

Low back pain in schoolchildren: the role of school bag weight and carrying way

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Abstract

It is common today to see school children buckling from weight of their school bags . many children bear the burden of carrying school bags that are too heavy for their body frames, that might end up facing a number of health problems. The objectives to measure the school bag weight and percentage to body weight and to investigate the effect of school bag weight and carrying methods on the back of school children. It is a cross-sectional study.

From 1st March to 30 April , school based study was conducted in Hilla city in Babylon governorate in Iraq. 242 primary school students ,116 male and 126 female , with range age (6-12years) , with the ability to walk and wear school bag independently. The results : the mean \pm standard deviation (SD) of students weight was (29.144 \pm 8.267) . bag weight and bag weight to body weight percentage were also evaluated with mean \pm SD (5.111 \pm 2.023) and (18.896 \pm 9.239) respectively. nearly (31%) of students reported that their school bag weight is of normal weight , (28.5%) as lighter weight and (40.1%) as heavier weight . the students also reported low back pain were (36.8%) , (45%) neck- shoulder pain , (18.2%) reported no pain . the significant association between bag weight and health effect (p=0.001) were (80.4%) of students had lower back pain carried bag weight \geq 5 Kg and (19.6%) of students had lower back pain carried bag weight < 5 Kg . shows there was significant difference with (p<0.001) between health effects and gender , with (50%) of females had back and shoulder pain In this study lower back pain was associated with heavy school bag as (56.7%) , (35.1%) had LBP and neck- shoulder pain respectively .

Conclusion : a high weight and percentage of school bag by primary school children the girls carried more school bag weight than boys. Many students reported that their school bag were heavy . the female gender , students weight, bag design ,bag percentage , heavy bag weight and heavier bag weight are risk factors associated with lower back pain & neck- shoulder pain in school children

Keywords: back pain, school children, school bags.

1. Introduction

Back pain in children is much more likely to have a serious underlying disorder compared with adult back pain and deserves careful attention Unfortunately the diagnosis of serious disease causing back pain in children is often made late or missed completely (Henkus HE *et al* 2002), although persistent back pain in children and adolescents is more often due to a specific or serious cause , back pain in children and adolescents is still often benign (Bhatia NN *et al* 2008). While Nonspecific back pain in children is increasingly prevalent (Geldhof E *et al* 2006).

•However, back pain is much less common than in adults with fewer than 30% of children and adolescents reporting back pain, and very few presenting to doctors with their pain (Feldman DS *et al* 2006).

Back pain occurs commonly in children and adolescents, affecting up to 50 percent of children by age 18 to 20 years. The pain may be sharp and shooting, burning, or aching, and may be felt anywhere in the back (Backpack safety 2009 ; Diepenmaat AC *et al* 2006).

Although back pain may be a sign of a more concerning problem, especially in children younger than 10 years, most episodes of back pain in children are not serious and resolve without treatment.

The most common cause of low back pain in children is muscle sprain and strain. This can occur while playing, from carrying a heavy backpack, or after a fall.

Less common causes include abnormalities in the spinal bones (vertebrae), infections, arthritis, and, rarely, cancer (Pellisé F *et al* 2009).

Epidemiological 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 the pathologic condition or deformity (Wiersema 2003)

Increased age, female gender, history of spinal trauma and familial history of back pain , smoking, participation in competitive sports, high level of physical activity, prolong sitting , school furniture features in addition to school bag load , shape and size , time spend carrying the bag , fatigue during school bag carrying and position

of the bag on the body are factors associated with non – specific low back pain in school age children (Lockhart *et al* 2004 ; Haselgrove *et al* 2008 ; Macias *et al* 2008).

Today, back pain in school children is becoming new topic of growing health problem raising a red flag and 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 heavy load may cause a problem on the developing spine (Dockrell *et al* 2006).

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 children carrying a backpack (Smith *et al* 2007).

The purpose of this study were to : (1) measure the school bag weight and percentage to body weight (2) investigate the effect of school bag weight and carrying methods on the back of school children

2. Subjects and methods :

2.1 Design and setting : this cross- sectional , school based study was conducted in Hilla city in Babylon governorate in Iraq during the second semester from 1st March to 30 April , Approval of the study protocol and written consent was obtain from the vice manager school prior to data collection. Consent form includes a simple description of the study and its significance was distributed upon school students to obtain parent approval.

2.2 Questionnaire : the preliminary version of the questionnaire was finalized for application after pretest in a pilot study of 20 school –age students , after which minor modifications were made on the original questionnaire . the final analysis did not include the results of pilot study. The questionnaire included (name , age , weight , school bag weight , school bag present) are completed by the researcher.

2.3 Subjects : a cross sectional study was conducted on a random sampling technique from seven randomly selected school in Al- Hilla city on 242 primary school students ,116 male and 126 female , with rang age (6-12years) , 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 or any child on chair.

2.4 Data collection : data collection took place in two steps : the first step was to information about : name ,age , weight , school bag weight and percentile of school bag weight to body weight and questionnaire included school bag type (2 straps backpack, 1 straps backpack or roller trolley) , way of carrying the bag(1 shoulder , 2 shoulders or rolling trolley) , perception of students toward school bag weight(normal ,lighter .heavier weight) and health effects (back pain, shoulder pain , falling with trauma and no pain).

The second step was take a weight of student & school bag by using a calibrate digital scale of all students without jacket and bar foot with accepted error of 0.1 Kg.

Data collection and measurement were done with the assistant of ten trained fourth year medical student distributed as groups . data were collected on a random day chosen by the researcher so that the students could not modify their school bag weight and at the begins of the school day to measure all the books and any food items . the questionnaire and measuring process took approximately 10-15 minutes.

2.5 Statistical analysis: descriptive statistical were used to determine mean , standard deviation , frequency variables and Chi –sequer test .all analysis were conducted using SPSS version 18 . results were considered significant at the level of 0.05.

3. Results

Across sectional study for two hundred forty two school age children , 116 (47.9%) males and 126 (52%) females ,completed the questionnaires and school bag evaluation , their mean age mean was (8.781± 1.547years) (rang 6-12) , the mean ± standard deviation (SD) of students weight was (29.144± 8.267) (rang 15-63) . the bag weight and bag weight to body weight percentage were also evaluated with mean ± SD (5.111±2.023) and (18.896 ±9.239) respectively .

Table 1 represents the frequent distribution were 109 (45%) of the students were at age group 6-8 years and(73.6%) of the students weight between 21-40 Kg .

From 242 school age children , 105 (43.4%)carry bag weight <5 Kg, while 137(56.6%) carry bag weight ≥5 Kg . the ways of school bag carriage were (28.5%) two straps on two shoulders , (55%) wear one strap on one shoulder and (16.5%) used roller trolley . nearly (31%) of students reported that their school bag weight is of normal weight , (28.5%) as lighter weight and (40.1%) as heavier weight . the students also reported low back pain were (36.8%) , (45%) neck- shoulder pain , (18.2%) reported no pain .

Table 2 shows no significant association between bag weight and age groups (p= 0.106) , were (65.2%) of age group 9-10 years carried bag weight ≥ 5 Kg , while 50.5% of age groups 6-8 years carried bag weight < 5 Kg .

A significant difference was documented in bag weight and gender ($p < 0.001$) with (77%) of female carry bag weight ≥ 5 Kg and (65.5%) of males carry weight < 5 Kg . also significant association between bag weight and the design of the bags and bag % with ($p = 0.011$, $p < 0.001$) respectively.

no significant association between bag weight and students weight and with ($p = 0.1$) .

the significant association between bag weight and health effect ($p = 0.001$) were (80.4%) of students had lower back pain carried bag weight ≥ 5 Kg and (19.6%) of students had lower back pain carried bag weight < 5 Kg . table 2 also shows significant association between bag weight and student felling about school bags ($\chi^2 = 14.926$, $p < 0.001$) were (92.8%) of students reported their bags were heavier when bag weight ≥ 5 Kg and (19.7%) of normal weight with bags weight ≥ 5 Kg .

table 3 shows significant association between health effects and gender ($p < 0.0001$) were (41.3%) of females had lower back pain compare with (31.1%) males , a significant association also between health effects and students weight were (44.7%) of students weight between 21-40 Kg had neck-shoulder pain and (53.3%) students weight ≤ 20 Kg and had neck- shoulder pain and (52.6%) of students weight > 40 Kg had no pain. Significant association also between health effects and school bag% were (51.1%) of bag % group $> 20\%$ had lower back pain , (54.8%) of bag % group 11-20% had neck- shoulder pain and (65.2%) of $< 10\%$ bag % had no pain. (56.7%) heavier bag weight had lower back pain , (62.3%) lighter weight had neck- shoulder pain and (25%) of normal weight had low back weight ($p < 0.001$) . table 3 also shows significant association between the health effects and bag weight ($\chi^2 = 33.3$, $p < 0.001$) , (48.9%) of students with bag weight ≥ 5 Kg had lower back pain compared with (21%) lower back pain when carrying bag weight < 5 Kg , with no significant association between health effects and age groups ($p = 0.282$) .

4. Discussion

The health and wellbeing of students is a priority subject . carrying school bags in a concern from some students and families , the prevention of back pain and other musculoskeletal injuries is important for students current wellbeing and long term health (Dockrell *et al* 2006). The result of this study reported that the mean age of children is (8.7 ± 1.5 years) , carrying school bags weight with mean (5.1 ± 2.02) , that is lower than found by Whittfield et al that reported (6.6 ± 2.2 Kg) and Sheir-Neiss et al that report (8.3 ± 2.1 Kg) (Whittfied *et al* 2005 ; Sheir-Neiss *et al* 2002).

this study reported significant association between bag weight and gender with ($\chi^2 = 44.4$, $p < 0.0001$) , (56.6%) of study school children carrying bag weight ≥ 5 Kg. Most children are required to tote heavy school bags to and from school each day, and the load increases as they reach higher grades. Sports clothing and equipment often adds another bag to their load. This finding agree with other study that report the weight of the average backpack is heavier, proportionally, than the legal load-bearing limit for adults (Nigrini S *et al* 1999).

about (77%) of girls carry school bag weight ≥ 5 Kg compared with (34.5%) for boys , this may be explain as school girls bring more school items than necessary to take to school with bring of some food items and bottle water or ice water , especially we measures the school bag at beginning of school day while most boys shiny from bring food items or water and be less care to bring all the books and copybooks.

This study also reported that increased school bag weight associated with increase risk of lower back pain ($p = 0.001$) which is inconsistent with other studies (Nigrini S *et al* 1999 ; Skoffer 2005), and agreed with other studies that found an association between school bag weight and back pain (Whittfied *et al* 2005 ; Skaggs *et al* 2000) . many epidemiologic data collected during the past 20 years, suggested that the majority of neck and back pain of children is of non- specific causes , as school bag weight and not related to pathological conditions (Wiersema 2003 ; Whittfied *et al* 2005). (Shamsoddini *et al* 2010) found that the weight of backpack carried by secondary school students in Tahrán appeared to be strongly related to shoulder , neck, back & extremities complaints. There was no association between bag weight and the students weight ($p = 0.193$) this may be explain by books & copybooks items are the same for the same class and not related to students weight so that the lighter and heavier students carried the same items.

In the present study revealed that significant association between bag weight and the design of bag ($\chi^2 = 9.112$, $p = 0.011$) that (65 %) of roller trolley are < 5 Kg and the bag carry on two shoulder weight ≥ 5 Kg was (60.9%) , this finding may be explain by Rolling bags with an extendable handle and wheels may be need to be lifted up stairs and can cause trip hazards during transit in crowded areas and when left in access ways so many school choice changes to other bag design when the school items are heavy. the other explanation may be the (45%) of the study children were from age group 6-8 , in those their school items are less than the older groups and those children tend to use the roller trolley that mostly small size in our markets .our findings supported that (40%) of students found that their school bag heavy and (28%) found that their bags were lighter weight than usual . these

findings were supported in part by results of Goodgold et al. who reported that few children find their bags as light and more than half of children reported that their bag was uncomfortable to carry (Goodgold *et al* 2002). They explained their results as the variation of children abilities to carry proportionally similar loads (Haselgrove *et al* 2008).

When evaluating a child without an obvious injury, the first thing to consider is the age of the child. Young children (under the age of 10 years) rarely complain of back pain, but child in this age group with a complaint that 'seems real' should be evaluated by a physician. Older children (age 10 and up) are more likely to have mechanical complaints. These can be associated with carrying a heavy back pack, sports activities, or structural abnormalities (Prins *et al* 2008). However, back pain is much less common than in adults with fewer than 30% of children and adolescents reporting back pain, and very few presenting to doctors with their pain (Feldman DS *et al* 2006).

This study reported no significant association between health effects and age groups ($\chi^2=5.087$, $p=0.282$), the age group 11-12 years had lower back pain (42%), while age group of 6-8 years had (52.3%) back and shoulder pain (table 4). the other study report (46.1 %) report back pain caused by their backpack, around (70%) of more than 10 years old Australian school children suffer from back pain by carrying school bags (10). Table 4 shows there was significant difference with ($p<0.001$) between health effects and gender, with (50%) of females had back and shoulder pain, (41.3%) had lower back pain and (8.7%) had no pain from carrying school bag compared with (39.7%, 31.9% and 28.4%) of males had back and shoulder pain, lower back pain and no pain respectively, that is agreed with other studies (Gunzburg *et al* 1999; Siambanes *et al* 2004). this may be explained as this sample of young girls are at the age of growth and their bone are soft and carrying heavy school bag may cause more physical stress and strain on their back. our study reported that (55%) of students carried bag on one shoulder, With significant associations between the three type of bag design and health effects with ($p<0.001$), that (50.4%) of children had neck and shoulder pain when they carried bag of one shoulder one, this can be explain us shoulder carrying methods resulted in a significant elevation of the strap supporting shoulder and concomitant lateral bending of the spine to the unweight side., and (58%) of children carry bag on two shoulder had lower back pain, this finding can compared with other study that found (73.4%) of students carried the loaded backpack on one shoulder may lead to more pain while carrying the backpack symmetrically over both shoulders is the best way ergonomically (Pascoe *et al* 1999). other study reported if back packs are too heavy or the weight is carried unevenly (over one shoulder) they can cause back pain (Cottalorda *et al* 2004).

As (16.5%) of study group carried roller trolley from those (25%) of students use roller trolley bag design had neck- shoulder pain, this may be explained that the students may need to carry the bag upstairs or transfer it from place to place and this consider un easy for small children. the other explanation is this rolling trolley dragged by one hand which leading to twisting of the Childs' trunk and cause neck-shoulder pain especially (45%) of study school groups are at age group 6-8 years.

In the present study (43%) of study group carried school bag, weighted (11-20%) of their body weight while (38%) carried school bag weight ($> 20\%$), that are higher the recommended guideline of 10% of body weight (Smith *et al* 2007). And agree with other studies that report the bag weight to body weight % was ($\geq 20\%$) (Dockrell *et al* 2006; Whittfied *et al* 2005). While this result is inconsistent with Viry *et al* 1999.

Also reported significant association of health effect with bag percentage ($p<0.001$), (54.8%) of bag percent between (11-20%) complain of neck - shoulder pain and (51.1%) of bag percent more than 20 % had lower back pain. Many researchers concluded that subjects carrying school bag weight 20% or more of their body weight reported lower back pain, muscle imbalance and musculoskeletal symptoms (Dockrell *et al* 2006; Whittfied *et al* 2005; Nigrini S *et al* 1999; Siambanes *et al* 2004). with significant association with bag weight ($p<0.001$), with $\geq 5\text{Kg}$ bag weight (48.9%) had lower back pain, this may be explained as the sample of study group are at age of growth and carrying such bag weight may cause more physical stress and strain on their back. In this study lower back pain was associated with heavy school bag as (56.7%), (35.1%) had LBP and neck-shoulder pain respectively. this finding can explain as pack the heaviest items in the child bag closest to the child's back is a correct use of backpack but if the heaviest items are packed further away, this throws out the child's center of gravity and causes unnecessary back strain (Haselgrove *et al* 2008). several studies have reported a relationship between heavier school bag and back pain (Viry *et al* 1999; Girmmer *et al* 2002). the (52.6%) of students weight $> 40\text{ Kg}$ reported no pain at any site in their body with significant association in health effects and students weight ($p=0.001$), while (53.3%) of students $< 20\text{ Kg}$ had neck and shoulder pain.

Therefore, it may be time to look at what pain, aches, disability and "disease" mean to schoolchildren themselves, and not to simply apply adult definitions to assess children and LBP (Girmmer *et al* 2002).

5. Conclusion

The results revealed a high weight and percentage of school bag by primary school children. the girls carried more school bag weight than boys. Many students reported that their school bag were heavy. the gender, students

weight, bag design ,bag percentage , heavy bag weight and heavier bag weight are risk factors associated with lower back pain & neck- shoulder pain in school children .

6. Recommendations

From the results of present study, the recommendation are the followings:

- 1-The backpack should weigh less than 10 per cent of your child's body weight. teachers and parents should work together to achieve This goal.
- 2- Correct lifting and carrying techniques by:
 - A-Adjust the shoulder straps so that the bottom of the backpack is just above the child's waist – don't allow them to wear the backpack slung low over their buttocks
 - B- When fitted correctly, the backpack should contour snugly to the child's back, rather than hang off their shoulders
 - C-Make sure your child understands that carrying the backpack over one shoulder will cause back pain and potential injury
- 3- the installation of lockers at schools is often raised as a solution to carrying heavy school bags.
- 4- Regularly clean out the backpack, since your child may be storing unneeded items.
- 5- Regularly ask your child if their backpack is causing fatigue or pain. If so, lighten the load and adjust the fittings.
- 6-See the doctor if your child complains of back pain
- 7- purchase of well designed back packs and their correct use is an important factor to promote good posture and minimize effort in carrying school bags.
- 8- further study to evaluating the modifiable risk factors of the incidence of back pain and of the consequences of back pain in schoolchildren is important for the development of preventive interventions and to determine the long term effects of carrying school bag .

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Table 1. Prevalence of different variables among students

Variable	Frequency	(%)
Age groups		
6-8 years	109	45.0
9-10 years	95	39.3
11-12 years	38	15.7
Total	242	100.0
Sex		
Male	116	47.9
Female	126	52.1
Total	242	100.0
Student weight groups		
Less than 20 kgs	45	18.6
21-40 kgs	178	73.6
More than 40 kgs	19	7.9
Total	242	100.0
Bag weight groups		
Less than 5 kgs	105	43.4
≥ 5 kgs	137	56.6
Total	242	100.0
Types of bag		
2 straps backpack	69	28.5
1 straps backpack	133	55.0
Roller trolley	40	16.5
Total	242	100.0
Bag to body weight		
Less than 10 %	46	19.0
11-20 %	104	43.0
More than 20%	92	38.0
Total	242	100.0
Student felling		
Normal weight	76	31.4
Lighter weight	69	28.5
Heavier weight	97	40.1
Total	242	100.0
Health effects		
Lower back pain	51	21.1
Shoulder pain	92	38.0
Falling with trauma	59	24.4
No pain	40	16.5
Total	242	100.0

Table 2. Association between bag weight and its associated risk factors

Variable	Bag weight		Total	χ^2	df	P values
	Less than 5 kgs (%)	More than & = 5 kgs (%)				
Age Groups (years)						
6-8 years	55 (50.5)	54 (49.5)	109 (45.0)	4.477	2	0.106
9-10 years	34 (35.6)	61 (64.2)	95 (39.3)			
11-12 years	16 (42.1)	22 (57.9)	38 (15.7)			
Gender						
Male	76 (65.5)	40 (34.5)	116 (47.9)	44.42	1	<0.0001*
Female	29 (23.0)	97 (77.0)	126 (52.1)			
Weight groups						
Less than 20 kgs	19 (42.2)	26 (57.8)	45 (18.6)	3.287	2	0.193
21-40 kgs	74 (41.6)	104 (58.4)	178 (73.6)			
More than 40 kgs	12 (43.4)	7 (36.8)	19 (7.9)			
Types of bag						
2 straps backpack	27 (39.1)	42 (60.9)	69 (28.5)	9.112	2	0.011*
1 straps backpack	52 (39.1)	81 (60.9)	133 (55.0)			
Roller trolley	26 (65.0)	14 (35.0)	40 (16.5)			
Bag to body weight						
Less than 10 %	45 (97.8)	1 (2.2)	46 (19.1)	113.54	2	<0.001*
11-20 %	55 (53.4)	48 (46.6)	103 (42.7)			
More than 20%	5 (5.4)	87 (94.6)	92 (38.2)			
Student felling						
Normal weight	61 (80.3)	15 (19.7)	76 (31.4)	96.684	2	<0.001*
Lighter weight	37 (53.6)	32 (46.4)	69 (28.5)			
Heavier weight	7 (7.2)	90 (92.8)	97 (40.1)			
Health effects						
Lower back pain	10 (19.6)	41 (80.4)	51 (21.1)	14.926	2	0.001*
Shoulder pain	45 (48.9)	47 (51.1)	92 (38.0)			
others	50 (50.5)	49 (49.5)	99 (40.9)			

* Significance level p value < 0.05

Table 3. Association between health effects and its associated risk factors

Variable	Health effects			χ^2	df	P values
	Lower back pain	Back & shoulder pain	No pain			
Age Groups (years)						
6-8 years	37 (33.9)	57 (52.3)	15 (13.8)	5.087	4	0.282
9-10 years	36 (37.9)	38 (40.0)	21 (22.1)			
11-12 years	16 (42.1)	14 (36.8)	8 (21.1)			
Gender						
Male	37 (31.9)	46 (39.7)	33 (28.4)	15.793	2	<0.0001*
Female	52 (41.3)	63 (50.0)	11 (8.7)			
Weight groups						
Less than 20 kgs	18 (40.0)	24 (53.3)	3 (6.7)	19.711	4	0.001*
21-40 kgs	68 (38.2)	79 (44.4)	31 (17.4)			
More than 40 kgs	3 (15.8)	6 (31.6)	10 (52.6)			
Types of bag						
2 straps backpack	23 (33.3)	32 (46.4)	14 (20.3)	5.253	4	0.262
1 straps backpack	50 (37.6)	64 (48.1)	19 (14.3)			
Roller trolley	16 (40.0)	13 (32.5)	11 (27.5)			
Bag to body weight						
Less than 10 %	2 (4.3)	14 (30.4)	30 (65.2)	92.153	4	<0.001*
11-20 %	40 (38.5)	57 (54.8)	7 (6.7)			
More than 20%	47 (51.1)	38 (41.3)	7 (7.6)			
Student felling						
Normal weight	19 (25.0)	32 (42.1)	25 (32.9)	38.951	4	<0.001*
Lighter weight	15 (21.7)	43 (62.3)	11 (15.9)			
Heavier weight	55 (56.7)	34 (35.1)	8 (8.2)			
Bag weight						
Less than 5 kgs	22 (21.0)	49 (46.7)	34 (32.4)	33.305	2	<0.001*
More than & equal 5 kgs	67 (48.9)	60 (43.8)	10 (7.3)			

* Significance level p value < 0.05

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