

Incidence of Back Pain in Egyptian School Girls: Effect of School Bag Weight and Carrying Way^[1-1]

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Abstract: Today school bag carried by school children as a daily load become a health problem. The purposes of this study were to: 1) measure the school bag weight and percentage to body weight, 2) report the incidence of back pain among Egyptian school girls and 3) investigate the effect of school bag weight and carrying methods on the back of school girls. The study was conducted on 254 healthy Egyptian school girls, divided into group A, 136 girls from 6-10 years and group B, 118 girls from 11-14 years. Almost half of group A (46.3%) and (45.8%) of group B suffered from back pain. The perception of pain intensity was 3.4 to 7.7 for group A and 4.5 to 8.8 for group B. School bag weight percentage was 13-50% for group A and 6.6-41.7% for group B. Most of group A (71.3%) used 2 strap backpack and (46.6%) of group B used 1 strap backpack. Nearly half of group A and about third of group B reported that their school bag were heavy. The results showed strong association between school bag weight and back pain (β 3.96, SE.152) and way of carrying (β 5.06, $p < .000$). There is a high incidence of back pain among Egyptian school girls. The relative weight of school bag carried by school girls was significantly high in relation to their body weight. School bag weight and way of carriage have association with girls back pain.

Key words: Back pain • Egyptian schoolgirls • Schoolbag weight • Way of carriage

INTRODUCTION

Today, back pain in school children is becoming a new topic of growing health problem raising a red flag and an alarm about the dangers associated with improper childhood school bag weight and use. Regarding the musculoskeletal development of school age children, the weight of school bag and the negative consequences of such a heavy load may cause a problem on the developing spine. [1-7] Increased age [3, 8-11], female gender [10-15], history of spinal trauma and familial history of back pain [13, 14], smoking [16], participation in competitive sports, high level of physical activity [17], prolonged sitting [8, 18], school furniture features [15] in addition to the school bag load, shape and size, time spend carrying the load [19], fatigue [20] during school bag carrying and position of the load on the body [20, 21] are factors associated with non-specific low back pain in school-aged children. There is no clear association of back pain with trunk asymmetry [22], increased height and adolescent growth spurt [23]. The average age of back

pain onset of the adolescent growth spurt is 10.5+2 years for girls and 12.5+2 years for boys [21]. The children back pain is a controversial issue within literature as some studies found no relation between school bag and back pain [16, 23, 24] and others [12, 25, 26] found an association between school bag and back pain. Epidemiologic data collected during the past 20 years, suggested that the majority of neck and back pain in children is of nonspecific origin and not related to a pathologic condition or deformity and often resolves without medical intervention [9, 16, 18, 26-29]. Much international attention among the health-related literature has been focused on the school bag weight, as general guideline of 10% of body weight continue to be the recommended guideline when child carrying a backpack [29]. Whittfield *et al.* [30], investigated the weight and use of schoolbags amongst 140 students from five New Zealand secondary school (70 third form students with mean age 13.6 years and 70 sixth form students with mean age 17.1 years). They reported that the third form students, who were smaller in stature and weight than

sixth form students carried schoolbag, weighed 13.2% of their body weight while sixth form students carried 10.3% of their body weight. They recorded that third form female students had highest prevalence of musculoskeletal symptoms than sixth form female students. Gunzburg *et al.* [31] investigated the prevalence of back pain and potential risk factors in 392 nine-year-old children in Belgium. They found that the prevalence of low back pain was high. Children, who reported that their satchels were heavy, were more likely to report having low back pain. Grimmer and Williams [8] investigated the backpack use and the occurrence of low back pain on 1269 high school students in South Australia, they found that, students with low back pain were carrying heavier backpacks. Pascoe *et al.* [32] concluded that the carriage of schoolbags weighing 17% of body weight and using one backpack strap may lead to variety of musculoskeletal complains such as muscle soreness and back pain. Troussier *et al.* [4] collected cross-sectional data on the prevalence of back pain in 1178 school-aged children in France. They found that 41.6% of participants experience back pain while sitting in class, 68.6% of children had back pain when they carried their satchels by hand, compared with 53.7% who carried their satchels on the shoulder and 45% when carried on their back. Korovessis *et al.* [33] reported that girls are on average 5.6 times more likely than boys to suffer from dorsal pain in the school period. Girls are on average 3.2 times more likely than boys to suffer from back pain in holidays and 4 times more likely than boys to suffer from high intensity pain. Shamsoddini *et al.* [34] found that the weight of backpack carried by secondary school students in Tehran appeared to be strongly related to the shoulder, neck, back and extremities complaints. Moore *et al.* [35] supported the use of 10% of body weight for safe use of backpack for 531 students from 5th to 12th grade of Northern California. They found that younger students and females are more at risk due to relatively lower body weight while females also carry heavier backpack than males. The evidence on the effect of school bag weight and whether they are carried by hand or by shoulders is conflicting.

The purposes of this pilot survey were to: 1) measure the school bag weight and percentage to body weight, 2) report the incidence of back pain among Egyptian school girls and 3) investigate the effect of school bag weight and carrying methods on the back of school girls.

MATERIALS AND METHODS

Preparation of the Study: This study was conducted at Al Orouba International School. We obtained approval from the vice manager of the school. Consent form that

includes a simple description of the study and its significance was distributed upon school students to obtain parent approval. A pilot study was conducted on two consecutive days with 20 school girls. Girls completed a brief Arabic mini questionnaire (Appendix I) designed by the researcher based on data in the literatures about these items [3, 17, 36].

Subjects_[15]: A cross sectional study was conducted on a convenience sample of 254 typically developing Egyptian school girls aged from 6 to 14 years with the ability to walk and wear school bag independently. Exclusion criteria were any orthopedic problems including foot or ankle deformities and leg length discrepancy. Girls were divided into two groups, group A, included 136 girls with mean and (SD) of age, height, body weight and body mass index (BMI) were as follow; 8.12±1.44 years, 128.2±7.6 cm, 35.471±9.199 Kg and 23.13%± 5.64% respectively. Group B, contained 118 girls with mean (SD) of age, height, body weight and (BMI) were as follow; 12.53±1.23 years; 154.3±5.8 Cm, 56.517±15.134 Kg and 33.21%±7.36% respectively (Table 1).

Instruments_[12]: Electronic body scale (TCS-200-RT, China) was used to electronically measure the weight and height of the participants. The questionnaire consists of two sections; the first section includes the demographic information (name, age, height, weight, school bag weight and percentile of school bag weight to body weight). The second section of the questionnaire includes seven questions, two questions about school bag type and way of carrying, two questions about the presence of pain in different body areas and the location of pain on the diagram; two questions about presence of pain during carrying school bag and pain intensity and one question that asked about the perception of student toward school bag weight. To establish content validity (3experts physical therapists evaluated the content validity of the questionnaire). Test re-test reliability was computed using the interclass correlation coefficient (ICC). The questionnaire was significantly moderate reliable (ICC 0.78- 0.83). The questionnaire items on back pain were operationally defined as the feeling of any musculoskeletal pain in the lumbar, lumbo-sacral, or shoulder regions.

Measurements: An explanation of the procedures of the study and questionnaire items were given to all participants. Data were collected on a random day chosen by the researcher so that the students could not modify their school bag weight. Weight and height scale were placed on a flat surface in a private corner in

Table 1: Variance between group A and group B in relation to the school bag weight and pain intensity as related to their characteristics_[1-18]

Groups	Group A (136 girls)		Group B (118 girls)		t- test	
	Range	X ⁻ ±SD	Range	X ⁻ ±SD	t	P
Age (years)	6-10	8.12±1.44	11-14	12.53±1.23	-	-
Height (cm)	117-144	128.2±7.6	148-165	154.3±5.8	-	-
Body Weight (Kg)	20-60	35.471±9.2	32-115	56.517±15.13	7.354	< 0.0001**
BMI	12.1-39.4	23.13±5.64	16.9-55.79	33.21±7.36	7.632	< 0.0001 _[1-20] **
School bag weight _[1-21] (Kg)	5-16	9.119±2.91	5-19	10.941±3.044	2.826	< 0.0058**
School bag (%)	13%-50%	25.28±9.76	6.6%-41.7%	21.014±7.04	2.713	< 0.0077
Pain Intensity	3.4-7.7	5.68±1.18	4.5-8.8	6.83±1.31	3.250	< 0.0021

X⁻= mean SD= standard deviation

the school's clinic. The body weight without and with school bag were measured by the researcher without jacket and bare foot (to avoid weight of extra clothes other than the school uniform and to observe way of carrying). All students were asked to determine the pain intensity on VAS or faces pain scale for young children. The young students of group (A) were helped in reading the questionnaire. The questionnaire and measuring process took approximately 15-20 minutes.

Statistical Analysis: Descriptive statistics were used to determine mean, standard deviation, frequency for all variables (age, weight, school bag weight, school bag percentile, pain intensity). Independent t-test was used to compare between means of different variables in both groups. Binary logistic regression test used to examine the association between back pain and school bag weight, school bag percentile to body weight and way of carrying associations. All analysis were conducted using SPSS (Statistical package of Social Sciences) version 18. Results were considered significant at the level of 0.05.

RESULTS

Two hundred fifty four girls completed the questionnaire and school bag evaluations. As noted in Table (1), a significant difference was documented in body weight and body weight with school bag between group A and B ($p < 0.0001$), school bag weight ($p < 0.0058$), percentage of school bag weight to body weight ($p < 0.0077$) and the severity of pain ($p < 0.0021$).

Backpack was used daily by 87% (119) of group A and 85.6% (101) of group B (Table 2). Nearly 17% of group A reported that their school bag weight is of normal weight, 37.5% as lighter weight and 45.6% as heavier weight. Nearly 16.1% of group B found their school bag as normal weight, 54.2% as lighter weight and 29.7% as heavier weight. The way of school bag carriage was recorded as 71.3% and 39% wear 2 straps on the two

shoulders, 12.5% and 46.6% wear one strap on one shoulder and 16.2% and 14.4% used as roller trolley for group A and B respectively. The girls reported low back pain were 46.3% and 45.8%, low back pain and shoulder pain were 36% and 34.7%, low back pain with pain in other areas were 12.5% and 10.2% for group A and B respectively.

Table (3) represents_[1-28] the results of binary logistic regression results of all girls. The results showed strong association between school bag weight and back pain (β .396, SE.152), back and shoulder pain (β -.356 SE.127) and back pain and pain in other areas (β -.430 SE.112) with $p < .000$. The increase_[1-29] back pain was associated with an increase in school bag weight percentile (β .117 SE.053) with $p < .001$, carrying backpack on one shoulder (β 5.064 SE.996) with $p < .000$, on two shoulders (β .3.393 SE.784) with $p < .000$ or use rolling trolley (β .149 SE.956) with $p < .029$.

DISCUSSION

School children back pain is a great health problem needs more effort and attention from health professionals. The results of this study reported that the mean weight of school bag used by girls was higher (9.119 kg for group A and 10.941 kg for group B) than that founded by Whittfield *et al.* [30] (6.6±2.2 Kg) and Sheir-Neiss *et al.* [10] (8.3Kg). The result of current study was consistent with Negrini and Carabalona [20] and Negrini *et al.* [37] who found that the mean of school bag weight were 9.06Kg and 9.3Kg respectively. The wide range of school bag weight for group A (5-16Kg) and group B (5-19Kg) may be explained as some school girls bring more school items than necessary to take to school.

This study reported that increase school bag weight associated with increase risk of girls' back pain, back and shoulder pain and back pain and pain in other areas ($p < .000$). The results of the present study were inconsistent with Mohseni-Bandpei *et al.* [37] who found

Table 2: Number and percentage of variables in relation to group A and group B

Variables	Group A (6-10y) 136 girls		Group B (11-14y) 118 girls	
	Number	%	Number	%
Girls use backpack daily	119	87%	101	85.6%
Perception of school bag weight				
Normal weight	23	16.9%	19	16.1%
Lighter weight	51	37.5%	64	54.2%
Heavier weight	62	45.6%	35	29.7%
2 straps backpack	97	71.3%	46	39%
1 strap backpack	17	12.5%	55	46.6%
Roller trolley	22	16.2%	17	14.4%
Girls have LBP	63	46.3%	54	45.8%
LBP and shoulder	49	36%	41	34.7%
LBP and other area	17	12.5%	12	10.2%
No pain	7	5.1%	11	9.3%

Table 3: Binary logistic regression analysis of back pain, back pain and shoulder pain, back and other areas pain with backpack weight, backpack percentile and way of carrying of 254 school girls

Variables	Back Pain β (SD)	OR	Back pain and shoulder pain β (SD)	OR	Back and other areas pain β (SD)	OR
Constant	1.286 (.152)**	53.510	-.927 (.139)**	23.380	.889 (.138)**	34.440
School bag Weight	.396 (.123)**	1.486	-.356 (.127)**	.700	-.430 (.112)**	.650
School bag %	.117 (.053)*	1.124	.010 (.050) NS	1.010	-.052 (.038) NS	.950
Way of carry One shoulder	5.064 (.996)**	158.170	.402(.974) NS	1.490	.656(.844) NS	1.928
Two shoulders	3.393 (.784)**	29.757	.916(.846) NS	2.499	.594(.456) NS	1.730
Rolling Trolley	.149 (.956)*	.041	(.816) NS	-	(.784) NS	-

**Significant at .01. *Significant at .05_[1-31] NS: not significant. OR. Odds ratio

School bag %: school bag percentile. β regression coefficient

SE: standard error of β _[1-32]

no association between school bag weight and risk of reporting low back pain. The explanation of these conflicting results could be that the weights carried in the present study were much higher than those used by Mohseni-Bandpei *et al.* [37]. The other explanation may be the gender and age as the current study examined only young girls who are more susceptible of rapid growing spins and back pain [3, 7-13, 38].

The researcher reported that the less school bag weight carried by group A, was 13% of body weight and that exceeded the recommended limits of 10% of body weight. Many researchers concluded that subjects carrying school bag weight 20% or more of their body weight reported more low back pain, [16], muscle imbalance, [29] and musculoskeletal symptoms [1, 30]. The finding of this current study on mean school bag weight and percentage to body weight were similar to those reported by Negrini *et al.* [37] who reported a higher incidence of subjects (11.2%) carrying more than 30% of their body weight and these findings reflect greater variation in school bag load across school children. The current study showed that the average school bag percentile for group A and B (25.28% and 21.01%) were associated with increased back pain ($p < .026$). The average

relative school bag percentile was less than that reported by Viry *et al.* 16 and consistent with Siambanes *et al.* [39].

Our findings supported that many girls of group A 45.6% (62) and group B 29.75% (35), found their school bag heavy and causing their back pain. Few girls reported that their school bag were normal in weight and more than third of group A (37.5%) and more than half of group B (54.2%) found that their bags were light weight than usual. These findings were supported in part by results of Goodgold *et al.* [36] who reported that few children find their bags as light and more than half of children reported that their bag was uncomfortable to carry. They explained their results as the variation of children abilities to carry proportionally similar loads.

In this study back pain experience and intensity was associated with heavy school bag and back pain as 46.3% (63) and 45.8% (54) of group A and B, respectively chose to check low back pain only in the questionnaire. Many girls 36% (49) of group A and 34.7% (41) of group B check low back pain and shoulder pain. The girls who chose to check low back pain with pain in other body area were 12.5% (17) and 10.2% (12) for group A and B respectively. Several studies have reported a relationship between backpack weight and back pain [8, 16, 31].

The perception of pain intensity reported by girls of group A was ranged from 3.4 to 7.7 by VAS and 4.5 to 8.8 for group B. Only seven girls (5.1%) from group A and eleven girls (9.3%) from group B recorded no pain. This may be explained as this sample of young girls are at the age of growth and their bones are soft and carrying heavy school bag may cause more physical stress and strain on their back. Siambanes *et al.* [39], reported that females are more likely to report higher levels of pain than males.

In the present study the finding revealed that 12.5% of group A and 46.6% of group B were carrying their school bag on one shoulder and this way of carrying was associated with back pain (β 5.06, $p < .000$). The loaded backpack carried on one shoulder may lead to more pain as mentioned by Pascoe *et al.* [32] who found 73.4% of children used only one strap school bag which seemed to encourage lateral spinal bending and shoulder elevation. School bag carried on two shoulders (71.3% for group A and 39% for group B) were associated with back pain (β 3.39, $p < .000$). In spite of carrying the backpack symmetrically over both shoulders is the best way ergonomically [4, 32], we can say that this association may be due to high school bag weight and percentile.

The school girls who used roller trolleys were 16.2% from group A and 14.4% from group B. The rolling trolley also was associated with back pain (β 1.49, $p < .029$). We can explain this result as the use of rolling trolley encourage the girl to put more school materials and at some time during school day they may carry their school bag to upstairs or transfer it from place to place. The other explanation is this rolling trolley dragged by one hand which leading to twisting of the girl's trunk and may cause back, shoulder or arm pain.

Physical therapists and other health professionals have warned that wearing a school bag that is too heavy or over one shoulder can lead to muscle spasm; neck, shoulder and back pain; upper extremity paresthesias and postural deformities [33, 38]. Goodgold *et al.* [36] concluded that, when school children wearing a backpack, the center of gravity is shifted in the direction of the load to compensate, the individual leans in the direction opposite to the force. Pascoe *et al.* [32] reported that a one-shoulder carrying method resulted in a significant elevation of the strap supporting shoulder and concomitant lateral bending of the spine to the un-weighted side.

Recommendations: From results of the current study, our recommendations are: 1) lower the percentage of school bag weight carried by school age children to less than 10% of body weight because at this age they passing in a rapid growth spurts (more porous bones and increase the activity of the epiphyseal plate). 2) Encourage the use of light textbooks or replace them by CD or even use of electronic books and iPod. 3) Encourage the physical activity to strengthen the back muscles. 4) Use work books with separate sheets to be lighter. 5) Teach children how to keep their back healthy and how to avoid different musculoskeletal problems. Further researches are needed to evaluate the effect of different safety programs on reducing school bag loads and associated musculoskeletal disorders. More research needs to be done to determine the long-term effect of carrying backpack. Cross sectional studies are needed with large sample including both boys and girls to help in determines the size of the problem and found the suitable solution.

CONCLUSION

The results revealed a high weight (5-19Kg) and percentage (13-50%) of school bag carried by Egyptian schoolgirls. The young girls carried more school bag weight percentile than the older girls. Many girls reported that their school bags were heavy, almost half of all the girls reported back pain and more than third of them complaint from back pain and shoulder pain. The high school bag weight, percentage and way of carrying are risk factors associated with back pain of Egyptian schoolgirls.

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Appendix I

English Version

Questionnaire to evaluate school girls back pain aged 6 to 14 years

Section I: completed by the researcher

- 1- Name:
- 2- Age :
- 3- Height:
- 4- Weight:
- 5- Weight with carrying school bag:
- 6- School bag weight:
- 7- School bag %:

Section II: completed by the student

1. Which of this School bag is your bag?



☐ One strap



☐ Two straps



☐ Rolling Trolley

2- Which of this Way you carry your school bag?



☐ On one shoulder



☐ On two shoulders

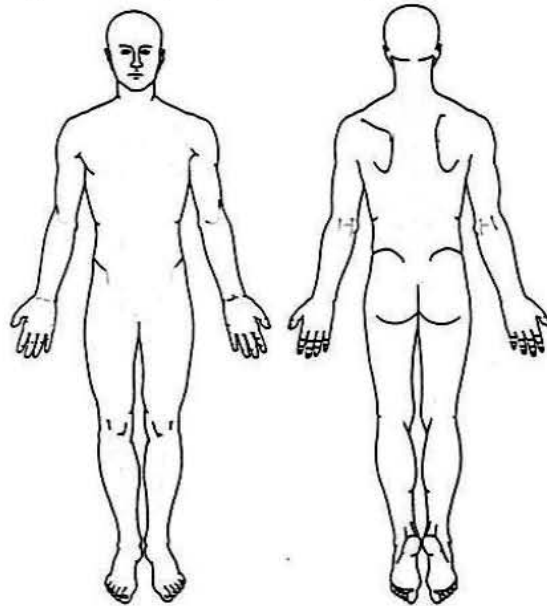


☐ Rolling trolley by hand

3- Since you started school in September, have you ever had any pain at these areas?

- | | | |
|------------------------|-----|----|
| - Back | yes | No |
| - Back & Shoulders | yes | No |
| - Back and other areas | yes | No |

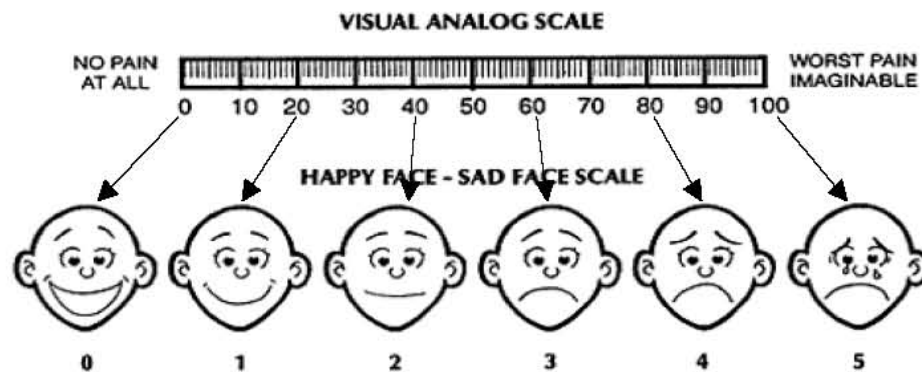
4- On the body diagram below, shading the area of pain you feel since you started school in September.



5- Since you started school in September, have you had any back or neck pain during carrying of school bag?

- ☐ Yes ☐ No

6- Put a mark on the horizontal 10 cm line below, the line started from the left side with no pain at all and ended with worst pain imaginable. Or check on the happy face- sad face scale which started with happy face with no pain and ended with crying face with imaginable pain.



7- What is your feeling toward weight of your school bag?

- ☐ Light weight
☐ Normal weight
☐ Heavy weight