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Short notice

Analiza snage pojedinih mišićnih grupa kod dece narušenog posturalnog statusa

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Apstrakt: Cilj ovoga rada je analiza nivoa snage pojednih mišićnih grupa, odnosno utvrđivanje razlika u varijablama : repititivna snaga trupa, eksplozivna snag a nogu i statička snaga ruku i ramenog pojasa kod dece narušene posture. Istraživanjem je bilo obuhvaćeno ukupno 67 ispitanika sa područja opštine Subotica, od čega je merenjima bilo podvrgnuto 22 ispitanika sa kifotičnim narušenim držanjem tela, 18 ispitanika sa lordotičnim lošim držanjem tela , dok je ispitanika sa ravnim stopalima bilo 27. Za merenje odnosno procenu nivoa snage pojedinih mišićnih grupa je primenjena baterija standardizovanih testova: izdržaj u zgibu, skok u dalj iz mesta i podizanje trupa za 60 sekundi. Rezultati do kojih se došlo ukazuju da postoje statistički značajne razlike u manifestaciji snage u sve tri varijable: kifotično loše držanje tela, lordotično loše držanje tela i ravna stopala.
Ključne reči: Posturalni status, snaga, loše držanje tela, mišići.

Uvod

Posturalni poremećaji su učestaliji u dečijem i adolescentnom uzrastu. U predškolskom i ranom školskom uzrastu najčešće se javljaju funkcionalni poremećaji posture, dok je za adolescentni uzrast karakteristična pojava strukturalnih deformiteta kičmenog stuba (Adar, 2004; Demeši, 2007). Tokom perioda školovanja, postura deteta se suprotstavlja mnogim spoljašnjim uticajima, koji dovode do neadekvatnih posturalnih navika. Postura se najviše menja između 7. i 12. godine života pod uticajem telesnih promena i psihosocijalnih faktora, sve u cilju postizanja ravnoteže u skladu sa novim proporcijama tela (McEvoy & Grimmer, 2005; Penha et all, 2005). Kako navode McEvoy& Grimmer (2005) posturalna kontrola razvija se segmentarno u cefalo-kaudalnom smeru, počevši od uspostavljanja kontrole glave, potom trupa

Analysis of strength of particular muscle groups in children with postural disorders

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Abstract: The objective of this paper was to analyse the level of strenght of particular muscle groups in children aged 10-11 who have postural disorder. The research was conducted in Subotica, on a sample of 67 children from which 22 had kyphotic postural disorder, 18 with lordotic potural disorder and a total of 27 children with a disturbed longitudinal instep ie flat foot. A battery of standard motor tests was used for measuring the level of strength of particular muscle groups: static strength of the arms and shoulders, standing broad jump (cm) and Sit-ups in 60 s (freq). The results indicate that there are significant statistical differences in the manifestation of strenght within all three variables: kyphotic postural disorder, lordotic postural disorder and disturbed longitudinal instep ie flat foot.
Key words: postural status, strength, bad posture, muscles.

Introduction

Postural disorders are more common in children and adolescents. In the preschool and early school age functional posture disorders are the most frequent, while the adolescence is characterized by the appearance of structural deformities of the spinal column (Adar 2004, Demes, 2007). During the period of schooling, the child's posture is opposed to many external influences that lead to inadequate postural habits. Posture varies the most between 7 and 12 years of age under the influence of body changes and psychosocial factors, in order to achieve balance in accordance with the new proportions of the body (McEvoy & Grimmer, 2005; Penha et al, 2005). As stated by McEvoy & Grimmer (2005) postural control is developing in segments following the cephalocaudal trend, beginning with the establishment of control of the head, then the torso and eventually by achieving postural stability when standing.

i na kraju postizanje posturalne stabilnosti pri stajanju. Motorički i senzorni sistem koji je odgovoran za posturalnu stabilnost prolazi kroz tranziciju u uzrastu od 4-6 godina, a postiže zrelost odrasle osobe u uzrastu od 7-10 godina. Evolucija posture u sagitalnoj ravni između 4. i 12. godine smatra se posledicom normalnog muskuloskeletnog sazrevanja ili rezultatom procesa adaptacije u smislu održavanja ravnoteže u sagitalnoj ravni (Lafond et all, 2007).). Slabost antigravitacione muskulature je pojava koja je više zastupljena u ranom školskom uzrastu u odnosu na adolescentni. Postura je usko vezana za dužinu i balans mišića koji se pripajaju na kičmenom stubu i karlici. Istraživanja su potvrdila da je poremećaj statike i dinamike kičmenog stuba, uz promene na statici i dinamici stopala, najzastupljeniji poremećaj kod školske populacije (Milenković, Bogdanović 2008).

Cilj istraživanja je analiza nivoa snage pojednih mišićnih grupa, odnosno utvrđivanje razlika u varijablama : repititivna snaga trupa, eksplozivna snaga nogu i statička snaga ruku i ramenog pojasa kod dece narušene posture.

Metod rada

Transferzalno istraživanje je sprovedeno na uzorku od šezdeset i sedmoro dece sa već postojećom dijagnozom (kifotično loše držanje, lordotično loše držanje i ravna stopala). Ispitanici su bili učenici osnovne škole „Ivan Goran Kovačić“ i osnovne škole „Jovan Jovanović Zmaj“ uzrasta deset i jedanaest godina (±6 meseci), odnosno učenici četvrtih razreda iz Subotice. Za procenu motoričkih sposobnosti kod ispitanika sa kifotičnim, lordotičnim lošim držanjem i ravnim stopalima, mlađeg školskog uzrasta bili su korišćeni standardizovani motorički testovi prema standardizovanom modelu Bala, Stojanović (2007: izdržaj u zgibu (s); za procenu statičke snage ruku i ramenog pojasa; podizanje trupa za 60 s za procenu repetitivne snage mišića trupa (frek.); skok u dalj iz mesta (cm) za procenu eksplozivne snage nogu.

Za obradu podataka koristili su se statistički postupci: deskriptivna statistika, potom je bilo izvršeno testiranje postojanja statistički značajnih razlika između grupa ispitanika za sve analizirane varijable pomoću univarijatne (ANOVA) analize varijanse i LSD Post Hok testa (serije nezavisnih t- testova).

Rezultati

Istraživanjem je bilo obuhvaćeno ukupno 67 ispitanika sa područja opštine Subotice, od čega je merenjima bilo podvrgnuto 22 ispitanika. Grupna struktura uzorka prikazana je na grafikonu 1.

The motor and sensory systems, which are responsible for postural stability, go through a transition at the age of 4-6 years, reaching maturity of adult person between the ages of 7-10. Sagittal plane postural evolution between 4 and 12 years of age is considered a normal consequence of musculo-skeletal maturation or the result of the adaptation process in terms of maintaining balance in the sagittal plane (Lafond et al, 2007). The weakness of the antigravity muscles is a phenomenon that is more common in the early school age than in adolescents. Posture is closely related to the length and balance of muscles that connect to the spine and pelvis. Also, studies have confirmed that the disorders of statics and dynamics of the spinal column, together with the changes in statics and dynamics of feet are the most common disorder in school population (Milenković, Bogdanović 2008).

The aim of the research is to analyze the strength levels of certain muscle groups, and to determine differences in the variables: repetitive strength of torso, explosive leg strength and static strength of arms and shoulders in children with postural disorders.

Method of work

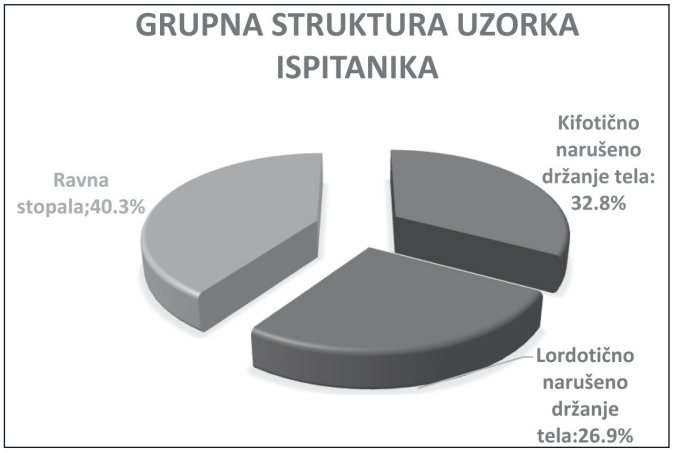
A transversal study was conducted on a sample of sixty-seven children with pre-existing diagnosis (postural kyphosis, postural lordosis and flat feet). The respondents were students of primary schools “Ivan Goran Kovačić” and “Jovan Jovanović Zmaj” of ages of ten and eleven (±6 months), i.e. fourth-grade students from Subotica. Standardized motor tests according to a standardized model by Bala, Stojanović (2007) were used for assessment of motor abilities in respondents of early school-age with kyphotic and lordotic postural disorder and flat feet. For assessment of excitation duration factors: *bent arm hang* (s), for assessment of static strength of arms and shoulders; *sit-ups in 60 s*, for assessment of repetitive strength of torso muscles (freq.) and for assessment of factors of regulation of excitation intensity; and *standing broad jump* (cm), for assessment of explosive strength of legs.

Statistical procedures used for processing of the obtained data were: descriptive statistics, then testing for the existence of statistically significant differences between groups of respondents for all variables analyzed using the univariate (ANOVA) variance analysis and LSD Post hoc test (series of independent t-tests).

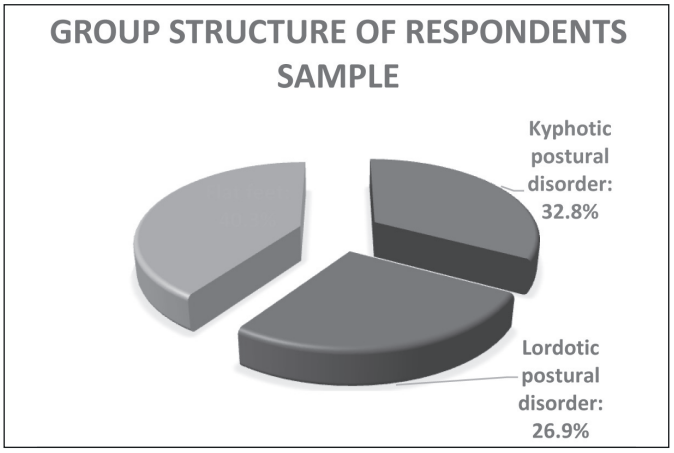
Results

The study involved a total of 67 respondents from the municipality of Subotica, of which 22 respondents were subjected to measurements. Group structure of the sample is shown in Graph 1.

Grafikon 1. *Grupna struktura ispitanika*



Graph 1 *Group structure of respondents*



Na osnovu deskriptivnih statistika u tabeli 1. može se zaključiti da su ispitanici na različitom nivou statičke snage ruku i ramenog pojasa, repetitivne snage trupa i eksplozivne snage nogu, posmatranih u okviru svojih grupa. Izuzetan varijabilitet rezultata, posledica je neujednačenosti razvoja navedenih vidova snage kod datog uzorka ispitanika i slabosti pojedinih mišićnih regija u neravnomernom odnosu kod svih ispitanika. Vrednosti minimalnih rezultata u varijabli za procenu hipotetskog motoričkog faktora trajanja ekscitacije *Izdržaj u zgibu* ukazuju na činjenicu da postoji velika neproporcionalnost između telesne mase i stanja generisanja mišićnih sila kod dece osnovnoškolskog uzrasta sa narušenim lošim držanjem. Dok pojedinci ostvaruju izuzetne rezultate (78,85 s zabeleženi kod grupe dece sa ravnim stopalima) drugi nisu u stanju da izvedu test (minimalni zabeležen rezultata u sve tri grupe je bio 0 s). Kao što se u tabeli 1. vidi, veliki su rasponi rezultata i u druge dve analizirane varijable, što je prouzrokovalo i povećan varijabilitet rezultata.

Based on descriptive statistics in Table 1 it can be concluded that the respondents are at different levels of static strength of arms and shoulders, repetitive strength of torso and explosive strength of legs, observed within their groups. Exceptional variability of the results is a consequence of imbalances in development of the above mentioned forms of strength within a given sample of respondents and weaknesses of individual muscle regions with uneven distribution in all respondents. The values of minimum results regarding variable for assessing the hypothetical motor factor of excitation duration *Bent arm hang* indicate that there is a great disproportion between body weight and the ability to generate muscular strength in children of primary school age with postural disorder. While individuals achieve outstanding results (78.85 s recorded in group of children with flat feet), others are not able to perform the test at all (minimum score recorded in all three groups was 0 s). As seen in Table 1, there are large ranges of results also in other two analyzed variables, causing the increased variability.

Tabela 1. *Rezultati deskriptivnih statistika motoričkih varijabli za ispitanike različitih grupa*

Table 1. *Results of descriptive statistics of motor variables for different groups of respondents*

Varijabla / *Variable*	Grupa / *Group*	AS / *Mean*	S / *SD*	MIN	MAX
Izdržaj u zgibu (s) / *Bent arm hang (s)*	K	14.70	10.20	0	32.10
	L	12.58	7.20	0	23.30
	RS	23.81	21.41	0	78.85
Podizanje trupa za 60 s (frek.) / *Sit-ups in 60 s (freq.)*	K	33.77	9.78	17	54
	L	19.67	5.30	8	31
	RS	35.70	10.97	15	58
Skok udalj iz mesta (cm) / *Standing broad jump (cm)*	K	167.32	19.49	108	200
	L	153.44	21.35	121	188
	RS	158.56	19.41	122	195

Legenda: *AS – aritmetička sredina; S – standardna devijacija; MIN – minimalni zabeleženi rezultat merenja; MAX – maksimalni zabeleženi rezultat merenja*

Legend: *SD – standard deviation; MIN – minimum recorded measurement result; MAX – maximum recorded measurement result*

Dobijene vrednosti F odnosa ukazuju na to da postoje statistički značajne razlike između ispitanika različitih subuzoraka u varijablama za procenu statičke snage ruku i ramenog pojasa *Izdržaj u zgibu* (p=0,03) i varijabli za procenu repetitivne snage trupa *Podizanje trupa za 60 s* (p=0,00). U varijabli za procenu eksplozivne snage nogu, *Skok u dalj iz mesta,* statistički značajne razlike nisu konstatovane (p=0,09).

The obtained values for F relationships suggest that there are statistically significant differences between respondents from different subsamples regarding variables for assessment of static strength of arms and shoulders *Bent arm hang* (p=0.03) and variable for assessment of repetitive strength of torso *Sit-ups in 60 s* (p=0.00). When it comes to variable for assessment of explosive strength of legs, *Standing broad jump*, statistically significant differences were not found (p=0.09).

Tabela 2. *Razlike između grupa ispitanika*

Table 2. *Differences between groups of respondents*

Varijabla / *Variable*	F	sig
Izdržaj u zgibu (0.1 s) / *Bent arm hang (0.1 s)*	3.58	**0.03**
Podizanje trupa za 60 s (frek.) / *Sit-ups in 60 s (freq.)*	17.51	**0.00**
Skok u dalj iz mesta (cm) / *Standing broad jump (cm)*	2.52	0.09

Legenda: F – F test; sig – nivo statističke značajnosti za F test

Legend: F – F test; sig – level of statistical significance for the F test

Da bi se dobio uvid između kojih grupa postoje statistički značajne razlike pribeglo se korišćenju t – testa za dve nezavisne grupe. U Tabeli 3. su predstavljene su vrednosti razlika aritmetičkih sredina pomoću nezavisnog t– testa primenom LSD Post Hock testa.

Dobijeni rezultati (tabela 4) ukazuju na to da se statistički značajna razlika manifestovala:

1. u varijabli *Izdržaj u zgibu*:
   a. između ispitanika sa kifotičnim lošim držanjem i ravnim stopalima (p=0,04) u korist ispitanika sa ravnim stopalima,
   b. između ispitanika sa lordotičnim lošim držanjem i ispitanika sa ravnim stopalima (p=0,02) u korist ispitanika sa ravnim stopalima;
2. u varijabli *Podizanje trupa za 60 s:*
   a. između ispitanika sa kifotičnim i lordotičnim lošim držanjem (p=0,00) u korist ispitanika sa kifotičnim lošim držanjem,
   b. između ispitanika sa lordotičnim lošim držanjem i ispitanika sa ravnim stopalima (p=0,00) u korist ispitanika sa ravnim stopalima;
3. u varijabli *Skok u dalj iz mesta:*
   a. između ispitanika sa kifotičnim i lordotičnim lošim držanjem (p=0,03) u korist ispitanika sa kifotičnim lošim držanjem.

In order to find out between which groups exactly statistically significant differences exist we used t – test for two independent groups. Table 3 presents the differences between the values of arithmetic means using independent t-test using the Post Hoc LSD test.

The obtained results (Table 4) indicate that a statistically significant difference was manifested:

1. in variable *Bent arm hang:*
   a. between respondents with postural kyphosis and flat feet (p=0.04) in favor of those with flat feet,
   b. between respondents with postural lordosis and respondents with flat feet (p=0.02) in favor of those with flat feet;
2. in variable *Sit-ups in 60 s:*
   a. between respondents with postural kyphosis and postural lordosis (p=0.00) in favor of those with postural kyphosis,
   b. between respondents with postural lordosis and respondents with flat feet (p=0.00) in favor of those with flat feet;
3. in variable *Standing broad jump:*
   a. between respondents with postural kyphosis and postural lordosis (p=0.03) in favor of those with postural kyphosis.

Tabela 3. *Serija t-testova (LSD) i razlike AS*

Table 3. *Series of t-tests (LSD) and differences in AMs*

Varijabla / *Variable*	**(I) Grupa / *(I) Group***	**(J) Grupa / *(J) Group***	**Razlika AS (I-J) / *Difference in AM (I-J)***	**sig**
Izdržaj u zgibu (s) / *Bent arm hang (s)*	K	L	2.12	0.67
		RS	-9.11	**0.04**
	L	K	-2.12	0.67
		RS	-11.22	**0.02**
	RS	K	9.11	**0.04**
		L	11.22	**0.02**
Podizanje trupa za 60s (frek.) / *Sit-ups in 60 s (freq.)*	K	L	14.11	**0.00**
		RS	-1.93	0.48
	L	K	-14.11	**0.00**
		RS	-16.04	**0.00**
	RS	K	1.93	0.48
		L	16.04	**0.00**
Skok u dalj iz mesta (cm) / *Standing broad jump (cm)*	K	L	13.87	**0.03**
		RS	8.76	0.13
	L	K	-13.87	**0.03**
		RS	-5.11	0.40
	RS	K	-8.76	0.13
		L	5.11	0.40

Legenda*:* *sig – nivo statističke značajnosti t testa*

Legend*:* *sig – level of statistical significance of t test*

Diskusija

Istraživanjem je utvrđeno postojanje statistički značajnih razlika u pogledu snage pojedinih mišićnih grupa ispitanika sa narušenim telesnim držanjima segmenata kičmenog stuba i stopala, što je potvrdilo i ranija istraživanja autora (Krsmanović, 1988; Ulić, 1997). Skraćenost grudne muskulature i izduženost mišića sa zadnje strane tela (mišića gornje trećine leđa) doprineli su lošijim rezultatima u varijabli *Izdržaj u zgibu* kod ispitanika sa kifiotičnim držanjem u odnosu na ispitanike sa ravnim stopalima, kao i između ispitanika sa lordotičnim lošim držanjem i ispitanika sa ravnim stopalima u korist ispitanika sa ravnim stopalima. Kod kifotičnog lošeg držanja u manjoj meri su zahvaćeni duboki mišići grudnog koša: spoljni i unutrašnji međurebarni mišići(*mm. intercostales externi et interni*); zatim poprečni grudni mišić (*m. transversus thoracis*) što je moglo da stvori razliku u korist ispitanika sa ravnim stopalima. Telesne promene na posturi takođe doprinose razlici u ispoljavanju snage, što potvrđuju istraživanja (McEvoy & Grimmer, 2005; Penha et all, 2005). Slaba muskulatura mišića leđa, pogotovo mišića gornje trećine leđa (površinskih i dubokih mišića), odgovorna je za slabe rezultate ove grupe ispitanika u varijabli za procenu statičke snage ruku i ramenog pojasa. Svi mišići u većoj ili manjoj meri mogu da budu oslabljeni kod dece sa kifotičnim lošim držanjem, i na

Discussion

The study found statistically significant differences regarding certain muscle groups of respondents with postural disorders of segments of the spinal column and feet, which also confirmed findings from previous research (Krsmanović 1988, Ulić 1997). Brevity of pectoral muscles and the elongation of the muscle on the back side of the body (muscles of the upper third of the back) have contributed to poor results regarding the variable *Bent arm hang* by kyphotic respondents compared to respondents with flat feet, as well as between respondents with postural lordosis and respondents with flat feet in favor of respondents with flat feet. In postural kyphosis deep muscles of the chest are affected to a lesser extent: external and internal intercostal muscles (*mm. intercostales externi et interni*); then transverse pectoral muscle (*m. transversus thoracis*) which might have created a difference in favor of those with flat feet. Physical changes in posture also contribute to the difference in the manifestation of strength, as evidenced by studies (McEvoy & Grimmer, 2005; Penha et al, 2005). Weak back muscles, especially the muscles of the upper third of the back (superficial and deep muscles), is responsible for the poor results of this group of respondents in variables for evaluation of static strength of arms and shoulders. All muscles to a greater or lesser extent can be weakened in children with postural kyphosis, and they

njih direktno treba uticati vežbama sa ciljem jačanja, dok se muskulatura grudnog koša mora permanentno istezati. Slabije stanje mišića leđa kod ispitanika sa lordotičnim lošem držanjem u odnosu na ispitanike sa ravnim stopalima je nastalo zbog protruzije trbušnog zida što potvrđuju i istraživanja Ishida & Kuwajima (2001) i Penha et all. (2005). Očito pored slabe muskulature trbuha, ovi ispitanici poseduju slabu i nerazvijenu muskulaturu leđa koja može da doprinese nastajanju kifo – skolioza koje su veoma česte, i nastaju kao posledica kompenzacije na kičmenom stubu kod dece sa lumbalnim lordozama. Evidentne statistički značajne razlike u varijabli za procenu repetitivne snage trupa *Podizanje trupa za 60 s* između analiziranih subuzoraka je posledica pre svega slabog stanja muskulature, pogotovo kod ispitanika sa lordotičnim narušenim držanjem, jer se pre svega misli na lumbalnu lordozu koju karakteriše mlitav i ispupčen trbuh, kao i slaba istegnutost mišića *m. iliopsoasa.* Slaba i istegnuta muskulatura prednjeg trbušnog zida je glavni problem kod ispitanika sa narušenim držanjem tela koji se odnosi na promene na kičmenom stubu. Slaba muskulatura, pre svega navedenih mišića ispitanika sa lordotičnim lošim držanjem je doprinela boljim i većim prosečnim rezultatima kod ispitanika sa kifotičnim lošim držanjem u varijabli za procenu eksplozivne snage nogu *Skok u dalj iz mesta.* Stanje mišića trbušnog zida moglo bi se uzeti kao izuzetno bitno za manifestaciju ove sposobnosti. Rezultati ovog dela rada potvrđuju dosadašnja istraživanja stranih autora koji ukazuju na slabost pojedinih mišićnih grupa kod ispitanika sa narušenim lošim držanjem, kao što su istraživanja Viole i Andrassy – a (1995) i Kratenove i sar. (2007).

Zaključak

Na osnovu postavljenog cilja i iznetih rezultata može se zaključiti da postoje statistički značajne razlike u manifestaciji snage kod ispitanika narušenog posturalnog statusa. Mišićna slabost, stepen skraćenosti elongiranosti određenih mišićnih grupa je osnovni razlog zbog kog su se te razlike i manifestovale. Upravo zbog navedenih činjenica se mora pristupiti izradi dugoročnog plana na polju telesnog vaspitanja i sporta koji uzima u obzir specifičnosti oslabljene muskulature kod određenih deformiteta. Istraživanje treba da bude smernica u daljem praćenju i istraživanju motoričkog prostora dece sa narušenim lošim držanjem. Zabrinjavajući podaci grupne strukture ispitanika ukazuju na to da se po pitanju prevencije narušene telesne posture i dalje jako malo deluje. Prisutnost posturalnih deformiteta kod dece je sve učestalija i definitivno tiho i sigurno uzima svoj danak ostav-

should be directly affected by exercise in order to strengthen, while the pectoral muscles have to be stretched constantly. The weaker back muscles in respondents with posture lordosis compared to those with flat feet result from the protrusion of the abdominal wall which is confirmed by research of Ishida & Kuwajima (2001), and Penha et al. (2005). Obviously, in addition to weak abdominal muscles, these respondents have poor and underdeveloped back muscles, which can contribute to emerging kyphoscoliosis, which is very common, and occur as a result of compensation at the spinal column in children with lumbar lordosis. Evident statistically significant differences in variable for assessing repetitive strength of torso *Sit-ups in 60 s* between the analyzed subsamples is a consequence of the poor condition of the muscles, especially in respondents with postural lordosis, primarily the lumbar lordosis characterized by flabby and bulging belly, and poorly stretched muscles *m. iliopsoas*. Weak and stretched muscles of the anterior abdominal wall are major problems in respondents with postural disorder relating to changes in the spinal column. Weak muscles of the body, especially above mentioned muscles of the respondents with the postural lordosis, have contributed to a better and higher average results in respondents with postural kyphosis regarding variable for the assessment of explosive strength of legs *Standing broad jump*. Condition of the abdominal muscles could be considered as extremely important for the manifestation of this ability. The results from this part of the research confirm previous studies by foreign authors that indicate the weakness of certain muscle groups in respondents with postural disorder, such as research by Viola & Andrassy – a (1995) and Kratenova et al. (2007).

Conclusion

On the basis of the set objective and presented results it can be concluded that there are statistically significant differences in the manifestation of strength in respondents with postural disorders. Muscle weakness and the degree of brevity of certain muscle groups is the main reason why these differences were manifested. Precisely because of these facts a long-term plan must be created in the field of physical education and sport that takes into account the specificities of the weakened muscles in certain deformities. The research should be a guideline in further monitoring and research of motoric space of the children with postural disorder. Disturbing data from the group structure of the respondents indicate that there are still only few works regarding the prevention of postural disorders. The presence of postural deformities in children is becoming more common and definitely quietly

ljajući " ožiljke" koji se kasnije jako teško mogu zaceliti. Porodica, zdravstvene institucije, sportski klubovi i škole moraju se više pozabaviti ovim problemom.

but surely take their toll leaving "scars" that are later very difficult to heal. Families, sports clubs and schools must be more engaged in addressing of this problem.

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