

1 **Title:** Effect of Schoolbag Weight on Musculoskeletal Pain among Primary School Children in Yaounde,
2 Cameroon: A Cross-sectional Study

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4 **Author names:** Wiliam Richard Guessogo,¹ Peguy Brice Assomo-Ndemba,² Edmond Ebal-Minye,¹ Jerson
5 Mekoulou-Ndongo,³ Claude Bryan Bika-Lélé,³ William Mbang-Bian,¹ Eva Linda Djuine-Soh,¹ Jean Bertrand
6 Ondoa,¹ Samuel Honoré Mandengue,³ Abdou Temfemo.⁴

7 **Degrees:** ¹ PhD; ² MD, PhD; ³ PhD; ⁴ PhD; ⁵ PhD; ⁶ MSc; ⁷ MSc; ⁸ MSc; ⁹ PhD; ¹⁰ PhD.

8 **Affiliations:** ¹. National Institute of Youth and Sports, Yaoundé, Cameroon, ². Faculty of Medicine and
9 Biomedical Sciences, University of Yaounde 1, Yaounde, Cameroon. ³. Exercise and Sport Physiology and
10 Medicine Unit, Faculty of Science, University of Douala, Cameroon, ⁴. Faculty of Medicine and Pharmaceutical
11 Sciences, University of Douala, Cameroon.

12 **About the author:** Assomo-Ndemba is a MD of the Faculty of Medicine and Biomedical Sciences of the
13 University of Yaounde 1, Cameroon.

14 **Acknowledgment:** We thank the principals, teachers and parents of children for their collaboration. We also
15 thank the students who participated and, Loick Pradel Kojom for its advices in statistical analysis.

16 **Financing:** The authors have no funding source to disclose.

17 **Conflict of interest statement by authors:** The authors have no conflict of interest to disclose.

18 **Compliance with ethical standards:** Yes

19 **Authors Contribution Statement:** Conceptualization: WRG & PBAN. Data Curation, Methodology,
20 Resources & Validation: WRG, PBAN, EEM, JMN, CBBL, WMB, ELDS, JBO & AT. Formal Analysis, Project
21 Administration, & Supervision: WRG, PBAN, SHM & AT. Investigation: WRG, PBAN, ELDS & JBO.
22 Visualization: WRG, PBAN & CBBL. Writing – Original Draft Preparation: WRG, PBAN, EEM, SHM & AT.
23 Writing – Review & Editing: WRG, PBAN, SHM & AT

24
25 **Manuscript word count:** 2375

26 **Abstract word count:** 243

27 **Number of Figures and Tables:** 04

28 **Personal, Professional, and Institutional Social Network accounts.**

- 29 • **Facebook:** temfemo@hotmail.com

30 **Discussion Points:**

- 31 1. What is the weight of the schoolbag?
32 2. What are the consequences of carrying heavy schoolbags in children?

33
34 **Publisher's Disclosure:** *This is a PDF file of an unedited manuscript that has been accepted for publication.*
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1 **ABSTRACT**

2
3 **Background:** Heavy schoolbag is known to cause health problems for school children. The aim of this study
4 was to determine the effects of carrying heavy schoolbags on the musculoskeletal pain among primary school
5 children of the two subsystems in Yaounde, Cameroon.

6 **Methods:** A cross-sectional study was carried out in primary schools in Yaounde. A total of 457 school-
7 children (8.2 ± 2.2 years) were included, 202 from the French-speaking subsystem, and 255 from the English-
8 speaking subsystem. Parameters studied included weight, height, and schoolbag weight. A questionnaire was
9 used to collect socio-demographic information and potential musculoskeletal pain in three regions: back,
10 shoulders, and neck.

11 **Results:** The mean weight of children and their bags was 28.4 ± 8.2 kg and 5.2 ± 2.3 kg respectively. More
12 than 50% of schoolchildren in the two subsystems carried a schoolbag weighing more than 15% of body
13 weight. The back (38%) was the least affected area in comparison to the shoulders (58.6%) and neck (42.4%)
14 ($p < 0.001$). Carrying heavy bags and walking to school was associated with pain in the back, shoulders, and
15 neck. School-children in the French-speaking subsystem had lower risk (adjusted Odds Ratio 0.438, 95% CI =
16 0.295-0.651; $p < 0.001$) to develop a sore neck compared to peers from the English-speaking subsystem.

17 **Conclusion:** Carrying heavy schoolbags is associated to musculoskeletal pain in schoolchildren. The means
18 moving to and from school is a main risk factor of developing musculoskeletal pain. French-speaking
19 schoolchildren develop less neck pain than English-speaking schoolchildren.

20
21 **Key words:** Weight-Bearing, Musculoskeletal Pain, Primary School, Cameroon (Source: MeSH-NLM).
22

1 INTRODUCTION

2
3 Excessive schoolbag weight is a health problem commonly reported in pediatric age.¹ Carrying heavy school
4 bags is associated with a multitude of body biomechanical affections or disorders such as changes in sagittal
5 plane in posture and balance, spinal curvature, consistency of repositioning and musculoskeletal discomfort.²⁻
6 ⁷ The particular situation of musculoskeletal pain is the basis of studies investigating the relative weight limit of
7 schoolbags which has a less impact on the imbalance of physiological and biomechanical functions.^{2-7,8}

8
9 Previous studies showed that school bags should be within acceptable limits of 10-15% of a child's body
10 weight to avoid musculoskeletal pain.^{1,8-14} Secondary school children are a target group at risk for
11 musculoskeletal pain because of the maximum development of the appendicular skeletal system that occurs
12 especially during puberty.^{15,16} Other studies conducted in the population of primary school pupils revealed
13 negative effects on the musculoskeletal system associated to heavy schoolbag carriage.^{6,17-22} In addition,
14 considering the musculoskeletal development of school-age in children, the schoolbag weight and the
15 negative consequences of heavy loads can lead to problems in the development of the spine.²³⁻²⁶ Studies
16 reported that the development of back pain in children can increase the risk of developing chronic back pains
17 in adulthood.^{27,28}

18
19 Items contributing to the weight of schoolbags include school manuals, and additional items such as afternoon
20 tea, bottles of water, sports equipment, and jackets.²⁹

21
22 Unfortunately, despite the negative consequences of carrying heavy schoolbags on the children's health,²⁻⁷ to
23 our opinion, this situation does not seem to worry parents and school officials. It is still accepted today that the
24 weight of the backpack should be further reduced in order to limit the prevalence of back pains in children;³⁰
25 and with this regard many studies have been conducted in variety of educational systems.^{1,2,6,8,9,18,20,21,29,31-33}

26
27 In Cameroon, the educational system is bilingual, and is subdivided into two sub-systems: French-speaking
28 and English-speaking. In November 2017, the Government recommended and prescribed one schoolbook per
29 subject matter instead of the multiple books per subject as it was previously. Before this Government decision,
30 the mean number of textbooks per student was 13 in Cameroon, whereas the average in Africa was 8.5.³⁴
31 One of the objectives of this prescription was to prevent health risks associated with increasing volume and
32 weight of schoolbag.

33
34 Since this Government decision, no scientific investigation in our knowledge has been carried to evaluate the
35 current impact of the weight of the schoolbag on musculoskeletal pain in Cameroon.

- 1 The purpose of this study was to determine the effects of carrying a heavy schoolbag on the musculoskeletal
- 2 pain among primary school children in the English-speaking and French-speaking educational systems of
- 3 Cameroon.

Accepted, in-press

METHODS

Study design

A cross-sectional study was conducted in primary schools of the two subsystems in Yaounde, the Capital of Cameroon, during the first term 2017/2018 school year.

Sampling

In Cameroon, the two sub-systems (French-speaking and English-speaking) operate independently, particularly on the aspect of training programs, with specific books and schedules used in each sub-system. According to the authorization of the Regional Delegate of the Ministry of Basic Education, we used a non-probability sampling method of convenience to investigate. In each school, one class per level of study (6 levels) was chosen. In order to avoid any interference, the administration of each school randomly selected one class per level in the three classes that comprises each level, using the draw method from the list of classes. The school administration was not informed of the purpose of the study. All school-children of both sexes attending the day of collection, able to walk and wear their schoolbag independently were included in the study. According to their medical informations available in the administration, school-children who were diagnosed by a medical doctor as having spinal and musculoskeletal problems such as leg length discrepancies were excluded.

Data collection

The body weight and schoolbag weight were measured using the same Tanita BC 532 electronic scale (Tokyo, Japan) placed on a flat and hard surface, calibrated before the start of data collection. The weight of each participant was first measured without schoolbag, then after, carrying his schoolbag, to obtain the total weight. The difference of the two weights was recorded as the schoolbag weight, and then, the schoolbag weight percentage compared to body weight was determined. The height was measured using a Graduated scale Mark Seca (Hamburg, Germany).

A questionnaire developed for the study and deriving from the Standardized Nordic Body Map Questionnaire was used to collect additional information. The questionnaire was administered and each student answered, if necessary with the help of the investigator. This study tool consisted of a self-administered questionnaire translated in French and in English, the two official languages spoken in Cameroon. The tool was pre-tested in order to simplify the language of the questions. A diagram was introduced to indicate the body parts to report the pain. The questionnaire included: the mean of moving to and from school and the location of musculoskeletal pain.

Data analysis

Data were entered into an Excel spreadsheet (Microsoft Office 2016) before being exported to the statistical analysis software StatView 5.0 for windows (SAS Institute, Inc., IL, USA). Categorical variables were presented as frequency and percentage while continuous variables were presented as mean \pm standard

1 deviation (SD). The schoolbag weight as percentage of body weight (%BW) was classified into those with
2 $\leq 10\%$ BW, those with BW located from $>10\%$ to $\leq 15\%$, and those with $>15\%$ BW. The descriptive statistics
3 were used to determine the anthropometric characteristics of the participants, the number of schoolchildren in
4 each category of schoolbag weight as percentage of body weight, and the prevalence of pain symptoms in
5 different regions of the body. The unpaired Student t-test was used to compare the mean schoolbag weight
6 among schoolchildren in the two educational subsystems as well as the characteristics of the participants.

7
8 A Pearson chi square test (χ^2) was used to compare percentages of participants in different categories of
9 schoolbag weight to body weight. Multivariate logistic regression was used to identify factors associated with
10 the presence/absence of pain on different body regions (back, shoulders and neck). The outcome variable
11 was the presence of pain on the body region of interest and the independent variables (factors) included
12 gender, age, educational system, means of transport and %BW. Adjusted values of odd ratio (aOR) along
13 with their confidence interval at 95% (95%CI) and level of significance were computed. A log-transformed
14 value of likelihood was used to appraise the goodness-of-fit of each logistic regression model. Statistical
15 significance was set at p-value < 0.05 .

16 17 **Ethics Clearance**

18 The current study received the approval of the National Committee of Ethics for Scientific Research and was
19 conducted in conformity with the recommendations of the Declaration of Helsinki revised in 1989. Access into
20 schools was authorized by the Regional Delegate of the Ministry of Basic Education. An informed written
21 consent form including the description of the study and its importance was distributed to school-children to
22 obtain parental consent.

1 RESULTS

2 *Characteristics of participants*

3 A total of 457 school-children (50.6% boys) were included; 202 (44.2%) from the French-speaking subsystem
4 and 255 (55.8%) from the English-speaking subsystem. The mean age, body height, body weight and body
5 max index (BMI) of participants were 8.2 (\pm 2.2) years, 132.3 (\pm 14.4) cm, 28.4 (\pm 8.2) kg and 16.1 (\pm 2.9)
6 kg/m² respectively.

7
8 No difference was found in the characteristics between boys and girls in both educational subsystems (Table
9 1).

11 *Schoolbag weight to body weight*

12 The mean schoolbag weight in the whole sample was 5.2 (\pm 2.3) kg, ranging from 1.2 kg to 14.8 kg with no
13 significant difference in the French-speaking subsystem (5.6 \pm 2.2 kg, ranging from 1.2 kg to 11.0 kg)
14 compared to the English-speaking subsystem (5.1 \pm 2.4 kg, ranging from 1.6 kg to 14.8 kg) (Table 2). The
15 majority of students in the whole population (62.30%) belonged to the category >15%, both in the French-
16 speaking (67.32%) and English-speaking subsystems (58.43%) (Table 2).

18 *Musculoskeletal pain*

19 A total of 174 (38.1%) participants reported pain at their back and 194 (42.4%) at the neck. But, 58.6% of
20 them reported having pain at the shoulders. The prevalence of pains was significantly different in the back (p
21 = 0.0091) and the neck (p = 0.0284) in the different category percentages of body weight. Self-reported pains
22 at the back, shoulders and neck across schoolbag weight related to body weight are detailed in Table 3.

24 *Risk factors*

25 In relation to risk factors, children whose schoolbag weight was >15% of their body weight were almost 4
26 times more likely to develop neck pain compared to those whose schoolbag weight was <10% of their body
27 weight (aOR = 3.56, 95% CI = 1.38 - 9.21, p = 0.008) (Table 4).

28
29 Except from the mean of moving to and from school, the other variables (Gender, age, educational system)
30 were not significantly associated, with the risk of developing localized pain at the back, shoulders and neck
31 (Table 4). Children who moved using public car transport to school were less likely to develop musculoskeletal
32 disorders at their back (aOR = 0.40, 95% CI: 0.27-0.60, p < 0. 001), shoulders (aOR = 0.48, 95% CI = 0.32-
33 0.72, p = 0.0004) and neck (aOR = 0.56, 95% CI = 0.37-0.83, p = 0.0043) compared to those walking to
34 school. Moreover, school-children who were enrolled in the French-speaking subsystem were less likely (aOR
35 = 0.44, 95% CI = 0.30-0.66, p < 0.001) to develop a sore neck compared to those in the English-speaking
36 subsystem (Table 4).

1 DISCUSSION

2 The objective of the current study was to investigate the association between schoolbag weight and
3 musculoskeletal pain among Cameroonian school-children.

4
5 We found that the average percentage of the schoolbag weight relative to the body weight of the school-
6 children was well above the recommended limits (10-15%)¹² in the two Cameroonian educational sub-
7 systems. In addition, musculoskeletal pain was common in school-children sample with a high prevalence of
8 back pain compared to the neck pain and shoulders pain. Our study showed that the average of schoolbag
9 weight in the whole population is close to what is reported by other authors.^{9,27,35} Nevertheless, this value is
10 higher than those found by Mwaka et al.¹, Dianat et al.¹⁹, and Furjuoh et al.³⁶ On the other hand, the value
11 obtained in school-children in the present study is lower than that reported by Ibrahim³¹ and Dorji et al.³⁷ This
12 disparity in schoolbag weight in these different studies could be explained by differences in curricula in each
13 country, by levels of development, and by behavioral and cultural differences between countries.

14
15 A possible reason for this increase in the average of schoolbag weight found in our study compared to the
16 norms would be the particular context of the textbook policy in Cameroon. Indeed, the Government published
17 in November 2017 a text fixing for each subject matter one textbook, but, to our observation of the educational
18 environment, there is persistent violation and non-respect of this regulation, leading to an increase the weight
19 of the schoolbag.

20
21 The percentage of the weight of the schoolbag relative to the body weight of school-children was higher in the
22 French-speaking subsystem compared to the English-speaking subsystem. Usman et al.³⁸ reported a slightly
23 higher value among school-children in Karachi, Pakistan. On the other hand, the percentage obtained in our
24 study is higher than those obtained by some authors.^{1,9,18,35} Some authors noted percentages close to the
25 recommended standard, like Al-Hazzaa³³ and Grimmer et al.³⁹

26
27 The results of our study revealed a higher proportion of school-children (67.3%) in the category > 15% of body
28 weight in the French-speaking subsystem. This observation justifies the fact that for a decade in Cameroon,
29 there was a gradual loss of interest in the French-speaking subsystem in favor of the English-speaking
30 subsystem. Indeed, the English-speaking subsystem is characterized with an earlier specialization of the
31 studies, and leads to a reduction of the number of textbooks. This result is consistent with the one generally
32 observed in many studies,^{17,19,36} thus explaining the difference in educational systems and curricula. This
33 result may also account for the low proportion of musculoskeletal symptoms in the participants of our study
34 compared to some similar studies where the percentages was generally high i.e. more than 60%.^{6,16,19,37}

35
36 The analysis of the adjusted odds ratio showed that the risk of developing musculoskeletal symptoms was
37 higher for school-children in categories >10% to ≤15% and >15% and this in the French-speaking subsystem
38 compared to the English-speaking subsystem ($p < 0.001$). There was no significant difference in gender. This

1 result justifies the governmental measures in the field of school policy that took place in November 2017 in
2 Cameroon, which prescribed a single textbook per subject. The back was the least affected zone in
3 comparison to the shoulders and neck ($p < 0.001$). This result joins the observations of Yamato et al.⁴⁰ who in
4 their review did not find an objective link between the symptoms at the back and the weight of the schoolbag.
5 According to these authors, the appearance of pain in this region is much more perceptible.

6
7 In the analysis of other factors determining the occurrence of musculoskeletal disorders, only the means
8 moving to and from school was significantly associated with the risk of developing localized pain in the back,
9 shoulders and neck ($p < 0.01$). School-children who moved to school using public car transport were less
10 likely to develop musculoskeletal symptoms.

11 **Recommendations**

12 Compliance with the Government circular on textbooks that prescribed one schoolbook per subject matter
13 instead of the multiple books by subject as it was previously is recommended.

14 **Limitations**

15
16 First, the limited sample size cannot allow a generalization of the results at National level. On the other hand,
17 the results obtained may be different if we take into account rural regions where access to the textbook is
18 limited. Second, there is also the cross-sectional nature of the study which does not allow reliable conclusions
19 on the causal link. Third, only few risk factors for musculoskeletal pain were studied. Future studies should
20 highlight the long-term effects of school bag weight on musculoskeletal pain and many other risk factors
21 should be investigated.

22 **Conclusions**

23
24 The schoolbag weight is high in the Cameroonian education system compared to international standards and
25 is associated with common musculoskeletal pain. Carrying heavy schoolbag is associated to musculoskeletal
26 pain in schoolchildren. The means moving to and from school is a main risk factor of developing
27 musculoskeletal pain. French-speaking schoolchildren develop less neck pain than English-speaking
28 schoolchildren.
29

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1 **TABLES**2 **Table 1.** Sociodemographic and anthropometric characteristics of participants

Educ. Syst.	Gender	n	Age (yrs)	Height (cm)	Weight (kg)	BMI (kg/m²)
French-speaking	Boys	100	8.1±2.3	132.4±16.4	30.2±9.9	17.1±3.9
	Girls	102	7.8±2.3 ^{NS}	131.0±15.6 ^{NS}	28.4±8.8 ^{NS}	16.3±3.3 ^{NS}
English-speaking	Boys	129	8.6±2.0	133.3±12.8	28.2±6.7	15.9±1.7
	Girls	126	8.3±2.1 ^{NS}	132.2±13.3 ^{NS}	27.3±7.6 ^{NS}	15.4±2.2 ^{NS}
Total		457	8.2±2.2	132.3±14.4	28.4±8.2	16.1±2.9

3 BMI = Body mass index; Educ. Syst. = Educational system. ^{NS}= Non significant difference between boys and
4 girls.

5

1 **Table 2.** Distribution of school-children by schoolbag weight as percentage of body weight

	Educational system			p-value
	Total (n=457)	English-speaking (n=255)	French-speaking (n=202)	
SBW (kg)	Mean (\pmSD)	Mean (\pmSD)	Mean (\pmSD)	
	5.2 (\pm 2.3)	5.1 (\pm 2.4)	5.6 (\pm 2.2)	0.0282
%BW	n (%)	n (%)	n (%)	
$\leq 10\%$	29 (6.4)	17 (6.66)	12 (5.94)	0.8875
$>10\%$ to $\leq 15\%$	143 (31.3)	89 (34.90)	54 (26.73)	0.0769
$> 15\%$	285 (62.3)	149 (58.43)	136 (67.32)	0.064

2 SBW = Schoolbag weight ; %BW = Percentage of body weight.

3

1 **Table 3.** Prevalence of pain symptoms in different regions of the body

Regions and symptoms	Total	SBW (kg)			χ^2	p-value
		$\leq 10\%$ n (%)	$>10\%$ to $\leq 15\%$ n (%)	$> 15\%$ n (%)		
Back						
NO	283 (61.9)	18 (62.1)	105 (71.9)	160 (56.7)	9.40	0.0091
YES	174 (38.1)	11 (37.9)	41 (28.1)	122 (43.3)		
Shoulders						
NO	189 (41.4)	14 (48.3)	66 (45.2)	109 (38.7)	2.31	0.3144
YES	268 (58.6)	15 (51.7)	80 (54.8)	173 (61.3)		
Neck						
NO	263 (57.6)	23 (79.3)	87 (59.6)	153 (54.3)	7.12	0.0284
YES	194 (42.4)	06 (20.7)	59 (40.4)	129 (45.7)		

2 SBW = Schoolbag weight.

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Table 4. Risk factors for musculoskeletal symptoms in the back, neck and shoulders

Variables	Back		Shoulders		Neck	
	aOR (CI95%)	P-value	aOR (CI95%)	P-value	aOR (CI95%)	p-value
Gender						
Girls	1		1		1	
Boys	1.02 (0.69 - 1.51)	0.927	1.19 (0.81 - 1.74)	0.381	1.35 (0.92 - 2.00)	0.128
Age (years)	1.05 (0.95 - 1.15)	0.334	0.97 (0.89 - 1.07)	0.574	1,05 (0.96 - 1.15)	0.295
%BW						
≤10	1		1		1	
>10 to ≤15	0.58 (0.24 - 1.37)	0.212	1.12 (0.49 - 2.53)	0.788	2.62 (0.98 - 6.95)	0.053
>15	1.19 (0.53 - 2.70)	0.670	1.48 (0.67 - 3.25)	0.327	3.56 (1.38 - 9.21)	0.008
Educ. Syst.						
English -speaking	1		1		1	
French-speaking	1.24 (0.83 - 1.84)	0.301	1.52 (1.03 - 2.25)	0.003	0.44 (0.30 - 0.66)	<0.001
Means of transport						
Feet	1		1		1	
Public car transport	0.40 (0.27 - 0.60)	<0.001	0.48 (0.32 - 0.72)	0.0004	0.56 (0.37 - 0.83)	0.0043

Educ. Syst. = Educational system; BW = Body weight; aOR = adjusted Odds Ratio; CI = Confidence Interval.