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Investigation of the Relationship Between Carrying School Bags (Handbags and Backpacks) and the Prevalence of Musculoskeletal Pains among 12-15 Year Old Students in Shiraz

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Abstract: Inappropriate school bags put students at risk of musculoskeletal problems and early fatigue. Heavy bags can change the body posture and the musculoskeletal system must react appropriately in order to compensate for this stress. It is recommended that the weight of a school bag must not be more than 10% of the student's body weight and the weight must be placed on both shoulders. The present study aimed to identify the risk factors associated with musculoskeletal disorders by comparing the prevalence of musculoskeletal pains among the students. The present descriptive, cross- sectional study was conducted in different educational districts of Shiraz. The study samples were selected using cluster sampling method. In this study, 800 students marked their painful areas on body maps and the SPSS statistical software (v. 11.5) was used to analyze the data. The results showed that among the students who used backpacks, 48.9% carried the weight on both shoulders, 40.4% carried the weight on their right shoulders, and 10.6% used their left shoulders. Besides, 68.02% of the students carrying handbags often used their right shoulders, while 31.98% used their left shoulders. The study results showed that similar to other countries, Iranian students also mostly made use of backpacks. Moreover, the musculoskeletal pains were most prevalent in the shoulders, which is in line with many other studies conducted on the issue.

Key words: Posture, body map, education, body weight

INTRODUCTION

People are faced with various forms of load carrying and its consequences in their daily life. Most occupations also expose people to the problems resulting from load carriage. One of the most common forms of load carrying is making use of backpacks. Students of various education levels use bags or backpacks for carrying their books and other education instruments (Legg and Cruz, 2004).

Studies have shown that more than 50% of the students carry very heavy school bags. Also, 55% of the students carry loads which weigh more than the allowed limit (10-15% of the body weight) to school which may damage the vertebral column and cause musculoskeletal pains (Iyer, 2001).

Nowadays, a large number of individuals suffer from spinal pain which is one of the most common reasons for visiting the physicians. Students also experience spinal pains quite early mainly due to using heavy school bags (Legg and Cruz, 2004; Grimer, 1996).

Studies have revealed a significant relationship between the backpack weight and body posture. For instance, in case the students use school bags which weigh more than 10-15% of their body weight, a forward head posture is created in order to compensate (Weir, 2002). Ideally, a school bag or backpack should not weigh more than 10% of the individual's weight and is better to be carried on both shoulders (Whittfield *et al*., 2005).

Carrying school bags (handbags or backpacks) not only creates some musculoskeletal as well as postural problems, but it also affects the lung mechanics and the respiratory volume. Besides, it has been shown that carrying loads close to the trunk can affect the pulmonary function (Weir, 2002; Siambanes *et al*., 2004). Of course, the rate of effects is various at different ages. Between 12 and 14 years of age (middle school), human's vertebral column is continuously growing and any kind of stress to the vertebral column presents as pain and discomfort (Leboeuf-Yde and Kyvik, 1998).

Up to now, the effect of carrying heavy bags on the adolescents' natural growth has not been proved. Studies

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have been conducted on the relationship between heavy school bags and educational failure, lack of motivation, lack of learning, and absenteeism; however, no definite results have been obtained (Ko and Kim, 2013).

Moreover, several studies have been performed on the physiological and biomechanical effects of carrying backpacks on the musculoskeletal system and human body. These studies have investigated various factors related to carrying backpacks or school bags. Most of the studies have shown the backpack weight as the main factor causing undesirable effects on human body, particularly when the backpack or school bag weighs more than 15-20% of the body weight. Length of carriage and design of the school bag were also among the factors which attracted the researchers' attention (Weir, 2002, Stuempfle *et al*., 2004; Mazzocca *et al*., 2005; Liu, 2007; Devroey *et al*., 2007).

According to what was mentioned above, it is necessary to conduct studies on this issue on Iranian students in order to clarify various dimensions of carrying heavy bags. The results of such studies can be used to plan and execute programs for changing the authorities', parents', and students' attitude toward carrying heavy bags and prevent pain as well as musculoskeletal problems among the children and adolescents.

MATERIALS AND METHODS

Subjects: In the present descriptive-analytical, cross-sectional study, the samples were selected through cluster sampling. First, Shiraz districts were defined as categories and each school was considered as a cluster. Then, random sampling was performed for selecting the clusters and all the students of each school were entered into the study.

The study was conducted on 12-15 year old middle school students. This group was selected because of their sensitive body growth. In addition, they use school bags more than the following levels and, at the same time, have more capability for completing the questionnaires compared to the primary school students.

Study protocol: The study data were collected through a researcher-made questionnaire whose validity had been confirmed. This questionnaire included both open-ended and close-ended questions classified in 5 categories of demographic information, history of the student's diseases, information about the student's activities, and features of the school bag and its carrying mode. The ratio of the bag weight to the body weight (kg) was also calculated in 3 different days.

Statistical analysis: Finally, the data were entered into the SPSS statistical software (v. 11.5) and analyzed through descriptive and analytical statistical methods. Chi-square was used to determine the independence of two qualitative variables, while one-way and two-way ANOVA were used for comparing the quantitative measures.

RESULTS

According to the results, 54.1% (424) of the participants were female, while 45.9% (360) were male and 16 questionnaires were excluded from the study due to the distortion of the answers to the main questions. Considering the educational districts, 24.6, 18.8, 30.4, and 26.2% of the students were from the first, second, third, and fourth educational districts, respectively. Moreover, 33.7, 33.8, and 32.4% of the students were studying in the first, second, and third grades of middle school, respectively.

The study results showed that 20.3, 33.6, 14.2, and 31.9% of the students carried their bags for less than 10 min, between 10 and 20 min, between 20 and 30 min, and more than 30 min, respectively. In addition, 10.8% of the subjects never, 42.3% rarely, 32.3% mostly, and 14.5% always felt a kind of pain due to carrying their bags. Furthermore, 18.8, 21.3, 26.3 and 33.6% of the participants watched TV or used computer for less than an hour, between 1 and 2 h, between 2 and 3 h, and more than 3 h, respectively. Besides, 60.5% of the students used benches, while 39.5% used chairs.

According to the study findings, 62.6, 16 and 21.3% of the students used backpacks, handbags, and shoulder bags, respectively. In addition, 31% of the students carried their bags on both shoulders, while 69% carried them on one side. Among the students who used backpacks, 48.9, 40.4 and 10.6% carried them on both shoulders, the right shoulder, and the left shoulder, respectively. Regarding those who made use of handbags or shoulder bags, 68.02% used the right side, while 31.98% used the left side.

Overall, 80.6% (632) of the students mentioned that their feeling of pain was related to carrying school bags. Among these students, 40.8% stated that they felt pain when they carried the bags, while 32% said that they felt pain when they put the bags down. Also, 27.2% mentioned that they always felt this pain.

The mean weight of school bags was compared between the two sexes. According to the results, the mean weight of the girls' and boys' bags was 3.67 and 3.88 kg, respectively and the difference was statistically significant ($P = 0.001$) (Table 1).

Table 1: Information about the students' weight, height, and bag weight

Variable	Students' mean weight (kg)	Mean height (m)	Mean weight of school bags (kg)
Sex			
Female	50.36	1.5	3.67
Male	50.16	1.48	3.88
Educational district			
First	52.12	1.51	3.87
Second	50.99	1.49	3.65
Third	48.78	1.47	3.67
Forth	50.26	1.48	3.88
Guidance School			
First year	45.81	1.44	3.76
Second	50.13	1.50	3.83
Third	54.27	1.53	3.71

Table 2: Relationship between the type of school bags and musculoskeletal pains

	Existence of	Type of bag			
Type of pain	pain	Backpack (%)	Handbag (%)	Shoulder bag (%)	p-value*
Pain in at least one part of the body	Yes	83	81.6	88	0.245
	No	17	18.4	12	
Neck pain	Yes	33.5	34.7	47.5	0.005
	No	66.5	65.3	52.5	
Shoulder pain	Yes	52.4	46	54.9	0.301
	No	47.6	54	45.1	
Back pain	Yes	33.2	25.8	33.4	0.213
	No	66.7	74.2	66.7	
Elbow pain	Yes	3.2	9.7	6.2	0.007
	No	96.8	90.3	93.8	
Waist pain	Yes	39.8	29.8	50.6	0.002
	No	60.2	70.2	49.4	
Hand and wrist pain	Yes	8.6	23.4	18.5	0.004
	No	91.4	76.6	81.5	
Thigh pain	Yes	9.3	7.3	13	0.233
	No	90.7	92.7	87	
Knee pain	Yes	21.3	29.8	13.6	0.004
	No	87.7	70.2	84.4	
Foot and ankle pain	Yes	19.8	28.2	18.5	0.085
	No	80.2	71.8	81.5	

*Chi-Square

The results also revealed a significant relationship between musculoskeletal pains and sex (P = 0.042). In fact, 86.3% of the girls and 81% of the boys reported pain. The relationship between the type of school bags and musculoskeletal pains are given in Table 2.

Moreover, a statistically significant relationship was observed between musculoskeletal pains and educational districts of Shiraz (P=0.037). The highest and lowest rates of pain were reported by the first district and second district students, respectively (90.2% vs. 80.3%). However, no significant relationship was found between the type of tables used in the classrooms and total musculoskeletal pains (P=0.334).

The results of the present study showed that 62.6% of the students used backpacks. In addition, 31% of the students carried their bags on both shoulders, while 69% carried them on one side. Among the students who used backpacks, 48.1, 40.2 and 11.7% carried them on both shoulders, the right shoulder, and the left shoulder, respectively.

In the study by Chow *et al.* (2007), 83% of the students used backpacks and 59.3% used single strap backpacks. Puckree *et al.* (2004) also conducted a study in South Africa and showed that 69% of the students used backpacks 40% of whom made use of double strap backpacks. In the same line, Moore *et al.* (2007) performed a study in England and reported that 81% of the students used backpacks. The results of the present study showed that similar to other countries, Iranian students also mostly made use of backpacks.

DISCUSSION

According to the results, the highest prevalence of musculoskeletal pains was detected in the shoulders followed by waist, neck, back, knees, feet, ankles, hands, wrists, and thighs while the lowest rate was related to the elbows. In the study by Brackley *et al.* (2009), the prevalence of shoulder pain, knee pain, and waist pain was reported as 36.9, 26.7 and 20.8%, respectively. Puckree *et al.* (2004) also conducted a similar study in South Africa and reported the prevalence of musculoskeletal pains among the students to be 86.9%. In the same line, Van Gent *et al.* (2003) performed a research

and reported the prevalence of musculoskeletal pains to be 43.6% for neck and shoulders and 46.5% for waist, which is in agreement with the findings of the current study.

In this study, 80.6% (632) of the students stated that neck pain was related to carrying school bags. In a similar study which was conducted by Cottalorda *et al.* (2003) on middle school students, 59% of the subjects believed musculoskeletal pains to be related to carrying bags or backpacks.

The results of the present study revealed a significant difference between the two sexes regarding the mean weight of school bags ($p<0.001$). The mean weight of the boys' school bags (3.88 kg) was higher than that of the girls' bags (3.67 kg). This is consistent with the studies performed by Van Gent *et al.* (2003), Bettany-Saltikov *et al*, 2008) and might be due to the fact that because of being stronger and having stronger muscle tissues, boys are able to carry more loads.

The study results also revealed a significant relationship between musculoskeletal pains and sex ($P=0.042$). Girl students felt more musculoskeletal pains in comparison to boys which might be due to their weaker and more sensitive muscle tissues and, consequently, their improper spinal alignment and disturbance in the function of their inter-vertebral discs which act like a bumper. This troubles their posture and, according to the specialists, improper posture causes musculoskeletal pains later in life. In addition, lack of physical activity makes the girls more susceptible to postural problems. Cottalorda *et al.* (2003) also mentioned the girls to be more susceptible to musculoskeletal pains; such a way that 80% of the girls and 63% of the boys had such pains. Also, they reported a significant relationship between sex and musculoskeletal pains, which is in agreement with the findings of the current study.

The present study also investigated the relationship between BMI and musculoskeletal pains in at least one body point; however, no significant relationship was observed. Similarly, Merati *et al.* (2001) investigated the students' anthropometric features and found no relationships between their BMI and musculoskeletal problems.

CONCLUSION

The allowed school bag weight is believed to be 0.07% of one's body weight. In addition, using a backpack is preferred in case it is carried on both shoulders. Otherwise, using a handbag has fewer consequences. Students are recommended not to carry bags for more than 20 minutes a day. Also, in case they use handbags or shoulder bags, they had better use them alternatively on both shoulders.

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