

Olatunya OS  
Isinkaye AO  
Agaja OT  
Omoniyi E  
Oluwadiya KS

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## Backpack use and associated problems among primary school children in Nigeria: a call to action by stakeholders

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Olatunya OS (✉)  
Department of Paediatrics,  
Ekiti State University, Ado – Ekiti,  
Ekiti State, Nigeria.  
Email: ladeletunya@yahoo.com

Isinkaye AO  
Department of Community  
Medicine, Federal Teaching  
Hospital, Ido – Ekiti Nigeria.

Agaja OT, Omoniyi E  
Department of Paediatrics,  
Ekiti State University Teaching  
Hospital, Ado Ekiti Nigeria.

Oluwadiya KS  
Department of Surgery,  
Orthopaedic surgery unit, Ekiti  
State University, Ado – Ekiti.  
Nigeria.

**Abstract:** *Background:* Carrying backpacks is believed to contribute to the musculoskeletal problems in school children. Studies on the use of backpacks by Nigerian school children are scanty.

*Objectives:* To evaluate the use of backpack and associated problems among primary school children.

*Methods:* A cross-sectional descriptive study was carried out on 813 children in six primary schools in Ado-Ekiti. Information about backpack use and associated problems were obtained.

*Results:* 788 (96.9%) children carried backpacks daily. The backpacks were all double strapped and 85% pupils wore them on both shoulders. The backpacks of 64.1% of the pupils contained educational materials. In 79.1% of cases, the backpacks exceeded 10% of their body weights. Pain and loss of sporting time were associated with carrying backpacks in 23.2% and 8.2% respectively, 15.3% took analgesic and 5.5% had medical consul-

tations because of backpack injuries. No pupil missed school and none was hospitalised for backpack injury. Complaint of pain was significantly associated with older subjects, carrying heavier backpack and longer period of carrying packs ( $p < 0.001$ ).

*Conclusion:* Backpack use and associated health problems are common among school children in the study area. Health workers should enquire about backpack use in children presenting with back and shoulder pain. We recommend more studies on backpack use. Also, Government and other stakeholders should draw up guidelines regarding the use of backpacks in Nigeria as practiced in other countries. Professional bodies including the Paediatric Association of Nigeria (PAN), and other stakeholders should be involved in formulating such guidelines.

**Keywords:** Backpacks, School children, Pain, Dysfunction, Nigeria

### Introduction

Backpacks are forms of manual load carriage technique and their use is very common among schoolchildren, students of higher educational institutions, soldiers, rescue workers, hikers and people engaged in other recreational activities.<sup>1-4</sup> Although they are used as a convenient method of carrying books, food items and other materials, they are believed to contribute to musculoskeletal problems in schoolchildren.<sup>1-5</sup> There are increasing concerns by health workers and other stakeholders about schoolchildren carrying backpack loads that are more than the recommended limits of 10% to 15% of their body weights.<sup>1-5</sup> Heavy backpacks lead to abnormal changes in the musculoskeletal system of the body.<sup>6-7</sup> Such changes include body discomfort, fatigue, abnormal postures, pain and impairments of vital organs' functions.<sup>1-5,7-8</sup> In recognition of the problems associated with inappropriate use of backpacks among children, professional bodies in many High-Income

Countries (HIC) have responded by setting out guidelines for the use of backpacks among schoolchildren in their countries.<sup>1-4</sup> These guidelines are made easily available to parents, teachers and other stakeholders in these countries for implementation.<sup>1-4</sup> The situation is totally different in Low to Middle Income Countries (LMIC).<sup>5</sup> In Nigeria, there are no guidelines on the use and design of backpack. Therefore, its use remains largely unregulated despite its being commonly found among all cadres of students in the country.<sup>9,10</sup> Equally worrisome is the dearth of literature on backpack use in the country and the few available literature were mostly conducted among students at higher levels of learning. This leaves backpack use among schoolchildren largely under-researched and unguided in Nigeria.

We therefore, set out to study the use of backpacks among primary school children in Ado-Ekiti metropolis with the aim of determining the rate of backpacks use, their design, contents, weights and the problems associated with their use among schoolchildren. Findings from

the study will sensitise stakeholders to the dynamics of backpack use by schoolchildren and its associated problems in our locality. It will also help in formulating appropriate guidelines regarding its use as practiced in developed countries.<sup>1-4</sup>

## **Subjects and methods**

### *Study setting*

The study was conducted among six primary schools in Ado-Ekiti (Population: 308,621) which is the capital of Ekiti State and headquarters of Ado Local Government Area in southwest Nigeria.<sup>11</sup> The city is home to many primary and secondary schools and six post-secondary institutions. It also has a tertiary health facility - the Ekiti State University Teaching Hospital.<sup>11</sup>

### *Study design and data collection*

This was a cross-sectional descriptive and questionnaire based study conducted among school children in six primary schools in Ado-Ekiti between January and March 2014. Two schools each were randomly selected by balloting from the list of primary schools in the three school administrative zones of the metropolis. All were day-schools that pupils commute to every day. All the pupils in the six schools whose parents gave consent and responded to our enquiries were recruited and studied. The exclusion criteria included: Inability of the pupil to walk independently and or presence of pathological causes of back pain or pain in other parts of the body in which case, appropriate treatments and referrals were offered.

The questionnaires and consent forms were translated into local languages and sent to the parents of participating pupils to fill. The questionnaires were in two parts. The first part requested the following information regarding the parent: name, address and telephone contact. Also, information was requested on name, age, sex, name of school and class of participating pupils. In addition, information about the means of commuting to school, duration of carriage of school bags and problems associated with the use of backpack in their children as well as interventions sought for them were requested. The second part was administered by the research team alongside five other trained assistants to the pupils at their various schools in both English and the local languages depending on the preferred language choice of the pupils. It contained information on biodata as obtainable from the class register, body weight, height, type of schoolbag, design, contents, weights, reasons for daily usage, methods and duration of carriage of the school bags as well as problems attributable to using the school bags such as feeling of fatigue and pain, location of the pain, school absenteeism and inability to engage in sporting activities as well as the interventions they had received to tackle backpack related problems. In order to ensure authenticity and clarity, information obtained from the questionnaires sent to the parents were recon-

ciled with our findings on the field and where applicable, any discrepancy in aspects that could not be ascertained directly on the field was reconciled by contacting the parents of affected pupils.

The weight of each child was measured by using mobile weighing scales (Harson Emperors Model H89 DK China). The weight was measured to the nearest 0.5kg and the weighing scales were standardized daily. Each child was asked to climb the weighing scale bare footed while dressed in the school uniform to read off the measurement. The weight was first measured with the child carrying the school backpack and then without the school backpack. The difference between the two weights was recorded as the weight of the school backpack. The relative backpack weight (RBW) was determined as the percentage of the backpack weight relative to each child's weight. Height was measured with mobile stadiometer mounted on vertical wall in each school. With the back straightened up against the wall, the heels of both feet placed together bare footed on horizontal level, and looking straight ahead in the Frankfort plane, height was determined by reading off the point at which a piece of ruler put horizontally on the vertex touches the stadiometer. Height was measured to the nearest 0.1cm. The contents of each school bag were also checked and recorded. The BMI for each child was determined by dividing the weight in kilogram by the square of height in metres.

Body map charts and mannequins were used to corroborate the description of the location of the pains felt by children aged less than six years, while in older children, their descriptions were taken at face value. The indicated painful areas were also examined for skin lesions like pressure marks, swellings, indurations, bruises and scars as these could result from the use of backpack because of the pressure effects of heavy backpacks on the skin.

### *Ethical considerations*

Written informed consent of parents/caregivers as well as verbal assents of participating pupils aged 8years and above were obtained after explaining the purpose of the research to them in simple and clear language. The cooperation of each school authority was also sought and consideration was given to the timing and conduct of the study such that normal teaching periods were not unnecessarily interrupted.

Ethical approval was obtained for the study from the Ethics and Research Committee of The Ekiti State University Teaching Hospital.

### *Data analysis*

Data analysis was done with IBM SPSS statistics version 20. Descriptive statistics, chi-square tests for association of pain with pupils' characteristics as well as binary logistic regression to determine significant predictors of pain were performed. Statistical significance was determined at  $p$  values  $\leq 0.05$ .

## Results

A total of 813 schoolchildren comprising 441 (54.2%) boys and 372 (45.8%) girls were surveyed. They were aged between two and 15 years with a median of five years. A third of them, 280 (34.4%), were less than five years old while those aged 5-10 years and above ten years were 493 (60.6%) and 40 (4.9%) respectively. The median BMI was 15.12 Kg/m<sup>2</sup> with a range of 8.89 to 34.32 Kg/m<sup>2</sup>.

In all, 788 (96.9%) of the children carried backpacks and these were all double strapped types. A total of 118 (15.0%) pupils used backpacks with the straps worn over one shoulder while the rest used packs with the straps worn over both shoulders. The backpacks contained only books and other educational materials in 505 (64.1%) children while in 283 (35.9%), they contained both educational materials and lunch packs. The pupils carried all their schoolbooks in the packs everyday and majority did not give any reason for doing so except in 98 (12.4%) where these were carried daily because of fear of impromptu test. Median backpack weight was 2.7 (range: 0.2 – 14.5) kg while the median backpack-body weight ratio was 0.14 (range: 0.01 – 0.47). Five hundred and two (63.7%) trekked to school daily and the remaining 286 (36.3%) commute to school either by cars, buses or motorcycles every day. The median duration of backpack usage was one hour, range (0.5 – 3.0 hours) per day. The largest proportion (82.2%) used backpacks for one to two hours daily while 10.4% and 4.4% used them for less than one hour and more than two hours respectively. As shown in table 1, using heavier backpacks in relation to body weight resulted in increasing prevalence of pain. However, BMI was not associated with having pain from the use of backpacks. Pain was reported in 6 (2.9%) children using backpacks weighing less than 10% of their body weights.

In all, 183 (23.2%) of those who carried backpacks complained of pain. They were aged between four and 15 years. Pain was limited to the shoulders in 84 (45.9%), back in 53 (29.0%), both back and shoulders in 39 (21.3%), head and neck in 6 (3.2%) each, while one child (0.5%) had pain in the upper arms. Pain was not reported in any of the children without backpacks and there was no pressure marks found on the painful areas as indicated by any of the children with backpack related pain.

Among those who had backpack related pain, 28 (15.3%) took analgesics to relieve the pain. These were largely bought over the counter without appropriate prescription. Fifteen (8.2%) missed school sporting activities, 10 (5.5%) received medical consultation in the hospital but none of them missed school completely or was hospitalised as a result of pain related to carrying backpacks.

The result of chi-square analysis for the relationship between subjects' characteristics and presence of pain is presented in table 1. As shown, older children, longer

duration of backpack carriage, carriage of backpacks exceeding 10% of bodyweight, and carrying backpacks with high RBW were all significantly associated with pain ( $p < 0.001$ ).

**Table 1:** Relationship between selected characteristics and presence of pain

Variables	Pain		2	p value
	Present n (%)	Absent n (%)		
<i>Age (years) (N=813)</i>				
Under 5 (n=280)	39 (13.9)	241 (86.1)	18.249	0.001
5 – 10 (n=493)	132 (26.8)	361 (73.2)		
> 10 (n=40)	12 (30.0)	28 (70.0)		
<i>Sex (N=813)</i>				
Boys (n=441)	94 (21.3)	347 (78.7)	0.7880	0.375
Girls (n=372)	89 (23.9)	283 (76.1)		
<i>Duration of backpack carriage (N = 788)</i>				
< 1 hour (n=82)	13 (15.9)	69 (84.1)	21.633	0.001
1 - 2 hours (n=671)	151 (22.5)	520 (77.5)		
> 2 hours (n=35)	19 (54.3)	16 (45.7)		
<i>Backpack exceeds 10% body weight (N = 788)</i>				
Yes (n=578)	177 (30.6)	401 (69.4)	66.601	0.001
No (n=210)	6 (2.9)	204 (97.1)		
<i>RBW (N=788)</i>				
<5% (n=48)	0 (0.0)	48 (100.0)	157.03	0.001
5-10% (n=162)	6 (3.7)	156 (96.3)	1	
11-15% (n=240)	26 (10.8)	214 (89.2)		
>15 % (n=338)	151 (44.7)	187 (55.3)		
<i>BMI (Kg/m<sup>2</sup>) (N=813)</i>				
< 18.5 (Underweight) (n=745)	168 (22.6)	577 (77.4)		
18.5 – 24.9 (Normal) (n=66)	14 (21.2)	52 (78.8)		Fisher's exact p = 0.411
24.9 – 29.9 (Overweight) (n=1)	0 (0.0)	1 (100.0)		
30 (Obese) (n=1)	1 (100.0)	0 (0.0)		

NB: Statistically significant p values are indicated in bold fonts

Binary logistic regression analysis with the presence or absence of pain as the dependent variable revealed that older children had higher odds of pain than younger ones. Similarly, longer duration of carriage (> 2 hours per day) and carrying heavier backpacks (RBW 15%), were associated with increased odds of pain (Table 2).

**Table 2:** Logistic regression for predictors of pain

Variables	OR (95% C.I.)	P value
<i>Age (years)</i>		
Under 5	1	
5 – 10	5.110 (3.177 – 8.220)	0.001
> 10	14.051 (4.529 – 43.595)	0.001
<i>Duration of backpack carriage</i>		
< 1 hour	1	
1 - 2 hours	1.370 (0.690 - 2.719)	0.368
> 2 hours	3.826(1.238 - 11.824)	0.020
<i>Backpack exceeds 10% body weight</i>		
No	1	
Yes	3.435 (0.036 - 32.183)	0.597
<i>RBW</i>		
< 5%	1	
5 - 10 %	5.469 (0.982 – 30.448)	0.052
11 - 15 %	3.162 (0.913 - 10.947)	0.069
> 15 %	4.181(1.334 - 13.098)	0.014

## Discussion

Studies all over the world have shown a high incidence of backpack usage ranging from 56.3 to 91% among different students' groups.<sup>5,9-10,12-15</sup> With a usage rate of 96.5% among the study participants, the present study confirms this trend, and shows that backpacks are extremely popular among young schoolchildren in the Nigerian community. The findings that some backpack associated problems may persist from childhood to adulthood<sup>16-19</sup> make it imperative that the government along with health professionals should become involved in formulating acceptable policies to guide and regulate the use of backpacks among schoolchildren in low income countries like Nigeria.

The finding that the contents of the backpacks were mainly educational materials is not surprising as the study took place in schools and pupils were expected to bring books and other educational materials to the schools.<sup>1,3,5</sup> The observation that all the backpacks were double strapped is commendable and a unique finding as no previous Nigerian study commented on the design of the backpacks.<sup>9,10</sup> Studies from other parts of the world have shown that the design of a backpack could greatly mitigate or worsen the health problems associated with their use.<sup>19,20</sup> For example, one review found that, using double strapped packs as found in the current study, was better than using single strapped packs.<sup>20</sup> Double strapped backpacks allow an even distribution of load pressure leading to better stability and reduced incidence of musculoskeletal injury for the backpack user.<sup>20,21</sup> Although, the median duration of time spent by children carrying their backpacks was longer in the current study than the findings by Mwaka et.al<sup>5</sup>, nonetheless, both studies were similar in showing that longer duration of backpack carriage was associated with increased incidence of musculoskeletal pain. The discrepancy in the backpack carriage duration between the two studies may be due to differences in the distances the study partici-

pants commute to school. Studies have shown that carrying heavy backpacks for long period could lead to postural changes, causing a child to lean in a direction opposite the load.<sup>16-19</sup> Maintaining such abnormal posture over a long period of time may lead to repetitive strain injuries.<sup>16-19</sup> In our study, 23.2% of the children had pains attributable to backpack use, whereas, none of those not using backpacks had similar complaints. One way of mitigating the problem of carrying heavy backpacks is for schools to provide adequate storage facilities such as lockers or desks for each child to keep their books safely in schools.

A look at the range of backpack weights recorded in the current study reflects the lack of standard guidelines regarding the use of backpack in the study locality. More worrisome is the observation that more than 70% of the pupils carried backpacks exceeding the recommended weight limits.<sup>1-5,8</sup> This excessive loading of the spine have been found to be inimical to the health of children.<sup>1-5,7-8,16-19</sup> This is due to the fact that a child's spinal structure is still growing<sup>7,19</sup> hence, loading it excessively at this growing phase can cause significant musculoskeletal dysfunctions like pain and postural problems.<sup>8,19</sup> One study actually proved that the lumbar lordosis of a child increases when the child's spine is loaded and the authors were worried that these changes may become irreversible.<sup>22</sup> Adopting different loading or carriage techniques could greatly alleviate the musculoskeletal injury resulting from backpack use. Some authors have suggested wearing a double pack i.e. worn on both the front and the back, claiming that such method allows better stability and weight bearing.<sup>20</sup> However, this method may impair lung function, visibility and mobility of the backpack wearer.<sup>20</sup> Other authors have suggested that, placing the backpacks lower on the spine produced less spinal strain.<sup>23</sup> Hence, using backpacks that are ergonomically designed to place loads lower on the spine or rolling pack may be advisable.

The observation that older children in the current study had more backpack related pain may not be unconnected with their possibility of being able to respond better to the questions on pain perception compared to younger age groups as similar pattern has been observed in a previous study.<sup>5</sup> In this study, only 23.6% of the children carried backpacks weighing less than 10% of their body weights in contrast to the 70% recorded elsewhere<sup>5</sup> and this indicate a higher rate of excessive loading of backpack among the Nigerian subjects. That only 2.9% of pupils in the current study using backpacks weighing less than 10% of their body weights had pain symptoms further reinforces the suggestions by most guidelines<sup>1-4,24</sup> that the backpack relative body weight lower cut off limits of 10% is safe. However, one should not lose sight of the fact that, pain in children could be very intriguing given the peculiarities of higher prevalence of psychosocial factors like the state of emotion and level of activities of the child as other determinants of pain symptoms.<sup>5,19</sup> Therefore, the current finding needs to be interpreted with caution and more studies are required on the backpack use among school children with the aim

of finding what reference limits should be suitable for Nigerians.

Although none of the previous Nigerian studies<sup>9,10</sup> compared the backpack pain sites. That shoulders were the commonest sites of backpack related pain in this study is not surprising given that the pupils carried their backpacks on their shoulders. Expectedly, they perceived pain on parts of the body where most of the weights of the backpacks were borne. This observation is in keeping with previous reports from other countries.<sup>13</sup> The observation by Arghavani et al<sup>13</sup> that, backpack related pain was commoner among the female pupils is not sustained by the current study. However, findings from the same study agreed with our observation that the BMI of backpack carriers have no relationship with incidence of pain symptoms among them.<sup>13</sup> Aside from pain, other dysfunctions and health seeking behaviour of our study participants in relation to backpack use have been previously described to varying degrees.<sup>5,19,24</sup> However, and contrary to some previous reports,<sup>5,24</sup> none of the participants in this study missed school days as a result of dysfunctions and or injuries attributable to the use of backpacks. This is a commendable finding and, could suggest that the effects of problems associated with backpack are milder on the study population compared to their counterparts elsewhere. Nevertheless, it may also suggest that our study population has a higher pain threshold than the ones in the reported studies.

The proportion of children who sought medical consultation as a result of backpack injury in this study is comparable to the 6.9% reported among Uganda schoolchildren<sup>5</sup> but much lower than the 25% reported among schoolchildren in the United States of America.<sup>24</sup> The wide disparity in health seeking behaviour may not be unconnected with the levels of health awareness and the difficulty with which healthcare can be accessed in Nigeria compared to the USA.<sup>24</sup> These could perhaps, explain why some of the parents of pupils in our study resorted to self-medication using over the counter analgesics to treat their children for backpack related pain. Indiscriminate use of analgesics could be fraught with the danger of developing body organ damage. Therefore, there is need for more health education targeted at helping the parents of children in the study location to adopt appropriate health seeking behaviours.

### Limitations

This study was limited by the possibility of recall bias and the possibility for the responders to project a positive image of themselves by giving favourable responses to the questions asked. However, we tried to ameliorate these limitations by ensuring that the second part of the

questionnaire was administered by the research team directly to the pupils in the schools thus providing on the spot assessment on the field. This helped in offsetting the tendency for false reportage by responders. In addition, clarifications were sought from the parents/caregivers as necessary. Also, we translated the instruments to local languages or use the local languages as applicable in order to enhance adequate understanding of the research subject by both the parents and the pupils. Despite these limitations, this study was able to demonstrate that backpack use was very common in the study locality.

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### Conclusion and recommendations

This study has shown that, a great majority of schoolchildren in the study locality use backpacks in carrying educational and other materials to school. Most of them carried more than the recommended load limits for their weight. In addition, almost one out of every four children in the study reported persistent pain which they ascribed to their backpacks.

We therefore recommend that, Government and other stakeholders draw up guidelines regarding the use of backpacks in Nigeria, as has been done in other countries. Importantly, appropriate Government agencies, professional bodies like the Paediatric Association of Nigeria (PAN), Nigerian Orthopaedic Association (NOA) and other stakeholders, such as, parents/caregivers and teachers should be involved in formulating such guidelines as this will make its implementation easy.

In the interim, health workers should include talks on appropriate use of backpack while giving health education to their patients and parents. They should also include queries about backpack use in the list of their enquiries whenever a child complains of back pain. There is need for more research on backpack use in the country as being currently encouraged in the developed world.<sup>1-4,21,24,25</sup>

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