Int. J. School. Health. 2023; 10(3)

Published online 2023 July.

Original Article

Schoolbag Weight and Low Back Pain: A Cross-Sectional Study among Children of Public and Private Primary Schools in Cameroon

Wiliam Richard Guessogo[1, 2], PhD; André Hamadou[1], PhD; Edmond Ebal-Minye[1], PhD; Jerson Mekoulou Ndongo[2], PhD; William Mbang-Bian[1, 2], PhD; Samuel Mbouh[1], PhD; Pascale Mibo'o[1], PhD; Maurice Père de Mpele[1, 2], MSc; Abdou Temfemo[3], PhD; Bienvenu Bongue[4], PhD; Samuel Honoré Mandengue[2], PhD; Peguy Brice Assomo Ndemba[2,5]*, PhD

[1]Laboratory of the Biology of Physical Activities, National Institute of Youth and Sports, Yaoundé, Cameroon
[2]Physiology and Medicine of Physical Activities and Sports Unit, Faculty of Sciences, University of Douala, Douala, Cameroon
[3]Department of Biological Sciences, Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Cameroon
[4]INSERM, UMR 1059, SAINBIOSE, Jean Monnet University, Saint Etienne, France
[5]Department of Physiology, Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, Yaoundé, Cameroon

Corresponding author:* Peguy Brice Assomo Ndemba, PhD; Department of Physiology, Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, Cameroon. **Tel: +237-699-319287; **Email:** assomo_ndemba@yahoo.fr

Received: March 27, 2023; **Revised:** April 30, 2023; **Accepted:** May 20, 2023

Abstract

Background: The issue of excessively heavy schoolbags remains a public health concern in Africa. This study aimed to determine the weight of schoolbags among students in the public and private sectors of Yaoundé city, Cameroon and identify factors associated with low back pain.

Methods: A cross-sectional study was conducted during the first term of the 2020/2021 academic year in French-speaking private and public primary schools in Yaoundé city, Cameroon. The study involved 2000 pupils (8.41±2.11 years), with 1000 from the public sector and 1000 from the private sector. The variables analyzed included weight, height, and schoolbag weight. A questionnaire, developed specifically for this study and based on the Standardized Nordic Body Map Questionnaire, was used to collect socio-demographic information and assess potential musculoskeletal low back pain. A diagram was included to indicate the lower back area for reporting pain. The questionnaire was administered, and each student answered it, with assistance from the investigator if needed. Descriptive and inferential statistics, as well as multiple logistic regressions, were employed for data analysis.

Results: The average weight of the children and their schoolbags was 28.51±8.04 kg and 4.04±1.72 kg, respectively. Nearly 45% of the pupils were carrying a schoolbag weighing more than 15% of their body weight, and 23% reported experiencing low back pain. Schoolbag weights ranging from 10-15% of body weight were associated with a threefold higher risk (OR=2.66; 95% CI=1.65 – 4.31; P<0.0001) of developing low back pain. Pupils in the public sector had a lower risk (OR=0.28; P<0.0001) of developing low back pain.

Conclusion: Children in the private sector experience low back pain more frequently. Carrying heavy schoolbags is associated with low back pain among pupils.

Keywords: Children, Schoolbags, Low back pain, Cameroon

How to Cite: Guessogo WR, Hamadou A, Ebal-Minye E, Mekoulou Ndongo J, Mbang-Bian W, Mbouh S, Miboʻo P, Père de Mpele M, Temfemo A, Bongue B, Mandengue SH, Assomo Ndemba PB. Schoolbag Weight and Low Back Pain: A Cross-Sectional Study among Children of Public and Private Primary Schools in Cameroon. Int. J. School. Health. 2023;10(3):136-143. doi: 10.30476/INTJSH.2023.98717.1308.

1. Introduction

In most educational systems worldwide, children are required to carry schoolbags to and from school to transport their school supplies and other equipment. Apart from heavy books, these bags often contain snacks, water bottles, sports accessories, and coats, among other items (1). These additional accessories contribute to the weight of the schoolbag, which can potentially cause muscle pain in children (2-4), particularly in the lower back.

Respected organizations in the field of public health, such as the Ontario Chiropractic Association, the American Occupational Therapy Association, the American Academy of Pediatrics, and the American Chiropractic Association, recommend that the weight of the schoolbag should not exceed 10-15% of the child's body weight. This is due to the significant risk of developing low back pain (5, 6).

Epidemiological data reveals that 13-40% of teenagers worldwide experience recurring non-specific low back pain (7-11). This issue has garnered attention from researchers primarily due to its detrimental consequences, including

increased healthcare costs, school absenteeism, functional disability, and the onset of chronic pain in adulthood (9, 10, 12). Moreover, it is widely accepted that experiencing low back pain during childhood raises the likelihood of developing chronic back pain in adulthood (13).

Studies conducted on school children have indicated that low back pain without an apparent cause is common (14), and there is an association between schoolbag weight and low back pain (2, 15-18). The teenage years are characterized by rapid growth, making it a critical period for spinal development (16). Consequently, the spine is particularly susceptible to external stressors during this phase (8).

Overall, the relationship between schoolbag weight and low back pain does not conclusively demonstrate a strong causal link (19, 20). Nevertheless, some studies conducted in various settings argue in favor of a causal relationship (21, 22).

In African settings, low back pain is prevalent among teenagers (23, 24). For instance, a study conducted in Zimbabwe revealed a high prevalence of recurring non-specific low back pain among teenagers (25). Additionally, Akbar and colleagues (5) reported significant geographical variation in the prevalence of low back pain among teenagers, with higher rates observed in European countries (26, 27) compared to African countries (10, 28). In Cameroon, a study involving pupils (29) found that the prevalence of back pain was 38%, and over 50% of school children carried schoolbags weighing more than 15% of their body weight. However, a recent study by Kemta Lekpa and co-workers (30) paradoxically concluded that schoolbag weight was not associated with low back pain in Cameroonian students from the city of Douala. Instead, they attributed other factors such as gender (female), participation in competitive sports, sitting posture, and family history as potential causes. These two studies shed light on the issue of pain related to schoolbag weight, but they also highlighted the lack of reliable data, particularly regarding the discrepancy between the weight of these schoolbags and international standards (29, 30). Furthermore, it is crucial to determine whether the measures implemented by the Cameroonian government in 2017, which aimed to limit the use of one textbook per subject to alleviate the issue of heavy schoolbags, have had a positive impact.

The objective of this study was to assess the weight of schoolbags carried by pupils in both public and private schools in the city of Yaoundé, Cameroon. Additionally, the study aimed to identify factors associated with low back pain.

2. Methods

A cross-sectional study was carried out in Yaoundé, the capital of Cameroon, focusing on French-speaking private and public primary schools during the first term of the 2020/2021 academic year. The study was conducted across seven schools within the city. To gain access to these schools, we obtained authorization from the Ministry of Basic Education (N° B1/1464/L/MINEDUB/SG/DRH/SDDRH/SFS). The study protocol underwent review and approval by the Regional Committee on Research Ethics for Human Health of the Centre Region (No. 2245/CRERSHC/2020). To obtain consent from the parents or legal guardians, a written and informed consent form was provided to each pupil, which included a description of the study and its significance.

2.1. Sampling

In Cameroon, the educational system is supported by both the State, which has a public service mission, and private initiatives. These two sectors operate simultaneously with some variations in the current program. The public sector has a social mission and therefore does not strictly require the availability of necessary school supplies, whereas their availability is mandatory in the private sector.

To conduct our study, we obtained authorization from the Minister of Basic Education and employed a non-probability convenience sampling method. To prevent any interference, the administration of each school randomly selected two classes out of the three classes at each of the six levels. This selection was made by ticking the list of available classes. The purpose of the study was not disclosed to the school administration. All pupils who were present on the day of data collection, capable of walking and carrying their schoolbags independently, were included in the study. Pupils diagnosed by a doctor with spinal or other musculoskeletal conditions, such as differences in leg length, were excluded based on the medical information available to the school administration.

2.2. Data Collection

The body and schoolbag weights were measured using a Tanita BC 532 (Tokyo, Japan) electronic scale placed on a flat and hard surface, which had been calibrated beforehand. Initially, the weight of each participant was measured without their schoolbag. Subsequently, the weight was measured again while the participant was wearing their schoolbag to obtain the total weight. The difference between the two weight measurements was recorded as the schoolbag weight. The percentage of the schoolbag to body weight ratio was then determined. Height measurements were taken using a Seca (Hamburg, Germany) graduated scale. A questionnaire, developed specifically for this study and derived from the Standardized Nordic Body Map Questionnaire, was utilized to gather socio-demographic information and assess potential low back musculoskeletal pain. To facilitate reporting of pain, a diagram illustrating the lower back area was included in the questionnaire. The questionnaire was administered, and each student answered the questions with the assistance of the investigator, if necessary. The data collection tool used was a self-administered questionnaire in the French language. Before the study, the questionnaire had undergone a pre-testing phase to ensure that the language used in the questions was simplified.

2.3. Statistical Analysis

The data were entered into an MS Excel spreadsheet (Microsoft Office 2013) and then exported to the StatView 5.0 statistical analysis software for Windows (SAS Institute, Inc., IL., USA). Categorical variables were presented as counts and percentages, while continuous variables were expressed as mean (SD). The weight of schoolbags, expressed as a percentage of body weight (%BW), was categorized into three groups: schoolbags weighing less than or equal to 10% BW, those weighing between 10-15% BW, and those weighing more than 15% BW. Descriptive statistics were used to determine the anthropometric data of the participants, the percentage of pupils in each schoolbag weight category, and the frequency of low back pain.

The unpaired Student's t-test was used to compare the average weight of schoolbags among pupils in the two educational sectors, as well as their characteristics. Pearson's chi-square test was employed to compare participants across the different categories of schoolbag weight as a percentage of body weight. Multiple logistic regression analysis was conducted to identify factors associated with the presence or absence of low back pain. The outcome variable (dependent variable) was the presence of low back pain, and the independent variables (factors) included in the logit model were gender, age, educational sector, and percentage of schoolbag to body weight ratio.

Based on the findings of the univariate analysis, variables with a $P<0.25$ and/or clinical importance were included in the multivariate logistic analysis, as previously proposed BY Zhang (31). Crude and adjusted odds ratios (cOR and aOR) with their corresponding 95% confidence intervals (95% CI) and levels of significance were calculated. The goodness-of-fit of the multivariate logistic regression model was assessed using the Wald test and coefficient of multiple determination (R^2). The normality of the distribution was checked using the Kolmogorov-Smirnov test. Statistical significance was defined as $P<0.05$.

3. Results

A total of 2,000 pupils, with 49% of them being boys, were included in the study. Out of the total, 1,000 pupils (50%) belonged to the public sector, while the remaining 1,000 pupils (50%) were from the private sector. The mean age, height, and weight of all participants were 8.41±2.11 years, 1.20±0.13 m, and 28.51±8.04 kg, respectively. There were no differences found between boys and girls in terms of these characteristics, regardless of their educational sector (Table 1).

The mean weight of the schoolbags was 4.04±1.72 kilograms, ranging from 1.67 to 6.27 kilograms. There was a significant difference ($P<0.001$) observed between the public sector (mean weight: 3.02±2.39 kg, ranging from 1.67 to 4.19 kg) and the private sector (mean weight: 5.07±1.40 kg, ranging from 1.48 to 6.27 kg) (Table 2). Moreover, the number of pupils whose schoolbag weight accounted for ≤10% of their body weight was significantly higher in the public sector compared to the private sector (48% vs. 4%; $P=0.00169$). Similarly, the number of pupils with schoolbag weights ranging between 10% and 15% of their body weight was significantly higher in the public sector compared to the private sector (35% vs. 23%; $P=0.0348$). Conversely, schoolbags

Table 1: Sociodemographic profile and anthropometric data of the participants

Educational Sector	Gender	Counts	Age (years)	Height (m)	Weight (kg)	Body + Schoolbag weight (kg)	%SW/BW
Public	Boys	513	8.29 (2.27)	1.2 (0.14)	28.2 (7.86)	31.3 (8.71)	11 (5)
	Girls	487	8.3 (2.30)	1.2 (0.13)	28.1 (7.43)	31.1 (8.31)	10 (5)
Private	Boys	504	8.4 (1.89)	1.2 (0.13)	28.5 (8.30)	33.5 (8.78)	19 (6)
	Girls	496	8.5 (1.97)	1.2 (0.14)	29.0 (8.51)	34.1 (9.04)	19 (6)
Total		2000	8.4 (2.11)	1.2 (0.13)	28.5 (8.04)	32.5 (8.81)	15 (7)

SW: Schoolbag Weight; BW: Body Weight

Table 2: Distribution of pupils according to schoolbag weight as a percentage of body weight

Variable	Total (n=2000)	Public (=1000)	Private (=1000)	P value
	Mean (SD)	Mean (SD)	Mean (SD)	
SW (kg)	4.04 (1.72)	3.02 (2.39)	5.0 (1.40)	<0.001
%BW	n (%)	n (%)	n (%)	
≤10%	516 (26)	481 (48)	35 (4)	0.00169
>10% to ≤15%	581 (29)	348 (35)	233 (23)	0.0348
>15%	903 (45)	171 (17)	732 (73)	0.00157

SW: Schoolbag Weight; BW: Body Weight

Table 3: Frequency of low back pain

Low back pain	Total n (%)	≤10% n (%)	>10 % to ≤15% n (%)	>15% n (%)	P value
Yes	465 (23)	25 (5)	104 (18)	336 (37)	<0.001
No	1535 (77)	491 (95)	477 (82)	567 (63)	

weighing >15% of body weight were significantly more prevalent in the private sector compared to the public sector (17% vs. 73%; P=0.00157) (Table 2).

Out of the total participants, 465 pupils (23%) reported experiencing low back pain. The frequency of low back pain significantly varied across different schoolbag weight categories (P=0.001) (Table 3).

Pupils carrying schoolbags weighing more than 15% of their body weight were nearly five times more likely to develop low back pain compared to those carrying schoolbags weighing less than or equal to 10% of their body weight (adjusted odds ratio [aOR]=4.68; 95% confidence interval [CI]=2.91 – 7.54; P<0.0001). Additionally, pupils carrying schoolbags weighing between 10% and 15% of their body weight were approximately three times more likely to develop low back pain compared to those carrying schoolbags weighing less than or equal to 10% of their body weight (aOR=2.66; 95% CI=1.65 – 4.31; P<0.0001) (Table 4). Furthermore, pupils enrolled in public schools had a lower risk of developing low back pain compared to those in private schools (aOR=0.28; 95% CI=0.21 – 0.38; P<0.0001) (Table 4). Gender and grade were not found to be associated with the risk of developing low back pain.

4. Discussion

The schoolbag is excessively heavy, leading to a prevalent occurrence of low back pain in the Cameroonian educational system. Specifically, low back pain is more frequently reported in the private sector, with schoolbags weighing over 10% of body weight posing a higher risk of causing such pain.

The findings of this study confirmed those of a recent study (29), which highlighted the heavy schoolbag burden in the Cameroonian educational system, resulting in low back pain among the affected students. The mean weight of schoolbags in this study (4.04±1.72 kg) was higher than that reported in a study (3.78±1.97 kg) conducted among Ugandan students (31). However, this weight was still lower than the weight recorded by Guessogo and colleagues (5.2±2.3 kg) (29) in a comparative study between the English-speaking and French-speaking educational systems in Cameroon, specifically regarding schoolbag weight. This difference can be attributed to the implementation of government measures in 2017, which introduced a policy of limiting each subject

Table 4: Risk factors of low back pain

Variables	N	n (%)	cOR (CI95%)	P value	aOR (CI95%)	P value
Gender						
Female	983	219 (22)	1		1	
Male	1017	246 (24)	1.11 (0.90 - 1.37)	0.31	1.12 (0.89 - 1.40)	0.32
Class						
Grade 1	350	74 (21)	1		1	
Grade 2	417	106 (25)	1.27 (0.91 - 1.78)	0.16	1.12 (0.77 - 1.62)	0.55
Grade 3	301	70 (23)	1.13 (0.7 - 1.64)	0.51	0.98 (0.65 - 1.47)	0.92
Grade 4	300	70 (23)	1.14 (0.78 - 1.65)	0.50	1.07 (0.71 - 1.61)	0.75
Grade 5	351	82 (23)	1.14 (0.79 - 1.62)	0.48	0.89 (0.60 - 1.31)	0.55
Grade 6	281	63 (22)	1.08 (0.74 - 1.58)	0.69	1.02 (0.67 - 1.56)	0.91
Educational Sector						
Private	1000	379 (38)	1		1	
Public	1000	86 (9)	0.15 (0.12 - 0.19)	< 0.0001*	0.28 (0.21 - 0.38)	<0.0001*
%SW/BW Category						
≤10 %	516	25 (5)	1		1	
>10 to ≤15%	581	104 (18)	4.28 (2.72 - 6.75)	< 0.0001*	2.66 (1.65 - 4.31)	<0.0001*
>15%	903	336 (37)	11.64 (7.62 - 17.78)	< 0.0001*	4.68 (2.91 - 7.54)	<0.0001*

SW: Schoolbag Weight; BW: Body Weight; cOR: Crude odds ratio, aOR: Adjusted odds ratio; 95%CI: Confidence interval at 95%; Univariate and multivariate logistic regression models were used to identify determinants of low back pain among children. *Statistically significant at P<0.05

to a single textbook instead of multiple textbooks that were previously used. While these measures aimed to address the issue of heavy schoolbags, on-the-ground observations indicate that schoolbag weight in Cameroon remains high.

In this study, the percentage of schoolbag-to-body weight ratio among students was higher in the private sector compared to the public sector. Over 73% of students in the private sector, as opposed to approximately 17% in the public sector, carried schoolbags weighing more than 15% of their body weight. This can be explained by the fact that the private sector in Cameroon is generally associated with a more affluent social class. The requirements imposed on students in this sector necessitate having all the prescribed school supplies to attend classes. This is not always the case in the public sector, which is managed by the State and serves a social mission of providing public service. This result contradicts the findings of Muhamad Salim Khan and colleagues (32) in the Kashmir valley, where 79% of children with schoolbags weighing over 10% of their body weight came from public schools. Overall, the percentage of students carrying schoolbags exceeding 15% of their body weight was lower than the figure obtained in our study (29). This difference can also be attributed to the larger sample size of our study.

The present study revealed that 23% of students experienced low back pain. This percentage falls within the reported range (13–40%) of low back pain in teenagers worldwide (8). The value obtained was lower than that reported by Akbar and colleagues (5) and Spiteri and co-workers (2), but comparable to the findings of Watson and colleagues (14).

The present study demonstrated that carrying a schoolbag weighing more than 10% of body weight was associated with a 3-5 times higher risk of developing low back pain. This finding contradicts the results obtained by Alghamdi and co-workers (1), who found no link between the weight of students' schoolbags and the intensity of low back pain. The age of the children could account for this discrepancy. In our study, the children had an average age of 8.41±2.11 years, whereas, in study by Alghamdi and co-workers (1), the children were between 13 and 15 years old. The weight of the schoolbag appears to have a greater impact on the musculoskeletal system of young children. Conversely, our study's results align with those of Farhood (33), who discovered that a majority of students with schoolbags weighing more than 5 kg experienced low back pain. Similarly, a strong correlation between schoolbag weight and low back pain was observed (34, 35). Additionally, students in private schools exhibited a higher incidence of low back pain. Consequently, the government measures implemented in 2017 to limit schoolbag weight in the Cameroonian educational system

should be extended to the private sector.

In a recent Cameroonian study investigating the factors associated with low back pain in Cameroonian school children, only the female gender, competitive sports, and family history were identified as related factors (30). The weight of the schoolbag did not show any association with low back pain. This finding contradicts the results of our study. One possible explanation for these differences lies in the sample sizes of the two studies (29, 30). Our study included 2000 school children, whereas the study conducted by Kemta Lekpa and co-workers (30) had a population of 1075 school children. Furthermore, public school pupils constituted the majority in study of Kemta Lekpa and co-workers (30), while our study included a similar number of pupils from both private and public schools. As we previously mentioned, private schools differ from public schools in terms of heavier schoolbags due to the substantial investment made by parents in paying school fees and purchasing necessary supplies. In our study, age and grade did not demonstrate an association with the risk of developing low back pain, which contradicts the findings reported by Kemta Lekpa and co-workers (30). The prevalence of low back pain (23%) in our study was higher than that reported by Kemta Lekpa and co-workers (12%) (30).

4.1. Limitations

The present study has several limitations. The cross-sectional design prevents drawing reliable conclusions about causal relationships. Further investigation on the composition and carrying style of backpacks may help determine the primary cause of low back pain.

5. Conclusions

The issue of heavy schoolbags in the Cameroonian educational setting is a genuine concern. Approximately 45% of students carry schoolbags that exceed 15% of their body weight. Low back pain is prevalent in the Cameroonian educational system, particularly in the private sector. Furthermore, schoolbags that weigh more than 10% of a student's body weight pose a higher risk of causing low back pain. Therefore, we propose that schoolbag weight should be limited to 10% of body weight, following international standards. It is strongly recommended to enhance awareness, early detection, prevention, and treatment to reduce the incidence of back pain among school children. Additionally, it is crucial to implement measures that restrict schoolbag weight to a level that safeguards the well-being of the children.

Funding: None

Ethical Approval

This study protocol was reviewed and approved by the Regional Committee on Research Ethics for Human Health of the Centre Region, No. 2245/CRERSHC/2020. Also, written informed consent was obtained from the participants.

Authors' Contribution

WRG: Substantial contributions to the conception, acquisition, analysis, and interpretation of data for the work, drafting the work and reviewing it critically for important intellectual content. AH: Substantial contributions to the conception, acquisition, analysis, and interpretation of data for the work, drafting the work and reviewing it critically for important intellectual content. EEM: Substantial contributions to the conception, acquisition, analysis, and interpretation of data for the work, drafting the work and reviewing it critically for important intellectual content. JMN: Contributions to the design of the work, drafting the work and reviewing it critically for important intellectual content. WMB: Contributions to the design of the work, drafting the work and reviewing it critically for important intellectual content. SM: Contributions to the design of the work, drafting the work and reviewing it critically for important intellectual content. PM: Contributions to the design of the work, drafting the work and reviewing it critically for important intellectual content. MPM: Contributions to the design of the work, reviewing it critically for important intellectual content. AT: Contributions to the design of the work, reviewing it critically for important intellectual content. BB: Contributions to the design of the work, reviewing it critically for important intellectual content. SHM: Contributions to the design of the work, reviewing it critically for important intellectual content. PBAN: Substantial contributions to the conception, acquisition, analysis, and interpretation of data for the work, drafting the work and reviewing it critically for

important intellectual content. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work, such that the questions related to the accuracy or integrity of any part of the work.

Acknowledgments

We would like to thank all the students who participated in this study.

Conflict of Interest

The authors of this manuscript declare no relationships with any company whose products or services may be related to the subject matter of the article. Peguy Brice Assomo Ndemba is a member of the editorial board.

References

1. Alghamdi RS, Nafee HM, El-Sayed A, Alsaadi SM. A study of school bag weight and back pain among intermediate female students in Dammam City, Kingdom of Saudi Arabia. J Nurs Educ Pract. 2018;8(12):105-12. doi: 10.5430/jnep.v8n12p105.
2. Spiteri K, Busuttill M, Aquilina S, Gauci D, Camilleri E, Grech V. Schoolbags and back pain in children between 8 and 13 years: a national study. Br J Pain. 2017;11(2):81-86. doi: 10.1177/2049463717695144. PubMed PMID: 28491300; PubMed Central PMCID: PMC5405972.
3. Moore MJ, White GL, Moore DL. Association of relative backpack weight with reported pain, pain sites, medical utilization, and lost school time in children and adolescents. J Sch Health. 2007;77(5):232–9. doi: 10.1111/J.1746-1561.2007.00198.X. PubMed PMID: 17430435.
4. Puckree T, Silal SP, Lin J. School bag carriage and pain in school children. Disability and Rehabilitation. 2004;26(1):54–59. doi: 10.1080/09638280310001616376.
5. Akbar F, AlBesharah M, Al-Baghli J, Bulbul F, Mohammad D, Qadoura B, et al. Prevalence of low Back pain among adolescents in relation to the weight of school bags. BMC Musculoskelet Disord. 2019;20(1):37. doi: 10.1186/s12891-019-2398-2. PubMed PMID: 30670005; PubMed Central PMCID: PMC6343268.
6. Brackley HM, Stevenson JM. Are children's backpack weight limits enough? A critical review of the relevant literature. Spine (Phila Pa 1976). 2004;29(19):2184–90. doi: 10.1097/01.brs.0000141183.20124.a9. PubMed PMID: 15454714.
7. Adegoke BO, Odole AC, Adeyinka AA. Adolescent low back pain among secondary school students in Ibadan, Nigeria. Afr Health Sci. 2015;15(2):429–37. doi: 10.4314/ahs.v15i2.16. PubMed PMID: 26124788; PubMed Central PMCID: PMC4480481.
8. Chiwaridzo M, Naidoo N. Differences in personal and lifestyle characteristics among Zimbabwean high school adolescents with and without recurrent non-specific low back pain: a two-part cross-sectional study. Arch Physiother. 2015;5:13. doi: 10.1186/s40945-015-0014-9. PubMed PMID: 29340182; PubMed Central PMCID: PMC5759904.
9. Jones MA, Stratton G, Reilly T, Unnithan VB. A school-based survey of recurrent non-specific low back pain prevalence and consequences in children. Health Educ Res. 2004;19(3):284–9. doi: 10.1093/her/cyg025. PubMed PMID: 15140848.
10. Prista F, Balague M, Nordin M, Skovron L. Low back pain in Mozambican adolescents. Eur Spine J. 2004;13(4):341–5. doi: 10.1007/s00586-004-0683-7. PubMed PMID: 15034774; PubMed Central PMCID: PMC3468049.
11. Sjolie AN. Associations between activities and low back pain in adolescents. Scand J Med Sci Sport. 2004;14(6):352-9. doi: 10.1111/j.1600-0838.2004.377.x. PubMed PMID: 15546330.
12. Hestbaek L, Leboeuf-Yde C, Kyvik KO. Is comorbidity in adolescence a predictor for adult low back pain? A prospective study of a young population. BMC Musculoskelet Disord. 2006;7:29. doi: 10.1186/1471-2474-7-29. PubMed PMID: 16539740; PubMed Central PMCID: PMC1431536.
13. Wirth B, Humphreys K. Pain characteristics of adolescent spinal pain. BMC Pediatr. 2015;15:42. doi: 10.1186/s12887-015-0344-5. PubMed PMID: 25886130; PubMed Central PMCID: PMC4411747.
14. Watson KD, Papageorgiou AC, Jones GT, Taylor S, Symmons DP, Silman AJ, et al. Low back pain in schoolchildren: the role of mechanical and psychosocial factors. Arch Dis Child. 2003;88(1):12-7. doi: 10.1136/adc.88.1.12. PubMed PMID: 12495949; PubMed Central PMCID: PMC1719294.
15. Duthey B. Background paper 6.24: low back pain. In: World Health Organisation, editors: Priority medicines for Europe and the world 'A public health approach to innovation'. Geneva: WHO; 2013. Available from: http://apps.who.int/medicinedocs/documents/s20245en/s20245en.pdf.
16. Grimmer K, Williams M. Gender-age environmental associates of adolescent low back pain. Applied

Ergonomics. 2000;31(4):343–360. doi: 10.1016/s0003-6870(00)00002-8.
17. Viry P, Creveuil C, Marcelli C. Non-specific back pain in children. a search for associated factors in 14–year-old schoolchildren. Rev Rhum Engl Ed. 1999;66(7-9):381-8. PubMed PMID: 10526378.
18. Troussier B, Davoine P, de Gaudemaris R, Fauconier J, Phelip X. Back pain in schoolchildren: a study among 1178 pupils. Scand J Rehab Med. 1994;26(3):143–6. PubMed PMID: 7801063
19. Calvo-Muñoz I, Kovacs FM, Roqué M, Fernández IG, Calvo JS. Risk factors for low back pain in childhood and adolescence: A systematic review. Clin J Pain. 2018;34(5):468–484. doi: 10.1097/AJP.0000000000000558. PubMed PMID: 28915154.
20. Calvo-Muñoz I, Kovacs FM, Roqué M, Seco-Calvo J. The association between the weight of schoolbags and low back pain among schoolchildren: A systematic review, meta-analysis and individual patient data meta-analysis. Eur J Pain. 2020;24(1):91-109. doi: 10.1002/ejp.1471. PubMed PMID: 31421006.
21. Dockrell S, Simms C. Blake C. Schoolbag weight limit: Can it be defined? J Sch Health. 2013;83(5):368–77. doi: 10.1111/josh.12040. PubMed PMID: 23517005.
22. Moore MJ, White GL, Moore DL. Association of relative backpack weight with reported pain, pain sites, medical utilization, and lost school time in children and adolescents. J Sch Health 2007;77(5):232–9. doi: 10.1111/j.1746-1561.2007.00198.x. PubMed PMID: 17430435.
23. Houngbedji GM, Alagnide E, Niama D, Akpogan F, Kpadonou TG. The back pain in adolescents schooled in the town of Cotonou. Annals of Physical and Rehabilitation Medicine. 2016;59:e96. doi: 10.1016/j.rehab.2016.07.216.
24. Tiendrebeogo WJZ, Ouédraogo S, Yago ISE, Zabsonre DS, Tiaho Y, Kaboré F, et al. Low back pain among primary school children: prevalence and risk factors. A cross sectional study in Ouagadougou (Burkina Faso). Journal of Rheumatology Research. 2020;2(2):98-106.
25. Chiwaridzo M, Naidoo N. Prevalence and associated characteristics of recurrent non-specific low back pain in Zimbabwean adolescents: a cross-sectional study. BMC Musculoskelet Disord. 2014;15:381. doi: 10.1186/1471-2474-15-381. PubMed PMID: 25406690; PubMed Central PMCID: PMC4246475.
26. Murphy S, Buckle P, Stubbs D. A cross-sectional study of self-reported back and neck pain among English schoolchildren and associated physical and psychological risk factors. Appl Ergon. 2007;38(6):797–804. doi: 10.1016/j.apergo.2006.09.003. PubMed PMID: 17181995.
27. Kristensen C, Bø K, Ommundsen Y. Level of physical activity and low Back pain in randomly selected 15-year-olds in Oslo, Norway? An epidemiological study based on survey. Advances in Physiotherapy. 2001;3(2):86–91. doi: 10.1080/14038190117038.
28. Bejia I, Abid N, Ben Salem K, Letaief M, Younes M, Touzi M, et al. Low back pain in a cohort of 622 Tunisian schoolchildren and adolescents: an epidemiological study. Eur Spine J. 2005;14(4):331–6. doi: 10.1007/s00586-004-0785-2. PubMed PMID: 15940479; PubMed Central PMCID: PMC3489209.
29. Guessogo WR, Assomo-Ndemba PB, Ebal-Minye E, Mekoulou-Ndongo J, Bika-Lele CB, Mbang-Bian W, et al. Effect of schoolbag weight on musculoskeletal pain among primary school children in Yaoundé: A cross-sectional study. International Journal of Medical Students. 2020;8(2):96-101. doi: https://doi.org/10.5195/ijms.2020.485.
30. Kemta Lekpa F, Enyama D, Noukeu Njinkui D, Ngongang Chiedjio A, Simeni Njonnou SR, Ngongang Ouankou C, et al. Prevalence and factors associated with low back pain in schoolchildren in Cameroon, sub-Saharan Africa. Int J Rheum Dis. 2021;24(9):1186-1191. doi: 10.1111/1756-185X.14172. PubMed PMID: 34235853.
31. Zhang Z. Model building strategy for logistic regression: Purposeful selection. Ann Transl Med. 2016;4(6):111. doi: 10.21037/atm.2016.02.15. PubMed PMID: 27127764; PubMed Central PMCID: PMC4828741.
32. Muhamad Salim Khan S, Saleem SM, Ul-haq I, Qurieshi MA. Back pain and school bag use: A cross-sectional study among school children in Kashmir valley. International Journal of Current Advanced Research. 2017;6(7):4598-4602. doi: 10.24327/ijcar.2017.4602.0542.
33. Farhood FH. Low back pain in schoolchildren: the role of school bag weight and carrying way. Journal of Natural Sciences Research. 2013;3(8):156-165.
34. Mwaka ES, Munabi IG, Ochieng J. Musculoskeletal pain and school bag use: a cross sectional study among Ugandan pupils. BMC Res Notes. 2014;7:222. doi: 10.1186/1756-0500-7-222. PubMed PMID: 24713177; PubMed Central PMCID: PMC3983861.
35. Ibrahim AH. Incidence of back pain in Egyptian school girls: Effect of school bag weight and carrying way. World Appl Sci J. 2012;17(11):1526-1534.