



PREVALENCE OF BACK AND SHOULDER PAIN VIS-À-VIS WEIGHT OF SCHOOL BAG AND OTHER LIFESTYLE FACTORS - AN EPIDEMIOLOGICAL STUDY

Rehabilitation Science

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ABSTRACT

Introduction: School children are at a development age and it is important that they do not carry excessive loads. Carrying a schoolbag is a daily activity for most children. Some research effort has been conducted in order to identify a safe load limit for children to carry their schoolbags. Heavy school bags can change the body posture and the musculoskeletal system must react appropriately in order to compensate for this stress.

Subjects and Methods: This cross-sectional study was performed in an urban school of North India. Seventy five school children (56% boys) in the age group 11-17 years studying classes 8th through 10th were surveyed and examined for demographic details and school bag type, weight, carrying habits, presence/absence of back, shoulder or other pains.

Results and Analysis: Most prevalent musculoskeletal discomfort was shoulder pain (17.3%). Only 24% children carried bags <10% of their body weight. 30.7% felt their schoolbag as heavy.

Bag weight as percentage of body weight has significant association with age group ($p=0.004$) and student's feeling of bag weight ($p<0.001$), while there was no significant association with gender ($p=0.058$) and bag carrying style ($p=0.215$).

There was significant association between health effects (shoulder, back and other body part pain) with bag carrying style ($p<0.001$), bag weight as percentage of body weight ($p<0.001$), and students feeling of bag weight ($p<0.001$), and no significant association with gender ($p=0.060$) and school bag weight ($p=0.068$).

Conclusion: A combined effort from education boards, schools, teachers and parent is needed to reduce school children's bag weight less than 10 percent of their body weight.

KEYWORDS

Adolescent, Backache, Shoulder Pain, Backpack, School Bag, School Children, North India.

Introduction:

School children are at a development age and it is important that they do not carry excessive loads. Carrying a schoolbag is a daily activity for most children. Some research effort has been conducted in order to identify a safe load limit for children to carry their schoolbags^{1,2}. Heavy school bags can change the body posture and the musculoskeletal system must react appropriately in order to compensate for this stress⁷⁻⁹. The postural deviations have been considered as a serious public health problem in view of its great impact on the population, bringing as a consequence, permanent or temporary disability¹⁰⁻¹². The incorrect handling of schoolbags with excessive bag weight can lead to back pain in children^{6,12-14}. In contrast few studies show that, there was little evidence of an increase in short-term risk associated with mechanical load across the range of weights commonly carried by children to school^{15,16}.

One of the most common symptoms studied in the literature is the back pain in relation to heavy school bags^{2,17}. In a New Zealand study (2005), on 140 high school children (mean age 13.6 years), it was found that the musculoskeletal symptoms, due to school bag carriage were experienced by 77.1% of the students. These were most prevalent in the neck, shoulder upper back and low back, respectively⁸.

The mean school bag weight reported in previous studies in other countries ranged between 4.7 kg and 9.3 kg^{8,18}. In a review of Canadian literature in 2004, it was concluded that a limit of 10-15% of body weight was acceptable². There are few recent studies conducted on school bag carriage among 13-14 year olds, 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 conclusion, that bag weight limit of 15% of body weight might be excessive⁵. Despite this, there is still no consensus about guideline weight and other factors associated with carrying a schoolbag⁴. Several studies in this area contribute that the average loads vary greatly between studies, the majority of reports indicate that the load carried by students are greater than the recommended limits^{19,20}. Most of the studies are consistent that 10% of body weight is reasonable for school children to carry^{6,11,21-23}. Children should be advised to carry their backpack on both shoulders rather than on a

single shoulder²¹ or use side hanging type bag. Heavy school bags are one of the universal factors that influence the incidence of musculoskeletal pain in school children¹¹.

This study was conducted to assess the weight of school bags in relation to school children's weight, their carrying style and other related factors. The authors also looked for the prevalence of musculoskeletal symptoms among them.

Subjects and Methods:

This is a cross-sectional study carried out among adolescent schoolchildren in an urban North Indian school. Necessary permissions to carry out the study were obtained.

The inclusion criteria were school permission, regular scholar, parental consent, pupil's consent, ability to ambulate independently, ability to wear school bag while standing. All children with pathological causes of back pain were excluded from the study. However, such children were given professional consultation and where necessary treatment was prescribed.

To collect data on musculoskeletal symptoms and the use of school bags among children, a questionnaire was used. Most of the studies regarding the use of school bags among children reflect the reporting by questionnaires^{12,24}. The questionnaire first recorded demographic details such as the age, gender and grade level of the children as well the type of schoolbag carried and how it was carried by the children.

In the beginning, the school was visited with prior scheduling. The principal, vice-principal, students and the teachers were given an overview about the study design and methods. The children, being minor, a parental consent form, along with contact details of the Principal Investigator (PI) were distributed to the students. PI was available to address the queries of the parents in couple of parent-teacher meetings. The consent forms were signed by either of the parents, countersigned by the class teacher and principal/ vice principal.

Only schoolchildren who presented themselves and whose parents/guardian had given informed consent were included in the

study. The students had their weights and heights measured. The digital weighing scale was placed on a flat surface in the corner of classroom and set to zero. Students dressed in their uniform with their shoes removed were then weighed. The weight was first measured when carrying the schoolbag and then without the schoolbag and the difference between the two weights was recorded as the weight of the schoolbag. All values were documented on the Performa. Care was taken to simplify the questions as much as possible and explanations were given whenever question arose. Performa were then assessed for completeness before data entry.

The outcome variables were shoulder, back and other pains. The low back pain was operationally defined as pain and discomfort in the low back region, from the lower rib curvature to the lower part of the seat region. Predictor variables are included bodyweight, schoolbag weight, schoolbag weight as a percentage of bodyweight, type of schoolbag, how the bag was carried, student's perception of bag weight and comfort while wearing the bag. Data collection was carried out on an unscheduled day so that children could not alter their schoolbags. The statistical analysis was performed through Pearson chi-square test to analyze the effects of schoolbag on back pain and students' perception on the weight of their bags. Correlations were considered significant when p-value was less than 0.05.

Observations and Results:

In this cross-sectional study, seventy five school children, 42 (56.0%) males and 33 (44.0%) females, completed the questionnaires, their physical examination and school bag evaluation. Their mean age was (14 year 5 months ± 1 year) with minimum age of 11 year 2 months and a maximum age 16 year 5 months. The mean of student's weight was 48.513 ± 10.941 kg (range: 27-87 kg). The bag weight and percentage of bag weight to body weight were also evaluated with mean ± SD being 6.307 ± 1.804 kg and 14 ± 4.689% respectively.

Table – 1 Demographic Details

Variables	Frequency (n)	%	
Age Group (years) (N=75)	Up to 13	5	6.7
	13-15	52	69.3
	> 15	18	24.0
Gender (N=75)	Boys	42	56.0
	Girls	33	44.0
Class (N=75)	VIII	33	44.0
	IX	26	34.7
	X	16	21.3
	XI	0	0.0
Student Weight (kgs) (N=75)	Up to 40	17	22.7
	41 to 60	48	64.0
	> 60	10	13.3
Schoolbag Weight (kgs) (N=75)	Up to 5	19	25.3
	5 – 7	35	46.7
	>7	21	28.0
Bag carrying style (N=75)	Both Shoulders	53	70.7
	Single Shoulder	20	26.7
	Carried by others	2	2.7
Bag Weight as percentage of Body Weight (%)	Up to 10	18	24.0
	11 – 20	49	65.3
	> 20	8	10.7
Students' Feeling of School Bag Weight (N=75)	Normal	39	52.0
	Light	13	17.3
	Heavy	23	30.7
Health effect (N=75)	Back pain	8	10.7
	Shoulder pain	13	17.3
	Back and Shoulder pain	11	14.7
	Other pain	9	12.0
	No pain	34	45.3

Table – 1 represents the demographic details with frequency distribution of all the 75 students, 52 (69.3%) were in the age group 13-15 years and 64.0% of the students had weight between 41-60 kg.

Table – 3 Association of Health Effects vis-à-vis Risk Factors

Variables	Health Effects					p value		
	Back Pain	Shoulder Pain	Back and Shoulder Pain	Other Pain	No Pain			
Age Group (years)	Up to 13	0 (.0%)	0 (.0%)	3 (60.0%)	2 (40.0%)	0 (.0%)	5	.003*
	13-15	4 (7.7%)	7 (13.5%)	8 (15.4%)	6 (11.5%)	27 (51.9%)	52	
	> 15	4 (22.2%)	6 (33.3%)	0 (.0%)	1 (5.6%)	7 (38.9%)	18	

Nineteen (25.3%) children used to carry bag weight <5 kg, while 21 (28.0%) carried bag weight >7 kg. Fifty three students (70.7%) were carrying schoolbags on both shoulders, 20 (26.7%) were carrying on one shoulder.

Fifty two percent of students reported that their school bag weight felt normal, while 30.7% felt it to be heavy. Majority (45.3%) of students had no pain, 17.3% complained of shoulder pain, 14.7% had both back and shoulder pain, while 10.7% complained of back pain alone.

Table – 2 Association of School Bag Weight as percentage of Body Weight vis-à-vis Risk Factors

Variables	Bag Weight as percentage of Body Weight (%)				p value	
	Up to 10	10 - 20	>20	Total		
Age Group (years)	Up to 13	0 (.0%)	2 (40.0%)	3 (60.0%)	5	.004*
	13-15	13 (25.0%)	34 (65.4%)	5 (9.6%)	52	
	> 15	5 (27.8%)	13 (72.2%)	0 (.0%)	18	
Gender	Boys	12 (28.6%)	23 (54.8%)	7 (16.7%)	42	.058
	Girls	6 (18.2%)	26 (78.8%)	1 (3.0%)	33	
Weight Group (kgs)	Up to 40	2 (11.8%)	10 (58.8%)	5 (29.4%)	17	.003*
	41 to 60	10 (20.8%)	35 (72.9%)	3 (6.2%)	48	
	> 60	6 (60.0%)	4 (40.0%)	0 (.0%)	10	
Bag carrying style	Both Shoulders	10 (18.9%)	38 (71.7%)	5 (9.4%)	53	.215
	Single Shoulder	8 (40.0%)	9 (45.0%)	3 (15.0%)	20	
	Carried by others	0 (.0%)	2 (100.0%)	0 (.0%)	2	
Students' Feeling of School Bag Weight	Normal	6 (15.4%)	33 (84.6%)	0 (.0%)	39	<.001*
	Light	12 (92.3%)	1 (7.7%)	0 (.0%)	13	
	Heavy	0 (.0%)	15 (65.2%)	8 (34.8%)	23	

*: Statistically significant (p<0.05)

Table – 2 shows statistically significant association between bag weight as percentage of body weight and age groups (p=0.004), 60% students up to 13 years age group carried bag weight >20% of their body weights, while only 25.0% students of age groups 13-15 years and 27.8% students of age group >15 years carried bag weight up to 10% of their body weights. There was no significant association between bag weight as percentage of body weight and gender (p=0.058), similarly no significant association was found between bag weight as percentage of body weight and bag carrying style (0.215). Table 2 also shows significant association between bag weight and students' feeling of school bag weight (p<0.001) as 92.3% of the students who felt their bags were light were carrying bags of less than 10% of their body weight, while almost all students, who felt their bags were heavy, were carrying bags weighing more than 10% of their respective body weights.

*: Statistically significant (p<0.05)

Gender	Boys	3 (7.1%)	6 (14.3%)	10 (23.8%)	3 (7.1%)	20 (47.6%)	42	.060
	Girls	5 (15.2%)	7 (21.2%)	1 (3.0%)	6 (18.2%)	14 (42.4%)	33	
Weight Group (kgs)	Upto 40	3 (17.6%)	1 (5.9%)	6 (35.3%)	4 (23.5%)	3 (17.6%)	17	.025*
	41 to 60	5 (10.4%)	9 (18.8%)	4 (8.3%)	5 (10.4%)	25 (52.1%)	48	
	> 60	0 (.0%)	3 (30.0%)	1 (10.0%)	0 (.0%)	6 (60.0%)	10	
School Bag Weight (kgs)	Upto 5	0 (.0%)	4 (21.1%)	1 (5.3%)	3 (15.8%)	11 (57.9%)	19	.068
	5 – 7	6 (17.1%)	5 (14.3%)	3 (8.6%)	3 (8.6%)	18 (51.4%)	35	
	>7	2 (9.5%)	4 (19.0%)	7 (33.3%)	3 (14.3%)	5 (23.8%)	21	
Bag carrying style	Both Shoulders	8 (15.1%)	0 (.0%)	11 (20.8%)	0 (.0%)	34 (64.2%)	53	<.001*
	Single Shoulder	0 (.0%)	13 (65.0%)	0 (.0%)	7 (35.0%)	0 (.0%)	20	
	Carried by others	0 (.0%)	0 (.0%)	0 (.0%)	2 (100.0%)	0 (.0%)	2	
Bag Weight as percentage of Body Weight (%)	Up to 10	0 (.0%)	5 (27.8%)	1 (5.6%)	3 (16.7%)	9 (50.0%)	18	<.001*
	11 - 20	8 (16.3%)	8 (16.3%)	5 (10.2%)	3 (6.1%)	25 (51.0%)	49	
	> 20	0 (.0%)	0 (.0%)	5 (62.5%)	3 (37.5%)	0 (.0%)	8	
Students' Feeling of School Bag Weight	Normal	0 (.0%)	11 (28.2%)	0 (.0%)	1 (2.6%)	27 (69.2%)	39	<.001*
	Light	0 (.0%)	2 (15.4%)	1 (7.7%)	3 (23.1%)	7 (53.8%)	13	
	Heavy	8 (34.8%)	0 (.0%)	10 (43.5%)	5 (21.7%)	0 (.0%)	23	

Table – 3 shows 57.6% girls complained different type of pain in comparison to 52.4% boys, but there was no significant association between health effects (back/shoulder pain or pain elsewhere) and gender ($p=0.060$), similarly no significant association between health effects and school bag weight ($p=0.068$) was found.

There was significant correlation between health effects and students age group ($p=0.003$). All students up to 13 years age complained some kind of pain, in comparison 51.9% student of age group 13-15 years and 38.9% of age group >15 years had no pain. Significant association was also seen between health effect and weight group ($p=0.025$). Around thirty-five percent of students, weighing <40 kg had back and shoulder pain in comparison to 17.6% with no pain. Almost fifty-two percent students, weighing 41-60 kg and 60.0% of students weighing >60 kg had no pain.

Table – 3 also shows significant association between the health effects and bag carrying style ($p<0.001$). 64.2% students carrying bag on both shoulders had no pain complaints while 65.0% of students carrying bag on one shoulder had complaint of shoulder pain. All students carrying bag weight >20% of their body weight had either back or shoulder pain (62.5%) or pain in some other body part. Only 50% of students carrying bag weight up to 10% of their body weight had some painful health effect, most commonly shoulder pain (27.8%). This shows that health effect and bag weight as percentage of body weight had significant association ($p<0.001$). 78.3% of students feeling bag as heavy had complaint of back pain alone or combined with shoulder pain, while 69.2% student feeling bag being light had no complaint of pain showing significant association between health effect and students feeling of school bag weight ($p<0.001$).

Discussion:

Carrying a heavy school bag for long periods of time could result in repetitive stress injuries to the growing body²⁵. This follows the shifting of the child's center of gravity in the direction of the load when carrying a backpack^{10,26}. To compensate, the child either moves the head and trunk forward or hyperextends the lumbar spine accompanied by hand support on the shoulder straps. Carrying schoolbag on single shoulder results in lateral bending of spine. Such postural deviation at the head and trunk places soft tissues at a biomechanical disadvantage,

resulting in fatigue and injury¹⁰⁻¹².

The result of this study reported that the mean age of children is (14 years 5 month \pm 1 year), carrying school bags weight with mean 6.307 \pm 1.804 kg, as also reported by Dockrell et al (2006)⁷ and Whittfield et al¹². About 76 % of school children studied were carrying bag weight >10% of their body weight. Most children are required to toe heavy school bags to and from school each day, and the load increases as they reach higher grades. Negrini et al (1999) found that 34-8% of Italian schoolchildren carried more than 30% of their bodyweight at least once a week²⁷. Our study found no significant association between bag weight as percentage of body weight and gender ($p=.058$) in contrast to Puckree et al (2004)¹⁴.

There are many studies, suggesting that the majority of neck and back pains in children are of non-specific causes, like school bag weight and not related to pathological conditions^{8,28}. This study also reported that increased school bag weight is not associated with increased health risk ($p=0.068$) same as in other studies^{2,27}, while some studies found an association between school bag weight and back pain^{8,27}. Shamsoddini et al (2010) reported that the weight of backpack was strongly related to shoulder, neck, back & extremities complaints²⁹.

In this study, 30.7% of students complained that their school bag was heavy and 17.3% found it lighter than usual. Similarly Goodgold et al (2002) reported that few children find their bags as light and more than half of children reported that their bag was uncomfortable to carry²⁴.

Prins et al (2008) found that young children (under the age of 10 years) rarely complained of back pain, but child in this age group with a complaint that 'seemed real' should be evaluated by a physician. Older children (age >10 years) were more likely to have mechanical complaints. These can be associated with carrying a heavy back pack, sports activities or structural abnormalities. This review concludes that the duration of sitting posture and psychosocial factors may influence the experience of musculoskeletal pain among children and adolescents³⁰.

This study reported significant association between health effects with

age groups ($p=0.003$), similar correlations were reported by Grimmer et al (2000) that there were gender- and age-specific associations with recent low back pain¹⁸. In this study we found no significant association between health effects and the gender ($p=0.060$) in contrast to some other studies^{17,18,31}.

This study reported that 70.7% of students carried bag on both shoulders, with significant associations between the three type of bag carrying styles and health effects ($p<0.001$), that 64.2% of children carrying bag on both shoulders had no pain. This finding can be compared with Pascoe et al (1999) who 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 was the best way ergonomically¹⁰. Cottalorda et al (2004) reported if backpacks were too heavy or the weight is carried unevenly (over one shoulder) they could cause back pain³².

In the present study 65.3% of study group carried school bag weighing 11-20% of their body weight while 10.7% carried school bag weight >20%, that are higher than the recommended guideline of 10% of body weight^{7,8,33}. There was significant association of health effect with bag weight as percentage of body weight ($p<0.001$), supported by many similar findings in peer-reviewed literature^{7,8,19,31}, but in contrast to other studies^{18,20}, there was no significant association between bag weight and health effect directly ($p=0.068$). This suggests that bag weight as percentage of body weight is more important than bag weight alone.

Haselgrove et al (2008) suggested that heaviest items in the child bag should be placed closest to the child's back, if the heaviest items are packed further away, they throw out the child's center of gravity and cause unnecessary back strain³⁴.

Limitations: Small study sample was the main limitation. Further studies with larger representative population with inclusion of more variables will definitely provide better understanding.

Conclusions:

This study again emphasizes the need for education boards, educators, teachers and parents to find ways to reduce the weight of the school bags to manageable values (less than 10% of the body weight) to avoid locomotor aches and pains to the children. Some of the working areas may be reducing the syllabi, 2 sets of books with lockers at schools, thoughtful time tables so that children don't need to bring all the books to the school, parents may actively check bags for required/non-required books/note books.

Acknowledgements:

The authors thankfully acknowledge the support from Prof MS Dhillon, Head of the Department of PRM at PGIMER Chandigarh, in conducting the study. Gratitude is due to the daughter of the corresponding author, Ms. Gunit Cour, whose persistent complaints of heavy school bag and back/shoulder pains inspired him to take up this project. The authors also thank Dr. Prashant K. Bajpai and Dr. YP Singh for statistical analysis. Many thanks to the school principal, vice-principal, class teachers and games teacher for permitting and cooperating with the authors in conducting this study. Above all, the students that volunteered to be subjects in this project.

No third party financial sponsorships were involved in this study.

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