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Weight of School Backpacks and its Impacts on Students' Health: A Cross-Sectional Study

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ABSTRACT

The study was conducted to assess the weight of school backpacks in relation to student's body weight. A total of 250 semi-urban students from one of the schools in Thimphu participated in this study. A cross-sectional non-experimental survey was conducted. The weight of the school backpacks and weight of the students were measured. The findings from the study, among others, revealed that more than half of the students (n=127, 50.8%) from the school carried backpacks more than the internationally recommended weight of 10% of their body weight. It is recommended that the school authorities and the Ministry of Health work collaboratively to address its implications and future health challenges of children carrying excess weight in their backpacks.

Keywords: School backpacks, Body mass index, Musculoskeletal discomfort

Introduction

The problem of overweight school backpack is gaining more attention from sports medicine specialists, school leaders, teachers, and parents alike (Kasovic et al., 2018). During the entire period of schooling, school backpacks are the main means of transfer of books and accessories, and it makes the daily activity of majority of children (Al-Saleem, et al., 2016). It has been discovered that school backpack's excessive weight could lead to muscle imbalances during the growth phase, and later in life, to chronic pain and posture problems (American Academy of Orthopedic Surgeon, 2018). Many researchers also confirm that carrying school backpacks beyond recommended weight causes multiple problems in children (Bauer & Freivalds, 2009; Brackley et al., 2009; Dockrell et al., 2012; Kasovic et al., 2018). Research shows that children carrying school backpacks more than 10% of their body weight can elevate pressure on neck and back muscles leading to excessive fatigue and potential damage to the skeletal system. The study also indicates that it ultimately contributes to spinal deformities (Ahmed et al.,

2024) and changes in kinetic, kinematic and electromyographic parameters (Bobet & Norman, 1984; Chow, et al., 2005), while values that exceed the upper limit of this interval as well as certain types of school backpacks can cause pressure on the nerves at the tip of the neck, leading to muscle spasms as well as neck and shoulder pain (Mao et al., 2015). In urban environments, children mostly walk on hard asphalt and concrete surfaces, which is why the load on their feet and entire bodies is uniform, providing no proper stimulation of body muscles that promotes proper development of the feet and overall body posture (Kasović et al., 2014).

Although some studies have been conducted to identify a safe load limit of school backpacks, there is still no consensus on the standard guideline for weight of school backpacks. For instance, a report from Ireland, Europe, and Health Promotion Board of Singapore states that 10% of body weight is reasonable for school children to carry. However, in the review of Canadian literature (2004) and the American Occupational Therapy (2011), it is recommended that 15% of body weight should be the limit. It has been found that heavy school backpacks are one of the universal factors that influence the incidence of musculoskeletal pain in school children (Kasovic et al., 2018). One of the most common symptoms studied in the literature is the back pain in relation to heavy school backpacks. In Bhutan, 14.3% of the population in the age group of 15 – 49 years old presented in the hospitals suffered from musculoskeletal disorders in 2017 (Dorji, et al., 2019).

Despite the letter issued by the Royal Education Council to schools in 2017 to strategize in minimizing the weight of children's backpacks, the study conducted by Dorji, et al. (2019) found that more than 50% of his participants carried beyond the recommended weight, and 93.2% of samples had musculoskeletal pain (Dorji et al., 2019 p.31). Since the study also recommended the weight of school backpacks to be 10% of the body weight for the students, 10% of the body weight is taken as the recommended weight for the current study.

Problem Statement

The weight of school backpacks carried by the students and its impacts on the body are left undetermined in almost all the schools across the country. More surprisingly, no educational institution in Bhutan has conducted any research on the weight of school backpacks or strategies to reduce weight of school backpacks. In the current research site, a few classes had improvised wooden shelves for students to keep their books, but it was found that students seldom used it in fear of losing their books. Similarly, series of nails used as snug hooks helped to maintain conducive seating arrangement in the classroom. However, students still had to carry their backpacks while travelling home. The school did not have a homework policy to reduce the number of books to be carried and no strategies and recommendations designed to reduce the weight of school backpacks. Therefore, it evoked researchers to assess the weight of school backpacks and Body Weight (BW) for school students to provide the necessary feedback.

Literature Review

Backpack and bag usage are prevalent in daily life (Saleem, 2016). Students carry various items in their backpacks resulting to different carrying weights. In general, a backpack is useful for holding students' daily goods because of its loops (Dockrell et al., 2015; Algamdi et al., 2018). During school days, a load of backpack of a school student supposedly ranges from 10% to as high as 25% of his/her body weight, and it may have a negative impact on his/her body (Perrone et al., 2018).

However, heavy school backpacks are one of the universal factors that influence the

incidence of multitude of body biomechanical afflictions or disorders such as changes in the sagittal plane in posture and balance, spinal curvature, consistency of repositioning and musculoskeletal discomfort in school children (Cuessogo, 2020; Saleem, 2016). In the study conducted by Kasović et al. (2018), it was revealed that walking with a school backpack changes the plantar pressure pattern causing imbalance pressure on the foot, resulting in high risks to health and improper growth of the child. School backpacks' excessive weight can also lead to muscle imbalances during the growth phase and later in life to chronic pain and posture problems (AAOS, 2018).

The study conducted by Al-Saleem (2016) in Saudi Arabia found that 72.46% of students were carrying backpacks of weight more than 15% of their body weight. The prevalence of heavy school backpacks was higher among the female children compared to the male children of the same age group. Understandably, back pain was reported by 42% of the school children. The weight of school backpacks of Al-Ahsa primary school children were higher than the internationally acceptable standards, and as a result, back pain was reported by 42% of school children.

Chen (2021) investigated influences of carrying load and the method of carrying it on participants' muscle activations, body posture alterations, and subjective discomfort ratings. The results revealed that the carried load and method of carrying it significantly affected body posture and trapezius activation. The unbalanced load of side backpack may cause an uneven shoulder posture, thus resulting in extra body strains. Orloff and Rapp (2004) observed that spine and back health may be adversely affected by load carriage sooner than previously thought. People were more likely to have a forward head posture, rounded shoulder posture, and increased lateral tilting of the shoulders while walking with increased backpack load (Mo et al., 2013). Another study carried by Perrone et al. (2018) found that on an average, students carried over 15% of their own body weight which caused biomechanical and physiological adaptations that could increase musculoskeletal injury risk, fatigue, redness, swelling and discomfort. Moreover, Guessogo et al. (2020) found that the weight of school backpacks is high in Cameroonian education system compared to international standards. Interestingly, it was found that carrying heavy school backpacks was associated with musculoskeletal pain in Cameroonian school children.

A study of school backpack's weight and back pain was conducted among intermediate female students in Dammam City, Kingdom of Saudi Arabia. The results of the study indicated that a total of 288 school children (96.2% out of 300) were carrying backpack of weight more than 15% of their body weight. Accordingly, shoulder and neck pain were reported by 40% of the female students. Statistically, there was a significant relationship between school backpacks' weight and severity of shoulder pain ($p = .042$) (Alghamdi et al., 2018).

The International Chiropractic Pediatric Association (ICPA) suggested that a school backpack should not exceed 15% of a child's body weight. It has been found that carrying a heavy backpack with a weight exceeding 15% of the student body weight can lead to a change in posture resulting to pain in the upper, mid-back, neck and low back in addition to local effects such as headaches, muscle weakness, tingling in the arms, and stooped posture.

Dorji et al. (2019) stated that carrying of loads greater than 10% of one's body weight (BW) induces postural change and morbidity related to spinal pain. They studied the weight of school backpacks and the prevalence of musculoskeletal pain related to carrying school backpacks among children in Thimphu, Bhutan. The weight of school backpack that were more than the recommended 10% Body weight (BW) was a strong factor in reporting musculoskeletal pain. The findings revealed a considerably higher prevalence of muscular pain with 93.2% of students suffering from it. The study recommends that parents and students be educated on the use of school backpacks with safety features. It

was also recommended that other measures such as providing storage facilities in schools may reduce the weight of backpacks.

The Royal Education Council (REC) officially recommended schools across the country to reduce the weight of school backpacks. The recommendation included digitization of textbooks, carrying lightweight, re-designing classroom settings and locker facilities, holding classes for certain subjects in a day, developing homework policies and bringing down number of notebooks. Despite the recommendation made by the Royal Education Council, students still carry the bags beyond the recommended weight of 10% BW (“Not many schools adopted”, 2018; Dorji, et al. 2019).

The main reason for not following the recommendation could be due to lack of resources to re-design the classroom settings and locker facilities owing to large number of students in a class. Other reasons include lack of digital tools and gadgets such as computers, laptops, mobile phones, and tablets in the school and at home, lack of reliable and affordable internet connectivity, lack of stringent policies in schools banning students to use digital gadgets, willingness and preferences of students to learn from the textbooks, rigid textbooks and syllabus prescribed by the Ministry of Education and Skills Development.

Methods

This cross-sectional study was conducted among students ranging from Pre-primary to 11th grade. The study explored the weight of school backpacks in relation to their body weight. It employed a quantitative approach with a descriptive non-experimental survey design similar to the studies carried out by Alghamdi et. al (2018), Al-saleem et. al. (2016), Dorji et. al. (2019), Guessgo et. al. (2020), and Layuk et. al. (2020). This study design was chosen as it provided the opportunity to investigate the relationship between students carrying overload backpacks and their back pain and musculoskeletal discomfort.

Sample

The sample for this study consisted of day-school students (N = 250) who carried backpacks to and from school covering certain distance over a certain period of time. Simple random sampling technique was used to recruit the participants of this study as it provided every student the equal opportunity to be selected as the sample of the study (Creswell & Creswell, 2018). All the participants were travelling to the same school from their respective home covering certain distance with backpacks of varying weights. The age of participants ranged from five to 24 years, and most of the participants had been regularly carrying backpacks to the school. The detailed demographic characteristics are presented in Table 1.

Data Collection

Using the questionnaires, data were collected after two months of post Covid-19 school reopening. The questionnaire partly consisted of a self-administered questions in English. An aggregate of 250 students took part in the study. Researchers measured the weight of students, the weight of school backpacks, and the height of students using standard weighing scale calibrated by Bhutan Standard Bureau.

Data analyses

The data were cleaned and analyzed in IBM SPSS 23.0. The weight of school backpacks related to students' body weight were classified into 10% BW and >10% BW. Data were analysed using descriptive statistics to determine students in the risk of musculoskeletal disorder.

Result and Discussion

Demographic Result

There were 250 students ranging from pre-primary to 11th grade, out of which, 106 were male and 144 were female as shown in Table 1.

Table 1. The proportion of the weight of school backpacks’ in one of the schools in Thimphu in 2022.

Backpacks Weight to BW (%)				
Gender (N= 250)	10%		≥ 10%	
	n	%	n	%
Male (n=106)	38	35.8%	68	64.1%
Female (n=144)	85	59.02%	59	40.97%
TOTAL	123	49.2%	127	50.8%

BW=Body Weight

Students carrying backpacks 10% and ≥ 10% of the students’ body weight (N=250)

The results of this study represent a concerning situation as more than half of the students carried backpacks more than the recommended weight of 10% of their body weight. Almost all school backpacks that students carried were filled with textbooks and notebooks. However, a small portion of the backpacks were occupied by other materials such as geometry boxes, pens, pencils, rulers, plates, and water bottles. The mean bodyweight of the students was 43.4 kg while the mean weight of school backpack was 4.4 kg (range: 0.8-13.4kg). It can be seen in Table 1 that more than half of the participants (n=127, 50.8%) carried more than recommended weight of 10% of the body weight. There was a significant difference in gender as 68 (64.1%) of male students carried backpacks ≥10% of their body weight compared to 59 (40.97%) of female children who carried backpack weight of ≥10% of their body weight. On the contrary, only 38 (35.8%) of male students carried backpacks 10% of the body weight, while 85 (59.02%) of female students carried backpack 10% of the body weight. The textbooks and notebooks in the school backpacks were the main reason why students had to carry more than the recommended weight of 10% of the body weight.

Conclusion

Weight of school backpacks of children are much higher than the internationally recommended percentage of body weight. Though there are higher chances that it might lead to the prevalence of back pain and musculoskeletal disorder in school-going children, school authorities and the Ministry of Education and Skills Development have no capacity to conduct clinical research on this issue. The Ministry of Health needs to take the lead role in tackling the risk and impacts of school backpacks on students’ health. The study recommends the need for reliable public transportation, homework policies, lockers or bookshelves in schools, curriculum revision (to reduces the bulky textbooks), and annual health check-ups. It is because of the heavy weight of textbooks and notebooks that students must carry more

than the recommended weight of 10% body weight. Thus, the school authorities, the Ministry of Health, and parents should work collaboratively to tackle the problem.

Implications

This study has implications for policymakers, educationists, curriculum developers, school administrators, teachers and parents. The findings from this study require education stakeholders to rethink the use of backpack as a means of carrying books and other necessities. Despite the office order and the circular issued by the Royal Education Council and the Ministry of Education, overweight school backpacks are still prevalent in most of the Bhutanese schools. A policy revision on the prevalence of the overweight of school backpacks should be reviewed by the relevant policymakers as the previous studies show that it causes numerous muscle imbalances and musculoskeletal disorders.

Limitations

Several factors limited this study. First, the study only investigated whether the weight of the school backpack is in line with the international recommended weight. That means no scientific or medical study was carried out to prove that the excess weight of the backpacks really affected the students' health. Second, the small sample size also limited the generalizability of the study's findings. That is to say that the findings from this study cannot be applied to other students across Bhutan and beyond. Third, the study did not consider the students who travelled by vehicle, and the distance travelled were also not categorized. Most importantly, the study did not explore the existence of back pain in students as a result of overweight backpack. More in-depth studies could explore these issues in future.

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