volleyball with those who were not engaged in volleyball. A higher incidence of scoliosis was present in the group that was engaged in volleyball 5.2%, compared to the group that did not play volleyball 1.0%, although the control group had more participants with thoracic scoliosis (26.7%). The authors emphasize that playing with a dominant hand is associated with the direction of the curve (Modi et al., 2008). The percentage of scoliotic poor posture in the chest part of the spinal cord in volleyball in this study was 15.6%, and in the participants who are not involved in sports 11.8%, indicating the differences between these studies in terms of thoracic scoliosis.

An analysis of the postural status of young female volleyball players, conducted by the clinical method, emphasizes the presence of certain undesirable changes that are identified as the poor posture of shoulders in over 40% of cases, as well as poor posture of winged shoulder blades in over 60% of cases, indicating kyphotic poor posture and

certain deviations of the spinal cord in the frontal plane in volleyball players in over 40% of the cases (scoliotic poor posture) (Krneta, Protić-Gava, Vuković, & Šćepanović, 2012). Similar results were obtained in the study by Protić-Gava, Šćepanović, & Rakić (2011), where 62% of the participants had poor shoulder and winged shoulder blades posture. Almost the same results were obtained in the present study where 59.4% of the participants who were engaged in volleyball had winged shoulder blades and 12.5% of the participants had kyphotic poor posture.

Puberty is one of the critical periods which is characterized by pronounced children's growth and development, and therefore the critical period for the possibility of postural deformities (Kosinac, 2008). Proper physical activity can alleviate the process of development and improve the body's resistance, correct postural disorders and develop positive motor habits (Grabara & Hadzik, 2009b). Also, it is of the utmost importance in the practice to include compensatory exercises, given that they can reduce the risk of postural deformities (Krneta, Protić-Gava, Vuković, & Šćepanović, 2012).

CONCLUSION

The aim of this study was to determine whether there are statistically significant differences in postural status and the percentage in which postural disorders occur in primary school students of Novi Sad in relation to participation in various sports.

Based on the results, it can be concluded that a similar percentage of postural disorder occurs in athletes and non-athletes. It can be assumed that the postural disorders in athletes occur due to premature selection in some sports, large loads of muscles and bones in periods of development, as well as the use of asymmetric exercise and early specialization, thereby contributing to the development of postural disorders. The appeal should be addressed to coaches and physical education teachers who need to insist on their students and athletes performing exercises properly, and include remedial exercises into their training programmes, in order to avoid negative impacts caused by a specific sport. This would have a significant preventive influence regarding the reduction of postural disorders in young adults who play sports.

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RAZLIKE U POSTURALNOM STATUSU UČENIKA OSNOVNE ŠKOLE KOJI SE BAVE RAZLIČITIM SPORTOVIMA I NJIHOVIH VRŠNJAKA KOJI SE NE BAVE SPORTOM

Pubertet je jedan od kritičnih perioda za mogućnost nastanka posturalnih poremećaja. Pravilnom fizičkom aktivnošću moguće je korigovati posturalne poremećaje i razviti pozitivne motorne navike. Cilj ovog istraživanja bio je analiza posturalnog statusa učenika osnovnih škola Novog Sada i utvrđivanje eventualnih statistički značajnih razlika u odnosu na sport kojim se ispitanici bave. Uzorak je činilo 197 učenika uzrasta od 11 i 12 godina. Posturalni status utvrđenje kliničkim metodom. Podaci su obrađeni statističkim programom SPSS, verzija 20, a razlike utvrđene χ2 testom na nivou zaključivanja p≤0.05. Rezultati pokazuju da su najučestaliji posturalni poremećaji ravna stopala (62.9%), krilaste lopatice (53.3%), „X" noge (29.9%), leva grudna skolioza (28.9%) te lordotično loše držanje (23.9%). Utvrđene su statistički značajne razlike u posturalnim poremećajima krilaste lopatice (p=0.050), leva grudna skolioza (p=0.000) i „X" noge (p=0.000) između ispitanika koji se ne bave sportom i onih koji se bave različitim sportovima. Treneri i profesori fizičkog vaspitanja treba da insistiraju na što pravilnijem izvođenju vežbi kod svojih učenika i sportista, i da u svoje programe rada uključe i korektivne vežbe.

Ključne reči: *posturalni poremećaji, držanje tela, fizička aktivnost.*