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# The Effect of School Bags Weight on Musculoskeleton of Schoolchildren

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## *ABSTRACT*

***Background***: *Schoolchildren usually use school bags to carry their school materials. Carrying heavy school bags can cause several problems such as musculoskeletal problems among schoolchildren. The aim of this study was to investigate the association between the weight of school bags and the occurrence of low back, shoulder and hand/wrist symptoms among primary school children.*

***Method***: *This cross-sectional, descriptive- analytical study was conducted among a sample of 500 elementary school children in Baqubah Iraq. Data were collected using a questionnaire and from measurement of the school bag weight, body weight, distance on foot and any muscular pain of each participant. Data were analyzed using SPSS software.*

***Results***: *The average load carried by schoolchildren was 4.250 kg, representing approximately 28.4% of the children's body weight. Girls and lower grade children carried a greater percentage of their body weights. Approximately 83% of the children reported some kind of musculoskeletal symptoms. The results of binary logistic regression indicated that the school bag weight (expressed as a percentage of body weight) was only significantly associated with shoulder/wrist symptoms ($P<0.05$). Girls were more likely to complaint from low back pain than boys were..*

***Conclusion***: *The results indicate a high prevalence of musculoskeletal symptoms among elementary schoolchildren. Preventive measures and appropriate guidelines with regard to safe load carriage in schoolchildren are needed to protect this age group.*

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## Introduction

In recent years, there has been an increasing attention to the amount of loads carried by schoolchildren to and from school [1-10]. The mean school bag weight reported in previous studies in other countries has a range between 4.7 kg and9.3 kg [1, 3, 11-17]. Effectively, the relative load carried by school children expressed as percentage of body weight (% BW) in these studies represents a range between10% and 22% BW. The relative load carried by schoolchildren (expressed as % BW) has been considered one of the contributory factors for developing musculoskeletal problems among this age group. A school bag weight limit of10% to 15% of body weight has been suggested as a maximum load for school students [18]. However, a recent study conducted on school bag carriage among 13-14 year old children, found significant changes in body posture, rating of perceived exertion (PRE) and muscular strain when school bag load reached 10% of their body weight, and therefore the authors suggested that a school bag weight limit of 15% of body weight might be excessive [5]. Furthermore, it has been noted that carrying loads exceeding 10% of body weight should be avoided as these loads induce significant changes in electromyography, kinematics and subjective assessments [19]. There is evidence that the prevalence of musculoskeletal problems in schoolchildren and adolescents is increasing [7, 13, 20]. Carrying heavy school bags may be an additional factor contributing to musculoskeletal complaints in schoolchildren. In a study of140 high school students (mean age 13.6 years) in New Zealand in 2005, it was found that the musculoskeletal symptoms due to school bag carriage were experienced by 77.1% of the students and the symptoms were most prevalent in the neck, shoulder, upper back and low back, respectively [3]. Therefore, further research on this issue can help to understand better the demands of school bag carriage and its impact on the musculoskeletal systems of schoolchildren, and to introduce appropriate preventive measures and develop guidelines with regard to safe load carriage in schoolchildren. The purpose of this study was to investigate the use of school bags and the occurrence of musculoskeletal symptoms among primary school children in Iraq.

## Materials and Methods

A sample of 500 primary school children including 263girls and 237 boys, aged between 6 and 12 years the mean is 8.5 years old. Children were randomly selected from two elementary schools located in the city of Baqubah, Iraq. This cross-sectional, descriptive-analytical study was conducted during Oct 2015 till Fib2016. Children were selected from two elementary schools that were randomly selected from all elementary schools located in the study area one in rural and other from urban area. A digital electronic scale was used to measure the body weight and the weight of the school bag (including any additional items carried separately from the school bag). To collect data on musculoskeletal symptoms and the use of school bags among children, a

questionnaire was used. The questionnaire first recorded demographic details such as the age, gender and grade level of the children as well as the type of school bag carried by the children. Musculoskeletal symptoms in different body regions was assessed using the modified Nordic Musculoskeletal Disorders Questionnaire [24] ,in which including gender ,age , body weight ,bag weight ,distance on foot to school ,(shoulder, neck .back , knee ,wrist ,ankle )pain or numbness to report areas of musculoskeletal symptoms [3, 7, 25, 26] . The children were asked to indicate if they had experienced any ache, pain, discomfort or numbness that may be because of carrying their school bags. ), as well as school bag weight expressed as a percentage of body weight (BW %) (less than 10% BW and equal or more than 10% BW). $P < 0.05$ were considered as significant for all analyses.

## Results

Children (263 girls and 237 boys) are included with age of (6-12years old) with mean age 8.5 year. The results indicated that approximately 83% of the children reported some type of musculoskeletal symptoms in at least one body region, with shoulder complaints being the most reported symptom 70%. The mean school bag weight expressed in this study was approximately 28.4%. The results were showed a significant ($p \leq 0.05$) positive correlation body weight (26. 2 ± 7.8) with bag weight (4.2 ± 0.9), while a significant ($p \leq 0.05$) negative correlation was showed for body weight and bag weight with distant on foot, back pain, hold bag, shoulder pain, neck pain, and knee pain. A distant on foot was revealed to negative correlation with body weight, bag weight and back pain. However, the result conducted the positive correlation hold bag, shoulder pain, neck pain, and knee pain. For the hold bag with other parameters showed a significant ($p \leq 0.05$) correlation with body weight and bag weight. In the other hand, the results were showed significant ($p \leq 0.05$) positive correlation with each distant on foot, back pain, shoulder pain, neck pain, and knee pain. (Table 1).

**Table 1:** Correlation between body weight, bag weight, distant on foot and hold bag with back pain, hold bag, shoulder pain, neck pain, and knee pain

| Parameters | | body weight | bag weight | distant on foot | back pain | hold bag | shoulder pain | neck pain | knee pain |
|---|---|---|---|---|---|---|---|---|---|
| BODY WEIGHT | Pearson Correlation | 1 | .253** | -.034 | -.093* | -.111* | -.242** | -.205** | -.125** |
| | Sig. (2-tailed) | | .000 | .455 | .037 | .013 | .000 | .000 | .005 |
| BAG WEIGHT | Pearson Correlation | .253** | 1 | -.143** | -.288** | -.227** | -.263** | -.306** | -.273** |
| | Sig. (2-tailed) | .000 | | .001 | .000 | .000 | .000 | .000 | .000 |
| DISTANT ON FOOT | Pearson Correlation | -.034 | -.143** | 1 | -.035 | .589** | .060 | .046 | .016 |
| | Sig. (2-tailed) | .455 | .001 | | .436 | .000 | .178 | .309 | .727 |
| HOLD BAG | Pearson Correlation | -.111* | -.227** | .589** | .163** | 1 | .265** | .108* | .065 |
| | Sig. (2-tailed) | .013 | .000 | .000 | .000 | | .000 | .016 | .146 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | | | | | |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | | | | | | |

In the (Table 2) the result showed that body weight effect on the pain in 81%. while the bag weight effect on the pain in the 202% (Table 3) and the result showed that hold bag effect on the pain in the 91% (Table 4), but distant on foot effect on the pain in the 0.6 % (Table 5).

**Table 2: The effect of body weight on the pain**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .285[a] | .081 | .074 | 7.54825 |

**a. Predictors: (Constant), knee pain, back pain, shoulder pain, neck pain**
**b. Dependent Variable: body weight**

**Table 3: Effect of bag weight on the pain**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .449[a] | .202 | .195 | .78538 |

**a. Predictors: (Constant), knee pain, back pain, shoulder pain, neck pain**
**b. Dependent variable: bag weight**

**Table 4: Effect of hold bag on the pain**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .302[a] | .091 | .084 | .19238 |

**a. Predictors: (constant), knee pain, back pain, shoulder pain, neck pain**
**b. Dependent variable: hold bag**

**Table 5: Effect of distance on foot on the pain**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .081[a] | .006 | -.002 | 346.99186 |

**a. Predictors: (Constant), knee pain, back pain, shoulder pain, neck pain**
**b. Dependent variable: distant on foot**

## Discussion

The present study investigated the prevalence of musculoskeletal symptoms among elementary school children in relation to the use of school bags. The results indicated that approximately 83% of the children reported some type of musculoskeletal symptoms in at least one body region, with shoulder complaints being the most reported symptom (70%)., school bags weights expressed as % BW were heavier for lower grade children (i.e. they carried a greater percentage of their body weights), which is also in agreement with the findings of the study conducted by Pau and Pau in Italy [17] . As shown by the results, the mean school bag weight carried by the children in the current study (which is 4.250 kg) was much higher than weights reported in most previous studies conducted in other countries [1, 3, 11-17] .

This result suggests that schoolchildren in this study are required to transport fewer educational or recreational materials to or from schools, which may be attributable to the differences in school curriculum or the type of books required in each of the different countries. In addition, the mean school bag weight expressed as% BW in this study was approximately 28.4%, which is much higher than those reported in some previous studies [12, 14] . The results indicated that the mean school bag weight expressed as % BW that was included in the logistic regression models was only associated with shoulder/wrist symptoms, and contribute to increased risk for shoulder or low back complaints. The association between the weight of school bags and low back pain in this study is not consistent with previous reports [3, 7, 15, 26] .

The findings of the present study indicated that the mean school bag weight (as expressed by % BW) carried by children is high within the recommended weight limit of 10% BW recommended in the literature [5, 19] .

However, the prevalence of musculoskeletal symptoms reported by

the children in the current study is relatively high. It seems that the percentage of body weight may not alone represent the demands on the musculoskeletal systems of school children and recommendations regarding a weight limit for school bag carriage should take into account other conditions involved. Another possible explanation is that the current proposed weight limit for school bag carriage may not be appropriate for elementary school children. This is simply because these recommendations regarding weight limit are mostly based on studies that have studied older age group of school students than those studied in the current study.

However, further studies are recommended to investigate this possibility However, as noted by Auvinen et al., so far no objective method to measure pain has been evolved [27] . Another limitation is the cross-sectional nature of the study, which prevented an evaluation of the relationship between cause and effect. Therefore, the results should be regarded as a general indication of the problem.

## Conclusion

The findings of the present study provide additional information about the use of school bags and musculoskeletal symptoms among elementary school children. The results indicated that the prevalence of musculoskeletal complaints among schoolchildren was considerably high. This suggests the need for preventive measures and appropriate guidelines with regard to safe load carriage in schoolchildren to protect this age group. It was shown that girls were more likely to complaint from musculoskeletal symptoms in the low back than boys. The mean school bag weight expressed as BW % was found to be associated with the presence of musculoskeletal symptoms of the shoulder, lower back/wrists. In addition, individual factors including age, gender and body mass index was shown to be associated with the presence of musculoskeletal symptoms in different body regions.

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