

# Back pack injuries in Indian school children: risk factors and clinical presentations

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**Abstract:** The use of backpack increased substantially among the school children. Studies have shown that carrying a backpack cause to develop different symptoms of musculoskeletal disorders among the carrier of the backpack. In India there are fewer studies available in literature which explains the musculoskeletal discomfort among the school children. This study aimed at to find out the prevalence of different musculoskeletal problems among the school children. In a retrospective study data were collected for twenty two students. The main diagnostic criteria were pressure mark (redness or swelling) over neck and shoulder corresponding to the straps of the backpack, stooping posture while carrying the back pack, pain or stiffness in the neck, upper back and shoulders predominantly while carrying the back pack and absence of these symptoms during school holidays. Results revealed that pain in the upper back (40%), neck (27%) and shoulder (20%) were most prevalent body regions followed by forearm and wrist pain (7%) and low back (6%). Results further revealed that all the students participated in this study have a pressure mark over shoulder. 54.55% of the children were diagnosed with myofascial pain and rest with thoracic outlet syndrome.

Keywords: retrospective analysis, subjective pain questionnaire, pressure mark over shoulder

## 1. Introduction

The Backpack is one of the several forms of manual load carriage that provides flexibility and is often used by hikers, and soldiers, as well as by the school children [9]. Backpack is the appropriate way to load the spine closely and symmetrically while maintaining stability [19]. Use of backpack increased substantially for carrying necessary equipments. Backpacks are becoming more and more common in school children for carrying school books, laptops, water bottles, lunch boxes etc. However the use of heavy backpack lead to develop different musculoskeletal discomfort among the school children and it becomes a concern area for ergonomists [2, 8, 12, 15, 17, 20]. Even in day to day clinical practice, backpack related injuries became significantly common [2]. Studies have revealed that "Backpack load carriage increases ground reaction forces and increases the stiffness in the upper extremity that can cause transmission of higher amount of forces from the lower extremity to the head [18]. Studies have shown that the school children across the world suffer from musculoskeletal pain or discomfort in the shoulder and back [6].

Apart from this reporting of scoliosis, rucksack palsy [14, 21] and reduced lung functions [4, 10, 11] are also seen. Researchers also reported that reporting of musculoskeletal pain among the school children is multi factorial in nature. Carrying a backpack may be one of them [20].

The spinal structures of the child are markedly different from those of adults. As growth of the spinal structures extends over a longer period of time than the other skeletal tissues, incongruities in rate of tissue development can pose a threat to postural integrity. Literature revealed that the load weight ratio has a positive relationship with many factors like, pain, pain location, kyphosis, and other variables [1]. Consequently, posture in adolescent can be affected by both internal and external influences, which may make adolescent more susceptible to injury. When load is positioned posterior to the body in the form of backpack it changes posture because of the changes to centre of gravity. The body tries to keep the centre of gravity between feet, so with a backpack, the trunk is in a more forward position, placing abnormal forces on the spine.

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In today’s life there is a growing concern among the teachers, medical professionals and parents over the increasing incidents of backpack related injury in school children [7, 16, 24].

While carrying the back pack children unknowingly place a strain on their body especially, when they use it in one shoulder. Though there is neither any consensus nor any guidelines available for ideal back pack weight, In a study conducted in India, it was found that the mean bag weight carried by urban school children is 7.1Kg which is 17% of their body weight and for rural school children its 3.2Kg [13]. These back packs can seriously attribute to the regional pains in the children especially in the upper back, shoulder and neck [25]. The severity of the said problems in children can aggravate to such an extent that it interferes with their activities of daily living and their parents has to take them off and spent for treatment. Unfortunately in most of the Indian school authorities do not take any proactive approach or provide any solution to control MSDs in school children that may cause using the backpack. The objective of the study was to find out the risk factors and clinical presentation caused by backpacks among Indian school children.

**2. Methodology**

A retrospective analysis of clinical notes from paediatric orthopedician in a tertiary level Neuromusculoskeletal Rehabilitation centre in India found a sample count of 22 subjects were diagnosed with severe backpack injuries. The severity of the pain was such that the child was forced to miss school for at least a day and receive physiotherapy. The main diagnostic criteria were pressure mark (redness or swelling) over neck and shoulder corresponding to the straps of the backpack, stooping posture while carrying the back pack, pain or stiffness in the neck, upper back and shoulders predominantly while carrying the back pack and absence of these symptoms during school holidays. The body regions were further categorized in 7 areas i.e. neck, upper back, shoulder, forearm and wrist, lower back, thigh and wrist. On clinical evaluation, specific signs and symptoms were collected, along with subjective pain questionnaire. Descriptive Statistical analyses were used in this study.

**3. Results**

The demographic result showed that mean age, and BMI of the participants were 12.94±4.53 and 16.70±2.81 respectively which is represented in Table 1. The distribution of gender was almost similar (OR – 1.49, CI – 0.85 to 2.61), 55% of respondents were females and 45% were male which is represented in Figure 1.

Table 1. Demographic data of the Participant

Participants	Age (yrs)	BMI
N=22	12.94±4.53	16.70±2.81

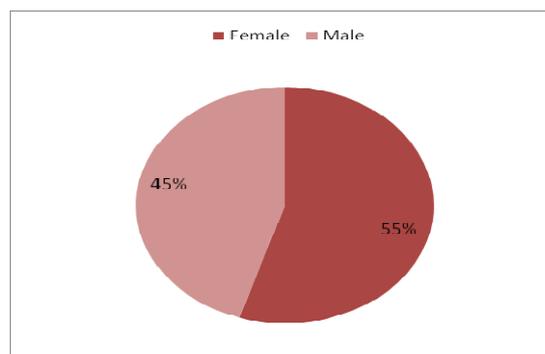


Figure 1. Distribution of gender in the sample

The result of regional pain distribution was presented in Figure 2.

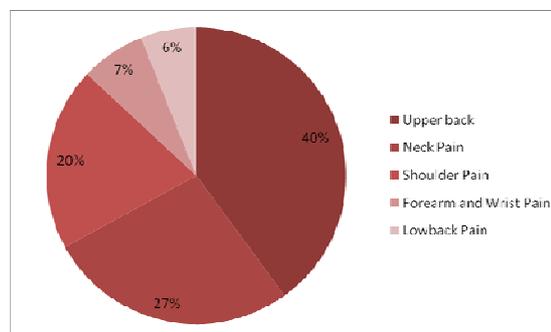


Figure 2. Distribution of Body discomfort

The Figure 2. Revealed that upper back, neck and Shoulder were most prevalent body regions followed by low back, forearm and wrist pain.

Result further revealed that all the students participated in this study had a pressure mark over shoulder. 54.55% subjects were diagnosed with myofascial pain and rest with thoracic outlet syndrome. They also reported numbness, discolouration of arm forearm and hands. It was observed that, all these symptoms were present while carrying which were the diagnostic criteria for the backpack injuries. The average duration of discomfort was 56 days and the mean load of the back pack was 5.57Kg, which indicates carrying load is a risk factor in the development of back pack injuries. All the children were found to be carrying backpacks more than 15% of their body weights. The main aggravating factor was carrying the backpack, and the relieving factor was putting the backpack off. All these 22 children had to undergo physical therapy (with skilled sequential manual therapy protocol) for at least one month period in order to manage the condition. After the treatment 70% of them had no pain measured in the VAS, while 30% had pain of severity less than 3 on the VAS scale. No child was found to have scoliosis though postural kyphosis of thoracolumbar spine was noted in all subjects 36.36% of the children were found to have hypermobility of joints as diagnosed by the Wynne- Davis criteria.

### 3.1 Recommendations

The back of the pack should be padded to prevent being poked by sharp objects that may be in the backpack [23]. The backpack should be of right size for the child and should be worn properly. Both shoulder straps should be worn, only wearing it on one shoulder puts excess strain on the upper back [23]. The backpack should not extend below the lower back. Teachers must be informed about reducing the need to bring home textbooks or if at all possible, have an extra set for home use [22]. The weight should be properly distributed by putting the heavier items on the bottom and against the back to keep the weight off of your shoulders and to maintain neutral posture [26]. Backpack should be taken off while standing for a long period of time. Extended carrying time increases the pressure on the spine [23]. A lumbar support and the cushion will redistribute weight to the lower extremities, creating a fulcrum that facilitates an upright standing position and good posture that is essential for proper spinal health [22]. A waist belt distributes weight evenly and

shifts the weight off the shoulders, neck and upper back to the lower back. This will prevent injury and is more comfortable [22]. Multiple compartments in the Back pack will allow better weight distribution [26].

## 4. Discussion

Load carried in a backpack shift the centre of gravity behind the body in order to compensate this; the body pulls the load forward and thus centre of gravity moves over the base of the support in between the feet. This is accomplished by either leaning forward at the ankle and hip or inclining the head to support the backpack, which leads to the rigidity of postural muscles. These alterations can lead to back pain and injury by stressing ligaments or muscles in the back or by changing the forces applied to the inter vertebral discs. As the individuals fatigue and these changes become more pronounced, there is potential for the risk of injury to the load carrier. The weight varies from 10% - 15% of children's body weight. There are rare studies to find out the appropriateness of the weight carried by school children. Recently, a study carried out in Australia reports the appropriateness of these load carrying recommendation [3, 5].

## 5. Conclusion

The study results revealing the relevant clinical features and risk factors which helps in the ergonomic recommendations and control measures must be given by the school authorities/governing bodies to prevent or manage the incidents of back pack related injury among Indian school children. Also it will help in the future for developing a comprehensive backpack injury prevention and management strategy.

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