

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 χ^2 -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
Musculoskeletal 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