

The Ratio of School Bag Weight to Body Weight and Its Relationship with some Factors in Elementary School Students of Gorgan, Iran, in 2013-14

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Background: School age is a sensitive period in the child growth. Backpack weight has an important impact on physical growth and neuromuscular development of the children. Regarding this, the present study was conducted to determine the ratio of backpack weight to body weight and investigate its relationship with some factors among the elementary school students of Gorgan, Iran, within 2013-14.

Methods: This cross-sectional descriptive-analytical study was conducted on 258 elementary school students of Gorgan, Iran, in academic year of 2013-14. The participants were selected via stratified random sampling. The data were collected using a digital scale, a meter, and a checklist. The body weight and height of the students were measured once in the presence of the researcher. Data analysis was performed using the Mann-Whitney, Kruskal-Wallis, and analysis of variance through the SPSS version 16.

Results: According to the results, 57.4% of the participants were female. Regarding the bag type, the backpack and other types of bags, such as file-box, had the highest (89.5%) and lowest (0.8%) frequencies, respectively. The mean ratio of students' bag weight to their body weight was 9.4 ± 3.78 . Furthermore, the ratio of bag weight to body weight had a significant difference ($P < 0.001$) between the two groups of boys and girls, between the various school levels, and also between the different school bag types. Nevertheless, there was not a significant difference in bag weight considering the parental occupation. Moreover, the most common pain and discomfort was found to be in the neck (27.3%).

Conclusion: Although this study indicates that the ratio of bag weight to students' body weight is in the standard limit, but neck pain was common, and this issue could be considered and taught in school schedules by managers of educational settings.

Keywords: Body weight, Elementary schools, Gorgan, School bag, Students

Introduction

Among the social institutions, school is one of the most important officially organized centers (1). School is considered as an educational-social center, which is related to various growth aspects of the children (2), who constitute 20% of the active agents of the society (3). During the school period, the child experience physical, mental, emotional, and social variations (1).

On the other hand, the children face numerous physical and psychological injuries during the school years (3). These problems might lead to growth disorders and childhood diseases if enough attention is not paid to the ergonomic factors (4), and suitable environment is not provided for their growth and development. All these factors would not only pose serious obstacles to learning and education process, but also bring about many physical and psychological diseases and disorders in the adulthood (1, 5).

A suitable and healthy body condition is the right of the future adults of the society (6). Therefore, considering the sensitivity of physical growth in the childhood and adolescence, the health development programs should be applied in schools in order to prevent the injuries and side effects (3).

In the school period, the main reasons for physical injuries and growth disorders should be searched in incorrect sitting positions, walking, and lots of other problematic habits. Carrying heavy things, such as heavy bags that are full of books or shoulder bags, by one hand could cause organ deformity (1), and plays an important role in occurrence of movement disorder during the youth period (3).

If the body structures do not form properly in the childhood, the individuals will certainly confront serious problems in the next stages of life (7). Furthermore, the bags and educational equipment are carried in different ways, affecting students' efficiency and health condition (8). Using backpacks and other types of school bags may impose hidden and evident influences and pressure on the stature and skeleton of students, and result in some disorders in the physiological functions

(e.g., metabolic, cardiovascular, and respiratory systems) (9).

According to the Ontario Chiropractic Association in Canada, the bag weight should be less than 10% of the body weights for the elementary school students (10). Consistent with the previous studies, carrying backpacks that weigh more than 10% of the body weight causes such injuries as neck pain, shoulder pain, and backache. The heavy backpacks and the way of carrying them could cause pressure on the musculoskeletal system, which clearly leads to the change of body structure and walking, and gradually ends in discomfort. Almost half of the students have complaints about various musculoskeletal disorders, such as muscular fatigue, numbness, backache, shoulder pain, and neck pain during their school years (11).

There are some factors that could affect the students' health. These factors include inattention to the schedules in schools, disconformity of the measures and tools, and students' unawareness about a proper sitting position, correct method of carrying, and suitable bag type. These factors might lead to some problems for the students in the future if happening again and again (4).

In a study conducted by Whittfield on the students of New Zealand, about 77.1% had experienced some musculoskeletal signs during their school life (12). However, this value was reported as 30-65% in a study carried out by Linton (13). This difference might be due to the study design and/or exaggerated responses of the children. The high prevalence of musculoskeletal signs among the students is a matter of fundamental importance, which is related to the use of heavy backpacks and carrying methods based on various studies.

The prevalence of these disorders in the students has been reported to be more than 80%. If these disorders are not identified and prevented properly, they will have irreparable consequences (14). Considering the importance of the harmful effects of the heavy school bags on the students' health, this study was performed with the aim of determining the ratio of school bag weight to body weight and evaluating its relationship with some factors among the students of

elementary schools in Gorgan, Iran, during 2013-14.

Methods

This cross-sectional descriptive-analytical study was conducted on the elementary school students (grades one to six) in Gorgan, Iran. Following a study conducted by (1), the sample size was determined as 258 cases. Firstly, all the schools of Gorgan (i.e., 108 schools) were assigned into two groups of all girls and all boys schools, and then five schools were randomly selected from each group. Subsequently, based on the number of the students in each grade, the samples were randomly chosen.

The data was collected using a demographic checklist, including some information about gender, school grade, as well as parental literacy level and jobs. In addition, some questions were also posed regarding whether the students had any problem for carrying the bag, and also their discomfort and problems. In order to measure the students' weight and also their bags' weight, a digital scale (SWANQF-2003B) was used, and their height was measured from head to feet using a meter.

After the measurement of the students' bags, their height and weight without the bag were measured by the researchers. In order to prevent the research bias, the sampling days were selected randomly. Sampling was

performed within September-November, Association of Canada, the bags of the elementary school students should weigh less than 10% of their body weights (10). Therefore, the ratio of the bag weight to body weight of the students was calculated through dividing the bag weight by body weight multiplied by 100.

The data was analyzed using descriptive statistics and statistical tests, including the independent t-test, Mann-Whitney U test, analysis of variance, and the equivalent non-parametric test of Kruskal-Wallis test when the statistical assumptions (e.g., normality) did not apply to the data. The data was entered into the SPSS version 16 software. P-value less than 0.05 was considered statistically significant.

Results

According to the results, the majority of the students (57.4%) were female. Furthermore, most of the students (21.3%) were in grade one and the least of them (13.2%) were in grade five. Regarding the bag type, the backpack had the highest frequency (89.5%). The findings demonstrated that the mean of bag weight was 2.8 ± 0.8 kg. The mean of bag weight to body weight ratio was 9.4 ± 3.78 . Additionally, considering the standard, the ratio of bag weight to body weight was less than 10% in 59.48% of the students and more than 10% in 40.32% of the students (Table 1).

Table 1. Descriptive statistics and Analytic of the bag weight to body weight ratio in the elementary school students

Bag type	Number	Percentage	Mean \pm SD	P-value
Backpack	231	89.5	9.58 \pm 3.47	P<0.001
Satchel and handbags	10	3.9	8.03 \pm 5.78	
Wheeled bag	5	1.9	15.89 \pm 4.04	
Shoulder bag	10	3.9	5.12 \pm 4.43	
Others (e.g., binder bag)	2	0.8	7.54 \pm 6.3	
Total	258	100	9.45 \pm 3.78	

Table 2. Mean ratio of bag weight to body weight based on school grade

School grade	Mean±SD	P-value
First	11.4±3.68	P<0.01
Second	11.26±3.78	
Third	9.27±3.19	
Fourth	9.65±3.19	
Fifth	7.46±2.97	
Sixth	6.35±2.68	
Total	9.45±3.78	

Regarding gender, the mean ratio of bag weight to students' body weight was 10.19±3.88 and 8.5±3.44 in the female and male students, respectively. Based on the Shapiro-Wilk test, the data did not have normal distribution in neither of the groups. The results of the Mann-Whitney U test revealed that the mean ratio of bag weight to body weight was significantly different between the two groups (P<0.001). Furthermore, there was a significant difference between the students of different grades regarding the ratio of bag weight to body weight according to the results of the Kruskal-Wallis test (P<0.001).

Additionally, the father's and mother's job and education were not effective factors in the ratio of bag weight to students' body weight (P=0.784, P=0.124, P=0.327, and P=0.024, respectively). The Spearman correlation

coefficient indicated no significant linear correlation between the bag weight and body weight (P=0.371). Nonetheless, there was a significant linear correlation between the bag weight to body weight ratio and the students' height (r=-0.611, P<0.001), indicating that the taller people had more standard bag weights.

Regarding the students' pain and discomfort, the "other" type of bag was omitted due to their low frequency, and then the other groups were analyzed. The results showed that 81.4%, 17.4%, and 1.2% of the students had neck pain, shoulder pain, and pain in the back and hands, respectively (Table 3). Among those students with backpack, 83.1%, 15.6%, and 1.3% of the participants reported discomfort in the neck, shoulder, as well as back and hands, respectively.

Table 3. Frequency distribution of pain and discomfort in the neck, shoulder, and back and hand based on bag type

Pain frequency	Neck pain	Shoulder pain	Back and hand ache	Total
Bag type	N(%)	N(%)	N(%)	N(%)
Backpack	64(83.1)	12(15.6)	1(1.3)	77(100)
Satchel and handbag	3(50)	3(50)	0	6(100)
Shoulder bag	3(100)	0	0	3(100)
Total	70(81.4)	15(17.4)	1(1.2)	86(100)

According to the results of the Fisher's exact test, the school bag type did not affect the induction of discomfort in the neck ($P=1$), shoulder ($P=0.74$), and back ($P=0.92$).

Discussion

As the findings of this study indicated, 40.3% of the studied elementary school students carried bags weighing more than 10% of their body weights, which is an almost high percentage, compared to those reported by the similar studies. Accordingly, in a study conducted by Emdadi (1), 12% of the students used to carry bags weighing more than 10% of their body weights. This difference might be due to the gradual increase of the number of the school books, compared to the previous years.

One of the results of this study was that the difference in the bag weight to body weight ratio was significant between the two groups of female and male students, which is consistent with the study of Emdadi (1). Moreover, in a study performed in Hamedan, the frequency of the female elementary students, carrying bags weighing more than 10% of their weights, was higher than that of the male students. This finding is consistent with those of the present study, which might be due to having snacks or more complete stationery.

According to the results of the current study, the ratio of bag weight to body weight indicated a statistically significant difference between different school grades. In this regard, the mean of bag weight to body weight ratio decreased in higher grades, and the highest ratio belonged to the first grade. Shamsalddini et al. (11) demonstrated that the older students had lighter bags, which is consistent with our study. On the other hand, Emdadi et al. (1) showed that the first grade students carried 200 g heavier bags than their second grade counterparts.

In a study conducted in Italy, Moseliano et al. indicated that the 10% backpack weight to body weight ratio was standard. Furthermore, in the mentioned study, 21% of the heaviest backpacks belonged to the third grade students, and the eighth grade students had the lowest percentage (9%) of the heaviest backpacks (5). This might be due to the fact

that the younger students are less experienced in bringing the books for the day. On the other hand, it is expected that the students gain more weight as they grow older, which by itself leads to the reduction of this ratio.

We found no significant relationship between the bag weight to body weight ratio and parental occupation, which is consistent with the study performed by Emdadi et al. (1). In this study, the occurrence rates of the neck pain, shoulder pain, backache, and hand pain were 2.7%, 26%, 8.9%, and 2.3%, respectively. In a study conducted by Beheshtipour et al. on 1,255 students, the shoulder and neck pain and backache were estimated as 45% and 6%, respectively (3). In another study carried out by Stephan et al., 46% of the participants had moderate backache (15). In a study performed in Milan, Italy by Nigrini et al., 46.1% and 65.7% of the students complained of backache and fatigue due to school bag weight, respectively (16). This minor difference is probably due to the cultural and population differences.

Conclusion

As the findings of the present study indicated, the ratio of bag weight to body weight was higher than standard in 104 students (40.3%). In addition, 33.3% of the students had some complaints about physical problems due to their school bags weight. Although the reported complaint rate was not very high, this low rate might result in some consequences and various problems in the future. Therefore, the healthcare personnel and other school teachers should inform the students and even their parents about school bags weight, bag type, and way of carrying them in order to diminish the respective complaints and injuries.

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