

Schoolbag Weight, its Content, and Incidence of Back Pain in Different Medium Primary Schools in Kuala Lumpur

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ABSTRACT

Introduction: Schoolbag weight across different types of school and schoolbag content has not been studied in Malaysia. This cross sectional survey determines the weight of schoolbags, its content and occurrence of back pain among primary school children in different medium primary school in Kuala Lumpur. **Methods:** Students' body weight, and schoolbags weight were measured using a calibrated scale. Schoolbag content was examined, and weighed according to necessary learning materials or unnecessary materials. Back pain in the past one week was assessed using a self-administered questionnaire, adapted from previous studies. **Results:** A total of 358 students (167 male, 191 female) were enrolled, of which 119 were from National School (NS), 122 from Chinese Medium School (CMS) and 117 from Tamil Medium School (TMS). The mean schoolbag weight was 4.55±1.62kg for NS, 8.53±1.94kg for CMS and 6.06±2.09kg for TMS, which was 11.7%, 22.0% and 16.6% of body weight, respectively. The mean weight of unnecessary schoolbag content was 0.64(0.91)kg for NS, 2.18(1.49)kg for CMS and 1.96(1.56) for TMS students. Back pain was detected in 87.0% NS students, 68.0% CMS students and 66.7% TMS students. Significant association was found between occurrence of back pain and types of school ($\chi^2=16.64, p=0.00$). **Conclusions:** Students from all the three mediums primary school, in particular Chinese medium school carry school bag heavier than that generally recommended, with unnecessary materials weigh up to 2kg. The occurrence of back pain is high and this is associated with the types of school.

Keywords: Schoolbag weight, schoolbag content, back pain, primary school children

INTRODUCTION

The heavy weight of schoolbags and its negative impact on children's spine is an ongoing concern among parents and consumer associations all over the world. There is particular concern for the junior students age below 15, as they are still quite small but carry loads similar to or heavier than older children. The often high ratio of schoolbag weight to body weight in junior students, places the spine at greater risk of physical stress, especially during the age, the spine is at a critical stage of development^[1].

Unfavorable effects in the spinal region, associated with carrying heavy schoolbag has been reported in several studies. Heavy bags carried over the back, can cause a child to hyperextend his or her back, or lean the head and trunk forward to compensate for the weight of the bag. Alternatively, if the bag is frequently carried over a shoulder, functional thoracic scoliosis may develop over a certain period of time. These postures can stress the muscles in the neck and back, increasing the risk of injury and fatigue, and can cause irritation to the spine joints and the rib cage^[2]. Among the effects observed in previous population-based studies include changes in cervical posture^[3], increased stress on spinal structures^[4] and development of back pain^[5].

The way students carry schoolbag also contributes to the development of negative effects in the spine. Students engage in a variety of motion and position, such as climbing stairs, riding bicycle, walking or running over rough terrain during the school days. Back pack with two straps is the most common design and thought to be ergonomically-friendly, however most students use only one strap and suspend their bag over one shoulder^[6]. Carrying schoolbag using one arm has been reported to be the most inefficient method, as it consumes energy twice than that of the back pack method^[6].

Guidelines have been developed in many countries to minimize unhealthy consequences of schoolbag weight on school children. Most guidelines recommend that schoolbags should be not more than 10% of the students' weight^[7,8]. The weight of 10% of body weight has recently reported as the load limit not to cause trunk flexion and perceived exertion among students aged 11 to 14 years^[9] and does not result in posture and gait alterations in school children age 10 years^[10].

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Despite the recommendations, students, teachers and parents are often unaware of the weight being carried in the schoolbags. A study reported that 96% of parents of 188 students who carried schoolbag heavier than the weight generally recommended had never checked their child's schoolbag weight, and 36% had never checked the schoolbag content^[11]. Children carry a variety of items to and from school. In addition to books and sports equipment, they might carry electronic devices, lunch or a snack, and a number of personal items. Carrying unimportant items results in unnecessary increase in the weight of the schoolbag, thus checking the schoolbag content from time to time is important.

In Malaysia, schoolbag weight carried by students in primary school has also become a major concern. A non scientific survey conducted in a primary school in Kuala Lumpur found that most students regarded carrying schoolbag as a heavy job^[12]. A recent study by Fazrolrozi and Rambely (2008) reported that more than 90% of the first year students (mean age 6.5 years) and more than 70% of the second year students (mean age 7.5 years) carried backpack loads of greater than 15% of their body weight to school nearly everyday^[13]. Tamrin *et al.* (2005), in a study of eighty four primary schoolchildren aged 8 and 11 years found that 58.3% of the children have low back pain associated with carrying heavy schoolbags. They also found that the weight of the schoolbag and method of carrying schoolbag were among the risk factors for the development of back pain among the primary schoolchildren^[14].

To date, no study has looked into schoolbag weight issue in different types of school. Primary schools in Malaysia are divided into three categories, i.e. National School (NS), Chinese National-Type School (or Chinese Medium School, CMS) and Tamil National-Type School (Tamil Medium School, TMS) Malay Language. NS use Malay language as a medium of instruction, and Mandarin and Tamil are used as the medium of instruction in CMS and TMS respectively. Although educational policy is standardized across the 3 types of school, there are differences in the number of subjects, teaching methodology and learning activities, hence the schoolbag weight carried by students in these schools could be different. The content of schoolbags has also never studied. To understand why students carry certain amount of weight, it is important to explore what actually make up the schoolbag weight. The aim of this study was to measure the weight of schoolbag, explore its content, and determine the occurrence of back pain in the three different types of primary school.

MATERIALS AND METHODS

Subjects

Three primary schools were randomly selected from a list of NS, CMS and TMS schools in Kuala Lumpur in order to obtain a representative cross section of Kuala Lumpur primary schools. Year five students from selected schools were screened for eligibility to participate in the study. Exclusion criteria were failure to obtain consent from parents, not carrying bags to school (using bag with wheels or bag carried by carer), and back pain due to direct trauma, congenital anomaly such as spina bifida, congenital spinal deformity such as scoliosis or kyphosis, or other spinal pathology such as tumour.

Data Collection

Students' weight and the weight of their schoolbags were measured using a calibrated electronic weighing scale (Tanita Model HD 306). Students were also asked to divide the content of their schoolbags into 2 categories; 'necessary learning materials' (books, files, stationary, other equipments according to the time table of the day), and 'unnecessary materials' (books, files and other learning materials not according to the day time table, and other non-learning materials), which were then weighed separately. All measurements were repeated three times to ensure accuracy, and were carried out on unscheduled days to prevent the students from altering the school bag weight. Occurrence of back pain in the past one week was detected using a 10-items self-administered questionnaire, adopted from a previous study conducted in California^[15]. The questionnaire was piloted on ten students prior to the actual study. The study was approved by the Secretariat for Research and Ethics of National University of Malaysia.

Data Analysis

Data was entered into Statistical Package for Social Sciences (SPSS) version 12.0. Demographic data was analysed using descriptive statistics and analysis of variance (ANOVA) performed to compare the variables of interest between the three schools. Association between types of school and back pain was analysed using Chi square test. Level of significance was set at $p < 0.05$.

RESULTS

Demographic characteristics

A total of 358 year five students (191 females and 167 males) were recruited. Of this, 119 (58 males, 61 females) were

from NS, 122 (50 males, 72 females) were from CMS and the remaining 117 (59 males and 58 females) were from TMS. The mean age of subjects was 11 (± 1) years, with mean body weight 40.84(± 11.93) kg. The mean body weight based on types of school was 41.49(± 13.68) kg, 40.93(± 10.87) and 40.09 (± 11.12) kg respectively for NPS, CMS and TMS (Table 1).

Table 1. Demographic characteristics of the subjects

		NS	CMS	TMS	Total
Mean age, yr (SD)		11(0.0)	11(1.0)	11(0.00)	-
Gender	Male(%)	58(48.7)	50(41.0)	59(50.4)	167(47)
	Female(%)	61(51.3)	72(59.0)	58(49.6)	191(53)
	Total	119	122	117	358
Mean body weight (SD), kg		41.49 (13.68)	40.93(10.87)	40.09(11.12)	40.84(11.94)

Weight of school bag

The mean weight of school bags carried by the students was 6.40(± 2.51)kg. Based on types of school, the mean weight of school bags was 4.55(± 1.62)kg, 8.53(± 1.94)kg and 6.06 (± 2.09)kg for NS, CMS and TMS, respectively. Of this, the weight of the unnecessary materials was 0.64(0.91)kg for NS, 2.18(1.49)kg for CMS and 1.96(1.56) for TMS students. There were significant difference in the weight of school bag between the three types of school, with CMS students carrying significantly heavier school bag compared to NPS and TMS students, $F=135.59$, $p=0.00$.

Table 2. School bag weight and perceived back pain according to types of school

	NS	CMS	TMS	Total	ANOVA F, p value
Mean schoolbag weight (SD), kg	4.55(1.62)	8.54 (1.94)	6.06 (2.09)	6.40(2.51)	135.59, 0.00
Mean weight of necessary learning materials (SD), kg	3.91(1.45)	6.34(1.61)	4.09(1.81)	4.80(1.97)	
Mean weight of unnecessary materials (SD), kg	0.64(0.91)	2.18(1.49)	1.96(1.56)	1.60(1.57)	
Mean % of schoolbag weight of body weight(SD)	11.72(4.82)	22.02(7.32)	16.04(7.10)	16.64(7.76)	
Carried schoolbag >10% of body weight, n (%)	72 (60.5)	120 (98.4)	97 (82.9)	289(80.1)	

Reported back pain

Back pain in the past one week was reported by 104(87.4%) students from NS, 83(68%) students from CMS and 78(66.7%) students from TMS. Chi-square test, used to analyze the association between perceived back pain and types of school demonstrated significant result, $\chi^2=16.64$, $p=0.00$ (Table 3).

Table 3. Perceived back pain and its association between the types of school

Back pain	NS n(%)	CMS n(%)	TMS n(%)	Total n	χ^2	p value
Yes	104 (87.4%)	83 (68.0%)	78 (67.0%)	265	16.64	0.00
No	15 (12.6%)	39 (32.0%)	39 (33.0%)	93		
Total	119	122	117	358		

DISCUSSION

Students in this study carry school bag of 6.4kg in average. Their mean body weight is 40kg, hence the school bag weight is 16.6% of their body weight. This has exceeded the weight generally recommended to prevent risk of back pain among school children, i.e. no more than 10% of body weight. These findings are comparable with the result of previous local studies^[13,14] and similar studies from several countries^[10,16,17,18]. Negrini *et al.* (1999) who interviewed 237 year 6 students in Italy reported that majority students carried backpack loads of more than 30% of their body weight at least once a week^[16]. In another study in Boston, Goodgold *et al.* (2002) showed that 55% out of 345 schoolchildren aged between 11 and 14 years old carried backpack loads greater than 15% of their body weight and almost one third of the students reported a history of back pain^[17]. Sheir-Ness (2003), who enrolled 1126 students age 12 to 18 years, found that on average, the weight of the schoolbags was 14.7% of the students' weight. They also found positive association between school bag load and the development of back pain^[18]. In Hong Kong, students aged between 9 and 10 years old carried backpack loads of 20% of their body weight^[10].

The school bag is heaviest among the CMS students (8.53kg), which is 22.0% of their body weight. This somewhat reflects higher use of learning materials and higher intensity of teaching in the school compared to the National school and the Tamil medium school. While this is good for the students' education process, the fact that they are carrying too heavy load for a long period is worrying. The negative impact of carrying too heavy load has been established in many studies. Schoolbags weight of 15% of body weight results in posture and gait alterations; such as increase in trunk forward inclination^[10,19], decrease stride length and gait speed^[20], and decreased trunk angular motion and swing duration during walking^[21]. At a load of 20% of body weight, vertical ground reaction force (GRF) increased almost three times compared to 10% of body weight, the anterior-posterior GRFs became asymmetrical^[19], and there is increase in double support and stance duration, as well as prolonged blood pressure recovery time following walking^[21].

The heavy weight of the school bags is partly attributed to unnecessary materials (0.64 to 2.18kg). This is in the range of 11 to 25% of the total weight of the schoolbags. Non-learning materials include umbrella, lunch box, drinking water and jacket, and some students were found to carry story books, toys and grooming accessories to school. Content of schoolbags was rarely examined in previous studies of schoolbag load. Comparing this result with those by Negrini and colleagues (2004), in which unnecessary materials contributed 9.9% of the overall content of the schoolbags, students in this study carry a significantly heavier additional load^[22]. The weight of text books supplied by the Ministry of Education ranges between 1.19 kg and 2.36 kg, and only one workbook is allowed for main subjects for year 4 to year 6 students, i.e. Malay Language, English, Mathematics, Science, Chinese Language and Tamil Language. If students abide to the daily time table and avoid carrying materials that are not important for their learning, the unnecessary additional weight carried by them can be substantially reduced.

The occurrence of back pain is high in all three types of school (66.7% to 87.4%). The occurrence is highest in NS, in which 104 of 119 students reported back pain (87.4%) although the average schoolbag weight is lightest among the 3 schools. There is also strong association between the types of school and the occurrence of back pain. As this is the only study that examines the role of types of school in the occurrence of back pain, comparison could not be made. However, several explanations could be given for this finding. Firstly, this result supports the opinion that culture has a role to play in influencing the perception and behavior of pain^[23]. The 3 types of primary school are strongly ethnicity-related. NS is dominated by the Malay, and CMS and TMS by the Chinese and the Indian, respectively. The Malay may perceive pain easier than the Chinese and the Indian, however, due to lack of study that investigates the association between pain and these ethnic groups, this possibility could not be proven. Secondly, there could be bias in the reporting of back pain by the students. In this study, the occurrence of back pain was detected by asking the students to tick 'yes' or 'no' to previous experience of pain in the back region. No definition was given for back pain, thus the students used their own discretion in determining back pain experience. There was also no privacy during the completion of the questionnaires. Older children are known to frequently compare themselves with their peers^[24] thus, there was a possibility that answers given by some students in this study resulted from influences by others.

The findings of this study are subjected to several limitations. The schoolbag weight was measured in only one day, thus does not reflect the actual weight of the schoolbag carried by the students during the school days. The variability of schoolbag weights due to differences in the time table across a week should be considered to better estimate the actual weight of the schoolbag, and this can be done by weighing the schoolbag over a week and calculate the mean. There is also weakness in the measurement of back pain. Using retrospective pain experience, without an appropriate definition of pain might induce perception and recall bias. Although previous study has shown that children above 6 years are reliable and have good memory^[24], this may not be true in all situations. Including a clinical assessment to confirm the occurrence of back pain would minimize these biases, although this may only be feasible for a smaller scale study. In addition, this study does not have adequate power to represent the whole primary school children in Malaysia. Although the sample size is larger than previous local studies, the localization of the study been in Kuala Lumpur only, limit the generalisability of its findings.

Nonetheless, the findings of this study have implications on organizations and individuals who deal directly with

primary school children. More preventive measures are required to ensure that our young generations stay healthy in their journey towards adulthood. Ministry of Education has taken several measures to reduce the weight of schoolbags by introducing a more flexible time table, with lesser number of subjects per day, and recommends that each text book exceeds 128 pages should be published in two separate parts, however cooperation from teachers and publishers are strongly required to ensure compliance to these recommendations.

Another possible way to minimize the weight of schoolbags is by building students' locker within the school compound. Students may keep non-learning materials such as umbrella, hat, etc and less frequently used learning material in the locker rather than carry them on a daily basis. However, this would require additional spatial and financial allocation. In addition, there is a need for monitoring to ensure students optimize the use of the locker, as previous studies have reported poor use of locker amongst students due to inconvenience, lack of time between classes and fear of break-ins^[25]. If providing built-in lockers is not possible, an alternative is to allow students to use classroom tables as an individual's locker, with lock and key provided to ensure safety of their belongings.

Special attention should be given to students from the Chinese medium school, who carry the heaviest schoolbags. Even if the weight of unnecessary materials, which is 2.1 kg on average, is reduced to zero, students from this school still carry around 6.4 kg of schoolbag weight, which is 16% of body weight. Individuals in the Ministry of Education, who are responsible in monitoring educational activities for Chinese medium school should sit together with representatives from selected schools to discuss strategies to overcome this problem. The number of subjects taught in a day, and the number of books used for each subjects should be re-looked to reduce the load of schoolbag to the optimum.

Parents should also play a more active role and regularly check that their children do not carry too heavy schoolbags. Parents could observe for signs that indicate a schoolbag is too heavy, such as struggling to get the back pack on or off, pain, tingling or numbness when wearing the back, red marks and changes in the natural curvature of the spine^[26]. The content of their children schoolbag should also be checked on a regular basis, to ensure no unnecessary materials are carried to school.

In conclusion, this study shows that schoolbags carried by year 5 students from the 3 mediums school are heavy and exceed the general guideline of 10% of body weight proposed to prevent back pain among school children. Students from Chinese medium school carry the heaviest school bag, amounting to almost one-fourth of their body weight. The occurrence of back pain is also high in all the 3 schools, and this is associated with the types of school. A nation wide study, which includes urban and rural schools is recommended to establish the findings of this study.

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