

Educational Intervention study to Reducing the School Bags Weight in Selected School Children in Bihar

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Abstract:

Background: Excessive school bag weight has emerged as a growing public health concern among school-going children, leading to musculoskeletal problems, fatigue, and poor posture. Despite awareness of recommended weight limits, overburdened school bags continue to be prevalent, especially in low-resource educational settings. Educational interventions targeting students, parents, and teachers may play a vital role in promoting behavioral change and achieving sustainable reduction in school bag weight.

Aim: To assess the effectiveness of a structured educational intervention in reducing the weight of school bags among primary and middle school children in selected schools.

Methods: A community-based interventional study was conducted in November 2018 to August 2020 among 620 students from grades 3 to 8 in government and private schools in the Muzaffarpur region. Baseline school bag weights were recorded and expressed as a percentage of the child's body weight. A multi-tiered educational program was implemented involving students, teachers, and parents. Post-intervention school bag weights were measured after three months. The proportion of students carrying bags exceeding 10% of their body weight was compared pre- and post-intervention. Data were analyzed using paired t-tests and McNemar's test for statistical significance.

Results: At baseline, 62.9% of students carried school bags exceeding the recommended limit of 10% body weight. Following the intervention, this proportion reduced significantly to 34.8% ($p < 0.001$). The mean bag weight dropped from 4.92 ± 1.05 kg to 3.78 ± 0.87 kg ($p < 0.001$). Significant improvement was noted in awareness levels and compliance with school bag guidelines among both parents and teachers. Girls were found to be more responsive to the intervention compared to boys ($p = 0.02$).

Conclusion: Educational interventions targeting all stakeholders in the school ecosystem are effective in reducing school bag weight among children. This simple, low-cost strategy can be integrated into broader school health programs to prevent long-term musculoskeletal complications in growing children.

Keywords: School bag weight, Educational intervention, Children, Musculoskeletal health, School health program, Community-based study.

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Introduction

Carrying heavy school bags has become a pervasive concern among school-going children, particularly in low- and middle-income countries where awareness and enforcement of ergonomic recommendations are limited. Multiple studies have reported that carrying school bags exceeding 10% of a child's body weight is associated with increased risk of musculoskeletal pain, fatigue, forward head posture, spinal deviations, and long-term orthopedic complications [1]. In India, the issue is more pronounced due to academic pressure, inadequate locker systems, and lack of standardization in school bag policies [2].

The Ministry of Education and various pediatric associations recommend that the weight of a school bag should not exceed 10% of the student's body weight [3]. However, observational studies continue to show that a large proportion of students, especially in primary and middle school levels, carry bags far heavier than the recommended limit [4]. Factors contributing to this include uncoordinated homework schedules, lack of timetable compliance, carrying unnecessary materials, and lack of awareness among parents and teachers.

Educational interventions aimed at improving awareness and promoting healthy school practices

have been shown to produce measurable improvements in child health outcomes [5]. In the context of school bag weight, such interventions can target behavioral change by educating children about safe bag-packing practices, informing parents of the risks, and sensitizing school authorities to enforce guidelines [6]. Implementing school-wide awareness programs can also ensure that preventive measures are sustained beyond the immediate term.

Despite clear guidelines, there remains a significant gap between policy and practice in many parts of rural and semi-urban India. Data on the effectiveness of educational interventions in reducing school bag weight in these regions are limited. Hence, there is a need to evaluate such initiatives, especially in resource-constrained settings where infrastructure modifications may not be feasible.

This study was therefore conducted to assess the impact of a structured educational intervention program on school bag weight among primary and middle school students in the Muzaffarpur region of Bihar. The intervention targeted children, parents, and teachers, with the aim of reducing the proportion of students carrying bags heavier than 10% of their body weight.

Methodology

Study Design and Setting: A community-based interventional study was conducted in November 2018 to August 2020 targeting primary and middle school students. The study aimed to evaluate the effect of a structured educational intervention on reducing the weight of school bags carried by children.

Study Population and Sampling: The study included students from grades 3 to 8, aged approximately 8 to 14 years. A multistage sampling technique was used to select 620 students across six schools (three government and three private), ensuring representation from both rural and urban school environments. In each selected school, eligible students were identified based on enrollment records, and written informed consent was obtained from parents or legal guardians prior to participation.

Inclusion and Exclusion Criteria: Students present on the day of baseline assessment and willing to participate with parental consent were included. Children with physical disabilities, diagnosed orthopedic conditions, or chronic illnesses affecting body weight or musculoskeletal status were excluded.

Baseline Assessment Procedure: At baseline, data collection included measurement of each child's body weight using calibrated electronic weighing scales and school bag weight using a spring balance

accurate to 100 grams. Bag weight was then calculated as a percentage of body weight. A pretested, semi-structured questionnaire was administered to assess knowledge, attitudes, and practices among students, parents, and teachers regarding safe school bag use, appropriate contents, and awareness of recommended weight limits.

Intervention Strategy

The intervention consisted of three components:

1. **Student sensitization sessions** focused on appropriate bag-packing practices, avoiding unnecessary items, and regular use of timetables.
2. **Teacher workshops** on coordination of homework schedules and ensuring subject-wise load distribution.
3. **Parent meetings** emphasizing the health risks of heavy bags and encouraging periodic monitoring of their child's school bag. Printed materials and visual posters were distributed in classrooms and staff rooms to reinforce messages.

Follow-Up and Post-Intervention Assessment:

After three months, a follow-up assessment of school bag weight and knowledge scores was conducted using the same methodology. Comparisons were made between pre- and post-intervention measurements. Feedback was also obtained from school management and teachers regarding feasibility and acceptance of the program.

Statistical Analysis: Data were entered and analyzed using SPSS version 25.0. Descriptive statistics were calculated for demographic variables. Paired t-test was used to compare mean school bag weights before and after the intervention. McNemar's test was used to analyze categorical outcomes such as the proportion of students carrying bags >10% of body weight. A p-value <0.05 was considered statistically significant.

Results

A total of 620 students from six schools (three government and three private) were enrolled in the study. The mean age of participants was 11.2 ± 1.4 years, with 52.6% boys and 47.4% girls. At baseline, 390 students (62.9%) were found to be carrying school bags exceeding 10% of their body weight. The average weight of school bags was 4.92 ± 1.05 kg, while the average body weight of children was 33.9 ± 5.8 kg. After the educational intervention, a significant reduction in the proportion of overweight bags was observed, along with improvements in knowledge and practices among students, parents, and teachers. The following tables detail the demographic distribution, pre- and post-intervention measurements, and behavioral changes observed during the study

Table 1: Demographic Characteristics of the Study Population (n = 620)

Variable	Frequency (n)	Percentage (%)
Age (mean $\pm$ SD)	11.2 $\pm$ 1.4	–
Gender (Boys/Girls)	326 / 294	52.6 / 47.4
School Type (Govt/Private)	310 / 310	50.0 / 50.0
Class (Grades 3–5)	276	44.5
Class (Grades 6–8)	344	55.5

Table 2: Mean School Bag Weight Before and After Intervention

Time Point	Mean Bag Weight (kg)	SD	p-value
Pre-Intervention	4.92	1.05	
Post-Intervention	3.78	0.87	<0.001

Table 3: Proportion of Students Carrying Excessive Bag Weight (>10% of Body Weight)

Time Point	>10% Weight (n)	Percentage (%)	p-value
Pre-Intervention	390	62.9	
Post-Intervention	216	34.8	<0.001

Table 4: Mean Reduction in Bag Weight by Gender

Gender	Pre (kg)	Post (kg)	Mean Difference	p-value
Boys	4.98	3.87	1.11	<0.001
Girls	4.86	3.66	1.20	<0.001

Table 5: Proportion of Students with Heavy Bags by Class Level

Grade Group	Pre (%)	Post (%)	p-value
Grades 3–5	71.7	39.9	<0.001
Grades 6–8	55.2	30.2	<0.001

Table 6: Student Awareness Scores on Safe School Bag Use (Max Score = 10)

Time Point	Mean Score $\pm$ SD	p-value
Pre-Intervention	4.2 $\pm$ 1.8	
Post-Intervention	7.6 $\pm$ 1.2	<0.001

Table 7: Teacher-Reported Compliance with Timetable Adjustments

Indicator	Pre (%)	Post (%)	p-value
Coordinated Homework Planning	38.9	82.1	<0.001
Weekly Subject Load Review Meetings	22.3	74.5	<0.001

Table 8: Parental Monitoring Practices of School Bag Contents

Practice	Pre (%)	Post (%)	p-value
Regular Bag Content Checks	31.6	70.4	<0.001
Removal of Non-essential Materials	28.1	66.9	<0.001

Table 9: Number of Students Carrying Extra Non-essential Items

Item Category	Pre (n)	Post (n)	p-value
Extra Books	213	74	<0.001
Duplicate Notebooks	167	48	<0.001

Table 10: Self-Reported Symptoms Related to Heavy Bags

Symptom	Pre (%)	Post (%)	p-value
Shoulder/Back Pain	27.7	13.2	<0.001
Fatigue During Commute	33.2	16.5	<0.001

Table 11: Change in Heavy Bag Proportion by School Type

School Type	Pre (%)	Post (%)	p-value
Government	65.5	38.7	<0.001
Private	60.3	30.9	<0.001

Table 12: Perceived Usefulness of Intervention (Feedback Survey)

Stakeholder	Found Program Useful (%)	Recommended Continuation (%)
Students	86.4	92.7
Teachers	90.1	95.5

Summary of Results

The study demonstrated a statistically significant reduction in school bag weight following the educational intervention. The proportion of students carrying bags above the 10% body weight limit declined from 62.9% to 34.8% (Table 3), with corresponding improvements in student awareness (Table 6), teacher compliance (Table 7), and parental monitoring (Table 8). Girls and students in lower classes showed slightly higher responsiveness (Tables 4 and 5). Post-intervention reductions were also evident in unnecessary item carriage (Table 9) and self-reported musculoskeletal symptoms (Table 10). The intervention was well received across both government and private school setups (Tables 11 and 12), demonstrating its broad feasibility and impact.

Discussion

This study evaluated the effectiveness of an educational intervention in reducing school bag weight among primary and middle school children in Muzaffarpur, Bihar. The findings demonstrated a substantial decrease in the proportion of students carrying bags heavier than 10% of their body weight, accompanied by improved awareness and behavioral changes among students, parents, and teachers. These results are consistent with prior research highlighting the impact of school-based health promotion strategies in addressing ergonomic risks faced by children [7].

A high prevalence of overweight school bags at baseline, particularly among younger students, reflects the widespread neglect of recommended load limits in Indian school settings. Several contributing factors such as poor scheduling practices, unnecessary items in school bags, and limited caregiver oversight appear to influence this burden. The structured educational intervention in this study directly targeted these domains, emphasizing coordinated efforts across home and school environments. Behavioral improvements, including reduced carriage of duplicate notebooks and increased parental monitoring, illustrate the intervention's multidimensional impact [8].

Girls and children in lower grades appeared more responsive to the intervention, possibly due to higher parental engagement and greater sensitivity to structured guidance. Previous literature supports the idea that health-related behaviors and their responsiveness to interventions can differ by gender and developmental stage. Teachers also played a crucial role in ensuring timetabling compliance and

regulating subject-wise material distribution, reinforcing the importance of institutional engagement [9].

Importantly, the intervention yielded clinical benefits as well. Students reported fewer musculoskeletal symptoms after the intervention, suggesting that reducing bag weight is not only a behavioral shift but also a protective factor against physical strain [10]. This underscores the health relevance of what is often considered a logistical or administrative issue.

Despite the positive findings, the study has certain limitations. It was confined to a single district, and data were self-reported, which may introduce response bias. However, the large sample size, use of a pre-post evaluation model, and triangulated feedback from teachers and parents strengthen the validity of the outcomes. Moreover, the high acceptability of the intervention among stakeholders supports the feasibility of integrating such programs into broader school health initiatives.

Overall, this study demonstrates that an educational intervention targeting multiple stakeholders can bring about significant and meaningful improvements in school bag-related practices. These findings advocate for the implementation of low-cost, replicable programs that prioritize behavioral change in school settings to protect children's physical well-being.

Conclusion

This study demonstrated that a structured educational intervention involving students, teachers, and parents significantly reduced the weight of school bags among primary and middle school children. The proportion of students carrying bags heavier than 10% of their body weight declined from over 60% to less than 35% following the intervention. Improvements were also observed in student awareness, parental involvement, and teacher practices related to school bag management. Importantly, a corresponding reduction in self-reported musculoskeletal complaints indicates that such behavioral changes yield measurable health benefits. Girls and younger children were particularly responsive, suggesting the importance of tailoring interventions by age and gender. The success of this low-cost strategy underscores the potential for replication in similar educational settings where infrastructure changes are not feasible. The intervention's acceptability among all stakeholders further reinforces its practicality for school-wide implementation. Although the study

was limited to a specific geographic area, the methodology and outcomes provide a strong framework for future programs. Integrating such interventions into school health programs can help mitigate long-term physical strain and promote healthy habits from early childhood. Broader policy-level adoption of these practices is recommended to sustain the impact across diverse school environments.

References

1. Dianat I, Javadivala Z, Allahverdipour H. School Bag Weight and the Occurrence of Shoulder, Hand/Wrist and Low Back Symptoms among Iranian Elementary Schoolchildren. *Health Promot Perspect*. 2011 Jul 25;1(1):76-85. doi: 10.5681/hpp.2011.008. PMID: 24688903; PMCID: PMC3963609.
2. Perrone M, Orr R, Hing W, Milne N, Pope R. The Impact of Backpack Loads on School Children: A Critical Narrative Review. *Int J Environ Res Public Health*. 2018 Nov 12;15(11):2529. doi: 10.3390/ijerph15112529. PMID: 30424517; PMCID: PMC6267109.
3. Spiteri K, Busuttill ML, Aquilina S, Gauci D, Camilleri E, Grech V. Schoolbags and back pain in children between 8 and 13 years: a national study. *Br J Pain*. 2017 May;11(2):81-86. doi: 10.1177/2049463717695144. Epub 2017 Feb 1. PMID: 28491300; PMCID: PMC5405972.
4. Chaudhary A, Sudzina F, Mikkelsen BE. Promoting Healthy Eating among Young People-A Review of the Evidence of the Impact of School-Based Interventions. *Nutrients*. 2020 Sep 22;12(9):2894. doi: 10.3390/nu12092894. PMID: 32971883; PMCID: PMC7551272.
5. Wolfenden L, Nathan NK, Sutherland R, Yoong SL, Hodder RK, Wyse RJ, Delaney T, Grady A, Fielding A, Tzelepis F, Clinton-McHarg T, Parmenter B, Butler P, Wiggers J, Bauman A, Milat A, Booth D, Williams CM. Strategies for enhancing the implementation of school-based policies or practices targeting risk factors for chronic disease. *Cochrane Database Syst Rev*. 2017 Nov 29;11(11):CD011677. doi: 10.1002/14651858.CD011677.
6. Brzek A, Plinta R. Exemplification of Movement Patterns and Their Influence on Body Posture in Younger School-Age Children on the Basis of an Authorial Program "I Take Care of My Spine". *Medicine (Baltimore)*. 2016 Mar;95(12):e2855. doi: 10.1097/MD.0000000000002855. PMID: 27015165; PMCID: PMC4998360.
7. Skoffler B. Low back pain in 15- to 16-year-old children in relation to school furniture and carrying of the school bag. *Spine (Phila Pa 1976)*. 2007 Nov 15;32(24):E713-7. doi: 10.1097/BRS.0b013e31815a5a44. PMID: 18007232.
8. Bettany-Saltikov J, Cole L. The effect of front-packs, shoulder bags and handheld bags on 3D back shape and posture in young university students: an ISIS2 study. *Stud Health Technol Inform*. 2012;176:117-21. PMID: 22744472.
9. National Academies of Sciences, Engineering, and Medicine; Division of Behavioral and Social Sciences and Education; Board on Children, Youth, and Families; Committee on Supporting the Parents of Young Children; Breiner H, Ford M, Gadsden VL, editors. *Parenting Matters: Supporting Parents of Children Ages 0-8*. Washington (DC): National Academies Press (US); 2016 Nov 21. 2, Parenting Knowledge, Attitudes, and Practices. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK402020/>
10. Tamis-LeMonda CS, Briggs RD, McClowry SG, Snow DL. Maternal Control and Sensitivity, Child Gender, and Maternal Education in Relation to Children's Behavioral Outcomes in African American Families. *J Appl Dev Psychol*. 2009 May 1;30(3):321-331. doi: 10.1016/j.appdev.2008.12.018. PMID: 20161193; PMCID: PMC2729094.