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## ORIGINAL RESEARCH

### Prevalence of Heavy Backpack Use Among Primary School Pupils in Ibadan, Nigeria

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#### Abstract

**Background:** Heavy backpacks may be associated with neck and back pain.

**Objective:** To determine the prevalence of heavy backpack use and its perceived effects among selected primary school pupils in Ibadan Oyo State, Nigeria.

**Methods:** A cross-sectional design that employed a multistage sampling technique was adopted. A semi-structured, interviewer-administered questionnaire was administered to 416 respondents. A standard weighing scale was used to measure pupils' body weight and weight of the backpacks. The heaviness of backpack weight was determined by calculating backpack weight as a percentage of body weight and was categorised into <10, 10-15 and >15.

**Results:** The mean age, weight, backpack weight and the weight of backpack as a percentage of pupil's body weight were 10.03±1.48years, 32.35±8.52kg, 4.18±2.34kg and 13.29±7.80%, respectively. The main perceived effects primarily associated with heavy backpack use, as reported by the pupils, were stooping (76.2%), neck pain (63.5%) and upper back pain (69.2%). Many (57.9%) of the schoolbags exceeded 10% of the pupil's body weight, while about one-third (31.7%) had the weight of the backpack as a percentage of body weight greater than 15%. The prevalence of heavy backpack use was associated with perceived effects of heavy backpack use ( $p = 0.001$ ).

**Conclusions:** The prevalence of heavy backpack use among school pupils is high in Ibadan. Guidelines regulating the use of heavy backpacks to protect school-aged children from potential adverse health are desired. Parents should also guide their children in arranging the contents of their bags.

**Keywords:** Backpack weight, Back pain, Neck pain, School pupils, School bag.

#### Introduction

Following the World Health Organization's recommendations, the load of school bags should not be more than 10% of a child's body mass. [1] It is considered heavy when the backpack exceeds

10% of the body mass. This increased load can lead to heightened cardiorespiratory demands due to reduced pulmonary volume, resulting from the forward lean of the neck and trunk. [2] One of the common reasons for the complaints of musculoskeletal and back pain among school

children is carrying heavy school bags. [3, 4] Although back pain can be attributed to several other factors that are connected with the incidence of generic back pain in children and adolescents, including age, gender, [5] involvement in sports activities for a long time, [6] time spent watching television per day, using the computer and playing video games, [7] several studies have shown the link between heavy backpack use and musculoskeletal pain; of all the effects resulting from heavy school bag carriage, back pain is the commonest effect studied in the literature concerning heavy school bag use. [8]

A study conducted in New Zealand [9] revealed that most (77.1%) students experienced musculoskeletal symptoms due to school bag carriage. The symptoms were most prevalent in the neck, shoulder, lower back, and upper back. Another study that compared Indian and American school children [10] also reported that three out of five students who experienced severe back pain attributed it to heavy backpack carriage. It has been reported that heavy school backpacks can change posture, which may lead to upper, mid-back, neck, and lower back pain, muscle tenderness, stooped posture, and tingling sensations in the arms. [11] Furthermore, in another study conducted in Saudi Arabia, [12] many participants stated that carrying their backpacks affects their posture, swinging them to a side or bending them forward. Studies have also reported a significant change in the craniovertebral angle in students carrying a backpack that exceeded 15% of their body weight, [13] and over half of the students experienced moderate pain in another study. [14]

A higher percentage of backpack weight relative to the bodyweight of 18% was reported in Iraq. [15] Similarly, a study conducted in Saudi Arabia showed that 96.3% of the students' school bag weight was more than 15% of their body weight, [12] which was similar to the findings in Brazil. [16]

[17] Research has also shown that girls are more likely to carry heavy backpacks than boys. [18-20]

Many reasons abound to explain the basis for the heaviness of children's backpacks. These include the lack of storage for books in schools and the use of multiple textbooks per subject, which adds to the homework. [21] This is coupled with uncoordinated work schedules. [12] Backpacks of over 10% of the body weight were more common among younger students, and this could be attributed to the fact that teachers and students do not follow a specific schedule for bringing books to school. [22] Also, studies reported that many parents do not check their children's backpacks for excessive and needless content. [23] Parents are considered the best judges in guiding their children regarding the weight, waist support, straps, and size of backpacks, and they monitor how their children carry bags and their contents. [24]

A universally accepted weight limit for backpacks is yet to be determined, but some agreement still exists as regards the guidelines for school bag use. [25] A bag weight that does not exceed 10% of body weight was previously suggested. [3, 21, 26 - 28] A backpack weight limit of 15% of body weight had earlier been recommended. [29]

More research is needed about the use of heavy backpacks among Nigerian pupils. Therefore, this study aimed to determine the prevalence, characteristics, and factors associated with heavy backpack use and the perceived effects among primary school pupils in an urban city in Nigeria.

## Methods

### *Study area and design*

The study was a descriptive, cross-sectional study carried out among primary school pupils in Ibadan North Local Government Area (LGA),

Oyo State, Nigeria. Ibadan North LGA is one of the eleven (11) LGAs in Ibadan, the capital city of Oyo State in Nigeria. It is bounded in the North by Akinyele LGA, in the South by Ibadan South East LGA, in the East by Ibadan North East and Lagelu LGAs, and in the West by Ibadan North West and Ido LGAs. It has a land area of 27km<sup>2</sup> and an estimated population of 856,988 people, according to the Oyo State Government in 2017. There are 74 public schools and 216 government-approved private schools in the LGA.

### *Sample size, sampling technique and study population*

Leslie Kish's formula ( $N = \frac{z^2pq}{d^2}$ ) for a single proportion for descriptive studies was used to determine the sample size. A prevalence of 44.83% reported to be the percentage of backpack use above 10% among students in a previous study in India [30] was used with precision set at 5%. Also, there was a 10% allowance for non-response, which was added to the calculated sample size of 380 to give a targeted sample size of 418 pupils.

A multistage sampling method was employed in this study as follows:

Stage 1: Schools were stratified into public and private schools.

Stage 2: Systematic random sampling was used to select four public and eight private schools in a ratio of 2:4 as there were more private schools.

Stage 3: Primaries 4-6 classes were selected in each of the schools that were chosen.

Stage 4: Pupils in selected classes were recruited for the study.

Pupils aged seven years and above in primary four to primary six in each school were randomly selected for the study. A proportional ratio was employed in selecting pupils in each school.

### *Instruments for data collection*

A semi-structured, interviewer-administered questionnaire was used for data collection. Also, a calibrated, bathroom weighing scale was used to measure the weight of the pupils and the weight of their backpacks to determine the

percentage of the backpack weight to body weight. All weight measurements were discrete numbers and reported mean scores were in decimals. Each pupil had their weight measured with and without the backpack while their shoe was removed and their pack weighed. For each measure, the scale was ensured to be set at zero. The instrument's reliability was ensured by pretesting it in a representative population among 10% of the study sample size, and a Cronbach Alpha reliability coefficient of 0.71 was obtained.

### *Measures*

The Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation (PRECEDE) framework was used to examine the predisposing, reinforcing, and enabling factors influencing the use of heavy backpacks among the study participants. The predisposing factors explain why a behaviour persists, such as knowledge and perception of an individual; reinforcing factors encourage repetition of behaviour while enabling factors encourage an individual to act on their predisposition, such as available resources, services, and policies. [31]

The framework was used to guide variables included in the questionnaire. Predisposing factors covered socio-demographic characteristics of respondents such as age, gender, class, type of school, and perceived effects of heavy backpack use. Reinforcing factors included questions on support from teachers and parents, while enabling factors covered questions on backpack size and availability of coordinated schedules or timetables in school, which can reduce the propensity to load backpacks beyond recommended limits.

### *Data analysis and management*

The Statistical Package for Social Sciences (IBM SPSS) version 20 was used for data analysis. Descriptive statistics are presented in tables and figures. A comparison between age, gender, type

of school, class, and prevalence of heavy backpack use was carried out. For this study, schoolbag weight exceeding 10% of the pupil's body weight was considered heavy, while the relative backpack weight to body weight greater than 10% was also regarded as high. Thus, the prevalence of heavy backpack weight was categorised into <10%, 10-15% and >15%. A 12-item and 12-point scale were used to assess the perceived effect of backpack use that was considered heavy, with scores 0 - 4, 5 - 8, and 9 - 12 categorised as mild, moderate, and severe effects, respectively. School backpack weight was self-rated/based on the pupils' perception of their backpack; it was categorised as light, medium or heavy. Chi-square and logistic regression were used to test significant differences in proportions of categorical data. Statistical significance was determined by p-values less than 0.05.

#### *Ethical considerations*

Ethical approval to conduct the research was obtained from the Oyo State Ministry of Health, Nigeria Ethical Review Committee (reference number AD 13/479/3088<sup>B</sup>). Consent forms were sent to all eligible students' parents one week before data collection. Only pupils whose parents gave consent and who assented to participate were enrolled in the study. Pupils were guided on how to complete the questionnaire.

#### *Patient and Public Involvement*

Patients or members of the public were not involved in our research's design, conduct, reporting, or dissemination plans.

## **Results**

#### *Socio-demographic characteristics*

The response rate was 99.5% (416/418). More than half of the pupils were males (220; 52.9%), and 196 (47.1%) were females. The mean age of

participants was  $10.03 \pm 1.48$  years. Many (56.0%) of the respondents attended private schools, while less than half (44.0%) attended public schools. As shown in Table I, less than half (41.8%) were in the primary four class.

#### *Pupils' characteristics of backpack use*

The majority (93.0%) of the respondents used backpacks; many (57.7%) considered their school bag as heavy, while almost all (97.8%) carried their school bag every day. Many pupils (56.0%) travelled to school by car, while 39.7% walked to school (Table I).

#### *Prevalence of heavy backpack use*

The mean body weight of the pupils was  $32.35 \pm 8.52$ kg while the mean backpack weight was  $4.18 \pm 2.34$ kg (Figure 1). The mean combined body weight and school bag was  $36.56 \pm 9.30$ kg, while the mean percentage of the pupil's body weight formed by the bag's weight was  $13.29 \pm 7.80$ %. Many (57.9%) of the schoolbags exceeded 10% of the pupils' body weights, while about one-third (31.7%) had backpack weight relative to a body weight greater than 15% (Table II).

There was a statistically significant association between the use of heavy backpacks and age group ( $p < 0.001$ ), type of school ( $p < 0.001$ ), and class, respectively ( $p = 0.003$ ) (Table III). *Reasons for heavy backpack use*

The majority (74%) of the respondents reported ownership of big backpacks, while about two-thirds (64.7%) reported that their parents complained about their heavy backpacks. Also, about two-thirds (63.0%) reported that their parents regularly checked their bags to remove unnecessary items, while only about a quarter (25.5%) reported that their parents arranged their backpacks for them. The majority (73.1%) of the respondents had a consistent school timetable, but only some (27.6%) packed their books to school based on the timeline.

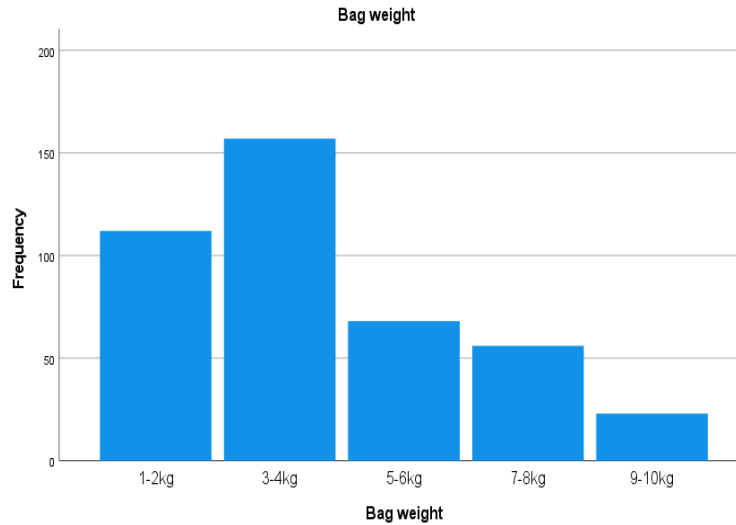


Figure 1: Backpack weight of respondents

About two-thirds (62.3%) of the respondents reported that the school provided a locker facility for them, while only one-third (33.2%) of the respondents kept their books in school (Table IV). There were significant associations between the use of a heavy backpack and factors related to the use of heavy school bags such as ownership of a big bag ( $X^2 = 29.243$ ,  $p < 0.001$ ), parents' complaints about heavy backpacks ( $X^2 = 64.771$ ,  $p < 0.001$ ), parents' tendency to arrange backpack contents ( $X^2 = 8.930$ ,  $p = 0.012$ ) and provision of locker facility in schools ( $X^2 = 14.058$ ,  $p = 0.001$ ).

*Pupils' perceived effects of heavy backpack use*

The reported perceived effects of carriage of heavy backpacks included stooping (76.2%), neck pain (63.5%), upper back pain (69.2%), imbalance (50.5%) and reduced mobility (55.8%). The effect scores were classified into mild, moderate, and severe. Less than half reported mild (43.0%) and moderate (46.7%) perceived effects, while only 9.4% reported severe impact. A statistically significant association existed between age group and perceived effects of backpack use ( $X^2 = 18.445$ ,  $p = 0.001$ ). Generally, there was a significant relationship between the prevalence of backpack

use and perceived adverse effects of backpack use ( $p < 0.001$ ; OR = 1.489, CI = 1.191-1.862).

**Discussion**

Most of the respondents in the present study used backpacks they carry to school daily, as previously reported by Khan *et al.* [30]. The study showed that the mean percentage of the bag's weight to the pupil's weight was  $13.2 \pm 7.9\%$ , which exceeded the recommendation of 10% from the literature. This finding was in contrast to the study conducted by Abdelati *et al.* in Egypt, [23] which reported the mean bag's weight to percentage of student's body weight as  $9.8 \pm 8.2\%$  but similar to  $14.4\% \pm 4.2\%$  reported by El-Nagar and Mady. [33]

Many of the pupils in the present study reported pain in the neck and upper back following the carriage of heavy backpacks. This observation was similar to the findings of Whittfield *et al.* in New Zealand [9], who reported that the majority of their participants experienced musculoskeletal symptoms due to school bag carriage, and the symptoms were most prevalent in the neck, lower back, and upper back areas.

Table I: Pattern of backpack use among school pupils

Characteristics		Frequency	Percentage
Type of school bag	Backpack	387	93.0
	Single strap/Handbag	6	3.9
	Trolley	13	3.1
Weight of School bag (kg) (self-rated)	Light	83	19.9
	Medium	93	22.4
	Heavy	240	57.7
Frequency of bag carriage in a week	Once	3	0.7
	Twice	4	1.0
	Thrice	2	0.5
	Everyday	407	97.8
Method of travel to and from home	Walking	165	39.7
	Bus	18	4.3
	Car	233	56.0
Time spent carrying school bag to school	<5 minutes	78	18.7
	5-10 minutes	163	39.2
	11-20 minutes	84	20.2
	21-30 minutes	70	16.8
	>30 minutes	21	5.0
Time spent carrying school bag home	<5 minutes	78	18.7
	5-10 minutes	156	37.5
	11-20 minutes	84	20.2
	21-30 minutes	71	17.1
	>30 minutes	27	6.5

Only a few pupils reported experiences of severe pain. These results were similar to the findings in other studies. [16, 33, 34] In the present study, a greater percentage reported moderate pain next to mild pain, while only a few experienced severe pain. This is similar to the findings of Alghamdi *et al.*, El-Nagar and Mady, and Shahid *et al.* [16, 33, 34]

The findings revealed that pupils reported that most of their parents did not arrange their

backpacks; this could account for the increased prevalence of heavy backpack use. This result was consistent with other findings. [24, 25, 35] Also, the study findings revealed that even though most students had regular school-timetable and locker facilities in school, only a few pupils reported that they arranged their backpacks based on school-timetable or kept books in school; these could result in carrying many books in their bags and thus carrying heavy backpacks.

Table II: Pupils' body weight and backpack weight

Variables	Category	Frequency	Percentage
Pupils' Body weight (kg)	1-20	9	2.2
	21-40	348	83.7
	41-60	54	13.0
	61-80	5	1.2
Combined pupils' and bag's weight (kg)	1-20	2	0.5
	21-40	311	74.8
	41-60	90	21.6
	61-80	13	3.1
The pack exceeded 10% of the pupil's body weight	Yes	241	57.9
	No	175	42.1
Percentage of bag's weight relative to body weight	<10	160	38.5
	10-15	124	29.8
	>15	132	31.7

Table III: Association between respondents' socio-demographic variables and prevalence of heavy backpack use

Variables	Prevalence of heavy backpack use			Chi-Square	Df	p-value
	<10%	10-15%	>15%			
<b>Age (years)</b>						
7-9	53 (30.8)	43 (25.4)	74 (43.8)	29.746	4	<0.001
10-12	89 (40.5)	74 (33.6)	57 (25.9)			
≥13	19 (70.4)	7 (25.9)	1 (3.7)			
<b>Gender</b>						
Male	80 (36.4)	69 (31.4)	71 (32.3)	0.957	2	0.620
Female	80 (40.8)	55 (28.1)	61 (31.1)			
<b>Type of School</b>						
Private	61 (26.2)	57 (24.5)	115 (49.4)	77.702	2	<0.001
Public	99 (34.1)	67 (36.6)	17 (9.3)			
<b>Classes</b>						
Primary 4	66 (37.9)	46 (26.4)	62 (35.6)	15.705	4	0.003
Primary 5	47 (38.2)	29 (23.6)	47 (38.2)			
Primary 6	47 (39.5)	49 (41.2)	23 (19.3)			

These results highlight the need for parents, guardians, and class teachers to guide or monitor the number of books to pack daily in pupils'

backpacks to school. Parents are considered key guardians and best judges concerning this. [25] The study findings highlight implications for



health promotion and education strategies to raise public awareness and advocate for guidelines and policies stipulating the acceptable school bag weight compared to pupils' body weight; this weight should not exceed 10% of pupils' body weight. Collaboration and integration between families, schools, and other

stakeholders should be increased so that there will be avenues to share information with parents about backpack safety periodically. The Parent Teacher Association (PTA) meetings and other gatherings that bring the stakeholders in the educational sector together could be utilised.

**Table IV: Factors associated with heavy backpack use among school pupils**

<i>Statements</i>	<i>Yes (%)</i>	<i>No (%)</i>
Ownership of big backpacks	308 (74.0)	108 (26.0)
Parents complained about heavy backpack	269 (64.7)	147 (35.3)
Parents check bags to remove unnecessary items	262 (63.0)	184 (37.0)
Parents arrange backpack contents	106 (25.5)	310 (74.5)
Consistent/regular school timetable	304 (73.1)	112 (26.9)
Arrangement of the backpack based on the timetable	115 (27.6)	301 (72.4)
Provision of locker facility for book storage in school	259 (62.3)	157 (37.7)
Keeping books in locker facilities at school	138 (33.2)	278 (66.8)

Training should be organised for parents to increase their knowledge about backpack safety and constantly check their children's school bags to ensure they do not exceed the appropriate weight limit. Also, teachers and pupils need to be enlightened on the need to adhere to and follow the daily schedules provided in the school. This will help students avoid packing unnecessary additional school books or materials that only add up to the backpack's weight. Further, backpack safety and injury prevention should be integrated into the physical and health education curriculum to ensure a positive attitude toward appropriate backpacking among pupils.

*Limitations*

Due to the cross-sectional design in this study, the interpretation of the findings is limited as associations do not infer causation. Also, data were collected through self-report measures. Therefore, inaccuracy or bias in the data reported is possible.

**Conclusion**

This study recorded a high prevalence of heavy backpack use with perceived resultant reported musculoskeletal effects regarding neck and upper back pain. Parents are considered stakeholders in ensuring pupils' backpack weights are within recommended limits; parents should also guide their children in arranging their backpacks. In addition, other stakeholders working with school pupils should consider implementing guidelines regulating the use of heavy bags, which could protect school-aged children from potential neck or back injuries. Future research should employ longitudinal or experimental designs to understand the effects of heavy backpack use better.

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