

# Effect of Backpacks Carried by Secondary School Students in Tanta City on the Musculoskeletal System

Anees G. Saleh and Ashraf H. Mohammed

Faculty of Physical Therapy, Cairo University

## ABSTRACT

*The weight of a backpack and its contents can cause a deterioration in person's posture. Heavy school backpacks may also cause deformity in natural curves of the back. The improper use of backpacks can lead to muscle imbalance that could turn into chronic back and neck problems later in life. The aim of this study was to determine discomfort due to carrying backpack in secondary school students in Tanta City, Egypt. As well as to determine the relationship between genders and musculoskeletal pain during carrying the backpack. This study was performed on secondary school students in Tanta City, Egypt. The study population consisted of 200 students of both sexes 110 female and 90 males, in the first, second and third class of secondary school selected by the randomized clustered method during the teaching year 2011-2012. Students received a questionnaire concerning complaints of the back, neck, shoulders, extremities. The study took place each morning as the students had arrived for classroom. Statistical analysis was performed with SPSS (version 15.0), using ANOVA test, and Student's t test. P value less than 0.05 considered statistically significant. The study proved that high percentage of the secondary students (45.1%) reported discomforts in shoulder, back and upper and lower extremities. The rate of discomfort in shoulders area 38.1 %, in neck 27.6 % and in back 16.7 % had been reported. In addition, females recorded the highest prevalence of upper extremities pain with 48.2% more than boys. Trunk pain was reported by females (4.3%) more than by males (3.9%). Lower extremities musculoskeletal symptoms were reported by females (8.5%) more than by males (7.3%).*

**Key words:** Backpack, musculoskeletal system, , and secondary school students.

## INTRODUCTION

Across the nation, millions of elementary, high school and college students are racing out to the school bus or carrying to their classes with overstuffed backpacks hang over their shoulders<sup>3</sup>. While carrying a backpack to

school each morning might seem harmless enough, it can cause some painful back and neck problems for students<sup>4</sup>.

Students carry their educational loads mostly in backpacks. The daily physical stresses associated with carrying backpacks cause significant forward lean of the head and trunk<sup>19</sup>. It is assumed that daily discontinuous postural adaptations could result in pain and disability in school going children<sup>16</sup>.

Children carrying backpacks for school that load is too much weight are also at risk for short-term and possible long-term health issues. A backpack should not weigh more than 15% of a child's total body weight. In other words, a child weighing 85 pounds should not be toting a backpack that weighs more than 12.75 pounds<sup>8</sup>.

The weight of a backpack and its contents can cause a person's posture to deteriorate. Heavy school backpacks may also deform natural curves in the back<sup>9</sup>. If the curves are interrupted in the lower and middle back, the result is muscle strain and irritation to the rib cage or spine joints. Much of this suffering is brought by bad habits initiated during our younger years may be because of carrying overweight backpacks to school<sup>10</sup>.

The improper use of backpacks can lead to muscle imbalance that could turn into chronic back and neck problems later in life<sup>2</sup>. In the UK the average backpack weight is 15-20% of their body weight, and some children carry backpacks as heavy as 30% to 40% of their body weight<sup>11</sup>.

Many children carrying bags over just one shoulder or very low on their backs. This greatly increases the risk of pain and injury. Local authorities have asked schools to check that backpacks are not overweight and are worn properly and over both shoulders<sup>13</sup>.

Students of all levels, carry a school bag packed with textbook, notebooks, library books, geometrical instruments, mathematic instruments, snacks, boxes, lunch packs and water bottles. The backpack is one of the

several forms of manual load carriage that provides versatility and often used by hikers' backpackers, soldiers, as well as by school children<sup>15</sup>.

The backpack is an appropriate way to load the spine closely and symmetrically, while maintaining stability<sup>14</sup>. Recent worldwide attention has focused on the role of backpacks in the development of children non-specific low back pain<sup>6</sup>.

There is critical backpack weight to body ratio that if exceeded affects health's studies indicate the incidents of backpacks use by school children in the developed countries is at least 90%. The average loads vary greatly between studies, the majority of reports indicate that the loads carried by students greater than the recommended limits<sup>17</sup>.

## MATERIALS AND METHODS

This study was performed on secondary school students in Tanta City, Egypt. The study population consisted of 200 students, in the first, second and third class of secondary school selected by the randomized clustered method.

To prevent over emphasis on backpacks and accurate responses to questionnaires, the secondary school students were told that the focus of the study was on complaints of the musculoskeletal discomfort. All students should be able to carry backpack by one shoulder and both shoulders.

Exclusion criteria were: 1) Having orthopedic and rheumatoid disease. 2) Having deformity in spine or in 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<sup>5,12</sup>.

Standardised questionnaires for the analysis of musculoskeletal symptoms in an ergonomic or occupational health context are presented. The questions are forced choice variants and may be either self-administered or used in interviews.

They concentrate on symptoms most often encountered in an occupational setting. The reliability of the questionnaires has been shown to be acceptable. Specific characteristics of work strain are reflected in the frequency of responses to the questionnaires.

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<sup>5,12</sup>.

After completion of the questionnaire, students were weighed using digital scale. In addition, the height of the school children with a portable stadiometer (Model KS 90T, USA) was determined.

The study took place each morning as the students had arrived for classroom. Statistical analysis was performed with SPSS (version 15.0), using ANOVA test, and Student's t test. P value less than 0.05 considered statistically significant.

## RESULTS

All 200 school children completed the questionnaire. The study population consisted of 130 girls (64.3%) and 70 boys (35.7%).

The mean age of students were  $15.03 \pm 0.39$  in the first year,  $16.2 \pm 0.7$  in the second year,  $17.61 \pm 0.52$  in the third year as shown in table(1), and figure (1).

**Table (1): Descriptive statistics of subjects (height, weight and age).**

	N	Height (cm)	Weight (Kg)	Age (year)
First year	70	141.26±7.5	33.8±9.9	15.03±0.39
Second year	50	144.74±8.7	38.26±8.8	16.2±0.7
Third year	80	151.71±7.8	43.18±8.4	17.61±0.52

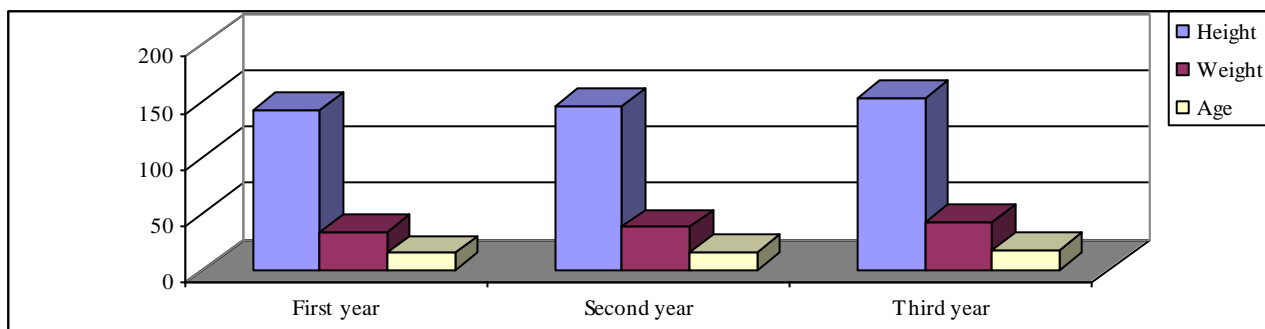


Fig. (1): Mean values of height, weight, and age for all students.

To examine the way of carrying, we divide students into two groups, the first group in which the students carry the backpack over one shoulder and the other group in which students carry the backpack over two shoulders at school and during transport.

The gained result revealed that, 46.2% students carried backpacks on two shoulders and 53.8% students carried backpacks on one shoulder. In all of secondary school students, most of musculoskeletal discomforts were in the shoulder area. In first year students,

(33.2%) of subjects were impaired in the shoulder area and (31%) of subjects were impaired in the neck.

In the second year students, (51.5 %) of subjects were impaired in the shoulder area and (32.1%) of subjects were impaired in the neck.

In the third year students, (29.3%) of subjects were impaired in the shoulder area and (23.4%) of subjects were impaired in the neck as shown in table (2), and figure (2).

Table (2): Distribution of musculoskeletal pain in subjects.

Regions involved	First year (%)	Second year (%)	Third year (%)	Total (%)
Shoulders	33.2	51.5	29.3	38,1
Neck	31	32.1	23.4	27.6
elbows	6.66	-----	14.7	7.1
Wrist and hand	6.66	5.8	-----	4.1
Upper back	9.99	6.4	5.8	7.4
Lower back	9.99	6.4	11.7	9.3
Lower limb	3.33	6.4	4.7	8.1

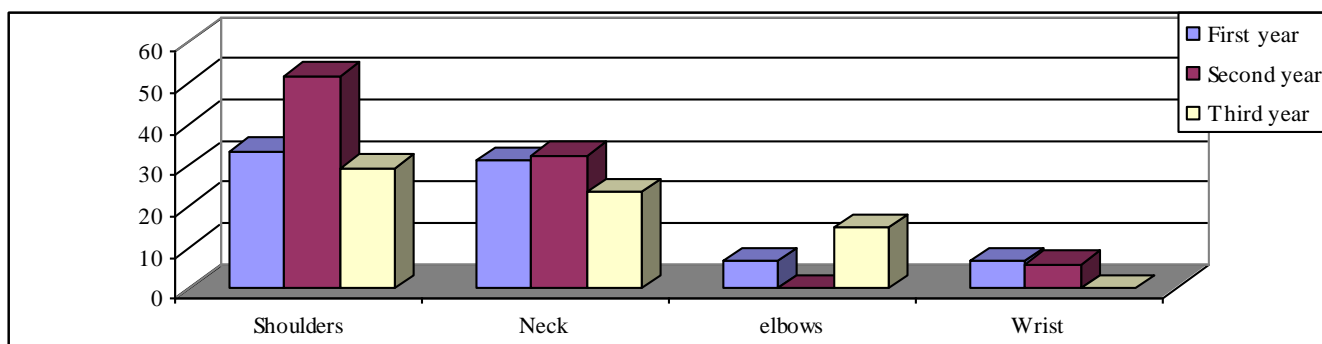


Fig. (2): Distribution of musculoskeletal pain in subjects.

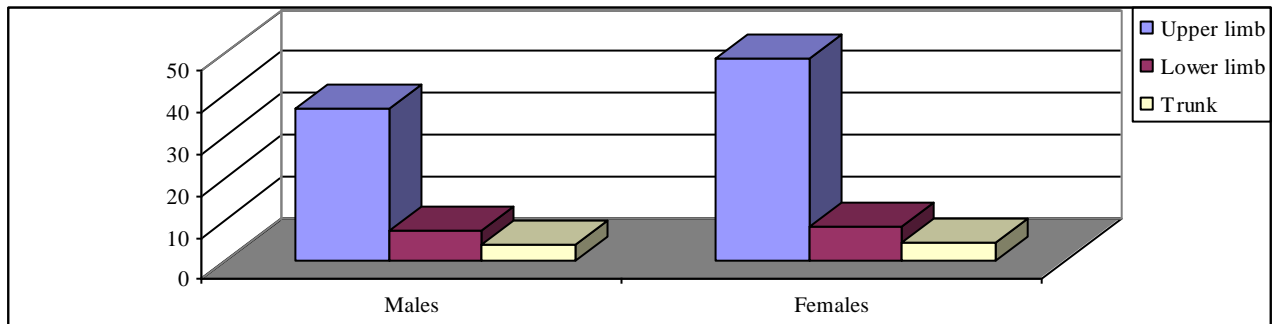
Females recorded the highest prevalence of upper extremities musculoskeletal discomfort with 48.2% more than boys.

Trunk pain was reported by females (4.3%) more than by males (3.9%).

Lower extremities musculoskeletal symptoms were reported by females (8.5%) more than by males (7.3%) (P=0.84) as explained in table (3) and figure (3).

**Table (3): The relationship between genders and musculoskeletal pain.**

Gender	Upper limb (%)	Lower limb (%)	Trunk (%)	P
Males	36.3	7.3	3.9	0.84
Females	48.2	8.5	4.3	0.84

**Fig. (3): The relationship between genders and musculoskeletal pain.**

## DISCUSSION

The study proved that high percentage of the secondary students (45.1%) reported discomforts in shoulder, back and upper and lower extremities. The findings of this research matched with study done by (Van Gent et al., 2003)<sup>18</sup>.

However, 45.1% of secondary students had expressed musculoskeletal complaints such as pain, discomfort, aching shoulders, numbness, and muscle soreness.

The rate of discomfort in shoulders area 38.1 %, in neck 27.6 % and in back 16.7 % had been reported. These results are consistent with previous research results<sup>1</sup>.

In this study, most musculoskeletal complaints were observed in shoulders and neck area. In another study done by Whittfield et al., 2005<sup>20</sup>, he found that the maximum numbers of musculoskeletal complaints were seen in shoulders and neck area.

In this 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 boys. This matching with Chansirinuk et al., 2001<sup>4</sup>, who reported that upper and lower back pain mostly occurred in the female students than the male students.

The gained results were supported by (Haisman, 1988)<sup>7</sup> who 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.

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.

The findings of this study recommended that secondary school students be more exposed to musculoskeletal disorder and as result longitudinal and wider studies on the risk factors for musculoskeletal discomforts in secondary school students are needed.

Finally although musculoskeletal discomforts are believed to be multi factorial in origin, the carriage and manipulating of heavy backpack is signally a suspected factor and may represent an overlooked daily physical stress for secondary school students.

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## Appendix 1

C E DICKINSON, K CAMPION, A F FOSTER, S J NEWMAN, A M T O'ROURKE AND P G THOMAS

Please answer by using the tick boxes   
 – one tick for each question

Please note that this part of the questionnaire should be answered, even if you have never had trouble in any parts of your body.

Have you at any time during the last 12 months had trouble (such as ache, pain, discomfort, numbness) in:	Have you had trouble during the last 7 days:	During the last 12 months have you been prevented from carrying out normal activities (eg. job, housework, hobbies) because of this trouble:
<b>1 Neck</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>2 Neck</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>3 Neck</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>
<b>4 Shoulders</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/> in the right shoulder 3 <input type="checkbox"/> in the left shoulder 4 <input type="checkbox"/> in both shoulders	<b>5 Shoulders</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/> in the right shoulder 3 <input type="checkbox"/> in the left shoulder 4 <input type="checkbox"/> in both shoulders	<b>6 Shoulders (both/either)</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>
<b>7 Elbows</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/> in the right elbow 3 <input type="checkbox"/> in the left elbow 4 <input type="checkbox"/> in both elbows	<b>8 Elbows</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/> in the right elbow 3 <input type="checkbox"/> in the left elbow 4 <input type="checkbox"/> in both elbows	<b>9 Elbows (both/either)</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>
<b>10 Wrists/hands</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/> in the right wrist/hand 3 <input type="checkbox"/> in the left wrist/hand 4 <input type="checkbox"/> in both wrists/hands	<b>11 Wrists/hands</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/> in the right wrist/hand 3 <input type="checkbox"/> in the left wrist/hand 4 <input type="checkbox"/> in both wrists/hands	<b>12 Wrists/hands (both/either)</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>
<b>13 Upper back</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>14 Upper back</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>15 Upper back</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>
<b>16 Lower back (small of the back)</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>17 Lower back</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>18 Lower back</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>
<b>19 One or both hips/thighs/buttocks</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>20 Hips/thighs/buttocks</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>21 Hips/thighs/buttocks</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>
<b>22 One or both knees</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>23 Knees</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>24 Knees</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>
<b>25 One or both ankles/feet</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>26 Ankles/feet</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>	<b>27 Ankles/feet</b> No Yes 1 <input type="checkbox"/> 2 <input type="checkbox"/>

Figure 2 Musculoskeletal questionnaire

**المخلص العربي****تأثير حقيبة الظهر على الجهاز العضلي الهيكلي  
عند طلاب المرحلة الثانوية في مدينة طنطا**

يهدف البحث إلى دراسة تأثير حقيبة الظهر على الجهاز العضلي الهيكلي عند طلاب المرحلة الثانوية في مدينة طنطا بمحافظة الغربية بمصر . شارك في البحث مائتان طالب وطالبة تتراوح أعمارهم من 15 إلى 17 عاما في الصفوف الأولى والثانية والثالثة من المرحلة الثانوية (110 من البنات و 90 من الذكور) وتم اختيار العينة عشوائيا ، تسلم الطلاب استمارة الاستبيان لتحديد المناطق التي يتضرر منها الطلاب وتؤثر على الجهاز العضلي الهيكلي وتم ذلك في الفترة الصباحية بعد دخول الفصول مباشرة . وقد اثبت البحث وجود تأثير ضار لحقيبة الظهر على مناطق مختلفة في الجسم منها مفصل الكتف والكوع والرسغ وأسفل وأعلى الظهر والطرف السفلي والعلوي . ظهر جليا التأثير الضار للحقيبة على البنات في الطرف العلوي أكثر من السفلي مقارنة بالأولاد كما تأثرت مجموعة البنات في منطقة الظهر والطرف السفلي أكثر من الأولاد .