

## Backpack Weight and Musculoskeletal Symptoms in Secondary School Students, Tehran, Iran

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### Abstract

**Background:** Increased complaints by school students about back and shoulder pain and discomfort have raised concerns among parents, education professionals, and orthopedists and these discomforts may be because of schoolbag carriage. The aim of this study was to investigate of relationship of musculoskeletal symptoms with weight of backpack in Tehran secondary school students.

**Methods:** This cross-sectional study was performed in the city of Tehran in 2009. Two hundred thirteen students participated in study. Nordic Musculoskeletal Questionnaire was used, asking about complaints of back, neck, and/or shoulders. Length and weight of the children were determined. Schoolbags were weighed, and the relative weight of the schoolbag was calculated.

**Results:** Most prevalent musculoskeletal discomfort was in shoulders as 38.1%, neck 27.6% and back 16.7%. Average difference of weight of backpack in sample that had musculoskeletal with other samples was significant ( $P < 0.05$ ).

**Conclusion:** Weight of the backpack appears to be strongly related to the occurrence of shoulder, neck, back, and extremities complaints in students. Although musculoskeletal discomforts are believed to be multifactorial in origin, the carriage and manipulating of heavy backpack is signally a suspected factor and may represent an overlooked daily physical stress for secondary students.

**Keywords:** Backpack, Musculoskeletal symptom, Schoolbag, Student, Iran

### Introduction

It is believed that heavy weight of children's backpack caused excess load into spine, and this is causing some concern for parent's and the students who have to carry them (1). There is particular concern for the junior students in secondary schools, as the spine is at critical stage of development in children between 12-14 yr of age (1, 2). Studies reveal that musculoskeletal discomforts experienced by growing children are significantly connected to backpack loads and have reported that heavy backpack loads can actually result in changes in posture. However, numbers of these studies are few (1, 3-8).

Although many factors can lead to musculoskeletal symptoms in school students- increased participation in sports or exercise, poor posture while sitting, and long periods of inactivity, and carriage of heavy backpack is manifestly a suspected

factor (4, 9, 10). Certainly carrying too much weight in a schoolbag, or wearing it incorrectly, can cause long-term musculoskeletal problems in all children (4, 6, 7). Significantly, relationship was found between the carriage of schoolbags and posture and gait of students, and suggested that it might lead to a variety of musculoskeletal problems such as muscle soreness, numbness, back pain and complains of aching shoulders (5). Musculoskeletal discomforts especially in shoulder prevalence in secondary school children (11). In addition, musculoskeletal discomfort for the neck, shoulder, spine, and extremities between secondary school students is reported in New Zealand (4).

Lifting, carrying and handling a heavy backpack on the back causes forward leaning and bad posture, which can lead to excess load on the spine, and pain and discomfort in the neck,

shoulders and back (6, 7). Carrying and manipulating a heavy backpack makes the secondary students unable to maintain proper standing and walking posture (11, 12). Nevertheless, the weight of backpack carried by secondary students varies from day to day, and causes various results (6, 9, 13). Initially, a government-working group found that many students were carrying bags that weighted significantly more than 10% of their bodyweight (5). A number of these students were actually carrying in excess of 20% of their bodyweight (1, 3, 4, 7). A general guideline of 10% body weight proposed by Voll when carrying a schoolbag (14). However, findings of recent studies may challenge this guideline (7, 15). The different age ranges of students participated in the various studies may explain some of this difference, but irrespective of age there is a considerable number of students lifting and carrying in more of 10% of their body weight. However, some studies stated that musculoskeletal complaints in students are multifactorial (6, 12, 16). Whitefield reported that the carriage of heavy backpacks is a main factor, and therefore represents an overlooked physical stress for secondary students (4). Some studies stated that musculoskeletal discomfort occur when a student uses bad postures such as drop of the shoulders, leaning forward, or using one strap (16, 17). Combined effects of heavy backpack, duration carrying the backpack, manipulating and handling of backpack, method of carrying, position of the load on the body of students are risk factors for musculoskeletal complaints associated with backpack carriage (18-20).

The aim of this study was to study of the weight of backpack and the effects of backpack carriage on secondary school students in Tehran. The Specific objectives were:

- Investigation the weights of backpacks
- Investigation percentage body weight carried
- To determine backpack weight to body weight ratio
- To determine discomfort due to backpack and schoolbag carriage

## Materials and Methods

This cross-sectional study was performed between October and December 2009 in Tehran, Islamic Republic of Iran. The study population consisted of 213 students, in the first, second, and third class of secondary school. To prevent overemphasis on backpacks and accurate responses to questionnaires, the secondary students were told that the focus of the study was on complaints of the musculoskeletal discomfort.

Inclusion criteria were: 1) students must be secondary school. 2) Ability to carry backpack by one shoulder and both shoulders. Exclusion criteria were: 1) having orthopedic, muscular, and rheumatoid disease. 2) Having deformity in spine and joints of upper and lower extremities.

Subjects received a questionnaire (standardized Nordic Musculoskeletal Questionnaire) asking about complaints of the back, neck, shoulders, extremities, and about potential risk factors (21, 22). After completion of the questionnaire, the backpacks and students were weighed. A digital scale (Model 10-22 S, Iran) with a plateau and an accuracy of 5 g was used. In addition, the length of the schoolchildren with a portable stadiometer (Model KS 90T, USA) was determined. The scales were calibrated prior to the study. A picture of the human body with nine body regions (neck, shoulders, upper arms, lower arms, upper back, lower back, hips/thighs, knees, lower legs) for expression of discomfort by students was provided (12). In this study, the relative weight of the backpack was calculated by dividing the weight of the backpack by the weight of the student. The study took place each morning as soon as the students had arrived for classroom. Weight of backpack carried by secondary students varies on different days. Therefore, fifteen different days were measured each day in order to get a typical sample of the weight of backpacks on different days during of five weeks. The backpacks were weighed with all of content that was carried to school that morning by students. Informed consent participates in study signed by all of parents.

Statistical analysis was performed with SPSS (version 15.0), and used of one ANOVA test, and Student's *t* test. *P* value less than 0.05 considered statistically significant.

## Results

All 213 schoolchildren completed the questionnaire. The study population consisted of 137 girls (64.3%) and 76 boys (35.7%). The mean age students were  $13.4 \pm 0.53$  yr. Average school bag weight in the first year students was  $2.14 \pm 0.66$  kg, in second year students,  $2.48 \pm 0.72$  kg and in third year students,  $2.38 \pm 0.68$  kg (Table1). To examine the way of carrying, we divide students in two groups, one who carried the backpack over one shoulder and another group that carried the backpack over two shoulders at school and during transport. In this way, 46.2% students carried backpacks on two shoulders and 53.8% students carried backpacks on one shoulder.

In all of secondary students, most of musculoskeletal discomforts were in the shoulder area. In first

year students, 10 subjects (33.3%) were impaired in the shoulder area and 9 subjects (30%) were impaired in the neck. In the second year students, 16 subjects (51.6 %) were impaired in the shoulder area and 10 subjects (32.2%) were impaired in the neck. In the third year students, 10 subjects (29.4%) were impaired in the shoulder area and 8 subjects (23.5%) were impaired in the neck. However, minimum of conditions in first and second years students were in lower limb and in third year students were in lower waist (Table2).

Mean weight of schoolbags in all of students had pain by musculoskeletal than subjects without pain are significant ( $P < 0.005$ ) (Table3). Females recorded the highest prevalence of upper extremities musculoskeletal discomfort with 48.1% more than boys did. Back pain was reported by females (8.5%) more than by males (7.3%). Lower extremities musculoskeletal symptoms were reported by females (4.3%) more than by males (3.9%) ( $P = 0.84$ ) (Table4).

**Table1:** Variables and descriptive statistics subjects

	n	Average height	Average weight	Age	Average weight of backpack
First year	70	140.27±7.6	33.9±9.9	12.04±0.39	2.14±0.66
Second year	57	145.75±8.9	38.27±8.8	13.4±0.7	2.48±0.72
Third year	86	152.72±7.9	43.19±8.4	14.62±0.52	2.38±0.68

**Table2:** Distribution of musculoskeletal discomforts in subjects

Regions involved	First year (%)	Second year (%)	Third year (%)	Total (%)
Shoulders	33.3	51.6	29.4	38.1
Neck	30	32	23.3	27.6
Elbows	6.66	---	14.7	7.1
Hand and Wrist	6.66	5.8	---	4.1
Upper back	9.99	6.45	5.8	7.4
Lower back	9.99	6.4	11.7	9.3
Lower Extremities	3.33	6.4	4.7	8.1
Total musculoskeletal discomforts in body	42.8	54.3	38.3	45.1
No musculoskeletal discomforts	57.2	45.7	61.7	54.9

**Table3:** The relationship between weights of backpack and musculoskeletal discomforts

Musculoskeletal complaints	number of students	average weight of backpack	SD	P
Yes	147	2.59	0.63	P< 0.05
No	193	2.31	0.67	

**Table 4:** The relationship between Genders of students and musculoskeletal discomforts

Gender	Upper extremities (%)	Lower extremities (%)	Trunk (%)	P
Females	48.1	8.5	4.3	0.84
Males	36.2	7.3	3.9	

## Discussion

We found that high percentage of the secondary students (45.1%) reported discomforts in shoulder, back and upper and lower extremities. This percentage is nearly similar to percentage found in another study (6). In addition, the findings of our research match with study done by Whitfield (2). In this research, some student's lack of experience in primary years of school in recognition of their need in what books needed during a day, was expressed(2). In addition, according to the research results (4), perhaps because of its reserve book shelves for students to higher levels are to and from the book to prevent repeated. Based on the results, a significant relationship are seen between the weights of backpack with musculoskeletal disorders, means that overweight backpack cause musculoskeletal discomforts occur more. Although, percentages found in the literature (23-25) vary widely (from 8% to 74%) and cannot be compared properly because of different definitions of physical discomforts. In our study, the weights of the schoolbags with an average of 2.14 kg for first students, 2.48 kg for second students, and 2.38 kg for third students were not high. In addition, in the present study, the average weight of backpack was less than of global standards, about 7.1% of total weight to the students. However, 45.1% of secondary students have expressed musculoskeletal complaints such as pain, discomfort, aching shoulders, numbness,

and muscle soreness. On this basis, rate of discomfort in shoulders area 38.1 %, in neck 27.6 % and in back 16.7 % has been reported. These results are consistent with previous research results (2, 9). Perhaps the question to be asked is why percentage of musculoskeletal discomforts of students that participated in our study was high, whiles backpack weight of students was in standard rate. Perhaps musculoskeletal complaints that expressed in this study by students, as research Grimmer (18) result from several causes, including mental and emotional problems and fatigue or even answer can be exaggerate. However, several studies on more percentage of musculoskeletal discomforts were also reported (2, 9, 12). In our study, most musculoskeletal complaints were observed in shoulders and neck area. In two another studies (16, 20), the maximum numbers of musculoskeletal complaints were seen in shoulders and neck area. In these researches, use of double or single band backpack caused load on shoulders/shoulder area and discomfort, were expressed. In the present study, more musculoskeletal complaints in female students were in the upper extremities. In addition, female students reported lower extremities and back complaints more frequently than boy students did. However, this difference was not significant. Hertzberg reported upper and lower back pain mostly occurred in the female students than the male students (26). In addition, other studies reported that back complaints more often

occur in girl students (27-29). Although, limited data are from the literature on the effect of gender on musculoskeletal discomfort in secondary students. Haisman reported that perhaps one reason for this is girl students tend to have lower muscle strength than boy students, particularly in the upper limb musculature (30). The carrying, lifting, transporting, and handling of backpack represent an ignored physical stress and exhaustion for secondary school students, and could lead to musculoskeletal complaints in these students. There is a need for further research in this area to investigate the effect of carrying and manipulating on children's musculoskeletal system. In addition, more studies are needed to determine guidelines for acceptable loads to be carried by secondary students.

In conclusion, the findings of this study recommended that student's age 10 to 14 yr be more considered and about musculoskeletal disorders and ways to prevent these effects are fully trained. Especially, longitudinal and wider studies on the risk factors for musculoskeletal discomforts in secondary school students are needed.

### Ethical Considerations

Ethical issues Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors.

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