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The Spinal Column State of Adolescent Boys of Different Levels of Physical Activity

Zoran Milić [1], Darijan Ujsasi[1], Aleksandar Miletić, Milan Cvetković[2], Mladen Brnić[3]
[1]Phd student at Faculty of Sport and Physical Education, Novi Sad, Serbia
[2]Faculty of Sport and Physical Education, Novi Sad, Serbia
[3]Professor of physical education and sport

Correspondence:
Zoran Milić
Faculty of Sport and Physical Education, Novi Sad
zoranmilic@yahoo.com

Abstract: *The sedentary form of behaviour, the effective holding of the body are potential causes of the formation of muscular asymmetries, and thus of poor body posture. The aim of the paper is to determine the differences in posture of children of different levels of physical activity. The research involved an assessment of a sample of 42 handball players 13.02 ± 0.89 years and 32 non-athletes 13.16 ± 0.88 years. Three tests were used to evaluate the presence of poor posture, to evaluate the scoliotic poor posture - Adam's forward bend test, to estimate the kyphotic poor posture –Reclination test with the contraction of the extensor muscle to assess the lordotic poor posture – Contraction test of the abdominal muscles. The obtained results of the chi square of the test indicate that there are no statistically significant differences between the analysed groups of subjects regarding the presence of the scoliotic (p = 0.85), the kyphotic (p = 0.77) and the lordotic poor posture (p = 0.82) between the defined groups. The assumption is that boys are involved in sports activities due to the impaired posture in adolescent age, in order to prevent further progression and formation of new bodily deformities and to avoid similar conditions.*

Key words: *spinal column, athletes, non-adherents, adolescents.*

Introduction

Good postural status or proper posture can also be defined as a condition of a good musculoskeletal balance that prevents the onset and progressive development of postural disorders and those structures that hold the body in an upright position or in some other position, either in motion or while resting (Madić, 2014). Systemic inactiv-

Stanje kičmenog stuba dečaka adolescentnog uzrasta različitog stepena fizičke aktivnosti

Zoran Milić [1], Darijan Ujsasi[1], Aleksandar Miletić, Milan Cvetković[2], Mladen Brnić[3]
[1]Student doktorskih studija Fakulteta sporta i fizičkog vaspitanja u Novom Sadu
[2]Univerzitet u Novom Sadu, Fakultet sporta i fizičkog vaspitanja, Novi Sad, Srbija
[3]Profesor fizičkog vaspitanja i sporta

Korespondencija:
Zoran Milić
Fakulteta sporta i fizičkog vaspitanja Novi Sad
zoranmilic@yahoo.com

Apstrakt: *Sedentarni oblik ponašanja, nepravilno držanje tela su potencijalni uzročnici formiranja mišićnih asimetrija, a time i narušenih držanja tela. Cilj rada je utvrđivanje razlika u držanju tela dece različitog nivoa fizičke aktivnosti. Istraživanje je podrazumevalo procenu na uzorku od 42 rukometaša 13,02±0,89 godina i 32 nesportista 13,16±0,88 godina. Za procenu prisustva narušenih držanja primenjena su tri testa; za procenu skoliotičnog lošeg držanja – Adams bending test, za procenu kifotičnog lošeg držanja – Test reklinacije sa kontrakcijom mišića ekstenzora i za procenu lordotičnog lošeg držanja – Test kontrakcije abdominalnih mišića. Dobijeni rezultati hi kvadrat testa ukazuju da ne postoje statistički značajne razlike između analiziranih grupa ispitanika u pogledu prisustva skoliotičnog (p=0,85), kifotičnog (p=0,77) i lordotičnog lošeg držanja (p=0,82) između definisanih grupa. Pretpostavka je da se dečaci zbog narušenosti posture u adolescentom uzrastu uključuju u sportske aktivnosti, kako bi sprečili dalje progresije i nastajanje novih.*

Ključne reci: *kičmeni stub, sportisti, nesportisti, adolescenti.*

Uvod

Dobar posturalni status odnosno pravilno držanje tela može se još definisati kao stanje dobrog mišićno – skeletnog balansa koji štiti od nastajanja i progresivnog razvoja posturalnih poremećaja i onih struktura koje drže telo u uspravnom stavu ili nekom drugom položaju, bilo u kretanju ili pri mirovanju (Madić, 2014). Sistemska neaktivnost i trendovi aktuelnih životnih stilova mladih doprinose porastu narušenih držanja tela

ity and current lifestyles trends contribute to the growth of poor posture of young people at the general level. Postural status is the result of previous growth and development, but also the result of physical activity (Jordan et al 2010).

The impact of long-term muscular inactivity or contraindicated physical activity can directly lead to muscular imbalance that influences the normal posture (Straker et al., 2008; Geldhof et al., 2007). There are many factors that can directly or indirectly affect the occurrence of poor posture. One of the leading risk factors for the formation of poor body holding is the increased body weight. Many authors who have dealt with a poor body holding have come to the conclusion that the scoliotic poor posture is in correlation with body weight (Trajković and Nikolić, 2008; Vlaškalić et al., 2006; Tudor et al., 2009). Studies (Esposito et al., 2013; Milošević et al., 2007a, Milošević et al 2007b) also confirm that obesity is one of the leading causes of impaired body posture. Researcher Mitova (2015) indicates that poor body postures, when it comes to the spinal column, have been steadily increasing and tend to significantly increase.

The effects of school bag load on spinal column also influence the creation of postural imbalances in school children (Popova-Ramova and Lazovic, 2010). In adolescents, the percentage of deformities has increased in the last 15 years (Kratenova et al., 2007; Aksonova et al., 2012; Watanabe et al., 2007) caused by sedentary habits, reduced activity and strength of the musculoskeletal system. Activities aimed at preventing poor body holding can largely affect their creation. Active involvement of the muscles that affect the holding of the body can reduce or completely eliminate the degree of imbalance (Grabar, 2014). For this reason, a proper kinesiological treatment is necessary in order to achieve functional adjustment of the muscular system and thus eliminate or mitigate the degree of impairment (Kučić i Kosinac, 2009; Bogdanović i Marković, 2009; Đokić i Stojanović, 2010; Jovović i Čanjak, 2012). Sports activities or targeted training effects can significantly prevent the occurrence of postural deviations. If sensitive periods are used correctly for the application of kinesiological treatments, there is less chance of disturbing the condition of the musculoskeletal system. Studies show that children and adolescents who are physically active during their youth tend to become healthier adults (Vlaškalić et al., 2006).

In line with this, the aim of this paper was to determine whether there are differences in the presence of impaired postures in children who are actively engaged in sports (handball for no more than 1 year) and children who are not engaged in sports activities.

na generalnom nivou. Posturalni status je rezultat prethodnog rasta i razvoja, ali i rezultat fizičke aktivnosti (Jordan i sar. 2010).

Uticaj dugotrajnog mišićnog inaktiviteta ili kontraindikovane fizičke aktivnosti mogu direktno da dovedu do mišićnog disbalansa što se manifestuje na normalno držanje tela (Straker i sar., 2008; Geldhof i sar., 2007). Postoje mnogi faktori koji mogu direktno ili indirektno da utiču na pojavu lošeg držanja tela. Jedan od vodećih riziko faktora za nastajanje narušenih držanja tela je povećana telesna masa. Mnogi autori koji su se bavili narušenom posturom došli su do zaključka da je skoliotično loše držanje u korelaciji sa telesnom masom (Trajković i Nikolić, 2008; Vlaškalić i sar., 2006; Tudor i sar., 2009). Istraživanja (Esposito i sar., 2013;Milošević i sar. 2007a, Milošević i sar.2007b), takođe potvrđuju da je gojaznost jedan od vodećih uzročnika narušenog lošeg držanja tela. Istraživanja Mitove (2015) ukazuju da su narušena držanja tela, kada je u pitanju kičmeni stub, u stalnom porastu i imaju izrazitu tendenciju porasta.

Opterećenost kičmenog stuba težinom školske torbe takođe utiče na stvaranje posturalnih disbalansa kod školske dece (Popova-Ramova i Lazović, 2010). Kod adolescenata, poslednjih 15 godina povećan je procenat deformiteta (Kratenova i sar., 2007; Aksonova i sar., 2012; Watanabe i sar., 2007) prouzrokovan sedentarnim navikama i smanjenom aktivnošću i snagom mišićnozglobnog sistema. Aktivnostima usmerenim na prevenciju lošeg držanja tela umnogome može da se utiče na stvaranje istih. Aktivno angažovanje mišića koji utiču na držanje tela može da se smanji ili potpuno ukloni stepen disbalansa (Grabara, 2014). Upravo iz tog razloga je neophodan pravilan kineziloški tretman kako bi se došlo do funkcionalnog prilagođavanja mišićnog sistema i na taj način uklonio ili ublažio stepen narušenosti (Kučić i Kosinac, 2009; Bogdanović i Marković, 2009; Đokić i Stojanović, 2010; Jovović i Čanjak, 2012). Sportskim aktivnostima ili usmerenim trenažnih uticajima bitno se može sprečiti nastajanje posturalnih odstupanja. Ukoliko se senzitivni periodi pravilno iskoriste za primenu kineziološkog tretmana manje su šanse da dođe do narušavanja stanja koštano mišićnog sistema. Istraživanja pokazuju da deca i adolescenti koji su fizički aktivni tokom mladosti izrastaju u zdravije odrasle osobe (Vlaškalić i sar, 2006).

Shodno iznesenom, cilj rada je bio da se proceni da li postoje razlike u prisustvu narušenih držanja tela dece koja se aktivno bave sportom (rukometom ne više od 1 godine) i dece koja se ne bave sportskom aktivnošću.

Method

The research was transversal. A draft of non-experimental research was used, specifically *Ex post facto* draft. In line with the nature of the scientific research, the empirical method was used, the applied method was used due to the aim of undertaking, while according to the knowledge of the problem, a confirmatory method was used. In relation to the degree of control, a semi-field method was applied.

The sample consisted of a total number of 80 male respondents: 48 handball players – (engaged in handball for at least 1 year) of HC "Borac" from Banja Luka (3,02 ± 0,89 years old) and 32 respondents who are not engaged in sports and are attending the elementary school "OŠ Miloš Dujić" in Čelinac (3.16 ± 0.88 years). Respondents who were previously divided into two subunits were approximately of similar age, body height, body weight and nutritional status (p> 0.05), (Table 1) which was a good starting point for further comparisons of the spinal column. Given that there is a very active handball club in Čelinac with a large number of handball school students every year, it was interesting to analyse their spinal column state.

Table 1. *Sample of respondents and descriptive statistics of anthropometric characteristics*

Metod

Istraživanje je bilo transverzalnog karaktera. Koristio se nacrt neeksperimentalnih istraživanja, tačnije *Ex post facto* nacrt. Prema prirodi naučnih istraživanja koristio se empirijski metod, prema cilju preduzimanja aplikativna metoda, dok je prema poznavanju problema bila korištena konfirmativna metoda. U odnosu na stepen kontrole primenjivao se poluterenski metod.

Uzorak je činilo ukupno 80 ispitanika muškog pola i to: 48 ispitanika koji se bave rukometom- najmanje 1 godinu RK „Borac"iz Banja Luke (3,02±0,89 godina) i 32 ispitanika koji se sportom ne bave, a učenici su „OŠ Miloš Dujić" u Čelincu (3,16±0,88 godina). Ispitanici koji su unapred bili podeljeni na dva subuzorka, bili su približno sličnih godina starosti, telesne visine, telesne mase i stanja uhranjenosti (p>0,05), (Tabela 1) što je bila dobra polazna osnova za dalje komparacije o stanju kičmenog stuba. S obzirom da je u Čelincu vrlo aktivan rukometni klub, da ima velik broj polaznika škole rukometa svake godine, interesantno je bilo analizirati njihovo stanje kičmenog stuba.

Tabela 1. *Uzorak ispitanika i deskriptivni statistici antropometrijskih karakteristika*

Parametar / *Parameter*	Vrednost / *Value*				
	N		*%*		
Ukupan uzorak / Total sample	80		100		
Rukometaši / Handball players	42		52.50		
Nesportisti / Non-athletes	38		47.50		
Parametri / *Parameters*	***AS***	***S***	***MIN***	***MAX***	**Studentov t-test / *Student's t-test***
Godine ukupno za ceo uzorak / Age for a whole sample	13.08	0.88	12	14	
Rukometaši / Handball players	13.02	0.89	12	14	p=0.51
Nesportisti / Non-athletes	13.16	0.88	12	14	
Telesna visina (cm) / Body height (cm)	165.59	11.26	148	192	
Rukometaši / Handball players	166.98	11.94	150	192	p=0.18
Nesportisti / Non-athletes	163.50	9.97	148	190	
Telesna masa (kg) / Body weight (kg)	60.28	12.18	40	93	
Rukometaši / Handball players	60.74	12.79	40	93	p=0.68
Nesportisti / Non-athletes	59.59	11.36	40	87	
BMI (kg/m²)	21.82	2.89	17.01	29.30	
Rukometaši / Handball players	21.61	2.91	17.01	28.76	p=0.40
Nesportisti / Non-athletes	22.16	2.85	17.72	29.30	

Legend: *AS - arithmetic mean, S - standard deviation, MIN - minimum recorded result of measurement, MAX - maximum recorded result of measurement - p≤0.05 there is statistically significant difference between groups, BMI body mass index*

Legenda: *AS – aritmetička sredina, S – standardna devijacija, MIN – minimalni zabeleženi rezultat merenja, MAX –maksimalan zabeležen rezultat merenja – p≤0.05 postoji statistički značajna razlika između grupa, BMI-indeks telesne mase*

For the assessment of postural status, standardised tests (Buckup, 2005, Neumann, 2010) were applied in a medical institution in Banja Luka by a physician:

Za procenu posturalnog statusa primenjeni su standardizovani testovi (Buckup, 2005, Neumann, 2010) u medicinskoj ustanovi u Banja Luci od strane lekara fizijatra:

1. Adam's Forward Bend Test, for assessing the scoliotic impaired holding of the body;
2. Reclination test with the contraction of the extensor muscle for the estimation of the kyphotically disturbed holding of the body, and
3. Abdominal muscle contractions, for assessing lordotic disturbed body posture.

The degree of postural disorder is evaluated from 0 to 2, where 0 is a normal finding. A slight degree of deformity, which is completely flexible (corrective) is rated by grade 1 and is classified into a functional muscular skeletal disorder. A clearly inflexible (unable to be corrected) structural deformity is rated by 2.

Of the anthropometric characteristics, the following are taken into consideration:

1. Body weight (kg),
2. Body height (cm) and
3. BMI indirectly calculated (kg / m2) by formula:

$$BMI = \frac{\text{Body weight(kg)}}{Body\ height\ (m)^2}$$

Given that it was a juvenile sample of respondents, the provisions of the Helsinki Declaration on the Child Participation in Research were applied.

For the realisation of the paper, the statistical procedures of the IBM Statistics 20.0 software were used: calculation of data frequencies where the frequency of the data responses in the ordinal and nominal variables are displayed, as well as the results of descriptive statistics for calculating the basic descriptive statistical interval and scale variables: arithmetic means (AS), standard deviation (S). The level of $p < 0.05$ was taken to determine the level of statistical significance. For the purposes of determining the differences in the representation of deformities between the two previously formed subunits, a $\chi 2$ (*hi square*) test was used. Student's t-test was used to determine differences in anthropometric characteristics.

Results

The obtained results $\chi 2$ square test (Table 2) for the *Adam's forward bend test* variable indicate that there are no statistically significant differences ($p = 0.85$) between the analysed groups of subjects regarding the presence of scoliotic poor posture.

1. Adams bending test, za procenu skoliotičnog narušenog držanja tela;
2. Reklinacije sa kontrakcijom mišića ekstenzora, za procenu kifotičnog narušenog držanja tela i
3. Kontrakcije abdominalnih mišića, za procenu lordotičnog narušenog držanja tela.

Stepen posturalnih poremećaja je ocenjivan od 0 do 2, pri čemu je 0 normalan nalaz. Blagi stepen deformiteta, koji je potpuno fleksibilan (korektivan) ocenjivan je ocenom 1 i svrstava se u funkcionalni mišićno skeletni poremećaj. Jasno nefleksibilan (nekorektibilan) strukturalni deformitet, ocenjivan je ocenom 2.

Od antropometrijskih karakteristika u razmatranje su uzete sledeće:

1. Telesna masa (kg),
2. Telesna visina (cm) i
3. Indirektno je izračunat BMI (kg/m^2) putem formule:

$$BMI = \frac{\text{Telesna masa (kg)}}{Telesna\ visina\ (m)^2}$$

S obzirom na to da se radilo o maloletnom uzorku ispitanika, primenjene su odredbe Helsinške deklaracije o pravima učestvovanja dece u istraživanjima.

Za realizaciju rada koristili su se statistički postupci softverskog programa IBM *Statistics* 20.0: izračunavanje frekvencija podataka gde su prikazane frekvencije odgovora za podatke na ordinalnim i nominalnim varijablama, kao i rezultati deskriptivne statistike za izračunavanje osnovnih deskriptivnih statističkih intervalnih i razmernih varijabli: aritmetička sredina (AS), standardna devijacija (S). Za određivanje nivoa statističke značajnosti uziman je nivo od $p<0,05$. Za potrebe utvrđivanja razlika u zastupljenosti deformiteta između dva unapred formirana subuzorka korišćen je χ^2 kvadrat test. Radi utvrđivanja razlika u antropometrijskim karakteristikama primenjen je Studentov t-test.

Rezultati

Dobijeni rezultati χ^2 kvadrat testa (Tabela 2) za varijablu *Adams bending test* ukazuju da ne postoje statistički značajne razlike ($p=0,85$) između analiziranih grupa ispitanika u pogledu prisustva skoliotičnog lošeg držanja tela.

Table 2. *Adam's forward bend test (scoliosis) chart in relation to the group of respondents*

Tabela 2. *Kontigencijska tabela Adams bending test (skolioza) u odnosu na grupu ispitanika*

Varijabla / *Variable*			Grupa / *Group*		Ukupno / *In total*
			Rukometaši / *Handball players*	Nesportisti / *Non-athletes*	
Adams bending test / *Adam's bend forward test*	Normalan nalaz / *Normal findings*	Frekvencija / *Frequency*	29	20	49
		% u okviru grupe / *% within the group*	60.4%	62.5%	61.3%
		% ukupno / *% in total*	36.2%	25.0%	61.3%
	Blagi stepen krivine ili fleksibilan deformitet / *Slight degree of curvature or flexible deformity*	Frekvencija / *Frequency*	19	12	31
		% u okviru grupe / *% within the group*	39.6%	37.5%	38.8%
		% ukupno / *% in total*	23.8%	15.0%	38.8%

$\chi^2 = 0,04$ $p=0,85$ $df=1$

Taking into account the obtained results χ2 square test of *Reclination test with the contraction of the extensor muscle* variable (Table 3), they indicate that there are no statistically significant differences between the analysed subunits with regard to the presence of the kyphotic poor posture (p = 0.77).

Uzimajući u obzir dobijene rezultate χ^2 kvadrat testa varijable *Reklinacija sa kontrakcijom mišića ekstenzora* (Tabela 3) upućuju na nepostojanje statistički značajnih razlika između analiziranih subuzoraka u pogledu prisustva kifotičnog lošeg držanja tela (p=0,77).

Table 3. *Contigenic table Reclination test with the contraction of the extensor muscle (kyphosis) in relation to the group of respondents*

Tabela 3. *Kontigencijska tabela Test reklinacije sa kontrakcijom mišića ekstenzora (kifoza) u odnosu na grupu ispitanika*

Varijabla / *Variable*			Grupa / *Group*		Ukupno / *In total*
			Rukometaši / *Handball players*	Nesportisti / *Non-athletes*	
Reklinacije sa kontrakcijom mišića ekstenzora / *Reclinations with the contraction of the extensor muscle*	Normalan nalaz / *Normal findings*	Frekvencija / *Frequency*	33	23	56
		% u okviru grupe / *% within the group*	68.8%	71.9%	70.0%
		% ukupno / *% in total*	41.2%	28.7%	70.0%
	Blagi stepen krivine Ili fleksibilan deformitet / *Slight degree of curvature or flexible deformity*	Frekvencija / *Frequency*	15	9	24
		% u okviru grupe / *% within the group*	31.2%	28.1%	30.0%
		% ukupno / *% in tottal*	18.8%	11.2%	30.0%

$\chi^2 = 0,09$ $p=0,77$ $df=1$

The obtained results χ2 square test of the *Abdominal muscle contractions for assessing lordotic disturbed body posture* variable (Table 4) indicate that there are no statistically significant differences (p = 0.82) between the analysed groups of subjects regarding the presence of scoliotic poor posture.

Rezultati χ^2 kvadrat testa varijable *Kontrakcije abdominalnih mišića za procenu lordotičnog lošeg držanja tela* (Tabela 4) upućuju na nepostojanje statistički značajnih razlika između analiziranih subuzoraka (p=0,82).

Table 4. *Contigenic table Abdominal muscle contractions (lordosis) in relation to the group of respondents.*

Tabela 4. *Kontigencijska tabela Kontrakcija abdominalnih mišića (lordoza) u odnosu na grupu ispitanika*

Varijabla / *Variable*			Grupa / *Group*		Ukupno / *In total*
			Rukometaši / *Handball player*	Nesportisti / *Non-athletes*	
Kontrakcija abdominalnih mišića / *Contraction of abdominal muscles*	Normalan nalaz / *Normal findings*	Frekvencija / *Frequency*	38	26	64
		% u okviru grupe / *% within the group*	79.2%	81.2%	80.0%
		% ukupno / *% in total*	47.5%	32.5%	80.0%
	Blagi stepen krivine ili fleksibilan deformitet / *Slight degree of curvature or flexible deformity*	Frekvencija / *Frequency*	10	6	16
		% u okviru grupe / *% within the group*	20.8%	18.8%	20.0%
		% ukupno / *% in total*	12.5%	7.5%	20.0%

$\chi^2 = 0,05$ $p=0,82$ $df=1$

Discussion

The results of the study indicate that respondents of predefined groups (handball players and non-athletes) are of similar height (handball players TV = 166.98 cm to TV = 163.50 cm in non-athlete subjects), similar body mass (TM = 60,74 kg to TM = 59.59 kg) and nutrition status (BMI = 21.61 to BMI = 22.16, Table 1). Taking into account the reference values of the National Center for Disease Control and Prevention (2000), it is possible to estimate an average normal amount of nutrition of both analysed subunits compared to their average age. Such data can be justified by the enviable level of physical activity of the respondents involved in handball activities. On the other hand, children who do not engage in sports have a potentially greater risk of developing premature and obesity (BMI = 22.16), but they can still be regarded as naturally fed (Bukara-Radujković and Zdravković, 2009; Hills- Andersen and Byrne, 2011).

The obtained results indicate that there is no statistical significance in the presence of a scoliotic, lordotic, and kyphotic poor posture in two different subunits. One of the most endangered age groups in terms of impaired postures is adolescents, as it is a period in which rapid changes occur, rapid development of the organism, and the fact that accelerated growth processes do not correspond to the development and condition of the muscular system. Such processes often carry negative consequences, which can be taken as one of the reasons for the results obtained. If we look at the age of the sample, we can conclude that physical activity - handball did not cause a difference between the two groups in the form of better results of the more active sample of the respondents. Observing data in the Adam's bend forwrd test, it can be noticed that 37.5% of the non-athlete subjects had a slight degree of curvature (grade 1) or the so-called A flexible deformity versus 39.6% of handball players. On this basis, it can be assumed that respondents practicing handball, perhaps for health reasons (noted deviations and recommendations from doctors), began to handle handball, thinking that in this way they will provide support to their developing organism and act in order to stop further progress (strengthening the skeletal muscular system through the training process) of detected changes. The research Jandrić (2015) points to the connection of healthy life habits and impaired body posture, and movement and sport clearly fall into the elements of quality of life, and it has been proven that impired body structure can be seen even in athletes (Jandrić, Jankovic and Vranić, 2009).

Another aspect of interpreting the results obtained can be seen from the point of muscle asymmetry. The

Diskusija

Rezultati istraživanja ukazuju da su ispitanici unapred definisanih grupa (rukometaši i nesportisti) sličnog telesnog rasta u visinu (rukometaši TV=166,98 cm prema TV=163,50 cm kod ispitanika koji se ne bave sportom), slične telesne mase (TM=60,74 kg prema TM=59,59 kg) i stanja uhranjenosti (BMI=21,61 prema BMI=22,16, Tabela 1). Uzimajući u obzir referentne vrednosti Nacionalnog centra za kontrolu bolesti i preventivu (*Centers for Disease Control and Prevention,* 2000) može se konstatovati prosečno normalan obim uhranjenosti oba analizirana subuzorka u odnosu na svoj prosečan uzrast. Ovakvi podaci se mogu opravdati zavidnim nivoom fizičke aktivnosti ispitanika koji su uključeni u sportske aktivnosti tipa rukomet. Sa druge strane, deca koja se ne bave sportom imaju potencijalno veći rizik za razvoj predgojaznog i gojaznog stanja (BMI=22,16) ali se i dalje mogu posmatrati kao normalno uhranjeni (Bukara-Radujković i Zdravković, 2009; Hills- Andersen i Byrne, 2011).

Dobijeni rezultati istraživanja ukazuju na nepostojanje statističke značajnosti kod prisustva skoliotičnog, lordotičnog i kifotičnog lošeg držanja tela kod dva različita subuzorka. Jedna od najugroženijih uzrasnih populacija za narušeno stanje posture čine adolescenti, jer je reč o periodu u kome dolazi do brzih promena, naglog razvoja organizma i činjenice da ubrzani procesi rasta ne odgovaraju razvoju i stanju mišićnog sistema. Takvi procesi vrlo često sa sobom nose i negativne posledice, što se može uzeti kao jedan od razloga za dobijene rezultate. Ako se pogleda godište uzorka, može da se konstatuje da fizička aktivnost – rukomet nije prouzrokovao razliku između dve grupe u vidu boljih rezultata aktivnijeg uzorka ispitanika. Posmatrajući podatke u varijabli *Adams bening test* može se uočiti da je 37,5% ispitanika nesportista imalo blagi stepen krivine (ocena 1) ili tzv. fleksibilan deformitet naspram 39.6% ispitanika koji se bave rukometom. Na osnovu toga može da se pretpostavi da su ispitanici koji treniraju rukomet možda baš iz zdravstvenih razloga (konstatovanih odstupanja i preporuke lekara) počeli da se bave rukometom, misleći da će na taj način obezbediti potporu svom organizmu u razvoju i delovati u pravcu zaustavljanja daljeg napredovanja (jačajući skeletno mišićni sistem kroz trenažni proces) detektovanih promena. Istraživanje Jandrić (2015) ukazuje na povezanost zdravih životnih navika i narušenih držanja tela, a kretanje i sport jasno spadaju u elemente kvaliteta života, a dokazano je da se i narušenost telesne strukture može videti i kod sportista (Jandrić, Janković i Vranić, 2009).

Drugi aspekt tumačenje dobijenih rezultata, može da se posmatra iz ugla mišićnih asimetrija. Dominacija

dominance of the stronger limb, which is conditioned by the structure of handball and biomechanical requirements that can contribute to muscular asymmetries (Jasycyak, 2008), could potentially cause the spinal column state in children who are engaged in handball. This refers to functional asymmetry caused by hemispherical domination of the brain, which implies the use of the dominant hand (Krzykała, 2012), which is the case with the handball game and the structure of the movement in it. Mostoflei and Banica (2010) point to the functional (instrumental) lateralisation described as being acquired by dominant motor skills for body extremity (hand - foot) by social learning and construction during voluntary interactions with the environment (training) that can again be associated with movements (elements) in handball (leading the ball, throwing the ball, catching and adding, and above all and pointing to the goal).

It should be emphasised that the representation of mild curvature or degree of flexible deformity in the results of the study (grade 1) was 28.1% of the presence of kyphotic impaired posture in non-athlete children, 18.8% of poor lordotic poor posture and a scoliotic poor posture of 37.5 %. As in the previous case, subjects engaged in handball had a higher percentage of mild degree of curvature or a more flexible deformity, and in this test (Reclination test with the contraction of the extensor muscle) 31.2% versus 28.1% of non-athletes. In the variable contraction of abdominal muscles, a higher percentage of a slight degree of curvature (grade 1) or a flexible deformity in the handball group (20.8% vs. 18.8%) was recorded.

Shifts in the frontal and sagittal levels could justify the biomechanical requirements of handball. Domination of one limb, in handball sports, strengthens the muscles of the scapular-lopatic region of one hand, and this can lead to the eventual pulling of the spinal column to the right or left side. Uneven muscular strength of the back and shoulder regions (*m. infraspinatus, m. supraspinatus, m. rhomboideus major, m. rhomboideus minor, m subscapularis)* may have an effect on the occurrence of a scoliotic impaired holding by pullling spinal column in a group of boys who are actively engaged in handball, so the differences between the groups must be viewed through the prism of one hand's dominance. Kendall et al. (1983) describe in their research the possible impact of a "stronger", dominant, side of the body on the impaired posture occurence.

Similar observations on the state of musculature or some changes in the spinal column in the form of impaired posture can be found in the research of Andrašić et al. (2015) where the existence of impaired body hold-

jačeg ekstremiteta koja je uslovljena strukturom rukometne igre i biomehaničkih zahteva koji mogu da doprinesu mišićnim asimetrijama (Jasycyak, 2008) potencijalno je mogla da prouzrokuje i stanje kičmenog stuba kod dece koja se bave rukometom. Ovde se misli na funkcionalnu asimetriju prouzrokovanu hemisfernom dominacijom mozga što implicira korišćenje dominante ruke (Krzykała, 2012) što je slučaj sa rukometnom igrom i strukturom pokreta u njoj. Mostoflei i Banica (2010) navode funkcionalnu (instrumentalnu) lateralizaciju koju opisuju kao stečenu od strane dominantne motoričke veštine za telesni ekstremitet (ruka – noga) socijalnim učenjem i izgradnjom za vreme dobrovoljnih interakcija s okolinom (treningom) koja se opet može povezati sa pokretima (elementima) u rukometu (vođenje lopte, bacanje lopte, hvatanje i dodavanje, a pre svih i šut na gol).

Treba naglasiti da je u rezultatima istraživanja zastupljenost blage krivine ili stepena fleksibilnog deformiteta (ocena 1) zastupljenost kifotičnog lošeg držanja kod dece koja se ne bave sportom bila 28,1%, lordotičnog lošeg držanja 18,8% a skoliotičnog lošeg držanja najveća 37,5%. Kao i u prethodnom slučaju, ispitanici koji se bave rukometom, imali su veći procenat blagog stepena krivine ili fleksibilnog deformiteta i kod ovog testa (*Reklinacije sa kontrakcijom mišića ekstenzora*), 31,2% naspram 28,1% nesportista. U varijabli *Kontrakcija abdominalnih mišića* je zabeležen veći procenat blagog stepena krivine (ocena 1) ili fleksibilnog deformiteta kod grupe rukometaša (20,8% prema 18,8%).

Upravo pomeranja u frontalnoj i sagitalnoj ravni mogla bi da opravdaju biomehaničke zahteve rukometne igre. Dominacije jednog ekstremiteta, u sportovima tipa rukometa, ojačavaju mišiće skapularno – lopatične regije jedne ruke i time može da dođe do eventualnog povlačenja kičmenog stuba u desnu ili levu stranu. Neujednačena snaga mišića leđa i rameno-lopatične regije (*m. infraspinatus, m. supraspinatus, m. rhomboideus major, m. rhomboideus minor*, *m subscapularis*) može da ima uticaj na pojavu skoliotičnog narušenog držanja povlačenjem kičmenog stuba kod grupe dečaka koji se aktivno bave rukometom, pa se dobijene razlike između grupa moraju posmatrati kroz prizmu dominacije jedne ruke. Kendall i sar. (1983) u svom istraživanju opisuju mogući uticaj „jače", dominantne, strane tela na pojavu narušene posture.

Slična zapažanja o stanju muskulature ili nekih promena na kičmenom stubu u vidu narušenih držanja tela se mogu pronaći i u istraživanju Andrašića i sar. (2015) gde je uočeno takođe postojanje narušenih držanja tela

ing in a group of athletes involved in volleyball at different ages 11 to 16 years old was noticed. The authors point to the existence of statistically significant differences between the age groups examined in the variables for assessing the spinal column deviation at the frontal level (scoliosis assessment), with athletes of older age groups with a higher percentage of representation of impaired postures, where the impaired postures and length of sports engagement are clearly connected . Similar results are also described by Krneta et al (2012) who have determined the existence of certain deviations from the normal holding of the body in volleyball players from Vojvodina and also the occurrence of scoliotic poor postures. What can be said is that the impaired posture has a clear connection with the sports experience. These allegations only confirmed the previous experience and the results of the research in the field of muscular asymmetries on the population of athletes, where major or minor deviations were found in the frontal or sagittal level.

Conclusion

No statistically significant differences were found between children involved in the handball training exercise, for a period not longer than one year, and boys who are not engaged in sports. Sport subjects even have poorer spinal columns in the frontal (scoliotic poor posture) and sagittal level (kyphotic and lordotic poor body) than those who are not engaged in sports. The results of previous studies of other authors from similar areas have been confirmed. In order to fully understand the impact of the training process, it will be necessary to monitor the same sub-sample of the respondents in the future and repeat the same tests to assess the impaired posture after a period of one year.

The overall repertoire of program models, regardless of whether it is a continuation of physical education or other organised forms of physical activity, must be redesigned and put more emphasis on proper growth and development. Include more children of junior primary school in sports activities of extracurricular character (sports clubs). This research also draws attention to the need for more intense prevention ofimpaired postures. Trainers, PE teachers and kinesiologists should work to reduce the occuraence of impaired body holding.

kod grupe sportista koji se bave odbojkom različitih uzrasta od 11 do 16 godina. Autori ukazuju na postojanje statistički značajnih razlika između ispitivanih starosnih grupa u varijabli za procenu odstupanja kičmenog stuba u frontalnoj ravni (procena skolioze) pri čemu su sportistkinje starijih uzrasnih grupa sa većim procentom zastupljenosti narušenih držanja, gde su u jasnoj vezi narušena držanja i dužina bavljenja sportom. Slične rezultate opisuju i Krneta i saradnici (2012) koji su utvrdili postojanje određenih odstupanja od normalnih držanja tela kod odbojkašica iz Vojvodine i takođe pojavu skoliotičnih loših držanja. Ono što se može konstatovati je da narušena držanja tela imaju jasnu povezanost sa sportskim stažom. Ovakvim navodima samo su potvrđena dosadašnja iskustva i rezultati istraživanja na polju mišićnih asimetrija na populaciji sportista, gde su utvrđena veća ili manja odstupanja u frontalnoj ili sagitalnoj ravni.

Zaključak

Nisu utvrđene statistički značajne razlike između dece koja su uključena u trenažni proces bavljenja rukometom, ne duže od 1 godine, i dečaka koji se ne bave sportom adolescentnog uzrasta. Ispitanici koji se bave sportom čak imaju i lošije držanje kičmenog stuba u frontalnoj (skoliotično loše držanje tela) i sagitalnoj ravni (kifotično i lordotično loše držanje tela) od ispitanika koji se ne bave sportom. Potvrđeni su rezultati dosadašnjih ranijih istraživanja drugih autora iz slične oblasti. Kako bi se u celosti sagledao uticaj trenažnog procesa neophodno bi bilo u budućnosti pratiti isti subuzorak ispitanika i ponoviti iste testove za procenu narušenih držanja tela nakon perioda od godinu dana.

Ukupan repertoar programskih modela, bez obzira da li se radi o nastavi fizičkog vaspitanja ili drugim organizovanim vidovima fizičke aktivnosti, moraju se redizajnirati i veći akcenat staviti na pravilan rast i razvoj. Uključiti veći broj dece mlađeg osnovnoškolskog uzrasta u sportske aktivnosti vannastavnog karaktera (sportske klubove, sportska društva). Ovim istraživanjem je takođe skrenuta pažnja na potrebu intenzivnije prevencije narušenih držanja tela. Na trenerima, pedagozima fizičke kulture, kineziolozima je da svojim radom utiču na smanjenje pojave narušenih držanja tela.

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