

ORIGINAL ARTICLE

ASSOCIATION BETWEEN WEIGHTS OF SCHOOLBAG WITH MUSCULOSKELETAL SYMPTOMS AMONG SAMPLE OF PRIMARY SCHOOL STUDENTS

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ABSTRACT

Background: A heavy schoolbag is one of the most common health problems worldwide among school aged children. Frequently using the heavy schoolbag and using it incorrectly during school days may cause risk of musculoskeletal symptoms (involving pains in neck, both shoulders, back, waist, elbow, hand and wrist, thigh, knee, and foot), and can be a risk factor for other health problems including a change in body posture and spinal cord deformity. The study objectives were to investigate the association between the weight of schoolbags and the occurrence of neck, lower back, and shoulders and hand/wrist symptoms among primary school children.

Material & Methods: A descriptive (cross-sectional) design was carried out in public schools in Erbil city, during the academic year 2022-2023. Epi Info 7 (produced by CDC) computer program was used for sample size estimation. The sample involved 624 students aged 6 to 12 years from 12 primary schools in Erbil city.

Results: The majority (79.6%) of the students were using risky (heavy) weight schoolbag. The prevalence of pain (in one or more sites) was 41.3%. There was significant association between prevalence of pain and hand type of schoolbag ($p=0.022$), weight of bag ($p=0.011$), and ratio of weight of bag/body weight of more than 10% ($p=0.020$). Prevalence of pain was higher among students aged ≥ 10 years, who were using hand type bag, and who used to carry risky weight bag. Regression analysis showed that the following factors were associated with pain: age (≥ 10 years), lifting heavy weight, not practicing exercise.

Conclusion: In conclusion the prevalence of Musculo-skeletal pain was relatively high, which was multi-factorial.

KEY WORDS: Primary school student; Schoolbag weight; Back pain; Musculoskeletal; Children back pain.

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INTRODUCTION

A heavy schoolbag is one of the most common health problems worldwide among school aged children¹. Frequently using the heavy schoolbag and using it incorrectly during school days may cause risk of musculoskeletal symptoms (involving pains in neck, both shoulders, back, waist, elbow, hand and wrist,

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thigh, knee, and foot), and can be a risk factor for other health problems including a change in body posture and spinal cord deformity²⁻⁷. Prevalence of musculoskeletal pain is not constant in all related studies because there were many factors that interfere with the results such as age of participants, methods of data collection, and definitions of pain. Studies indicate that more than half (53%) of adolescents experienced musculoskeletal pain at least once in their lifetime, and 15% had persistent musculoskeletal pain at least once a week⁸⁻¹⁰. Girls are more vulnerable than boys to develop back problems due their short stature and thin body mass¹¹.

Most of the students don't have lockers to store their belongings in the school, accordingly, the students are obliged to carry their bags for long periods of time. These bags contain in addition to the textbooks and stationery, many items such as: extra

clothes and socks, foods and lunch box, electrical devices, personal hygiene items, and small band instruments¹²⁻¹⁶.

Many studies recommended that acceptable schoolbag weight is 10-15% of child's weight⁴⁻⁶. In order to avoid musculoskeletal disorders related to carrying a heavy schoolbag, the guidelines are carrying a schoolbag of not more than 10% of boys' weights and not more than 5% of girls' weights^{17,18}, and it's necessary to educate children, parents, and teachers about selecting the best schoolbag for students which should be of light weight and comfortable for students¹⁹. A study that was carried out in Thrissur district, Kerala to identify ideas of students aged 8-12 year about the best schoolbag. Results indicated that 60 % of the students preferred a new model of schoolbag by considering its aesthetic, economic feasibility, and ergonomic design²⁰.

Up to researchers' knowledge, no previous study had been carried out in the public primary schools of Erbil to study the effect of schoolbags on potential musculoskeletal symptoms among a sample of students aged 6 to 12 years. The objectives of the study were to investigate the association between the weight of schoolbags and the occurrence of neck, lower back, and shoulders and hand/wrist symptoms among primary school children.

MATERIALS AND METHODS

A cross-sectional study was carried out in the public schools in Erbil city, during the academic year 2022-2023. The sample involved 624 students aged 6 to 12 years of both sexes, gathered from 12 primary schools in Erbil city. The Epi Info 7 computer program (produced by CDC) was used for sample size estimation where the following information had been entered into the odprogram: Students population size as 148,850²¹; expected prevalence of musculoskeletal problems as 80%²². Absolute precision as 5%; design effect 2. Accordingly, the estimated sample size was 490 students while 624 students participated in the study. Both genders (male and female), and students in classes 1-6 were included. The questionnaire, designed by the researchers, consisted of five parts. Part I: students' socio-demographic data such as age, gender, school name, class, parents' occupation and educational levels. Part II: involved musculoskeletal symptoms experienced by the students. Part III involved distance of school from students' house, way and time needed to reach the school and students' activities after school hours (such as sports activities, working, using of computer and time of using computer). Part IV involved students' weights, heights, and body mass index (BMI), the height was taken bare footed using tape measure in centimeters. It was recorded into the nearest millimeter. The weight was measured in kilogram (without wearing shoes,

and wearing the least amount of clothes) by digital weighing scale. One kg as estimated weight of the clothes was subtracted from the whole body weight of the students. Standardizing the scale was made routinely before recording the weight of each subject. Part V: the weight of schoolbags was measured in Kg to the nearest gram by the weighing scale. Ethical consideration: the research was approved by the Ethics Committee of the College of Nursing, Hawler Medical University.

Statistical analysis: The statistical package for the social sciences (SPSS, version 22) was used for data entry and analysis. The Chi square test of association was used to compare proportions. Binary logistic regression was used, where the dependent variable was the prevalence of pain. The covariates that have been entered into the model, were every variable found to be significantly associated (By the Chi square test) with the prevalence of pain. A 'p' value of ≤ 0.05 was considered as statistically significant.

RESULTS

The total number of students who participated in the study was 624 students, taken from 12 schools. Their age ranged from 6 to 12 years. The mean age \pm SD was 9.16 ± 1.91 years. The median was 9 years. Around half (49.4%) were aged 10 years or more, and more than half of the children (53.5%) were males. The male: female ratio was 1.15: 1. In general, nearly equal numbers were taken from each of the year of the study in the primary school (Table 1).

Table 1. Age, gender, and years of study.

	No.	(%)
Age (years)		
6-7	130	(20.8)
8-9	186	(29.8)
≥ 10	308	(49.4)
Gender		
Male	334	(53.5)
Female	290	(46.5)
Class		
First	106	(17.0)
Second	108	(17.3)
Third	106	(17.0)
Fourth	107	(17.1)
Fifth	99	(15.9)
Sixth	98	(15.7)
Total	624	(100.0)

Table 2 shows that 20% of the children had shoulder pain, 7.5% had pain in the right hand or wrist, 6.6% had pain in the foot or ankle, 6.4% had pain in the middle back, and 5% had pain in the lower back. Other sites of pain are presented in the mentioned table.

Table 2. Sites of pain.

Site of pain*	n = 624	
	No.	(%)
Shoulder	125	(20.0)
Right Hand/wrist	47	(7.5)
Foot / ankle	41	(6.6)
Middle back	40	(6.4)
Lower back	31	(5.0)
Upper back	21	(3.4)
Knee	17	(2.7)
Left hand / wrist	10	(1.6)
Neck	9	(1.4)
Waist	4	(0.6)
Chest	3	(0.5)
Elbow	2	(0.3)
Thigh	1	(0.2)

*Note: The child may complain from pain in more than one site.

The prevalence of pain (even in one site) was 41.3% as presented in Table 3. It is evident that the more the age, the more the prevalence of pain (p-value = 0.029). The table demonstrates that all of those who had symptoms during summer, had symptoms at the time of the study, compared with 39.9% of those who didn't have symptoms during summer (p-value < 0.001). The prevalence of pain was 72.7% among those who lift heavy weights after school hours, compared with 40.2% among those without such a history (p-value = 0.002). No significant association was detected between the prevalence and the way to school (p-value = 0.812), and possessing a computer (p-value = 0.839). The prevalence was significantly (p-value = 0.005) high among those who don't practice exercise which was 47.3%.

Regarding the type of the bag, the highest prevalence (72.2%) was among those who use the hand bag, and the least prevalence (37.3%) was among those who use the backpack bag (p-value = 0.022) as presented in Table 4. The table shows that the prevalence of pain was lowest (32.2%) when the weight of the bag was less than four Kg, then the

prevalence increases with the increase in the weight of the bag reaching 47.6% when the weight of the bag was 5-5.9 Kg, but it decreases to 44.2% when the weight of the bag was 6 or more Kg (p-value = 0.011). The prevalence of pain was significantly high (43.7%) when the ratio of the weight of the bag/weight of the child was more than 10% (p-value = 0.020). No significant (p-value = 0.0504) association was detected between the weight for age Z scores with the prevalence of pain. It is observed that there was no consistent pattern regarding the prevalence and BMI categories.

Results showed that 497 out of 624 students (79.6%) carry risky weight bag (Ratio of weight of bag/body weight > 10%).

Table 3. Prevalence of pain by some factors.

Risk factors	NO.	Prevalence of pain		p-value
		No.	(%)	
Age (years)				
6-7	130	44	(33.8)	0.029
8-9	186	71	(38.2)	
≥ 10	308	143	(46.4)	
Symptoms during summer				
No	609	243	(39.9)	< 0.001
Yes	15	15	(100.0)	
Lifting heavy weight after school hours				
No	602	242	(40.2)	0.002
Yes	22	16	(72.7)	
Way to school				
Walking	532	221	(41.5)	0.812
By car (or bus)	92	37	(40.2)	
Possessing a computer				
No	539	222	(41.2)	0.839
Yes	85	36	(42.4)	
Practicing exercise				
No	292	138	(47.3)	0.005
Yes	332	120	(36.1)	
Total	624	258	(41.3)	

Table 4. Prevalence of pain by type and weight of the school bag and the BMI for age of the children.

	Prevalence of pain			p-value
	No	No.	(%)	
Type of school bag				
Shoulder bag	336	137	(40.8)	0.022
Backpack bag	201	75	(37.3)	
Hand bag	18	13	(72.2)	
Trolley bag	69	33	(47.8)	
Weight of bag				
< 4	211	68	(32.2)	0.011
4-4.9	225	102	(45.3)	
5-5.9	145	69	(47.6)	
≥ 6	43	19	(44.2)	
Ratio of weight of bag/body weight%				
Not risky (≤ 10%)	127	41	(32.3)	0.020
Risky (> 10%)	497	217	(43.7)	
BMI for age Z scores categories				
< -2	21	3	(14.3)	0.0504
-2 to -1.1	75	37	(49.3)	
-1 to 1	295	127	(43.1)	
1.1 to 2	159	64	(40.3)	
> 2	74	27	(36.5)	
Total	624	258	(41.3)	

Table 5 shows that pain (at least in one site) is associated with age of 10 years and over (OR = 2.88; 95% CI 1.72-4.79), lifting heavy things after the school hours (OR = 3.26; 95% CI 1.22-8.69), and not practicing exercise (OR = 1.84; 95% CI 1.30-2.59). Regarding type of the bag, the probability of pain is more in all the types mentioned compared with the backpack. Risky weight of bag (the proportion of the weight of bag to the body weight is more than 10%) was a significant predictor of pain (OR = 1.71; 95% CI 1.10-2.66).

DISCUSSION

The present study showed that pains among students were reported more in the shoulder (20.0%), followed by right hand/ wrist, foot/ ankle, middle back respectively. A study done in China by Balamurugan (in the year 2014), and involved 510 elementary school students aged 6 to 12 years indicated that the prevalence of musculoskeletal pain was high in both males (60.6%) and females (65.7%). The study showed that the frequency of pain was higher in the back and neck area than the others areas.¹¹ A study had been done in India by Rai and Agarwal, it involved students aged 10 to 13 years. Results showed that the majority of the students reported the occurrence of shoulder pain, back pain, neck pain, red marks on shoulder, and muscle spam.²³ Many studies indicated that lower back pain was high among students in addition to the pains in neck, both shoulders, and upper back areas.^{15,24,25}

The Etiology of back pain in children is not easy to study because there are many factors that precipitate the condition.¹⁵ The study showed that the prevalence of musculoskeletal pain significantly increased with

Table 5. SPSS output of binary logistic regression analysis between prevalence of pain and several factors.

	B	p	OR	95% C.I. for OR	
				Lower	Upper
Age (years)		< 0.001			
6-7 (reference)					
8-9	0.421	0.103	1.523	0.918	2.526
≥ 10	1.058	< 0.001	2.881	1.729	4.798
Lifting heavy things after school	1.184	0.018	3.267	1.227	8.694
Not practicing exercise	0.611	< 0.001	1.841	1.309	2.590
Type of bag		0.006			
Backpack (Reference)					
Shoulder type	0.527	0.018	1.693	1.096	2.617
Hand	1.467	0.009	4.337	1.443	13.040
Trolley	0.839	0.010	2.315	1.225	4.376
Risky weight of bag*	0.542	0.016	1.719	1.108	2.669
Constant	-2.194	< 0.001	0.111		

*The proportion of the weight of bag to the body weight is more than 10%

the increase in the age of students. The prevalence was high among those who used to lift heavy weights after the school hours, and among those who did not practice exercise. There were differences in prevalence of pain according to the type of schoolbag, hand bag reported the highest prevalence, followed by trolley bag, while the lowest prevalence was among those using backpack bag. A study done by Rontogiannis et al., that was carried out in Greece in the year 2017 among primary school students, indicated that the trolley bag is safer than backpacks, and it recommended the use of backpacks with shoulders' straps and trolley bags, and to avoid using either single shoulder's straps, or double shoulders' straps but carrying the bag by one arm.²⁶ The optimum way of carrying the schoolbag is to be placed in the level of students' dorsum and to tightly fit the straps without gaps to avoid overloads in upper side of back²⁷. The present study showed that nearly 80% of the students were carrying heavy schoolbags that weigh more than 10% of their own weights (the risky ratio), and the prevalence of pain was higher among students who used to carry heavy bags that exceeds the mentioned ratio. This coincides with the study of Mwaka et al which indicated that the majority of the students were carrying schoolbags that exceeds the risky ratio.¹⁵ Another two studies indicated that back pain and other musculoskeletal pains were higher among children carrying bags that weigh 10-15% of their own weights.^{28,29} Regarding the primary schools' students, two studies suggested that the school bags' weights should not be more than 10% of boys' weights and not more than 5% of the girls' weights.^{17,18} In the present study inconsistencies were detected between BMI categories and the prevalence of pain. On the other hand, the prevalence of pain was significantly higher among students lifting bags that weigh more than 10% of their body weight. This may lead us to the conclusion, that this risky ratio (10%) is a more important predictor of pain than the BMI.

An Egyptian study involving 254 girls aged 6 to 14 years showed that the prevalence of musculoskeletal pain increased with the increase of the weight of the schoolbag. The prevalence was higher among those who used to carry the schoolbag on one shoulder, than among those use other methods.³⁰

Regression analysis showed that age (≥ 10 years), lifting heavy things after the school hours, type of bag (shoulder, hand, trolley), and the risky weight of bag were associated with the prevalence of pain. Study of Dorji et al indicated that carrying a heavy schoolbag (of more than 10% of students' weights), and loading the bag on one shoulder, are two significant risk factors for developing musculoskeletal symptoms³¹. Heavy schoolbags have association with many posture changes especially in head and trunk placing soft tissues at a biomechanical wrong position and causes musculoskeletal pain.³²

Taking in consideration that is not only heavy school-

bag weight is risk factor for musculoskeletal symptoms, there are many other factors that play roles. A study done by Dianat et al., in Tabriz/Iran in the year 2010, involving 307 primary school children aged 7 to 12 years, showed that suitable schoolbag weight for primary school students is not the only method to avoid musculoskeletal symptoms.³³

A study by Oak et al that was carried out in India indicated that there are some factors such as history of injury to the back, family history of back pain; watching television for a long time, and hyperactivity problems were found to have significant association with back pain. So the study recommended necessary focusing on physical and psychological factors when studying musculoskeletal symptoms.³⁴

The strength of this study is that the actual sample size (624) was more than the estimated sample size (490), which gives more power to the study. This discrepancy happened as the researchers took all the students in one class even if their number is more than what was required and estimated.

CONCLUSION

Considerable proportion of the students were complaining from pain attributable to lifting the school bag. The most common site of pain was the shoulder. Significant association was detected between the prevalence of pain with the age of the students (≥ 10 years), lifting heavy things after the school hours, not practicing exercise, type of the school bag (shoulder, hand and trolley type compared with backpack), and the heavy weight of bag compared with student's weight.

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CONFLICT OF INTEREST

Authors declare no conflict of interest.

GRANT SUPPORT AND FINANCIAL DISCLOSURE

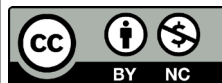
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	IHM, SMA
Acquisition, Analysis or Interpretation of Data:	IHM, SMA, JMA, NAT
Manuscript Writing & Approval:	IHM, SMA, JMA, NAT

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



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