Effect of Heavy School Bag on Musculoskeletal System of the Students

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ABSTRACT

Background: The recommended weight of school bag is 10% of body weight.

Objective: To determine the percentage of school bag weight to body weight of the students and to assess the effect of heavy school bag on the musculoskeletal system of them.

Methods: This observational descriptive cross-sectional study was conducted in ten primary schools in Baghdad Al-Karkh during the month of October 2019. The sample size was 600 students, aged from 6 to 12 years. The stratified random sampling method was used, where each school was stratified into six classes. Then the samples were taken from each class by using the simple random sampling. Official permission was obtained from principal of each school. Each students' body weight, school bag weight and percentage of school bag weight to body weight were measured.

Results: Mean age was 9 ± 1.8 years, mean of body weight of students was 29.83 ± 6.09 kg, mean of school bag weight was 5.124 ± 0.847 kg. Seventy percent of students were carrying their bags on their backs, 10 % were carrying their bags on one shoulder, 20% were pulling their bags with their hands. The females have more shoulder pain than males and the highest percentage of school bag weight to body weight was recorded in class III (20%) and the lowest percentage was in class VI (15%).

Conclusion: There is an excess in percentage of school bag weight to body weight more than recommended weight.

Keywords: Heavy school bag, Musculoskeletal system, Recommended weight of school bag.

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Problem of heavy schoolbags is a global problem and a number of studies addressed this problem in different countries[1]. In recent years, non-specific back pain, neck pain, shoulder pain and poor posture among school children are topics of growing importance in the literature and these conditions were mostly related to overloaded caused by heavy schoolbags[2]. Other consequences of heavy schoolbags include bad posture, fatigue, exhaustion, and consequently concentration problems and poor school performance[3].

A general guideline of 10% body weight was initially proposed by a Germans (Voll and Klimt) in 1977[4]. Many of studies later on continued to recommend and emphasize that the schoolbag load should not exceed this limit[5].

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The majority of reports indicated that schoolbag greater than the recommended weight for long period of time might affect the musculoskeletal alignment which will cause back pain, neck pain, and shoulder pain in addition to deformities in the stature[6]. If a schoolbag is worn incorrectly, it may cause strain or injury to the back and abdominal muscles[7].

Non-specific musculoskeletal pain is a common symptom in childhood, and it may occur more frequently in some cases[8]. Pain associated with musculoskeletal disorders is a musculoskeletal system over a longer period. This load does not only affect the tendons and muscles but also the cervical nerves and joints, upper and lower back, thorax, shoulders, arms, and hands[9].

Studies have shown that more than 50% of the pupils carry very heavy school bags[10]. There are many problems associated with carrying heavy schoolbags. They are multifactorial in nature as effects

are highly dependent on heavy loads, mode of carrying, mode of travelling and time spend on carrying the bags[11]. Peak rate of growth occurs during childhood, puberty and the growth of the appendicular skeletal system ceases around 16 years of age for females and 18 years for males[12]. Carrying posterior loads by young people has been linked with spinal pain, and the amount of postural change produced by load cause tissue damage[13]. Injuries may occur when a child tries to balance for the extra weight by leaning forward, bending his or her back or leaning to the side[14]. The majority of the studies focused on the schoolbag weight as the most important factor affecting the musculoskeletal system, while there are also other factors such as duration and method of carrying schoolbags affecting the musculoskeletal system[15]. A study in New York found that about one third (30%) of children and adolescents investigated reported back pain but only a minority visited doctors[16].

The current study aims to determine the percentage of school bag weight to body weight of students and to assess the effect of heavy school bag on the musculoskeletal system of them.

Methods

This observational descriptive cross-sectional study was conducted on ten primary schools located in different places in Baghdad Al-Karkh from the 1st of October till 15th of October 2019. The sample size was 600 students divided equally for each gender as 300 males and 300 females.

Inclusion criteria include all students aged form 6 to 12 years, both males and females from all classes. Students with congenital deformity, had a history of trauma to bones or muscles, very obese students were excluded.

The schools were visited and meeting was held with school principals to inform them of the importance of the study and its purpose and to take approvals. The study procedure was explained to school teachers. Official permission was obtained from principal of each school.

The stratified random sampling method was used, where each school was stratified into six classes. Then the samples were taken from each class by using the simple random sampling. The name of each male student was written on a small piece of paper and placed in a black small box, while the names of the female students were placed in white small box. Five names were withdrawn from the black box (5 males), and five names were withdrawn from the white box (5 females), this is to ensure that every student has the same opportunity to participate in the study. Therefore, the number of the sample from each school will be sixty students, 30 male students and 30 females, so the number of the sample for the ten schools would be 600 students, 300 males and 300 females.

Each students' body weight and school bag weight were measured using -powered Seca electronic scale. The weight was first measured when carrying the school bag and then without the school bag and the difference between the two weights was recorded as the weight of the school bag. Special questionnaire was used to gather the required data: age, grade of class, gender, the students' weight, the weight of schoolbag, site and severity of pain, method and duration of carrying a schoolbag, mode of transport to reach school and the percentage of school bag weight to body weight was measured and then assessed with recommended limit.

Each student's bag was checked to know the types of school bag (single strap, dual strap or trolley school bag) and its contents to determine whether students commit to the lesson schedule or not. Statistical package SPSS version 23 was used. Descriptive statistics and Chi square test were used for data analysis, p-value less than 0.05 was considered the level of significance.

Results

Mean age was 9 years ± 1.8. Mean of body weight of students was 29.83 kg ± 6.09 kg with minimum weight 22.32 kg and maximum was 23.65 kg. Mean of school

bag weight was 5.124 kg ± 0.847 with minimum weight 4.156 kg and maximum 7.282 kg. Carriage of school bag up to 10 minutes was 192 students (33%) while 344 (57%) students carried their school bag within 11-20 minutes, about more than 20 minutes were only 60 students (10%) carried their school bag within this limit. Regarding mode of transport of students to reach their schools the result was 335 students (56%) were walking, 190 students (32%) arrive at their schools by public transport, other students were using private transport to get to their schools were only 75 students (13%), (Table1).

Concerning the method of carrying school bag, 420 (70%) of students were carrying their school bags on their backs by two shoulders (dual strap school bag), 60 (10%) of the students were carrying their bags on one shoulder (single strap school bag), 20(20%) of the students were pulling their school bags with their hands (trolley school bag), (Figures 1 and 2).

According to gender distribution of shoulder pain, the result was 110 male and 220 female students, for neck pain the result was 19 male and 23 female students, regarding back pain the result was 43 male and 65 female students, for limb pain, the result was 56 male and 64 female students, (Figure 3).

The recommended school bag weight to body weight the result was in all classes 2.98 kg, for a class I was 2.26 kg, the result for class II was 2.79 kg, concerning the result in class III was 2.52 kg, for class IV the result was 3.41 kg, for class V was 3.41 kg and lastly the result of class VI was 3.53 kg. The percentage of bag weight to body weight in all study groups (all classes) was 17.16%, the result in class I was 18.39%, for class II was16.04%, regarding class III the result was 20.33%, in class IV was 15.50%, for class V was 18% and the result for class VI was 15.88%, (Table 2 and Figure 4).

The occurrence of shoulder and neck pains with different variables; gender, method of carrying a schoolbag and mode of transport to reach school are shown in tables 3 and 4.

Table 1: Characteristics of students in study group.

Variables	Descriptive statistic
Mean of age (years) ± SD	**9 ±1.8**
Gender No. (%)	
Male	**300 (50%)**
Female	**300 (50%)**
Mean of body weight of pupils (kg) ± SD	**29.83±6.09**
Minimum	**22.32**
Maximum	**39.65**
Mean of school bags weight (kg) ± SD	**5.124±0.847**
Minimum	**4.156**
Maximum	**7.282**
Duration of carrying of school bag No. (%)	
Up to 10 minutes	**196 (33%)**
11-20 minutes	**344 (57%)**
More than 20 minutes	**60 (10%)**
Mode of transport to reach school No. (%)	
Walking	**335 (56%)**
Public transport	**190 (32%)**
Private transport	**75 (13%)**

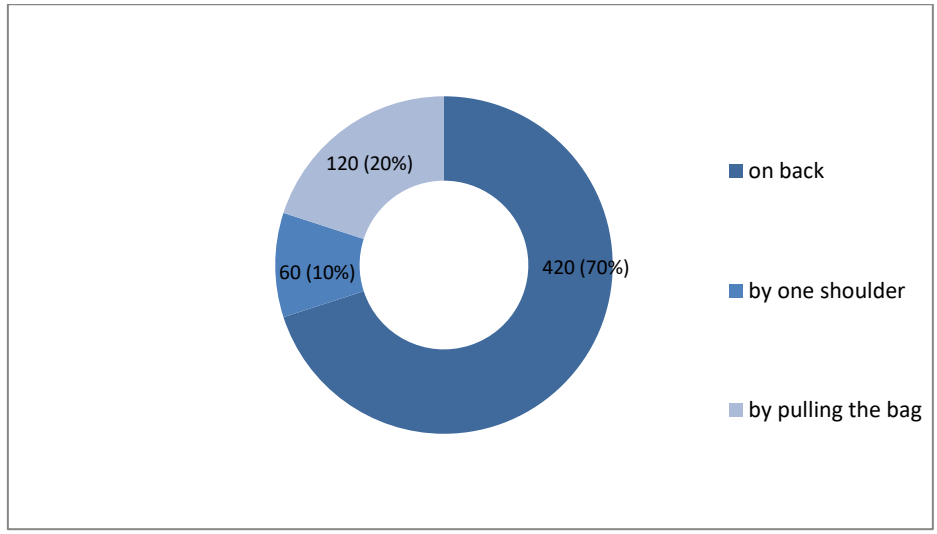

Figure 1: Method of carrying of school bag

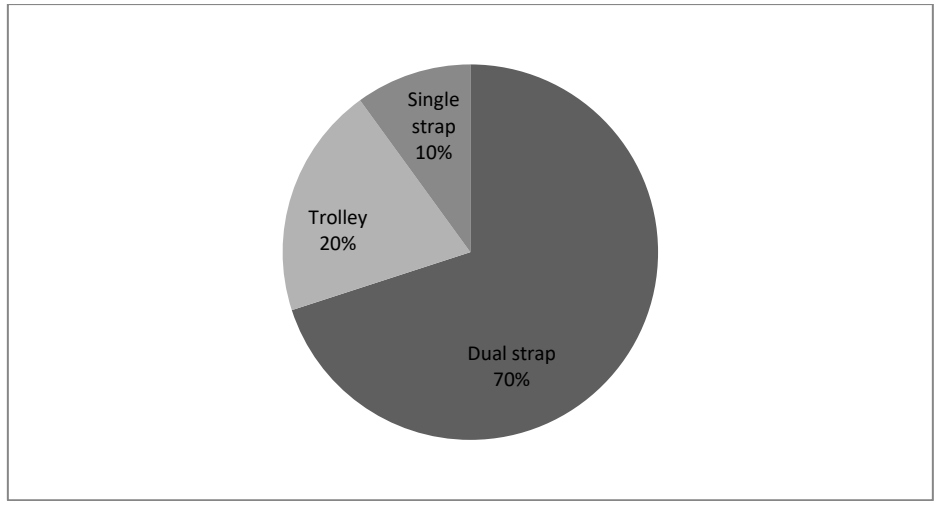

Figure 2: Types of school bag.

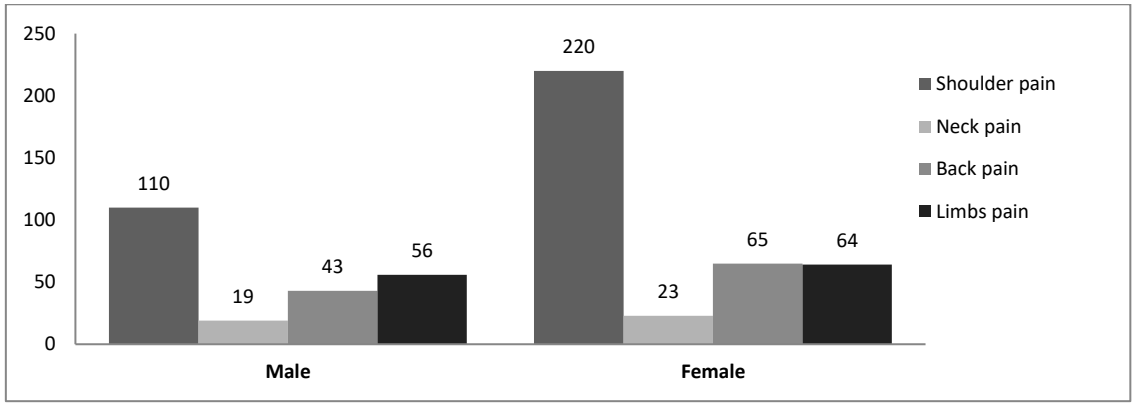

Figure 3: Musculoskeletal pains and discomfort according to gender.

Table 2: Distribution of mean of body weight of students, mean of school bag weight, recommended of bag weight to body weight and percentage of school bag weight to body weight in study group .

Grade of class	Mean of body weight of pupils (kg)	Mean of schoolbag (kg)	Recommended of bag weight (kg) to body weight (10% of body weight)	Percentage of bag weight to body weight in study group
All classes (n=600)	29.83 ±6.9	5.12 ±0.8	2.98	**17.16%**
Class I	22.61 ± 0.1	4.159 ±0.3	2.261	**18.39%**
Class II	27.86±7.8	4.467±0.1	2.786	**16.04 %**
Class III	25.19 ±0.4	5.104±0.2	2.519	**20.334%**
Class IV	34.12±7.8	5.292±0,1	3.412	**15.50%**
Class V	34.07±0.1	6.134±1.5	3.407	**18.00%**
Class VI	35.31±0.7	5.609±0.2	3.531	**15.88%**

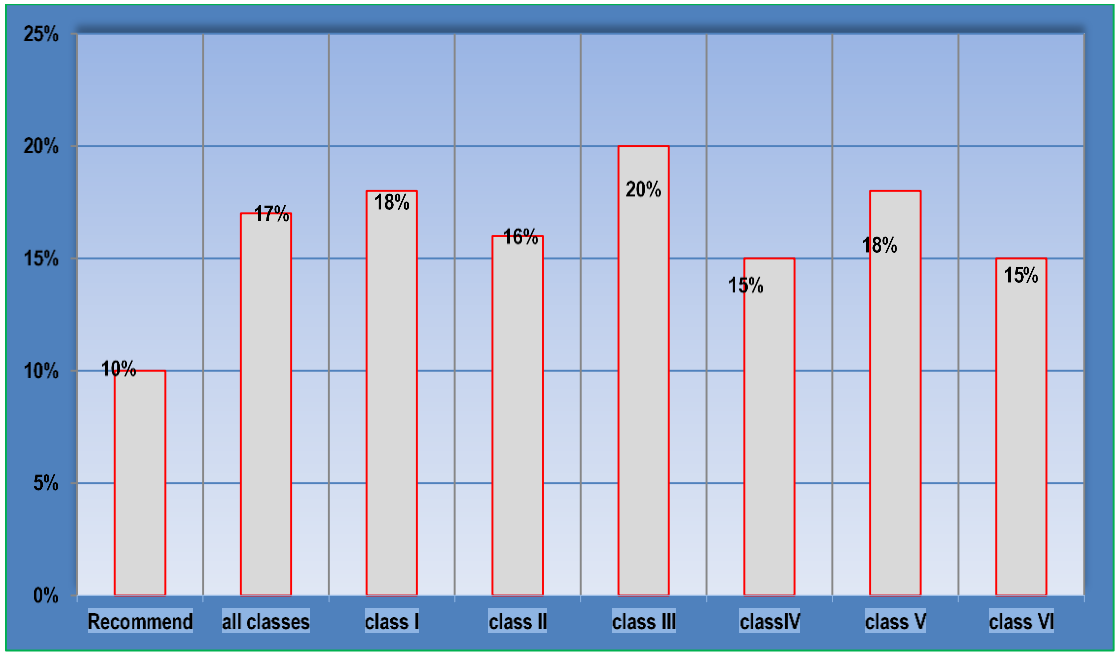

Figure 4 :The excess of ratio of the weight of school bag to the body weight of the students.

Table 3: Level of significance difference between shoulder pain with different variables.

Variables	Shoulder pain			
	Present	Not present	Chi square	P value
Male	110	190		
Female	220	80	80.007	0.000
Method of carrying of school bag				
On back	310	110		
By one shoulder	10	50	201.251	0.000
By pulling the bag	10	110		
Duration of carrying of school bag				
Up to 10 minutes	150	45		
11-20 minutes	130	214	97.335	0.000
More than 10 minutes	50	10		
Mode of transport to reach school				
Walking	205	130		
Public transport	110	80	42.957	0.000
Private transport	15	60		

Table 4: Level of significance difference between neck pain with different variables.

Variables	Neck pain			
	Present	Not present	Chi square	P value
Male	19	281		
Female	23	277	0.230	0.631
Method of carrying of school bag				
On back	30	390		
By one shoulder	8	52	6.188	0.04
By pulling the bag	4	116		
Duration of carrying of school bag				
Up to 10 minutes	6	190		
11-20 minutes	29	315	7.759	0.02
More than 10 minutes	7	53		
Mode of transport to reach school				
Walking	28	307		
Public transport	8	182	3.335	0.1
Private transport	6	69		

Discussion

The most common school bag was dual strap because most students prefer this type of bags for ease of carrying and availability in the market more than other types. This result compatible with the study conducted by Balamurugan J in 2014 in South India who found that 77% of pupils carried their school bag as back pack (dual strap bag), this study which was conducted in India, was preceded by a study conducted in Iran in 2010, the results of which were almost similar to the study of India[17,18].

In the present study, the females complained of shoulder pain more than males, this result agreed to study conducted by Panicker RK in Mangalore published in 2014 which included 580 students in which found that the shoulder pain was more in female than male[19]. Another study was conducted among 135 students of private school in Pakistan, Lahore in 2016 done by Rubina Khan et al

which showed the results which closely resembles to our research[20].

The highest excess of percentage of school bag weight to body weight in the current study was 20% of body weight in class III, this is may be due to the increase in the number of books in this class, this result compatible with study conducted in India 2006 done by Mayank Mohan in which the result of this study revealed that most of the Indian children carried school bag weighing between 10-18% of their body weight[21]. The weight of the school bag expressed in percentage of body weight was found to be consistent with studies done by Pascoe et al in their study done in America found that the mean weight of school bag carried by school children was 17% of their body weight[22]. Also, JK Whitefield et al in their study done in New Zealand school reported that the mean weight of school bag carried by students was13.2% of body weight for third class and 10.2% for sixth class[23].

There was strong relation between occurrence of shoulder pain and method of carriage school bag, duration of carriage school bag and mode of transport to reach school, these results compatible with study conducted in 2004 at South Africa done by Puckree and et al in which they concluded that the shoulder and other bodily pain were strongly related to the type of school bag, method of carriage and the gender of the students[24]. In other hand, there was no relation between gender and neck pain, this result disagreed with study done by Mohseni Kh[25] in Iran 2012. In the current study, there was strong related of the neck pain and method of carrying school bag and duration of carrying school bag. This result compatible with study conducted in Saudi Arabia in 2006 which concluded that there was strong relation between neck and shoulder pain and the type of schoolbag and method of carriage[26]. Also, our results consent with other study conducted in India 2001 done by Iyer MSR in which the results were closely resemble the results of the current study[27].

In conclusion; there is an excess in percentage of school bag weight to body weight more than recommended weight.

References

1. Pavić IS. School bags and health of students. Croatian Journal for Public Health 2012; 8(31): 114-9.
2. Khan R, Jabeen H, Arshad HS. Neck, shoulder, and back pain with carrying heavy back packs among the spirit school children in Lahore. Int J Sci Res 2016; 5(6): 397-400.
3. Rai A, Agarawal S. Back problems due to heavy backpacks in school children. IOSR J Hum Soc Sci 2013;10:22-6..
4. Lasota A. Schoolbag weight carriage by primary school pupils. Work: A Journal of Prevention, Assessment and Rehabilitation. Work 2014; 48(1):26-12. Accessed 9 March 2013 available in http://www.ncbi.nlm.nih.gov/pubmed/23531575.
5. Clare Haselgrove, Leon Straker, Anne Smith, Peter O'Sullivan, Mark Perry, Nick Sloan. Perceived school bag load, duration of carriage, and method of transport to school are associated with spinal pain in adolescents: an observational study. Australian J Physiotherapy 2011; 54(3): 193-200.
6. vanGent, Dols J DeRover, Hira Sing, De Vet. Spine. The weight of schoolbags and the occurrence of neck, shoulder, and back pain in young adolescents. Spine 2003; 28: 916-21.
7. Yao W, Luo C, Ai F, Chen Q. Risk factors for nonspecific low-back pain in Chinese adolescents: A case-control study. Pain Med 2012; 13(5): 658- 64. https: //doi.org/10.1111/j.1526-4637.2012.01369.x.).
8. Chiwaridzo M, Naidoo N. Are parents and adolescents in agreement on reporting of recurrent non-specific low back pain in adolescents? A cross-sectional descriptive study. BMC Pediatric 2015; 15: 203. https: //doi.org/10.1186/s12887-015-0518-1.).
9. El-Nagar SA, Mady MM. School bag usage, postural and behavioral habits and its effect on back pain occurrence among school children. Am J Nurs Sci 2017;6:218-31.
10. Shumway CA. Control of normal mobility. In: Shumway CA, Woollacott MH (edrs.). Motor Control: Theory and Practical Applications. 2nd edition, Baltimore (Md.): Williams and Wilkins. 1995. P. 179-84.
11. Grimmer K, Dansie B, Milanese S, Pirunsan U, Trott P. Adolescent standing postural response to backpack loads: a randomized controlled experimental study. BMC Musculoskelet Disord 2002; 3: 10.
12. Lanes T, Gauron E, Spratt K, Wernimont T, Found E, Weinstin J. Long multidisciplinary rehabilitation program. Spine 1995; 20: 801-6.
13. Iyer MSR: An ergonomic study of chronic musculoskeletal pain in school children. *The Indian Journal of Pediatrics* 2001, 68(10):937-941.

14. Brzek A, Dyrda B, Nowotny-Czupryna O, Jachacz-Lopata M. Postural defects prevention programme as the exemplification of actions in the scope of health promotion in early school education-an action research perspective. New Educ Rev 2011; 24(2):194-204.
15. vanGent, Dols J DeRover, Hira Sing, De Vet. The weight of schoolbags and the occurrence of neck, shoulder, and back pain in young adolescents. Spine 2003; 28: 916-21.
16. Kistner F, Fiebert I, Roach K, Moore J. Postural compensations and subjective complaints due to backpack loads and wear time in schoolchildren. Pediatric Physical Therapy 2013; 25: 15-24.
17. Balamurugan J. School bags and musculoskeletal pain among elementary school children in Chennai City. Int J Med Sci Clin Inven 2014; 1(6): 302-9.
18. Shamsoddini AR, Hollisaz MT, Hafezi R. Backpack weight and musculoskeletal symptoms in secondary school students, Tehran, Iran. Iran J Public Health 2010; 39(4):120-5.
19. Panicker RK, Sandesh TS 17. Prevalence of musculoskeletal pain in school going adolescents using school bags: A co-relational research. Int J Ther Rehabil Res 2014; 3(4): 1. https: //doi.org/10.5455/ijtrr.00000039.
20. Khan R, Jabeen H, Arshad HS. Neck, shoulder, and back pain with carrying heavy back packs among the spirit school children in Lahore. Int J Sci Res 2016;5(6):397-400.
21. Mayank M, Upendar S, Nishat Q. Effect of backpack loading on cervical and shoulder posture in Indian school children. Indian J Physiotherapy Occupational Therapy 2006; 1: 3-12.
22. Pascoe DD, Pascoe DE, Wang YT, et al. Influence of carrying book bags on gait cycle and posture of youths. Ergonomics 1997; 40: 631-41.
23. Whittfield JK, Legg SJ, Hedderley DL. The weight and use of schoolbags in New Zealand secondary schools. Ergonomics 2001; 44: 819-24.
24. Puckree T ilal S, Lin J. School bag carriage and pain in school children. Disabil Rehabil 2004; 26(1): 54-9.
25. Mohseni Kh. The best bag and its features [Persian]. Tehran: Soroush Educational Center; Tehran 2012. Science Journal of Public Health 2014; 2(4): 305-8.

IMJ 2021; 67(2): 90-97.