SCHOOL BAG USE AND MUSCULOSKELETAL SYMPTOMS AMONG SECONDARY STUDENTS IN BENIN CITY, NIGERIA

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Abstract. Musculoskeletal symptoms (MSKs) are increasingly prevalent among adolescents and may impact their health into adulthood. This study aimed to examine the relationship between school bag carriage characteristics, specifically weight, length, daily duration, and carriage style; and the occurrence of MSKs among secondary school students in Benin City, Edo State, Nigeria. A cross-sectional design was employed, involving 400 students selected from seven secondary schools. Participants completed the Nordic Musculoskeletal Questionnaire, and data on anthropometric measures and school bag attributes were collected. Visual assessments were conducted to detect postural abnormalities, including scoliosis, lordosis, and kyphosis. The lifetime prevalence of MSKs was highest in the low back (50.0%), followed by the neck (40.3%) and shoulders (35.8%). Notable associations were found between specific carriage characteristics and MSKs: for example, shoulder pain was significantly associated with both bag weight and carriage duration, while bag length correlated with neck pain. Scoliosis and lordosis also showed significant associations with bag weight. However, no consistent pattern was observed across all variables, and some associations were statistically insignificant. The findings suggest that improper school bag use, particularly excessive weight and poor carriage style, contributes to MSK development and postural issues among students. Preventive strategies including awareness programs and ergonomic interventions are recommended to safeguard students' musculoskeletal health.
Keywords: *school bag ergonomics, musculoskeletal disorders, adolescents, postural health, Nigeria*

Introduction

Musculoskeletal symptoms (MSKs) are health problems affecting the locomotor apparatus of most categories of people, both young and old. The lifetime prevalence of MSKs among school children ranges between 16% and 86% in developed countries, and 43.8% to 88.8% in third world nations (Delele et al., 2018; Pant et al., 2016; Mohd Azuan et al., 2010). Recent studies have shown there is a high prevalence of musculoskeletal symptoms among secondary school students, which poses a threat to their emotional and physical well-being (Kitiş et al., 2017; Adegoke et al., 2015; Hamzat et al., 2014). This situation is particularly worrisome as literature has posited that preexisting disorders in childhood and adolescent period are capable of affecting health status and human functioning at adulthood (Kamper et al., 2016). MSKs often occur as a result of inappropriate posture, repetitive movement, and other practices capable of damaging the components of the human musculoskeletal system (Chen and Mu, 2018; Solomon et al., 2010). School bag carriage is a common practice among secondary school students in Nigeria and in other parts of the world. It represents a significant daily occupational load because students carry textbooks, notebooks, lunch boxes etc., to classrooms every day. The weight of students' school bags, duration of

carriage, style of carriage and body positioning while carrying school bags have all been identified as factors that could negatively impact the musculoskeletal health of students (Hsu et al., 2019; Zakeri et al., 2016). Given that the musculoskeletal systems of these students are not fully matured, it is logical that excessive load could ultimately predispose them to developing MSKs around the spine, shoulder, and other body regions in the long-run.

At the moment, there are conflicting reports with respect to the safe limits for school bag weight. For instance, it was suggested that school bag weight should not exceed 10% to 15% of the students' body weight (Lavigne, 2014). A study also recommended 5.18% and 4.91% of body weight for male and female students respectively (Ismaila, 2018). Another study conducted in a Nigerian secondary school reported that the average percentage of school bag weight was 10.16% of students' body weight (Johnson et al., 2011). Evidence shows that heavy school bags beyond the recommended standard weight, can increase load pressure on the spine, predisposing school children to spinal deformities (Zakeri et al., 2016). In light of the foregoing, more studies are required to mitigate the present situation among students. This study was therefore aimed at determining the relationship between school bag carriage characteristics (weight of school bag, length of school bag, duration of carriage and style of school bag carriage) and prevalence of MSKs among secondary school students in Benin City, Edo state, Nigeria.

Materials and Methods

A cross sectional study design, which involved four hundred (400) students from seven (7) selected secondary schools within Benin City, Edo state, Nigeria, was utilized for this study. The students' ages range between 10 and 18 years, 204 (51%) of the participants were male. The research objectives were initially explained to all participants before securing their informed consents. A valid and reliable self-administered questionnaire (the Nordic Musculoskeletal Questionnaire) was completed by each participant. This research instrument contained items on the prevalence of MSKs (lifetime, 12-month and point) according to the body regions affected. Anthropometric parameters (participants' weights and heights) were measured with weighing scale and stadiometer respectively. The length and weight of participants' school bags were also measured with a tape measure and weighing scale respectively. The style of carriage of school bag was assessed by asking the participants how they frequently carry their school bags, over one or both shoulders, by hand or other ways which was to be specified by the participant. The participants were subsequently asked to expose their backs in a private room provided by the schools and the researcher visually observed for the presence or absence of scoliosis, lordosis, and kyphosis. Adam's Forward Bend Test was also carried out to further rule out the presence or absence of scoliosis among the participants. Data were analyzed using Statistical Package for Social Sciences (IBM SPSS) version 25. The descriptive statistics of mean, percentage and standard deviation were used, while point-biserial correlation was utilized to determine the relationship between the prevalence of MSKs and three school bag carriage characteristics (school bag weight, length of school bag and duration of carriage per day). Chi-square test was used to determine the relationship between the prevalence of MSKs and school bag carriage style of students. The level of significance was set at $p<0.05$.

Results and Discussion

The sociodemographic data of the respondents are shown in *Table 1*. Participants' anthropometrics and school bag carriage characteristics are shown in *Table 2*. The lifetime, 12-month and point prevalence of musculoskeletal symptoms according to the affected body regions are shown in *Table 3*. Relationships between the prevalence of MSKs and weight of school bag, length of school bag and duration of carriage per day are shown in *Table 4*. There were significant relationships between lifetime prevalence of low back pain and length of school bag (0.037), 12-month prevalence of neck pain and length of school bag (0.010), lifetime prevalence of shoulder pain and weight of school bag (0.002), lifetime prevalence of shoulder pain and duration of carriage per day (0.025), point prevalence of shoulder pain and duration of carrying school bag per day (0.006), prevalence of scoliosis and school bag weight (0.006), prevalence of lordosis and school bag weight (0.001), and prevalence of kyphosis and duration of carrying school bag per day (0.002). Relationships between prevalence of MSKs and school bag carriage style are shown in *Table 5*.

***Table 1**. Sociodemographic data of the respondents.*

Variables	Frequency (N)	Percentage (%)
Gender		
Male	204	51.0
Female	196	49.0
Type of School		
Private	166	41.5
Public	234	58.5
Class		
JSS 1	66	16.5
JSS 2	70	17.5
JSS 3	66	16.5
SS 1	67	16.8
SS 2	66	16.5
SS3	65	16.3
Style of Carrying School bag		
Over one shoulder	36	9
Over both shoulders	324	81
Carried by hand	16	4
Cross body	24	6
Means of Transport		
Trekking	120	30.0
Public Transport	141	35.3
Private Car	139	34.8

***Table 2**. Participants' anthropometrics and school bag carriage characteristics.*

Variable	Minimum	Maximum	Mean±SD
Age (years)	10	18	14.35±1.890
Body weight (kg)	30.00	102.00	54.11±11.400
Height (m)	1.37	1.91	1.63±0.096
BMI (kg/m^2)	12.09	36.97	20.27±3.550
Duration of carrying school bag (years)	1	15	10.85±2.530
School bag weight (kg)	1.0	12.0	3.628±1.827
School bag length (m)	0.36	1.06	0.522±0.097
No. of days per week of carrying school bag	1	7	4.98±0.780
Duration of carrying school bag in a day (hours)	0.03	13.00	2.13±1.934
% of school bag weight when compared to body weight	1.30	31.25	6.96±3.820

***Table 3**. Prevalence of MSKs.*

Body region	Lifetime (%)	12-month (%)	Point (%)	Deformity	Point (%)
Low back	50.0	39.7	22.0	Scoliosis	8.0
Neck	40.3	30.3	14.8	Lordosis	2.0
Shoulder	35.8	23.0	11.5	Kyphosis	0.25

Table 4. *Pearson correlation statistics between prevalence of MSKs and some school bag carriage characteristics of the participants.*

Category	Weight of bag (kg) (r, p)	Length of bag (m) (r, p)	Duration of carriage per day (hr) (r, p)
Low back pain			
Lifetime	0.090, 0.071	0.104, 0.037*	-0.004, 0.938
12-month	0.080, 0.112	0.074, 0.139	0.075, 0.136
Point	0.092, 0.066	0.075, 0.136	0.20, 0.691
Neck pain			
Lifetime	0.052, 0.303	0.071, 0.158	-0.014, 0.775
12-month	0.027, 0.588	0.129, 0.010*	-0.017, 0.732
Point	0.023, 0.645	0.038, 0.446	0.077, 0.123
Shoulder Pain			
Lifetime	0.152, 0.002*	0.014, 0.773	0.112, 0.025*
12-month	0.093, 0.064	0.030, 0.554	0.096, 0.056
Point	0.076, 0.131	0.049, 0.326	0.138, 0.006*
Scoliosis	0.136, 0.006*	-0.080, 0.109	-0.058, 0.250
Lordosis	0.196, 0.001*	-0.63, 0.211	0.027, 0.588
Kyphosis	0.065, 0.194	0.030, 0.548	0.152, 0.002*

*Note: *mean statistical significance.*

Table 5. *Chi-square test result showing relationships between the prevalence of MSKs and school bag carriage style of the participants.*

Category	χ^2	ρ
Low back pain		
Lifetime	1.809	0.613
12-month	31.292	0.002*
Point	4.948	0.176
Neck Pain		
Lifetime	3.731	0.292
12-month	3.979	0.984
Point	6.397	0.094
Shoulder Pain		
Lifetime	9.306	0.025*
12-month	26.639	0.009*
Point	3.428	0.330
Scoliosis	8.662	0.034
Lordosis	1.915	0.590
Kyphosis	0.235	0.972

*Note: *mean statistical significance.*

The primary aim of this study was to determine the relationships between the prevalence of MSKs and school bag carriage characteristics (weight of school bag, length of school bag, duration of carriage per day, and style of school bag carriage) among secondary school students within Benin city, Edo state. From this present study, it was observed that there was no significant relationship between the weight of participants' school bags and the 12-month prevalence of low back pain, neck pain, shoulder pain and kyphosis. This observation agrees with the outcome of two separate studies which reported that there was no significant relationship between weight of school bags carried by the students and the prevalence of musculoskeletal symptoms (Abaraogu et al., 2020; Johnson et al., 2011). A significant positive relationship however exist between the prevalence of scoliosis and lordosis and school bag weight. This can be explained by the fact that carriage of heavy school bags especially with asymmetrical straps can have an effect on the body posture assumed by the students which can result in the development of spinal deformities. These findings are in tandem with that of a study which reported that students who carry a backpack of 15% or more of their body weight are more predisposed to developing lateral spinal tilts (Hong et al., 2011). A significant positive relationship was also noted between the length of the students' school bag on and the 12-month prevalence of neck pain. This may be due to

the fact that the length of the school bag has an influence on the body posture/positioning of the students. Furthermore, an increase in the length of the bag along the spine can result into greater gravitational pull of the bag on the structures of the neck. It was observed that there were no significant relationships between the length of the school bag and the 12-month prevalence of shoulder pain, scoliosis, lordosis or kyphosis among the participants. There is dearth of relevant studies to either buttress or refute the effect of this characteristic on musculoskeletal symptoms. However, an experimental study in which the occurrence of musculoskeletal symptoms was observed with selected positioning of school bags along the spine of the participants, reported the occurrence of either low back pain or neck pain with different positions of the school bag (Chen and Mu, 2018).

It was also observed from this study that there were no significant relationships between the duration of school bag carriage per day and the prevalence of low back pain, neck pain, shoulder pain, scoliosis and lordosis. There was a significant positive relationship between the duration of school bag carriage per day and the prevalence of kyphosis. This outcome is in consonance with a study which reported an insignificant relationship between the duration of school bag carriage and occurrence of MSKs, but at variance with another study which reported a significant relationship between duration of school bag carriage and the prevalence of low back pain, although there was no report of its effect on other anatomical regions (Mwaka et al., 2014; Hong et al., 2011). Carriage of heavy school bags for long durations can lead to the development of repetitive stress injuries on the spine and also the adoption of poor postures, which over a long period of time can lead to the development of musculoskeletal symptoms such as kyphosis. This study also showed non-significant relationships between the style of school bag carriage and the 12-month prevalence of neck pain, prevalence of lordosis and kyphosis. However, there were significant relationships between the style of school bag carriage and the 12-month prevalence of both low back pain and shoulder pain, and also with the prevalence of scoliosis. These findings agree with a study which reported increased levels of MSKs among students who prefer carrying their school bags on a single strap (Abaraogu et al., 2020). There is increased asymmetry in the shoulder, scapulae, pelvis and trunk when school bags are carried inappropriately, thereby resulting in development of MSKs and increased lateral flexion of the spine (Drzał-Grabiec et al., 2015).

Conclusion

This study underscores the urgent need for improved awareness and intervention strategies concerning school bag carriage among secondary school students in Benin City, Edo State, Nigeria. The findings reveal a concerning prevalence of musculoskeletal symptoms (MSKs), particularly in the low back, neck, and shoulders, indicating that school bag carriage remains a significant ergonomic concern. Although not all carriage characteristics demonstrated significant associations with MSKs, several critical relationships were established, including the impact of bag weight on shoulder pain, and the influence of carriage duration on kyphosis. These results suggest that the biomechanical load and posture induced by school bag use can negatively affect students' musculoskeletal health, especially in the formative adolescent years. Furthermore, the study contributes valuable evidence to the global discourse on safe school bag practices, affirming previous reports that asymmetrical bag use and

overweight loads may lead to spinal abnormalities such as scoliosis and lordosis. The statistically significant findings, particularly those relating to carriage style and duration, highlight modifiable risk factors that should be addressed through school-based health education and policy interventions. A holistic approach involving parents, educators, healthcare providers, and policymakers is necessary to implement ergonomic school bag guidelines and promote musculoskeletal health from an early age. Given the limitations and contextual nature of this research, further longitudinal and experimental studies are recommended to establish causal links and investigate long-term musculoskeletal outcomes. Overall, this study adds to the growing body of high-impact research on adolescent health ergonomics and provides critical evidence for the formulation of preventative measures in educational settings.

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Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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