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# PREVALENCE OF UPPER BACK PAIN DUE TO HEAVY SCHOOL BAG AMONG STUDENTS

*Original Research*

**Muhammad Azam Ghaffar[1], Isra Rizwan[2], Iqra Khan[3], Raja Maqsood Ahmed[4], Sana Muneeb[5]*, Aqsa Lakhani[6], Uswa Ali[7]**
[1]Specialist Physiotherapist, Shifa Modern Physiotherapy Centre, Abha, Saudi Arabia.
[2]Physiotherapist, Jinnah Postgraduate Medical Center, Karachi, Pakistan.
[3]Pediatric Physiotherapist, Cureway Centre, Najran, Saudi Arabia.
[4]Physiotherapist, Former Student, University of Karachi, Karachi, Pakistan.
[5]Physiotherapist, Health Physio Clinic, Multan, Pakistan.
[6]Head Physiotherapist, Centre of Autism Training & Rehabilitation Sindh, Physiotherapist, Adaptive Fitness Academy, Pakistan.
[7]Clinical Physiotherapist, Azam Roshan Clinic of Physical Therapy, Indus Medical Center, Sakrand Road, Nawabshah, Pakistan.
**Corresponding Author:** Sana Muneeb, Physiotherapist, Health Physio Clinic, Multan, Pakistan, sanamuneeb1404@gmail.com
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## ABSTRACT

**Background:** Musculoskeletal discomfort in children, particularly upper back pain, is increasingly reported and often linked to heavy school bag use. Poor load distribution, excessive weight relative to body mass, and prolonged carriage time can contribute to spinal strain in growing children. This issue remains underexplored in many developing regions, including Pakistan. There is a growing need to assess prevalence and associated risk factors to guide preventive strategies and improve child musculoskeletal health.

**Objective:** To determine the prevalence of upper back pain among schoolchildren aged 10–14 years due to carrying heavy school bags in Khanpur city.

**Methods:** This cross-sectional study was conducted over seven months in two private schools of Khanpur: Manzil-e-Jahan Middle School and Horizon Public Middle School. A total of 100 students aged 10–14 years were enrolled using convenience sampling. Inclusion criteria involved students carrying heavy school bags and reporting upper back pain. A structured, researcher-designed proforma was used to assess pain location, intensity, and duration. Body weight and bag weight were measured using a digital scale (CAMRY EB 9320). Data were analyzed using SPSS version 16. Descriptive statistics were used to report frequencies and percentages, while numerical variables like age and weight were expressed as means and standard deviations.

**Results:** Out of 100 students, 52% were male and 48% female, with a mean age of 12.32 ± 1.46 years. Weight distribution showed 32% of students weighed 30–34 kg. Regarding backpack load, 42% carried 16–18.9% of their body weight. Pain localization revealed 45% experienced upper back pain, 23% shoulder pain, 11% low back pain, and 21% had no pain. Additionally, 90% used double-strap bags and 89% carried them on both shoulders.

**Conclusion:** The study concluded that a high prevalence of upper back pain among students was associated with carrying heavy school bags. Preventive measures such as load management and awareness interventions are strongly recommended.

**Keywords:** Back Pain, Body Weight, Cross-Sectional Studies, Musculoskeletal Pain, Prevalence, School Health Services, Students.

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## INTRODUCTION

The human back is an intricate anatomical structure composed of vertebrae, muscles, ligaments, and intervertebral discs, extending from the base of the skull to the pelvis. At the core of this structure lies the spinal column, which serves as the primary support for the upper body and protects the spinal cord—a delicate and vital component of the central nervous system that relays motor commands and sensory input throughout the body (1). This delicate balance of biomechanics and neurology can be significantly disrupted by external factors, including the improper use of school backpacks. Across the globe, millions of school-aged children, from elementary to high school, routinely carry heavy backpacks filled with textbooks, notebooks, water bottles, lunch boxes, and various school supplies. While such daily carriage is often perceived as harmless, accumulating evidence suggests that it may have detrimental effects on spinal health. Students frequently report symptoms of neck and back pain, often attributed to poor posture and the uneven distribution of backpack loads (2). The physical strain induced by heavy backpacks prompts an anterior shift in posture—characterized by a forward lean of the head and trunk—potentially leading to musculoskeletal discomfort, spinal deviations, and in some cases, chronic pain conditions (3).

Experts have recommended that a child's backpack should not exceed 10% to 15% of their body weight to minimize risk (4). For instance, a child weighing 85 pounds should not carry more than 12.75 pounds, while a 140-pound child should be limited to 21 pounds (4,5). Exceeding this limit not only compromises posture but may also distort the natural curves of the spine, especially in growing children whose musculoskeletal systems are still developing (5). Additionally, inappropriate backpack use, such as wearing it on a single shoulder or letting it hang too low, can cause muscle imbalances and increase the risk of long-term spinal issues (6). Alarmingly, reports indicate that some children carry bags weighing as much as 30–40% of their body weight, substantially above the recommended limit (7). Various educational and health authorities have raised concerns about this issue. In some regions, school administrations have been urged to monitor and regulate backpack weight, and to educate parents and teachers about the risks associated with heavy loads (7,8). The issue extends beyond mechanical strain; the perception of burden itself has been explored in research. A study conducted in Italy revealed that 79% of schoolchildren considered their backpacks excessively heavy, with 65% reporting fatigue and nearly half experiencing back pain, highlighting the subjective and physiological dimensions of the problem (9). Another investigation found that the average schoolbag weighed approximately 6.6 kg, representing about 11.7% of body weight—surpassing the limit for many children, particularly those in early grades (10).

Biomechanical studies further underscore the adverse effects of heavy backpack loads on postural alignment. Research has shown that carrying a backpack weighing more than 15% of body weight significantly alters cervical and trunk angles, even at loads as low as 5% (11). Postural changes of this kind may contribute to functional limitations and discomfort over time. Furthermore, the association between backpack weight and pain appears to be influenced by gender, with some studies noting a stronger positive correlation among girls compared to boys (12). Despite increasing attention, awareness about the so-called “backpack syndrome” remains limited among caregivers and educators. The term refers to a constellation of symptoms—muscle fatigue, spinal strain, and localized back pain—that can arise from chronically carrying heavy school bags (13,14). Unfortunately, insufficient knowledge of spinal anatomy and biomechanics often contributes to the lack of preventative measures. There remains a significant gap in understanding the prevalence and impact of upper back pain associated with backpack use, particularly among students at different educational levels. To address this gap, the present study aims to determine the prevalence of upper back pain due to heavy school bags among students, with the objective of informing better ergonomic practices and raising awareness of potential musculoskeletal health risks linked to daily backpack use.

## METHODS

This study employed a descriptive cross-sectional design and was conducted over a period of three months in two private schools located in Khanpur, Pakistan. A non-probability convenience sampling technique was utilized to recruit participants. The target population included school-going children aged between 10 and 14 years, of both genders, who carried heavy school bags and reported experiencing upper back pain. The inclusion criteria were clearly defined to include students within the specified age group, without discrimination based on gender, provided they carried heavy backpacks and complained of discomfort specifically in the upper back region. Exclusion criteria were also established to ensure data reliability and included students with any pre-existing musculoskeletal disorders, physical

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disabilities, or conditions that might have independently influenced upper back pain. A total of 100 students met the eligibility criteria and were included in the study. Prior to data collection, informed consent was obtained from all participants and their guardians, ensuring ethical compliance. The study was approved by the Institutional Review Board under letter number 39. A structured proforma was developed under the supervision of the research supervisor to ensure the comprehensive collection of relevant data. The proforma included demographic details such as age and gender, along with specific variables related to backpack characteristics including type, weight, and carrying style. To aid in the identification of pain location, a visual body diagram was provided on which respondents marked the areas of discomfort.

Objective measurements of the students' body weight and the weight of their school bags were taken using a calibrated digital weighing scale (CAMRY, Model EB 9320) (15). This allowed for accurate assessment of the backpack-to-body weight ratio, an important determinant in musculoskeletal load analysis. All measurements and responses were recorded manually on the data proforma. Data entry was carried out using SPSS version 16.0, and statistical analysis was conducted by calculating frequencies and percentages of the variables of interest. Although no advanced statistical tests were applied in this phase, descriptive analysis was adequate to meet the study objectives and illustrate patterns within the dataset.

## RESULTS

The study included 100 students aged 10 to 14 years, with a mean age of 12.32 ± 1.463 years. The median age was 12 years, and the mode was 14 years. The sample was almost equally distributed by gender, with 52% male and 48% female participants. With respect to body weight, 12% of the students weighed between 20–24 kg, 27% between 25–29 kg, 32% between 30–34 kg, 15% between 35–39 kg, and 14% between 40–44 kg. In terms of height, 25% of the students were between 4.0–4.4 feet, 45% between 4.5–4.9 feet, 28% between 5.0–5.4 feet, and only 2% were between 5.5–5.9 feet. Regarding the weight of school bags, 45% of students carried bags weighing 5 kg or less, while 55% carried bags of 6 kg or more. Analysis of the ratio of school bag weight to body weight revealed that 21% of students carried loads equivalent to 13–15.9% of their body weight, 42% carried 16–18.9%, 21% carried 19–21.9%, and 16% carried 22–24.9%. This indicates that a significant majority of students were carrying loads beyond the recommended 15% limit.

When examining Body Mass Index (BMI), 3% of students fell in the 9–11.9 range, 47% in the 12–14.9 range, 43% in the 15–17.9 range, 5% in the 18–20.9 range, and 2% in the 21–23.9 range, indicating that the majority were within or near normal BMI limits. The distribution of students by grade level showed that 20% were in 5th grade, 25% in 6th grade, 19% in 7th grade, and 36% in 8th grade. Concerning backpack type, 90% used double-strap bags, while 10% used single-strap bags. Most students (89%) carried their bags on both shoulders, whereas 11% used only one shoulder, which may indicate asymmetrical load bearing. Pain location analysis revealed that 21% of students reported no pain, 23% experienced shoulder pain, 45% reported pain in the upper back, and 11% experienced lower back pain. Notably, upper back pain was the most frequently reported, aligning with the primary objective of the study to assess upper back pain prevalence associated with heavy school bags.

The cross-tabulated analysis of pain location in relation to backpack weight as a percentage of body weight revealed a clear trend correlating increased load with a higher prevalence of musculoskeletal discomfort, particularly upper back pain. Among students carrying 13–15.9% of their body weight in backpacks, only 5 reported upper back pain, while 9 reported no pain. However, in the group carrying 16–18.9%, the number of students experiencing upper back pain rose sharply to 18, while only 10 reported no discomfort. This trend became even more pronounced among those carrying 19–21.9% and 22–24.9% of their body weight, where 12 and 10 students respectively experienced upper back pain, with a noticeable drop in the number of pain-free individuals. Furthermore, low back pain and shoulder pain were also more frequently reported in the higher weight categories. These findings suggest a direct relationship between increasing backpack load and the occurrence of upper back and related musculoskeletal pain among schoolchildren, reinforcing the importance of adhering to recommended weight limits to minimize risk.

**Table 1: Descriptive Characteristics of Schoolchildren Aged 10–14 Years Participating in the Study**

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Age (Years) | Mean | 12.32 | – |
| | Median | 12 | – |
| | Mode | 14 | – |
| | Std. Deviation | 1.463 | – |

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| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| | Std. Error | 0.146 | – |
| Gender | Male | 52 | 52 |
| | Female | 48 | 48 |
| Weight (kg) | 20–24 | 12 | 12 |
| | 25–29 | 27 | 27 |
| | 30–34 | 32 | 32 |
| | 35–39 | 15 | 15 |
| | 40–44 | 14 | 14 |
| Height (feet. Inches) | 4.0–4.4 | 25 | 25 |
| | 4.5–4.9 | 45 | 45 |
| | 5.0–5.4 | 28 | 28 |
| | 5.5–5.9 | 2 | 2 |
| BMI | 9–11.9 | 3 | 3 |
| | 12–14.9 | 47 | 47 |
| | 15–17.9 | 43 | 43 |
| | 18–20.9 | 5 | 5 |
| | 21–23.9 | 2 | 2 |

**Table 2: Distribution of study subjects according to the %age of school bag weight.**

| Weight (kg) | Frequency | Percent |
|---|---|---|
| ≤ 5 | 45 | 45 |
| 6 and above | 55 | 55 |
| Total | 100 | 100 |

**Table 3: Distribution of study subjects according to the school bag type.**

| School bag type | Frequency | Percent |
|---|---|---|
| Double strap bag | 90 | 90 |
| Single strap bag | 10 | 10 |
| Total | 100 | 100 |

**Table 4: Distribution of study subjects according to the way of carrying school bag.**

| Way of carry | Frequency | Percent |
|---|---|---|
| On both shoulders | 89 | 89 |
| On one shoulder | 11 | 11 |
| Total | 100 | 100 |

**Table 5: Distribution of study subjects according to location of pain.**

| Pain location | Frequency | Percentage |
|---|---|---|
| No pain | 21 | 21 |
| Shoulder | 23 | 23 |
| Upper back | 45 | 45 |
| Low back | 11 | 11 |
| Total | 100 | 100 |

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**Table 6: Backpack Load vs Pain Location**

| Bag Weight % | Total Students | Upper Back Pain | Shoulder Pain | Low Back Pain | No Pain |
|---|---|---|---|---|---|
| 13-15.9% | 21 | 5 | 6 | 1 | 9 |
| 16-18.9% | 42 | 18 | 11 | 3 | 10 |
| 19-21.9% | 21 | 12 | 5 | 4 | 0 |
| 22-24.9% | 16 | 10 | 1 | 3 | 2 |

**Distribution of study subjects according to the class.**

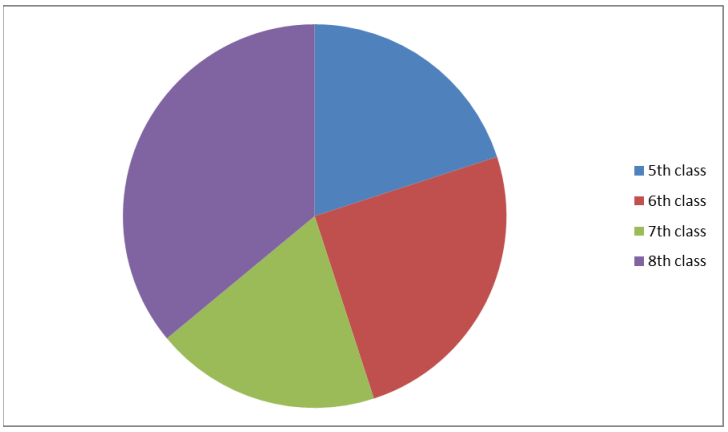


*Figure 1 Distribution of Study Subjects According to the Class*

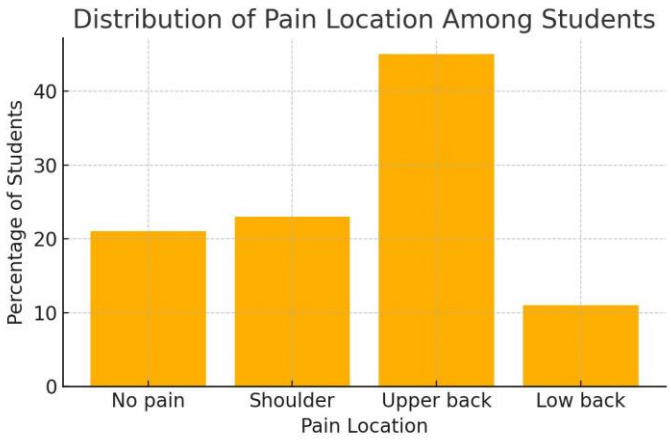


*Figure 2 Distribution of Pain Location Among Students*

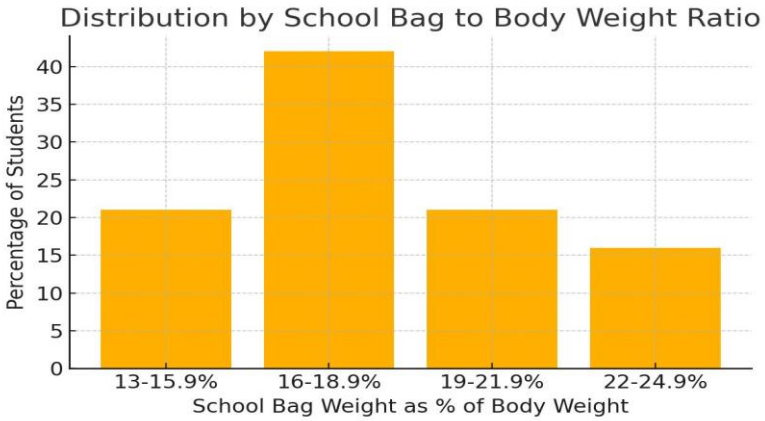


*Figure 3Distribution by School Bag to Body Weight Ratio*

## DISCUSSION

The present study was conducted to determine the prevalence of upper back pain among school children aged 10–14 years in Khanpur city, in relation to carrying heavy school bags. Findings revealed a significant burden of musculoskeletal discomfort, particularly upper back pain, among students, with 45% reporting this complaint. This is consistent with previous studies that identified a strong association between excessive backpack weight and upper or mid-back pain among school-aged children (10,16). The average age of the participants was 12.32 years, and a majority of students were found to be carrying school bags exceeding 15% of their body weight, which is above the commonly recommended threshold for safe load carriage. The distribution of weight-to-body ratio in this study was particularly concerning, with 42% of students carrying bags weighing between 16–18.9% of their body weight, and an additional 37% carrying

weights above this range. These observations align with earlier research that reported similar findings, where students carrying loads in excess of safe limits exhibited higher frequencies of musculoskeletal pain (17,18). In comparison, studies conducted in other countries such as New Zealand have documented relatively lower average backpack weights, ranging from 6.3 to 7.0 kg among younger students. In contrast, the mean weights observed in this study were higher, especially when compared to body mass, suggesting an increased biomechanical strain on school-going children.

The current research also highlighted that the vast majority of students (90%) used double-strap backpacks and 89% carried them on both shoulders, which aligns with recommended ergonomic practices. However, the presence of significant pain despite proper carrying technique indicates that backpack weight, rather than carrying method alone, plays a critical role in symptom development. Similar findings were reported in prior literature, which demonstrated that even with balanced carriage, exceeding the safe weight threshold remains a key contributor to spinal stress and musculoskeletal symptoms (19,20). Furthermore, the BMI distribution in this sample revealed that most students were within normal ranges, thus ruling out obesity as a confounding factor in back pain prevalence. A deeper analysis of the timing of pain onset showed that a considerable proportion of students began to experience discomfort within the first 10 minutes of carrying their bags, which further reinforces the notion of weight-induced mechanical stress. While only 6% reported pain persisting after unloading, the immediate nature of symptom onset following backpack use highlights the acute effect of load bearing on spinal structures. Comparatively, other studies have also documented similar temporal associations between backpack use and symptom emergence, particularly in younger populations with developing musculoskeletal systems (20,21).

Interestingly, the location-specific findings indicated that while upper back pain was most prevalent, shoulder pain and low back pain were also reported. Previous literature similarly documented multi-regional discomfort, with some studies indicating as high as 65% prevalence of shoulder discomfort and 43.6% of combined neck and shoulder complaints. However, this study reported a slightly higher frequency of upper back pain, possibly due to the age range and average load carriage among the participants. Despite these concerns, none of the students reported any impairment in activities of daily living, which may reflect the early or mild nature of symptoms at this stage. The strengths of this study include its focus on a well-defined age group and the use of objective weight measurements to quantify backpack load relative to body weight. A structured proforma with anatomical diagrams was used, enhancing the accuracy of pain localization by respondents. Nevertheless, the study had notable limitations. The use of non-probability convenience sampling introduces selection bias and limits generalizability. Additionally, the cross-sectional design restricts the ability to establish causal relationships between backpack weight and pain development. The relatively small sample size and confinement to private schools in a single city further reduce the external validity of the findings. The COVID-19 pandemic also constrained the researcher's ability to collect a more comprehensive dataset.

To mitigate these limitations in future research, larger-scale studies with stratified random sampling across diverse school types should be considered. Longitudinal designs would help to assess the progression of musculoskeletal symptoms over time and in relation to changes in backpack weight or ergonomic interventions. Furthermore, future investigations may incorporate clinical assessments alongside self-reported pain to enhance diagnostic accuracy and explore the role of physical activity levels and nutritional status in musculoskeletal health among schoolchildren. In conclusion, the study adds to growing evidence that excessive school bag weight is a significant contributor to upper back pain in children. While ergonomic practices such as using double straps and bilateral carriage are beneficial, they are insufficient alone in the presence of excessive weight. Preventive strategies should include routine monitoring of backpack weight, ergonomic education for students and caregivers, and promotion of physical strengthening and balanced nutrition during growth years.

## CONCLUSION

This study concluded that upper back pain is a prevalent concern among schoolchildren in the selected private schools of Khanpur, largely attributed to the carriage of heavy school bags. Despite the widespread use of double-strap bags carried on both shoulders, the burden of excessive weight relative to body size was a critical factor contributing to musculoskeletal discomfort, particularly in the upper back and shoulders. While not all students with back pain experienced symptoms in other regions, the intensity and location of discomfort appeared to correlate with backpack load and individual physical factors such as body mass index. These findings underscore the need for targeted health education initiatives involving students, parents, and school administrators to raise awareness about proper backpack use and the importance of adequate nutrition during growth. Further research is warranted to explore broader risk factors and develop practical interventions to mitigate school-related musculoskeletal issues in children.

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**AUTHOR CONTRIBUTION**

| Author | Contribution |
|---|---|
| Muhammad Azam Ghaffar | Substantial Contribution to study design, analysis, acquisition of Data<br>Manuscript Writing<br>Has given Final Approval of the version to be published |
| Isra Rizwan | Substantial Contribution to study design, acquisition and interpretation of Data<br>Critical Review and Manuscript Writing<br>Has given Final Approval of the version to be published |
| Iqra Khan | Substantial Contribution to acquisition and interpretation of Data<br>Has given Final Approval of the version to be published |
| Raja Maqsood Ahmed | Contributed to Data Collection and Analysis<br>Has given Final Approval of the version to be published |
| Sana Muneeb* | Contributed to Data Collection and Analysis<br>Has given Final Approval of the version to be published |
| Aqsa Lakhani | Substantial Contribution to study design and Data Analysis<br>Has given Final Approval of the version to be published |
| Uswa Ali | Contributed to study concept and Data collection<br>Has given Final Approval of the version to be published |

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