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# Differences in the Prevalence of Postural Disorders of the Spine in Lower Grades of Elementary School Students

# Razlike u zastupljenosti posturalnih poremećaja kičmenog stuba kod učenika nižih razreda osnovne škole

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***Abstract:*** *The study was conducted on a sample of 146 respondents - lower grade elementary school students, chronological age 7 - 11 years old, in the urban area of the city of Banja Luka. The total sample of respondents was divided into five subsamples according to chronological age. The main objective of the study was to determine the frequency and structure of postural disorders of the spinal column in the studied sample of subjects, as well as the differences in the prevalence of postural disorders with respect to the chronological age of the subjects, using a transversal cross-section. To assess the prevalence and differences in postural disorders of the spinal column, disorders in the sagittal plane (kyphosis and lordosis) and disorders in the frontal plane (scoliosis) were analyzed. The degree of postural disorders of the spinal column was determined using Contingency Tables - calculating frequencies (F) and percentages (%). The statistical significance of the differences in the prevalence of postural disorders of the spinal column in the sagittal (kyphosis and lordosis) and frontal planes (scoliosis) in lower elementary school students was determined using Univariate Analysis of Variance (ANOVA), and the differences in relation to their chronological age for each type of disorder were determined using the analysis of the results of the Post Hock comparison test. The degree of postural disorders of the spinal column determined by Contingency Tables - by calculating the frequency (F) and percentage (%) indicates a significant percentage of spinal column disorders (kyphosis 21.2%, scoliosis 19.9%, lordosis 19.2%), mainly in the first degree of deformation (minor deviation from the normal status), which allows for correction of the condition with the application of adequate corrective exercises in working with students of this age. The results of the univariate analysis of variance (ANOVA) show that the prevalence of kyphosis is statistically significant at the level of statistical significance p<.007 and scoliosis*

***Sažetak:*** *Istraživanje je provedeno na uzorku od 146 ispitanika-učenika nižih razreda osnovne škole, hronološke dobi 7 – 11 godina urbanog područja grada Banja Luka. Ukupan uzorak ispitanika podijeljen je na pet subuzoraka u odnosu na hronološku dob. Osnovni cilj istraživanja bio je da se transverzalnim presjekom utvrdi frekvencija i struktura posturalnih poremećaja kičmenog stuba kod ispitivanog uzorka ispitanika kao i razlike u zastupljenosti posturalnih poremećaja s obzirom na hronološku dob ispitanika. Za procjenu zastupljenosti i razlika posturalnih poremećaja kičmenog stuba analizirani su poremećaji u sagitalnoj ravni (kifoza i lordoza), te poremećaj u frontalnoj ravni (skolioza). Stepen posturalnih poremećaja kičmenog stuba utvrđen je Kontigencijskim tablicama – izračunom frekvencija (F) i postotka (%). Statistička značajnost razlika zastupljenosti posturalnih poremećaja kičmenog stuba u sagitalnoj (kifoza i lordoza) i frontalnoj ravni (skolioza) kod učenika nižih razreda osnovne škole utvrđena je primjenom Univarijantne analize varijanse (ANOVA), a razlike u odnosu na njihovu hronološku dob za svaku vrstu poremećaja ponaosob utvrđena je primjenom analize rezultata Post Hock testa upoređivanja. Stepen posturalnih poremećaja kičmenog stuba utvrđivan Kontigencijskim tablicama – izračunavanjem frekvencije (F) i postotka (%) ukazuje na značajan postotak zastupljenosti poremećaja kičmenog stuba (kifoza 21,2%, skolioza 19,9%, lordoza19,2%) i to uglavnom u prvom stepenu deformacija (manje odstupanje od normalnog statusa), što omogućava korekciju stanja uz primjenu adekvatnih korektivnih vježbi u radu sa učenicima ovog uzrasta. Rezultati univarijantne analize Varijanse (ANOVA) pokazuju da je zastupljenost kifoze statistički značajna na nivou statističke značajnosti p<.007 i skolioze p<.001 kod ispitivanog uzorka učenika. Statistička značajnost zastupljenosti lordoze*

*p<.001 in the studied sample of students. The statistical significance of the prevalence of lordosis in the studied sample of students was not determined (p= .255). The results of the LSD Post Hock comparison test show that there is a statistically significant difference in the prevalence of kyphosis and scoliosis between groups of students with regard to their chronological age.*

***Keywords:*** *spinal column, postural disorders, differences, students, Post Hock test.*

## Introduction

One of the priority tasks in working with children is undoubtedly taking care of their health, and proper growth and development. Proper posture is a basic prerequisite for good health, proper growth and development of children, which is why it is very important that posture education begins as early as possible. A particularly sensitive period of children's development is the primary school age because it is during this period that critical periods in children's development occur. Therefore, it is very important to continuously monitor the process of children's growth and development in which to insist on educating them about proper posture. It is especially important that it begins as early as possible. According to Kosinac (2008), proper posture creates favorable conditions for the activity of the locomotor apparatus. The muscles that maintain the body's balance are in normal tone (tension). Their tone is even, and this ensures the readiness of the muscles for movement. However, uneven tone and weakness of certain muscle regions, primarily the muscles of the back, chest and abdomen, are the primary causes of disorders in proper posture in children. Likewise, weakness of the pelvic girdle muscles and lower extremities can lead to secondary disorders in the upper body.

Karaiković, (1984) also points out that proper posture is influenced by the correct structure of the skeleton, the correct distribution of muscles, mass and strength, as well as the symmetry of paired body parts. Weakness or shortening of muscles can lead to poor body posture. This can be caused by everyday bad habits such as inadequate sitting and lack of motor activity that can cause poor posture or body deformities (Peterson-Kendall et al., 2005; Skender, N. 2001).

In this process, it is necessary to engage all participants in educational work (parents, teachers, medical staff) in order to achieve the integral development of all anthropological characteristics and abilities of children.

Previous experiences show that environmental characteristics influence lifestyle, including body posture, which is later reflected in the life cycle of each individual. The fact is that in the physical education of

*kod ispitivanog uzorka učenika nije utvrđena (p= .255). Rezultati LSD Post Hock testa upoređivanja pokazuju da postoji statistički značajna razlika zastupljenosti kifoze i skolioze između grupa učenika s obzirom na njihovu hronološku dob.*

***Ključne riječi:*** *kičmeni stub, posturalni poremećaji, razlike, učenici, Post Hock test.*

## Uvod

Jedan od prioritetnih zadataka u radu sa djecom neosporno se odnosi na brigu o njihovom zdravlju, te pravilnom rastu i razvoju. Pravilno držanje tijela je osnovni preduslov dobrog zdravlja, pravilnog rasta i razvoja djece, zbog čega je vrlo važno da vaspitanje držanja tijela počne u što ranijem uzrasnom dobu. Posebno osjetljiv period razvoja djece je vrijeme osnovnoškolskog uzrasta jer se u njemu i javljaju kritični periodi u razvoju djece. Zbog toga je vrlo važno neprekidno pratiti proces rasta i razvoja djece u kome insistirati na vaspitanju pravilnog držanja tijela. Posebno je značajno da ono počne u što ranijem uzrasnom dobu. Prema Kosincu, (2008), pravilno držanje tijela stvara povoljne uslove za aktivnost lokomotornog aparata. Mišići koji održavaju ravnotežu tijela nalaze se u normalnom tonusu (napetosti). Njihov tonus je ravnomjeran, a to obezbjeđuje spremnost mišića za kretanje. Međutim, neravnomjernost tonusa i slabost pojedinih mišićnih regija, u prvom redu mišića leđa, grudnog koša i trbuha primarni su uzroci nastanka poremećaja u pravilnom držanju tijela kod djece. Isto tako, slabost mišića karličnog pojasa i donjih ekstremiteta može dovesti do sekundarnih poremećaja u gornjim dijelovima tijela.

Karaiković, (1984) takođe ističe da na pravilno držanje utiče pravilnoa građe skeleta, pravilan rasporeda muskulature, mase i snage, kao i simetrija parnih dijelova tijala. Slabost ili skraćenje mišića mogu dovesti do lošeg položaja tijela. Ovo može biti izazvano svakodnevnim lošim navikama kao što su neadekvatno sjedenje i nedostatak motoričke aktivnosti koji mogu izazvati loša tjelesna držanja ili deformitete tijela (Peterson-Kendall i sar., 2005.; Skender, N. 2001).

U tom procesu neophodno je angažovanje svih učesnika u vaspitno-obrazovnom radu (roditelji, učitelji/nastavnici, medicinsko osoblje) kako bi se postigao integralni razvoj svih antropoloških karakteristika i sposobnosti djece.

Dosadašnja iskustva govore da karakteristike sredine utiču na način života, pa tako i na držanje tijela, koje se kasnije odražava na životni ciklus svakog pojedinca.

children there are a number of shortcomings that need to be eliminated. Incorrect posture is increasingly present in the young population.

The causes of incorrect posture are numerous. If we were to look for the causes of incorrect posture in children of primary school age, then they should certainly be sought first in the family, and then in school institutions, because the correct approach and understanding of the importance of physical activity in general by parents and educators represents prevention for school children.

Problems with postural disorders are very common. Many previous studies by various authors in the area of postural disorders and physical deformities in the school population in primary schools (Bogdanović, Z., Koničanin, A., 2009), indicate that the number of children with impaired postural status of the locomotor system is constantly increasing every year. In addition, physical education teachers and administrators play a significant role in the timely detection of postural disorders, the implementation of corrective treatments, as well as the process of educating children about proper posture (Koturović, Lj., Jaričević, D., 1984; Bogdanović, 2007; Bajrić, S., 2021),

This leads to the conclusion that physical and health education of children in this period is a very delicate process and that, due to possible complications (especially health complications), it should be approached very carefully and seriously. The practice is that, regardless of the sphere of human activity, the most complex and most responsible tasks are entrusted to the best experts: specialists, subspecialists, experts, etc. Is this also the case in physical and health education teaching? Except for individual cases, physical and health education teaching is not given nearly the importance it deserves. There are many objective and subjective reasons. The expertise of those who conduct the teaching is certainly one of them.

Today, it is still not sufficiently determined what teaching content and workload are needed in order to achieve optimal effects of desired transformations with a limited (insufficient) number of hours.

Due to all the above, the issue of this research is precisely related to determining the presence and possible group differences in the postural status of the spinal column among students of lower grades of elementary school in the city of Banja Luka.

## Method Of Work

### *A sample of respondents*

The research was conducted on a sample of 146 respondents-students of lower grades of elementary school,

Činjenica je da u tjelesnom odgoju djece postoji čitav niz nedostataka koje je potrebno otkloniti. Nepravilno držanje tijela je sve više prisutno kod mlade populacije.

Uzroci nepravilnog držanja tijela su brojni. Ako bi tražili uzroke nepravilnog držanja tijela kod djece osnovnoškolskog uzrasta onda ih zasigurno treba tražiti prvo u porodici, a zatim u školskim ustanovama, jer pravilan pristup i shvatanje značaja tjelesne aktivnosti uopšte od strane roditelja i vaspitača, predstavlja preventivu za školsku djecu.

Problemi sa posturalnim poremećajima su vrlo česti. Mnoga dosadašnja istraživanja različitih autora u prostoru posturalnih poremećaja i tjelesnih deformiteta kod školske populacije u osnovnim školama (Bogdanović, Z., Koničanin, A., 2009), ukazuju da se broj djece sa narušenim posturalnim statusom lokomotornog sistema svake godine stalno povećava. Pored rofitelj i prpfesori fizičkog vaspitanja imaju značajnu ulogu u pravovremenoj detekciji posturalnih poremećaja, sprovođenju korektivnih tretmana, kao i procesu vaspitanja pravilnog držanja tijela (Koturović, Lj., Jaričević, D., 1984; Bogdanović, 2007; Bajrić, S., 2021),

To navodi na zaključak da je fizičko i zdravstveno vaspitanje djece u ovom periodu vrlo delikatan proces i da mu, zbog mogućih komplikacija (posebno zdravstvenih), treba pristupiti vrlo oprezno i ozbiljno. Praksa je da se, bez obzira na sferu ljudskog djelovanja, najsloženiji i najodgovorniji poslovi povjeravaju najboljim stručnjacima: specijalistima, subspecijalistimam ekspertima i sl. Da li je tako i u nastavi fizičkog i zdravstvenog vaspitanja? Izuzev pojedinačnih slučajeva nastavi fizičkog i zdravstvenog vaspitanja se ni približno ne pridaje značaj koji zaslužuje. Objektivnih i subjektivnih razloga je mnogo. Stručnost onih koji izvode nastavu je, svakako, jedan od njih.

Danas još uvijek nije u dovoljnoj mjeri utvrđeno, kakvi su nastavni sadržaji i opterećenja potrebni da bi se, s jedne strane, pomoću ograničenog (nedovoljnog) broja sati postigli optimalni efekti željenih transformacija.

Zbog svega nevedenog, problematika ovog istraživanja upravo se odnosi na utvrđivanje zastupljenosti i eventualnih grupnih razlika u posturalnom statusu kičmenog stuba kod učenika nižih razreda osnove škole grada Banja Luka.

## Metod rada

### *Uzorak ispitanika*

Istraživanje je provedeno na uzorku od 146 ispitanika-učenika nižih razreda osnovne škole, hronološ-

chronological age 7-11 years, from the urban area of the city of Banja Luka.

The total sample of respondents was divided into five subsamples: the first subsample (19) consisted of 1st grade students, chronological age 7 years, the second subsample (45) consisted of 2nd grade students, chronological age 8 years, the third subsample (49) consisted of 3rd grade students, chronological age 9 years, the fourth subsample (23) consisted of 4th grade students, chronological age 10 years and the fifth subsample (7) consisted of 5th grade students, chronological age 11 years.

***Sample variables***

The data were obtained by assessing postural disorders of the spinal column in the frontal and sagittal planes.

**Variables for assessing the degree of postural disorders of the spinal column in the sagittal plane:**

| | |
|---|---|
| • Kyphosis (kipyphosis) | |
| - normal status | KIFONO |
| - kyphosis (kipyphosis) I degree | KYPHOS 1 |
| - kyphosis (kipyphosis) II degree | KYPHOS 2 |
| • Lordosis | |
| -normal status of the spinal column | LORDNO |
| - lordosis and degree | LORDO 1 |
| - lordosis (lordosis) II degree | LORDO 2 |

**Variables for assessing the degree of postural disorders of the spinal column in the frontal plane:**

| | |
|---|---|
| • Scoliosis | |
| - normal status of the vertebral column | SKOLNO |
| - scoliosis (scoliosis) I degree | SCOLI 1 |
| - scoliosis (scoliosis) II degree | SCOLI 2 |

***Data processing***

Degree of postural disorders of the spinal column was determined by Contingency Tables - by calculating frequencies (F) and percentage (%).

The statistical significance of differences in the presence of postural disorders of the spinal column in the sagittal (kyphosis and lordosis) and frontal (scoliosis) planes in lower grade elementary school students was determined using Univariate Analysis of Variance (ANOVA), and the differences in relation to their chronological age for each type of disorder was determined using the analysis of the results of the Post Hock comparison test.

## Results With Discussion

**Analysis of the frequency and structure of spinal column disorders in the total sample of respondents**

ke dobi 7 – 11 godina urbanog područja grada Banja Luka.

Ukupan uzorak ispitanika podijeljen je na pet subuzoraka i to: prvi subuzorak (19) činili su učenici 1. razreda, hronološke dobi 7 godina, drugi subuzorak (45) činili su učenici 2. razreda, hronološke dobi 8 godina, reći subuzorak (49) činili su učenici 3. razreda, hronološke dobi 9 godina, četvrti subuzorak (23) činili su učenici 4. razreda, hronološke dobi 10 godina i peti subuzorak (7) činili su učenici 5. razreda, hronološke dobi 11 godina.

***Uzorak varijabli***

Podaci su dobijeni procjenom posturalnih poremećaja kičmenog stuba u frontalnoj i sagitalnoj ravni.

**Varijable za procjenu stepena posturalnih poremećaja kičmenog stuba u sagitalnoj ravni:**

| | |
|---|---|
| • Kifoza (kipyphosis) | |
| - normalni status | KIFONO |
| - kifoza (kipyphosis) I stepen | KIFOZ 1 |
| - kifoza (kipyphosis) II stepen | KIFOZ 2 |
| • Lordoza (lordosis) | |
| - normalni status kičmenog stuba | LORDNO |
| - lordoza (lordosis) i stepen | LORDO 1 |
| - lordoza (lordosis) II stepen | LORDO 2 |

**Varijable za procjenu stepena posturalnih poremećaja kičmenog stuba u frontalnoj ravni:**

| | |
|---|---|
| • Skolioza (skoliosis) | |
| - normalni status kičmenog stuba | SKOLNO |
| - skolioza (skoliosis) I stepan | SKOLI 1 |
| - skolioza (skoliosis) II stepen | SKOLI 2 |

***Obrada podataka***

Stepen posturalnih poremećaja kičmenog stuba utvrđen je Kontigencijskim tablicama – izračunom frekvencija (F) i postotka (%).

Statistička značajnost razlika prisutnosti posturalnih poremećaja kičmenog stuba u sagitalnoj (kifoza i lordoza) i frontalnoj (skolioza) ravni kod učenika nižih razreda osnovne škole utvrđena je primjenom Univarijantne analize varijanse (ANOVA), a razlike u odnosu na njihovu hronološku dob za svaku vrstu poremećaja ponaosob utvrđena je primjenom analize rezultata Post Hock testa upoređivanja.

## Rezultati sa diskusijom

**Analiza frekvencija i strukture poremećaja kičmenog stuba ispitanika u totalu (učenika I-V razreda)**

**(students in grades I-V)**

Table 1 shows the frequency and structure of postural disorders of the spinal column by type of disorder for the total sample of respondents (students in grades I-V). The analysis of the frequency and percentage of kyphotic disorders shows that out of the entire sample (146) of respondents, 115 or 78.8% have a normal status (KIFONO) of the spinal column. In terms of the frequency and percentage of kyphotic disorders in the studied sample of respondents, it can be seen that the first degree of disorder (KIFOZ1) is present in 31 or 21.2% of the respondents-students. The second degree of kyphotic disorders of the spinal column (KIFOZ2) has not been determined.

In terms of the frequency and percentage of lordotic disorder in the studied sample, the attached table shows that 118 or 80.8% of the examinees have a normal status (LORDNO). The first degree of lordotic disorder (LORDO1) was determined in 27 or 18.5% of the examinees-students. The second degree of spinal column disorder (LORDO2) was determined in 1 or 0.7% of the examinees.

The analysis of the postural disorder of the spinal column in the frontal plane (scoliosis) shows that out of the entire sample (146) of examinees, 117 or 80.1% have a normal spinal column status (SKOLNO) in the frontal plane. In terms of the frequency and percentage of scoliotic disorder in the studied sample, the attached table shows that the first degree of disorder (SKOLI1) was determined in 29 or 19.9% of the examinees-students. The second degree of spinal column disorder in the frontal plane (SKOLI2) was not determined in the examined students.

Generally speaking, the obtained results of the frequency and structure of postural disorders in the sagittal (kyphosis and lordosis) and frontal plane (scoliosis) were approximately equally represented in students from grades I to V of primary school.

In the further procedure, using univariate analysis of variance (ANOVA) and Post hoc comparison test, possible differences in the presence of spinal column disorders in students based on their chronological age (from 7 to 11 years).

The statistical significance of differences in the presence of postural disorders of the spinal column in the sagittal (kyphosis and lordosis) and frontal plane (scoliosis) among students of lower grades of primary school was determined using Univariate Analysis of Variance (ANOVA) (table 2), and the differences in relation to their chronological age for each type of disorder was determined using the analysis of the results of the Post Hock comparison test (tables 3 - 5).

The value of the F-test (3.708) and its significance ($p < .007$) show that there is a statistically significant dif-

U tabeli 1 prikazana je frekvencija i struktura posturalnih poremećaja kičmenog stuba prema vrsti poremećaja za uzorak ispitanika u totalu (učenika I – V razreda). Analizom frekvencije i procentualne zastupljenosti kifotičnog poremećaja može se vidjeti da od cjelokupnog uzorka (146) ispitanika, njih 115 ili 78,8% ima normalan status (KIFONO) kičmenog stuba. U pogledu frekvencije i procentualne zastupljenosti kifotičnog poremećaja na ispitivanom uzorku ispitanika može se uočiti da je prvi stepen poremećaja (KIFOZ1) prisutan kod 31 ili 21,2% ispitanika-učenika. Drugi stepen kifotičnog poremećaja kičmenog stuba (KIFOZ2) nije utvrđen.

U pogledu frekvencije i procentualne zastupljenosti lordotičnog poremećaja na ispitivanom uzorku iz priložene tabele vidljivo je normalni status (LORDNO) ima 118 ili 80,8% ispitanika. Prvi stepen lordotičnog poremećaja (LORDO1) utvrđen je kod 27 ili 18,5% ispitanika-učenika. Drugi stepen poremećaja kičmenog stuba (LORDO2) utvrđen je kod 1 ili 0,7% učenika.

Analizom posturalnog poremećaja kičmenog stuba u frontalnoj ravni (skolioza) može se vidjeti da od cjelokupnog uzorka (146) ispitanika, njih 117 ili 80,1% ima normalan status kičmenog stuba (SKOLNO) u frontalnoj ravni. U pogledu frekvencije i procentualne zastupljenosti skoliotičnog poremećaja na ispitivanom uzorku iz priložene tabele se može vidjeti da je prvi stepen poremećaja (SKOLI1) utvrđen kod 29 ili 19,9% ispitanika-učenika. Drugi stepen poremećaja kičmenog stuba u frontalnoj ravni (SKOLI2) kod ispitivanih učenika nije utvrđen.

Generalno posmatrano, dobiveni rezultati frekvencije i strukture posturalnih poremećaja u sagitalnoj (kifoza i lordoza) i frontalnoj ravni (skolioza) približno jednako zastupljen kod učenika od I do V razreda osnovne škole.

U daljem postupku primjenom univarijantne analize Varijanse (ANOVA) i Post hock testa upoređivanja utvrđivane su eventualne razlike prisutnosti poremećaja kičmenog stuba kod učenika na osnovu njihove hronološke dobi (od 7 do 11 godina).

Statistička značajnost razlika prisutnosti posturalnih poremećaja kičmenog stuba u sagitalnoj (kifoza i lordoza) i frontalnoj ravni (skolioza) kod učenika nižih razreda osnovne škole utvrđena je primjenom Univarijantne analize varijanse (ANOVA) (tabela 2), a razlike u odnosu na njihovu hronološku dob za svaku vrstu poremećaja ponaosob utvrđena je primjenom analize rezultata Post Hock testa upoređivanja (tabele 3 – 5).

Vrijednost F-testa (3,708) i njegova značajnost ($p < .007$) pokazuju da postoji statistički značajna razlika između grupa ispitanika s obzirom na hronološku dob u

***Table 1.*** *Presentation of the frequency distribution and structure of the presence of spinal column deformities for the sample of examinees in total (students from grades I-V)*

***Tabela 1.*** *Prikaz raspodjele frekvencija i strukture prisutnosti deformiteta kičmenog stuba za uzorak ispitanika u totalu (učenika I-V razreda)*

| ***Type of disorder /*** **Vrsta poremećaja** | ***Status /*** **Status** | ***Frequency /*** **Frekvencija** | ***Percentage /*** **Procenat** ***(%)*** |
|---|---|---|---|
| *KYPHOSIS* / KIFOZA | KYPOHNO | 115 | 78.8 |
| | KYPHOS1 | 31 | 21.2 |
| | KYPHOS2 | - | - |
| | Total / Ukupno | 146 | 100 |
| *LORDOSIS* / LORDOZA | LORDNO | 118 | 80.8 |
| | LORDO1 | 27 | 18.5 |
| | LORDO2 | 1 | 0.7 |
| | Total / Ukupno | 146 | 100 |
| *SCOLIOSIS* / SKOLIOZA | SKOLNO | 117 | 80.1 |
| | SKOLI1 | 29 | 19.9 |
| | SKOLI2 | - | - |
| | Total / Ukupno | 146 | 100 |

ference between the groups of subjects with regard to chronological age in the presence of a postural disorder in the sagittal plane - kyphosis. Also, the value of the F-test (5.236) and its significance (p< .001) show that there is a statistically significant difference between the groups of subjects with regard to chronological age and in the presence of postural disorder in the frontal plane - scoliosis.

The value of the F test (1.435) and its significance (p= .225) show that there is no statistically significant difference between the examinees-students with regard to their chronological age in the prevalence of disorders in the sagittal plane – lordosis.

prisutnosti posturalnog poremećaja u sagitalnoj ravni – kifoza. Takođe, vrijednost F-testa (5,236) i njegova značajnost (p< .001) pokazuju da postoji statistički značajna razlika između grupa ispitanika s obzirom na hronološku dob i u zastupljenosti posturalnog poremećaja u frontalnoj ravni – skolioza.

Vrijenost F testa (1.435) i njegova značajnost (p= .225) pokazuju da ne postoji statistički značajna razlika između ispitanika-učenika s obzirom na njihovu hronološku dob u zastupljenosti poremećaja u sagitalnoj ravni – lordoza.

***Table 2.*** *Univariate Analysis of Variance (ANOVA)*

***Tabela 2.*** *Univarijantna analiza Varijanse (ANOVA)*

| **ANOVA** | | | | | | |
|---|---|---|---|---|---|---|
| | | **Sum of Squares** | **df** | **Mean Square** | **F** | **p** |
| KIFOSIS | Between Groups | 2.324 | 4 | .581 | 3.708 | **.007** |
| | Within Groups | 22.094 | 141 | .157 | | |
| | Total | 24.418 | 145 | | | |
| LORDOSIS | Between Groups | .988 | 4 | .247 | 1.435 | .225 |
| | Within Groups | 24.252 | 141 | .172 | | |
| | Total | 25.240 | 145 | | | |
| SKOLIOSIS | Between Groups | 3.006 | 4 | .751 | 5.236 | **.001** |
| | Within Groups | 20.234 | 141 | .144 | | |
| | Total | 23.240 | 145 | | | |

Table 3 shows the results of the LSD Post Hoc test of the prevalence of kyphosis with respect to the age of the examinees-students from 7 to 11 years. The analysis of Table 3 shows that there is a statistically significant difference in the prevalence of kyphosis between students of different chronological ages. Differences were found between students aged 11 and all other age groups. Differences between other age groups are not statistically significant.

U tabeli 3 prikazani su rezultati LSD Post Hoc testa zastupljenosti kifoze s obzirom na starosnu dob ispitanika-učenika od 7 do 11 godina. Analizom tabele 3 vidljivo je da postoji statistički značajna razlika zastupljenosti kifoze između učenika različite hronološke dobi. Razlike su utvrđene između učenika starosne dobi 11 godina sa svim ostalim dobnim grupama. Između ostalih dobnih grupa razlike nisu statistički značajne.

***Table 3.*** *KYPHOS - comparison of differences with respect to the chronological age of students (LSD Post Hoc test)*

***Tabela 3.*** *KIFOZA - upoređivanje razlika s obzirom na hronološku dob učenika (LSD Post Hoc test)*

| Dependent Variable | (I) Male / Muški | (J) Male / Muški | Mean Difference (I-J) | Std. Error | p | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| KIFOSIS | Students 7 years / Učenici 7 godina | 8 years / godina | -.08224 | .10729 | .445 | -.2943 | .1299 |
| | | 9 years / godina | -.05800 | .10698 | .589 | -.2695 | .1535 |
| | | 10 years / godina | -.19908 | .12272 | .107 | -.4417 | .0435 |
| | | 11 years / godina | -.60902* | .17502 | **.001** | -.9550 | -.2630 |
| | Students 8 years / Učenici 8 godina | 7 years / godina | .08224 | .10729 | .445 | -.1299 | .2943 |
| | | 9 years / godina | .02423 | .08039 | .764 | -.1347 | .1832 |
| | | 10 years / godina | -.11685 | .10039 | .246 | -.3153 | .0816 |
| | | 11 years / godina | -.52679* | .16015 | **.001** | -.8434 | -.2102 |
| | Students 9 years / Učenici 9 godina | 7 years / godina | .05800 | .10698 | .589 | -.1535 | .2695 |
| | | 8 years / godina | -.02423 | .08039 | .764 | -.1832 | .1347 |
| | | 10 years / godina | -.14108 | .10005 | .161 | -.3389 | .0567 |
| | | 11 years / godina | -.55102* | .15995 | **.001** | -.8672 | -.2348 |
| | Students 10 years / Učenici 10 godina | 7 years / godina | .19908 | .12272 | .107 | -.0435 | .4417 |
| | | 8 years / godina | .11685 | .10039 | .246 | -.0816 | .3153 |
| | | 9 years / godina | .14108 | .10005 | .161 | -.0567 | .3389 |
| | | 11 years / godina | -.40994* | .17087 | **.018** | -.7477 | -.0721 |
| | Students 11 years / Učenici 11 godina | 7 years / godina | .60902* | .17502 | **.001** | .2630 | .9550 |
| | | 8 years / godina | .52679* | .16015 | **.001** | .2102 | .8434 |
| | | 9 years / godina | .55102* | .15995 | **.001** | .2348 | .8672 |
| | | 10 years / godina | .40994* | .17087 | **.018** | .0721 | .7477 |

**Statistical significance at the p =0.05 level*

**Statistička značajnost na nivou p =0.05*

Table 4 shows the results of the LSD Post Hoc test of the prevalence of lordosis with respect to the age of the students from 7 to 11 years. The analysis of Table 4 shows a statistically significant difference in the prevalence of lordosis between students aged 8 and 9 years, but at the global level it does not show a static significance of the prevalence of lordosis in students with respect to their chronological age.

Table 5 shows the results of the LSD Post Hoc test comparing the prevalence of scoliosis with respect to the chronological age of the students from 7 to 11 years. The analysis of Table 5 shows that there is a statistically significant difference in the prevalence of scoliosis between students of different chronological ages. Differences were found between students aged 7 and 9 and 7 and 10 years. Also, differences were found between students aged 8 and 9 and 8 and 10 years. Students aged 10 differ from students aged 7 and 8 years. The results show that the differences between students aged 11 and all other age groups are not statistically significant.

The results obtained do not deviate from the results of previous research, which also show a significant prevalence of postural disorders in lower grades of primary school

U tabeli 4 prikazani su rezultati LSD Post Hoc testa zastupljenosti lordoze s obzirom na starosnu dob ispitanika-učenika od 7 do 11 godina. Analizom tabele 4 uočava se statistički značajna razlika u zastupljenosti lordoze između učenika starosne dobi 8 i 9 godina ali na globalnom nivou ona ne pokazuje statičku značajnost zastupljenosti lordoze kod učenika s obzirom na njihovu hronološku dob.

U tabeli 5 prikazani su rezultati LSD Post Hoc testa upoređivanja zastupljenosti skolioze s obzirom na hronološku dob ispitanika-učenika od 7 do 11 godina. Analizom tabele 5 vidljivo je da postoji statistički značajna razlika zastupljenosti skolioze između učenika različite hronološke dobi. Razlike su utvrđene između učenika starosne dobi 7 i 9 te 7 i 10 godina. Takođe, razlike su utvrđene između učenika starosne dobi 8 i 9 te 8 i 10 godina. Učenici starosne dobi 10 godina se razlikuju od učenika starosne dobi 7 i 8 godina. Rezultati pokazuju da razlike između učenika uzrasne dobi 11 godina sa svim ostalim uzrasnim grupama nisu statistički značajne.

Dobijeni rezultati ne odstupaju od rezultata dosadašnjih istraživanja koja takođe pokazuju značajnu zastupljenost posturalnih poremećaja kod učenika nižih

***Table 4.*** *LORDOSIS - comparison of differences with respect to the chronological age of students (LSD Post Hoc test)*

***Tabela 4.*** *LORDOZA - upoređivanje razlika s obzirom na hronološku dob učenika (LSD Post Hoc test)*

| Dependent Variable | (I) Male / Muški | (J) Male / Muški | Mean Difference (I-J) | Std. Error | p | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| LORDOSIS | Students 7 years / Učenici 7 godina | 8 years / godina | -.02851 | .11241 | .800 | -.2507 | .1937 |
| | | 9 years / godina | .16112 | .11208 | .153 | -.0605 | .3827 |
| | | 10 years / godina | .08924 | .12857 | .489 | -.1649 | .3434 |
| | | 11 years / godina | .12030 | .18337 | .513 | -.2422 | .4828 |
| | Students 8 years / Učenici 8 godina | 7 years / godina | .02851 | .11241 | .800 | -.1937 | .2507 |
| | | 9 years / godina | .18963* | .08422 | .026 | .0231 | .3561 |
| | | 10 years / godina | .11775 | .10517 | .265 | -.0902 | .3257 |
| | | 11 years / godina | .14881 | .16779 | .377 | -.1829 | .4805 |
| | Students 9 years / Učenici 9 godina | 7 years / godina | -.16112 | .11208 | .153 | -.3827 | .0605 |
| | | 8 years / godina | -.18963* | .08422 | .026 | -.3561 | -.0231 |
| | | 10 years / godina | -.07187 | .10483 | .494 | -.2791 | .1354 |
| | | 11 years / godina | -.04082 | .16758 | .808 | -.3721 | .2905 |
| | Students 10 years / Učenici 10 godina | 7 years / godina | -.08924 | .12857 | .489 | -.3434 | .1649 |
| | | 8 years / godina | -.11775 | .10517 | .265 | -.3257 | .0902 |
| | | 9 years / godina | .07187 | .10483 | .494 | -.1354 | .2791 |
| | | 11 years / godina | .03106 | .17902 | .863 | -.3229 | .3850 |
| | Students 11 years / Učenici 11 godina | 7 years / godina | -.12030 | .18337 | .513 | -.4828 | .2422 |
| | | 8 years / godina | -.14881 | .16779 | .377 | -.4805 | .1829 |
| | | 9 years / godina | .04082 | .16758 | .808 | -.2905 | .3721 |
| | | 10 years / godina | -.03106 | .17902 | .863 | -.3850 | .3229 |

** Statistical significance at the p =0.05 level*

**Statistička značajnost na nivou p =0.05*

***Table 5.*** *SCOLIOSIS - comparison of differences with respect to the chronological age of students (LSD Post Hoc test)*

***Tabela 5.*** *SKOLIOZA - upoređivanje razlika s obzirom na hronološku dob učenika (LSD Post Hoc test)*

| Dependent Variable | (I) Male | (J) Male | Mean Difference (I-J) | Std. Error | p | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| SKOLIOSIS | Students 7 years / Učenici 7 godina | 8 years / godina | -.06250 | .10268 | .544 | -.2655 | .1405 |
| | | 9 years / godina | -.32653* | .10238 | .002 | -.5289 | -.1241 |
| | | 10 years / godina | -.34783* | .11744 | .004 | -.5800 | -.1157 |
| | | 11 years / godina | -.28571 | .16749 | .090 | -.6168 | .0454 |
| | Students 8 years / Učenici 7 godina | 7 years / godina | .06250 | .10268 | .544 | -.1405 | .2655 |
| | | 9 years / godina | -.26403* | .07693 | .001 | -.4161 | -.1119 |
| | | 10 years / godina | -.28533* | .09607 | .004 | -.4752 | -.0954 |
| | | 11 years / godina | -.22321 | .15326 | .148 | -.5262 | .0798 |
| | Students 9 years / Učenici 7 godina | 7 years / godina | .32653* | .10238 | .002 | .1241 | .5289 |
| | | 8 years / godina | .26403* | .07693 | .001 | .1119 | .4161 |
| | | 10 years / godina | -.02130 | .09575 | .824 | -.2106 | .1680 |
| | | 11 years / godina | .04082 | .15307 | .790 | -.2618 | .3434 |
| | Students 10 years / Učenici 7 godina | 7 years / godina | .34783* | .11744 | .004 | .1157 | .5800 |
| | | 8 years / godina | .28533* | .09607 | .004 | .0954 | .4752 |
| | | 9 years / godina | .02130 | .09575 | .824 | -.1680 | .2106 |
| | | 11 years / godina | .06211 | .16352 | .705 | -.2612 | .3854 |
| | Students 11 years / Učenici 7 godina | 7 years / godina | .28571 | .16749 | .090 | -.0454 | .6168 |
| | | 8 years / godina | .22321 | .15326 | .148 | -.0798 | .5262 |
| | | 9 years / godina | -.04082 | .15307 | .790 | -.3434 | .2618 |
| | | 10 years / godina | -.06211 | .16352 | .705 | -.3854 | .2612 |

** Statistical significance at the p =0.05 level*

**Statistička značajnost na nivou p =0.05*

students (Šukova, 1986; Živković, 1987; Mihajlović et al., 2003; Bjeković et al., 2006; Kosinac et al., 2007; Paušić et al., 2008, Hodžić et al., 2010; Protić-Gava et al., 2010; Živković et al., 2011; Bajrić et al., 2012, Bajrić, S. 2021; Bozoljac et al., 2023).

Many previous studies (Kosinac et al., 2007; Bogdanović et al., 2008; Hodžić et al., 2010; Protić-Gava et al., 2010; Živković et al., 2011; Bajrić et al., 2012, Bajrić, S. 2021; Bozoljac et al., 2023) indicate that the most common causes of disorders are of the spine, long-term static sitting positions at home when writing homework, studying, a large number of classes at school, short breaks between classes, unsuitable school furniture, the way the school bag is carried and the weight. The manner of carrying and the weight of the school bag disrupts the static dynamics of the entire locomotor apparatus and leads to insufficiency of postural muscles, which promotes the occurrence of improper posture and the occurrence of pain in the neck, shoulder and back area.

This conclusion is supported by research (Paušić et al., 2008) which determined that the average weight of a school bag in relation to the weight of a student is 12.5% to 13.8% in some Dalmatian primary schools.

For years, many authors have emphasized the importance of proper posture, postural attitude, as an important element in the prevention of spinal deformities. The characteristic of postural disorders, or poor posture, is that they arise as a result of uneven growth of the skeletal system and the muscular system. Muscles develop more slowly, becoming shorter in relation to the bone. Due to this disproportion, the spinal column becomes curved (Kosinac et al., 2011; Nikšić et al., 2015).

The question arises whether the education system and the 2 hours of physical and health education, which are currently provided in primary and secondary schools in Bosnia and Herzegovina, can respond to all the problems caused by physical inactivity and a sedentary lifestyle. We confidently assert that it cannot and that in the prevention of locomotor apparatus deformities in children, the Ministry of Education and schools should take a leading role through changing curricula, increasing the number of hours of physical education and health education, education and changing the menus of children who eat in schools and kindergartens.

The normal and healthy growth and development of children of preschool and primary school age is of crucial importance for the overall development and health of a person during his lifetime (Lolić et al., 2012). Children should be allowed natural and free development with plenty of physical activities and play, because the basis for the correct status of the locomotor apparatus should be created

razreda osnovnoškolskog uzrasta (Šukova, 1986; Živković, 1987; Mihajlović i sar., 2003; Bjeković i sar., 2006; Kosinac i sar., 2007; Paušić i sar., 2008, Hodžić i sar., 2010; Protić-Gava i sar., 2010; Živković i sar., 2011; Bajrić i sar, 2012, Bajrić, S. 2021; Bozoljac i sar., 2023).

Mnoga dosadašnja istraživanja (Kosinac i sar., 2007; Bogdanović i sar., 2008; Hodžić i sar., 2010; Protić-Gava i sar.,, 2010; Živković i sar., 2011; Bajrić i sar, 2012, Bajrić, S. 2021; Bozoljac i sar., 2023) ukazuju da su najčešći uzroci nastanka poremećaja kičmenog stuba dugotrajni statički položaji sjedenja kod kuće prilikom pisanja domaćih zadaća, učenje, veliki broj nastavnih časova u školi, kratki odmori između časova, neprilagođen školski namještaj, način nošenja i težina školske torbe. Način nošenja i težina školske torbe narušavaju stato-dinamiku cjelokupnog lokomotornog aparata te dolazi do nastanka insuficijencije posturalnih mišića što pospješuje nastanak nepravilnog držanja tijela te nastanak pojave boli u području vrata, ramena i leđa.

U prilog ovoj konstataciji idu i istraživanja (Paušić i sar., 2008) koji su utvrdili svojim istraživanjem da je prosječna težina školske torbe u odnosu na težinu učenika od 12,5% do 13,8% u nekim Dalamatinskim osnovnim školama.

Godinama su mnogi autori isticali značaj pravilnog držanja tijela, posturalni stav, kao bitan elemenat u prevenciji deformacija kičmenog stuba. Karakteristika posturalnih poremećaja, odnosno lošeg držanja jeste da nastaju kao posljedica nejednakog rasta koštanog sistema i mišićnog sistema. Mišići se sporije razvijaju, postaju kraći u odnosu na kost. Usljed ove disproporcije dolazi do krivljenja kičmenog stuba (Kosinac i sar., 2011; Nikšić i sar., 2015.).

Postavlja se pitanje da li obrazovni sistem i 2 sata tjelesnog i zdravstvenog odgoja, koliko ga je trenutno u osnovnim i srednjim školama u Bosni i Hercegovini, mogu da odgovore na sve probleme koje nosi tjelesna neaktivnost i sedentarni način života. Sa sigurnošću tvrdimo da ne može i da u prevenciji deformiteta lokomotornog aparata kod djece vodeću ulogu treba da zauzmu Ministarstvo obrazovanja i škole kroz izmjenu nastavnih planova i programa, povećanje broja časova nastave tjelesnog i zdravstvenog odgoja, edukaciju i izmjenu jelovnika kod djece koja se hrane u školama i vrtićima.

Normalan i zdrav rast i razvoj djece predškolske i osnovnoškolske dobi od presudnog je značaja za cjelokupni razvoj i zdravlje čovjeka tokom životnog vijeka (Lolić i sar., 2012.). Djeci treba omogućiti prirodan i slobodan razvoj sa dosta tjelesnih aktivnosti i igre, jer osnovu za pravilan status lokomotornog aparata treba stvarati

from the earliest age. Also, the need for continuous cooperation between teachers, parents and medical staff should be emphasized, which should contribute to more effective intervention. to reduce the prevalence of postural disorders, the timely identification of disorders in the earliest stages of their occurrence, as well as the development of a program of corrective exercises and methodical procedures, is of particular importance (Lovrić, 2015).

Activities and content related to the prevention of postural disorders in school-age children can be organized indoors and outdoors. The entire program should consist of exercises for the prevention of postural disorders in the spinal column (prevention of kyphotic, lordotic, scoliotic posture). The program should include: exercises for establishing the balance of the pelvic-thigh muscles, exercises for stretching the spinal column and strengthening the trunk muscles, breathing exercises, balance exercises in the correction of postural disorders, as well as elementary games.

## Conclusion

The main goal of the research was to determine the frequency and structure of postural disorders of the spinal column, as well as any differences and significance of differences in relation to the chronological age of the subjects, in a sample of 146 subjects - students of lower grades of primary school, chronologically aged 7 to 11 years. The degree of postural disorders of the spinal column was determined by Contingency Tables - by calculating frequencies (F) and percentages (%). Analyzing the obtained results of postural disorders of the spinal column of students from 7 to 11 years old (grades I-V of primary school), it is observed that the highest percentage is represented by kyphosis (21.2%), followed by scoliosis (19.9%) and lordosis (19.2%). In general, it can be stated that the percentage of postural disorders of the spinal column in the studied sample of subjects - students from grades I to V of primary school is present in a significant number. Changes in the spinal column are mostly in the first degree of deformation, which allows for successful correction of the condition with the application of adequate corrective programs (exercises) in working with the student population of this age.

The statistical significance of the presence of postural disorders of the spinal column in the studied sample of respondents was determined using Univariate Analysis of Variance (ANOVA). The results of the Univariate Analysis of Variance (ANOVA) show that there is a statistical significance of the presence of kyphosis disorders ($p < .007$) and scoliosis ($p < .001$) in the studied sample of students. The statistical significance of the presence of lordosis in the studied sample of students was not determined ($p = .255$).

The results of the LSD Post Hock comparison test show

od najranijeg uzrasta. Takođe, treba istaći potrebu neprekidne saradnje učitelja, roditelja i medicinskog osoblja koja treba da doprinese efikasnijem uticaju na smanjenje zastupljenosti posturalnih poremećaja, jer od posebne je važnosti pravovremena identifikacija poremećaja u najranijoj fazi nastanka kao i izrada programa korektivnih vježbi i metodskih postupaka (Lovrić, 2015.).

Aktivnosti i sadržaji koji se odnose na prevenciju posturalnih poremećaja, u školskom uzrastu mogu se organizovati u zatvorenom i otvorenom prostoru. Cjelokupan program treba da bude sačinjen od vježbi za prevenciju posturalnih poremećaja na kičmenom stubu (prevencija kifotičnog, lordotičkog, skoliotičnog držanja). Program treba da se odnosi na: vježbe za uspostavljanje balansa karlično-butne muskulature, vježbe za istezanje kičmenog stuba i jačanje muskulature trupa, vježbe disanja, vježbe ravnoteže u korekciji posturalnih poremećaja kao i na elemetarne igre.

## Zaključak

Osnovni cilj istraživanja bio je da se na uzorku od 146 ispitanika – učenika nižih razreda osnovne škole hronološke dobi od 7 do 11 godina utvrdi frekvencija i struktura posturalnih poremećaja kičmenog stuba, te eventualne razlike i značajnost razlika u odnosu na hronološku dob ispitanika. Stepen posturalnih poremećaja kičmenog stuba utvrđen je Kontigencijskim tablicama – izračunom frekvencija (F) i postotka (%). Analizirajući dobivene rezultate posturalnih poremećaja kičmenog stuba učenika od 7 do 11 godina (I - V razred osnovne škole) uočava se da je u najvećem procentu zastupljena kifoza (21,2%), zatim skolioza (19,9%) i lordoza (19,2%). Generalno, može se konstatovati da je procenat zastupljenosti posturalnih poremećaja kičmenog stuba kod ispitivanog uzorka ispitanika – učenika od I do V razreda osnovne škole prisutan u značajnom broju. Promjene na kičmenom stubu su uglavnom u prvom stepenu deformacije, što omogućava uspješnu korekciju stanja uz primjenu adekvatni korektivnih programa (vježbi) u radu sa učeničkom populacijom ovog uzrasta.

Statistička značajnost prisutnosti posturalnih poremećaja kičmenog stuba kod ispitivanog uzorka ispitanika utvrđivana je primjenom Univarijantne analize varijanse (ANOVA). Rezultati univarijantne analize Varijanse (ANOVA) pokazuju da postoji statistička značajnost zastupljenosti poremećaja kifoze ($p< .007$) i skolioze ($p< .001$) kod ispitivanog uzorka učenika. Statistička značajnost prisutnosti lordoze kod ispitivanog uzorka učenika nije utvrđena ($p= .255$).

Rezultati LSD Post Hock testa upoređivanja poka-

that there is a statistically significant difference in the presence of kyphosis and scoliosis between different age groups of students.

The results of the research impose as a primary task of teachers in school and the obligation of parents to constantly instruct children in proper body posture when sitting, standing, walking and doing physical activities. Therefore, in order to preserve and improve the health of students in school, it is necessary to ensure continuous monitoring of students' postural status with the aim of timely identification of disorders and, in this regard, undertaking the necessary activities for preventive and corrective work, as well as systematic implementation of physical exercise and systematic examinations.

zuju da postoji statistički značajna razlika prisutnosti kifoze i skolioze između različitih uzrasnih grupa učenika.

Rezultati istraživanja nameću kao primaran zadatak učitelja u školi i obavezu roditelja da djecu neprekidno upućuju u pravilno držanje tijela pri sjedenju, stajanju, hodanju i tjelesnim aktivnostima. Zbog toga je za očuvanje i unapređenje zdravlja učenika u školi potrebno je obezbijediti kontinuirano praćenje posturalnog statusa učenika s ciljem pravovremene identifikacije poremećaja i stim u vezi preduzimanje potrebnih aktivnosti na preventivnom i korektivnom radu, kao i sistematsko provođenje tjelesnog vježbanja i sistematskih pregleda.

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