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EPIDEMIOLOGY OF MUSCULOSKELETAL DISORDERS IN PRIMARY SCHOOL CHILDREN IN BOSNIA AND HERZEGOVINA

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ABSTRACT

Introduction: Musculoskeletal disorders represent a significant problem of modern society which are more pronounced in young people and school children. Etiology of these disorders is found in inadequate ergonomic conditions, too heavy school bag, school furniture inadequate to age, poor posture, sedentary lifestyle, reduction of physical activity and lack of exercise. **Material and methods:** This cross-sectional study included 1315 pupils aged 8- 12 years. As a method was used "cluster sample" in the selection of subjects. The survey was conducted by questionnaire containing information on the demographic and individual characteristics of participants (age, gender, class), the manner and style of life and the performance of school tasks, followed by standardized Nordic questionnaire. The following parameters were measured: body height and weight for each student, and the weight of full and empty school bag that students that day brought to class. **Results:** The incidence of musculoskeletal pain regardless of localization was 48%. There is a statistically significant correlation between acute pain in the right shoulder and total weight of school bags, duration of caring the bag in school and time of wearing bag from school to home but not with the manner in which school bag was carried. Acute pain in the right shoulder and acute neck pain were significantly associated with the duration of sitting in school or in front of a computer at home. Acute pain in the shoulder negatively correlated with BMI percentile value of the respondents. Acute pain in the neck is also significantly associated with the weight of a full school bags, as well as time spent sitting at home doing homework. Acute back pain is statistically significantly correlated with the weight of school bags and duration of sitting periods in school. **Conclusion:** The prevalence of musculoskeletal pain, particularly chronic pain in school children aged 8-12 years is high. Weight of school bags, manner in which the bag is carried to and from school, duration of carrying bags, time spent sitting in the school and in front of the computer, duration of sitting and posture during homework, body mass index are ergonomic reasons for the development of musculoskeletal pain.

Key words: musculoskeletal pain, school age children, ergonomic factors.

1. INTRODUCTION

Musculoskeletal disorders represent a significant problem of modern society which are more and more pronounced in young people and children of school age (1). The frequency of musculoskeletal pain depends on the age of respondents, methods and definitions of pain and ways of collecting data. Research indicates that about 53% of adolescents experienced musculoskeletal pain at least once in their lifetime, while 15% had persistent musculoskeletal pain at least once a week (2, 3). Musculoskeletal pain has a negative impact on the emotional and physical well-being of children but its cause is still poorly understood (1). Etiology of these disorders is found in: inadequate ergonomic conditions, too heavy school bag, school furniture maladjusted to children, poor posture, sedentary lifestyle, reduction of physical activity and lack of exercise (4-6). At the onset of symptoms affecting also the emotional, social and behavioral factors, as well as the emergence of other somatic symptoms such as headache, stomach pain and sleep problems (13). The established risk factors in different studies are often contradictory (1). A prospective study of high school students found that physiological risk factors have more influence than physical on the occurrence of pain in the limbs and neck (7. 8). Significantly, the research of this problem in young children can give us additional insight about the early factors contributing to musculoskeletal pain in adults (1).

Universal factors affecting the incidence of musculoskeletal disorders in children can be divided into three groups, heavy school bag, furniture design that is not suitable by its dimensions to the body and inadequate posture when sitting (4). Wearing heavy school bags can be a risk for acute, short-term and chronic, long-term health problems (9, 10). The effects of heavy school bags and way of carrying is harmful not only for the back and spine, but also for other parts of the musculoskeletal system (11, 12).

Frequent musculoskeletal disorders in the majority of children are manifested only occasional limiting movements with pain and usually have little clinical implications. However, in a small number of children these symptoms may be persistent and recurrent, leading to chronic musculoskeletal pain and other consequences. The key preventive measure is to identify precisely those children who could have long-term consequences (13). In the scientific literature of Bosnia and Herzegovina there are no epidemiological studies that deal with issues of musculoskeletal pain in children and various ergonomic factors. The goal of our study was to investigate the epidemiological indicators of musculoskeletal disorders in children and to determine their association with different ergonomic stress.

2. MATERIAL AND METHODS

Cross-sectional study included 1,315 primary school students, aged 8-12 years (652 boys and 663 girls) selected randomly from 13 schools, from all 13 municipalities in Tuzla Canton (Most populated Canton in Bosnia and Herzegovina). The survey was conducted during the period September–December 2015. The method that was used is "cluster sample" in the choice of subjects: random selection of 2-5 students one class repeatedly over 1 lecture (average daily number of lectures 4-5), and 20 was selected from each class, while from each educational institution is selected a total of 100 students who attended from 3 to 7 grade. Excluding factor for respondents was the existence of congenital or acquired deformities and physical disorders (children who use wheelchairs, diagnosed with child musculoskeletal disease, determined disparity between the lower extremities, problems with the foot etc.). The study was approved by the Ministry of Education, Science, Culture and Sport of Tuzla Canton.

Prior to inclusion into the survey, respondents were provided with appropriate information, which explain the purpose, objectives and significance of the research. The survey was conducted by specially designed questionnaire, while diagnostic anthropometric measurements were made by two examiners. The questionnaire consisted of three parts. The first part consisted of data on demographic and individual characteristics of participants (age, gender, class), the second part is related to the assessment of the way and style of life and the performance of school tasks compared with ergonomic strain and the third part was standardized Nordic questionnaire for the analysis of muscle bone symptoms specially adapted for children's age (14). The survey was conducted on a voluntary basis with respect for ethical provisions of student's anonymity.

After the survey was carried out anthropometric measurements of the following parameters: body and body weight for each student, and the weight of full and empty school bag that students that day took in school. Body height and weight were measured using scales GIMA model 27310 Astra. The scale is calibrated before each measurement. The obtained values of body weight and body height were used to calculate body mass index (BMI) as a ratio of body weight (kg) by the square of height (m). In order to assess the nutritional status of patients BMI values are expressed as a percentile value for the appropriate age and gender (15). In children, the BMI changes with age. The risk of developing obesity has children which is a BMI above the 85th percentile, and obese those with BMI greater than 95 percentiles for age.

Statistical analysis: To analyze the results was used the standard Statistical Package for Social Sciences (SPSS) version 19.0. Statistical analysis used standard methods of descriptive statistics. To test the statistical significance of differences of selected variables were used χ2-test and t-test. For multivariate analyzes was used non-parametric Spearman's correlation test. Statistical analysis was performed with a confidence interval of 95%, a value of $p < 0.05$ was considered as significant.

3. RESULTS

The mean age of respondents was 11.31±1.483 years, the average weight of a full school bag was 3.977±0.973 kg, average time sitting at school is 5.03±0.731 hours, and the average time sitting in front of computers 1,422±1,343 hours. Characteristics of patients are shown in Table 1.

Characteristics of subjects	Mean	±Standard Deviation (SD)
Age (years)	11.311	1.483
School class	5.050	1.419
Weight (kg)	41.568	11.712
Height (cm)	146.175	10.605
Body mass index- BMI (m^2)	19.169	3.679
Body mass index- BMI (percentile)	60.897	30.832
Empty weight of school bag	0.501	0.068
School bag full weight	3.977	0.973
Hours sitting in school	5.033	0.731
Hours sitting in front of computer	1.422	1.343
Home work sitting time	1.990	1.304
Musculosceletal pain	1.474	0.499
The frequency of pain when carrying bag	2.661	1.291
Time carrying bag to school	2.721	1.319
Time carrying bag from school	2.757	1.339
Position change carrying bag	1.293	0.455

Table 1. Characteristics of all respondents (n= 1315)

The frequency of musculoskeletal pain regardless of localization was 48%. The analysis of the localization of pain on the body, we recognize that dominate acute in 15% and chronic pain in both shoulders in 22%. Acute pain in the right shoulder has a frequency of 19% and left only 1% (children are right-handed). Acute and chronic pain in the neck has the same prevalence, but which is high for this age, or 17%. Alarmingly high frequency also had presence of chronic back pain–16%, and chronic pain in the chest–12% (Table 2).

Estimated is also the association of acute musculoskeletal pain in patients and various ergonomic load (Table 3). There

Musculosceletal pain	Number (n)	Prevalence %
Musculosceletal pain	624	48
Acute neck pain	61	17
Chronic neck pain	221	17
Acute right shoulder pain	247	19
Acute left shoulder pain	15	1
Acute both shoulder pain	193	15
Chronic right shoulder pain	42	3
Chronic left shoulder pain	23	2
Chronic both shoulder pain	291	22
Chronic right elbow pain	23	2
Chronic left elbow pain	7	,5
Chronic both elbow pain	12	,9
Chronic wrist pain	12	,9
Chronic chest pain	158	12
Chronic back pain	214	16
Chronic pain in the hip	50	4

Table 2. Prevalence of musculosceletal pain among allrespondents (n= 1315)

is a statistically significant correlation between acute pain in the right shoulder and full weight of school bags (p=0.001); acute pain in the right shoulder and bag carrying time to school (p=0.004); acute pain in the right shoulder and carrying time of bags from school (p=0.001). There was no significant correlation between acute pain in the right shoulder and manner of carrying school bags. Acute pain in the right shoulder and acute neck pain were significantly associated with the duration of sitting in school (p=0.001) or in front of a computer at home (p=0.001). An interesting result revealed that the acute pain in the shoulders negatively correlated with BMI percentile value of the respondents. Acute pain in the neck was also significantly associated with the full weight of school bags (p=0.001), as well as the time spent sitting at home doing the homework (p=0.001). Acute back pain is statistically significantly correlated with the weight of the full school bags (p=0.001), and duration of sitting in school (p=0.001) (Table 3).

Correlation between musculoceletal pain and ergonomic risk	Spearman correlation factor	P-value
Musculosceletal pain and age	0.209	<0.000
Musculosceletal pain and sex	0.120	<0.000
Acute neck pain and school bag full weight	0.137	<0.000
Acute right shoulder pain and empty weight of school bag	0.017	0.540
Acute right shoulder pain and school bag full weight	0.076	0.006
Acute back pain and school bag full weight	0.151	<0.000
Acute right shoulder pain and way of carrying school bag	-0.016	0.552
Acute left shoulder pain and way of carrying school bag	0.044	0.111
Acute right shoulder pain and time carrying bag to school	0.079	0.004
Acute right shoulder pain and time carrying bag from school	0.089	0.001
Acute neck pain and hours sitting in the school	0.100	<0.000
Acute right shoulder pain and hours sitting in the school	0.121	<0.001
Acute left shoulder pain and hours sitting in the school	0.008	0.764
Acute back pain and hours sitting in the school	0.209	<0.000
Acute neck pain and hours sitting during home-work	0.102	<0.000
Acute right shoulder pain and hours sitting in front of computer	0.120	<0.000
Acute left shoulder pain and hours sitting in front of computer	0.025	0.145
Acute back pain and hours sitting in front of computer	-0.033	0.234
Acute neck pain and BMI	-0.044	0.109
Acute shoulder pain and BMI	-0.017	<0.001
Acute back pain and BMI	-0.046	0.093

Table 3. Association between ergonomic factors and musculosceletal pain among all respondents (n= 1315)

4. DISCUSSION

The frequency of musculoskeletal pain among school children in our study is similar to results of other authors (17-23). The most common locations of pain include the neck, shoulders and back which is consistent with our results (24, 25, 26). In our results, the prevailing is chronic pain in shoulders - 22%, the neck - 17% and back - 16%. In a study conducted in the Netherlands was recorded much lower prevalence of chronic pain in the shoulders of 11.5% and 7.5% in the neck (27). On the other hand, the representation of pain in the shoulders and neck in children in China was 41.1% (28). The incidence of chronic back pain ranged from 39% to 76.4% (19). Our results are slightly lower with the prevalence of back pain of 16%.

Prolonged sitting in school and at home, in front of computers and while doing homework is important ergonomic factor leading to musculoskeletal disorders in children (20, 21, 29). Our results have also shown that prolonged sitting leads to pain in the neck, right shoulder and the back. Children who are not physically active, especially if they spend leisure time in a seated position are at increased risk for developing postural deformities (21). Children in school are sitting 95% of time, and at home in front of the computer about 1.5 hours as shown by our research. In fact, children on average are sitting 5 hours at school and about 1.4 hours in front of computers (22, 23). Duration of seating alone, is probably not important, but also the fact that children are sitting in the inadequate posture where their torso, back and neck are flexed or rotated for longer periods of time is being partly caused by an non ergonomic furniture design (4,29).

The weight of full school bag in our study was 3.97±0.977 kg and it is positively correlated with the pain in the neck, right shoulder and back. A study conducted in Iran showed that school bag has an average weight of 2.9 kg (lighter than the bags of our respondents) causes pain in 80% of students (13). To prevent complications of carrying heavy school bags most experts recommended that the weight of school bags does not exceed 10-15% of the body weight of the child, and also requires adequate ergonomic design of the bags and manner of its carrying, lockers in schools and libraries (11). Acute pain in the shoulder is correlated with BMI which is contrary to international studies that have not confirmed such relation, or body mass index is not a contributor to musculoskeletal pain in children.

5. CONCLUSION

The prevalence of musculoskeletal pain, particularly chronic pain in school children aged 8-12 years is high. The weight of school bags, manner in which children carry bags to and from school, duration of carrying bags, duration of periods while sitting in the school and in front of the computer, duration of sitting and posture during making homework, body mass index are ergonomic reasons for the development of musculoskeletal pain.

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