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MUSCULOSKELETAL PAIN AND BACKPACK USAGE AMONG SCHOOL CHILDREN IN NAIROBI COUNTY, KENYA

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ABSTRACT

Background: School children travel to and from school on daily basis. Active transportation such as walking, running and cycling contribute significantly to the increase in physical activity, health, and wellbeing in children. However, there has been a growing concern on the effect of carrying heavy backpack on the health of school going children who are at an important developmental stage of their lives.

Objective: To determine the prevalence of musculoskeletal pain linked to backpack use and associated ergonomic factors among pupils in Nairobi City County in Kenya.

Design: Descriptive cross-sectional study.

Setting: Primary schools in Nairobi County

Subjects: 379 school-going children

Results: The study results indicate that a significant number of pupils (73.6%) complain of musculoskeletal pain. Low back pain (25.1%) was the most prevalent musculoskeletal pain followed by neck pain (16.9%). There was a significant association ($p=0.001$) between backpack weight-to-schoolchild body weight (BTSW %) and the presence of musculoskeletal pain. The proportion of pupils carrying school bag weighing more than 15% of their body weight was 28%.

Conclusion: Prevalence of musculoskeletal pain related to backpack usage among Kenyan school going children is high. School children who carry backpacks that weigh more than 15% of their body weight (BTSW %) are at risk of experiencing musculoskeletal pain.

INTRODUCTION

Musculoskeletal pain is discomfort in the body's joints, ligaments, muscles, nerves, tendons, and structures that support limbs, neck and the back (1). It results from disorders that can affect many different parts of the body including upper and lower back, neck, shoulders and extremities (arms,

legs, feet, and hands). These disorders can be attributed to biomechanical and physical strain. The burden of musculoskeletal pain and disorders can be manifested in lower levels of quality of life, work performance and productivity loss, impaired mobility, sleep disturbance, cardiovascular disorders and work or occupation related absence (2).

Musculoskeletal disorders can arise from a sudden exertion, repetitive strain or over use, or from repeated exposure to force, vibration, or awkward posture (1). Backpacks have a lasting physical impact on the backs of the school children. The physical impact affects the development of the skeletal structures on the children's back. Consequently, these effects may further influence the mechanical activity and flexibility of the child (3).

Many researchers have reported the prevalence of musculoskeletal pain among school going children ranging from 30% to 50%, even though the overall prevalence of musculoskeletal pain such as low back pain in school going children has been shown to be as high as 65% (4). The body structures of the school going children are undergoing rapid growth and therefore excessive load carrying may lead to structural damage due to additional stress (5).

The spines of younger children are more prone to backpack related injury because they lack control and the supporting muscles are not well developed (6). Heavy bags exert mechanical strain on the backs of school children, thus making the backbone to bend with the load (7). Subsequent strain on associated structures such as the muscles and nerves on the back make school children to develop back pains. Posture is especially important in children while the spine is still growing. However, school children tend to lose their posture due to the heavy backpacks that they often carry to the schools. Back pain is now chronic among the poor populations where children carry their heavy bags and walk longer distance (3).

Few studies conducted in Africa, notably in Nigeria, South Africa and Uganda (8, 9, 10) showed that a significantly large number of children experienced musculoskeletal pain that is linked to schoolbag use. Even though there are inconsistencies on recommended backpack weights, professionals agree that many of the

backpacks carried by children are heavy and can cause musculoskeletal injuries hence need to limit the weight (6, 11).

The purpose of this manuscript is to present the overall prevalence of musculoskeletal discomfort, aches, or pain and by body site. It will also present associations across pupil's body weight, backpack weight and backpack weight as a percentage of school child's body weight (BTSW %) with the presence of musculoskeletal pain.

METHODS

Study setting and population: The study participants were upper primary school pupils aged between 8 and 16 years attending class 4 to 8 drawn from 8 primary schools (2 private and 6 public) in Nairobi County.

Study design and sampling: The study used a descriptive cross-sectional research design that lasted 6 months. Starehe Sub – county in Nairobi Kenya was purposively selected for the study due to the metropolitan nature and diversity of the population in terms of socio-economic status. Simple random sampling was used to select the schools. Listing forms were administered in the relevant class rooms in each school to identify pupils who used backpacks. Systematic random sampling was used to select the requisite number of pupils in each school after calculating Kth interval.

Research approval and permission to conduct the study was obtained from the Kenyatta University and County Education Officer while ethical clearance was given by the Kenyatta University Ethical Review Committee. A research permit was also obtained from National Commission of Science Technology and Innovation (NACOSTI). Informed consent from parents/guardian and assent of eligible candidates were obtained.

Variables, definitions and statistical analyses Independent variables of this study included pupil's body weight, backpack weight and backpack weight as a percentage of school child's body weight (BTSW %) while the outcome variable was musculoskeletal discomfort, aches, or pain. An Interview based structured questionnaire was used to get the socio-demographic factors of the school going children. Cornell Musculoskeletal Discomfort Questionnaires (CMDQ) was used to find out musculoskeletal pains or aches in specific regions of the body. An observation checklist was used to verify method of bag carriage and body posture on carriage of backpack. Quantitative data analysis was done using SPSS version 21.0 while statistical significance was set at 0.05.

RESULTS

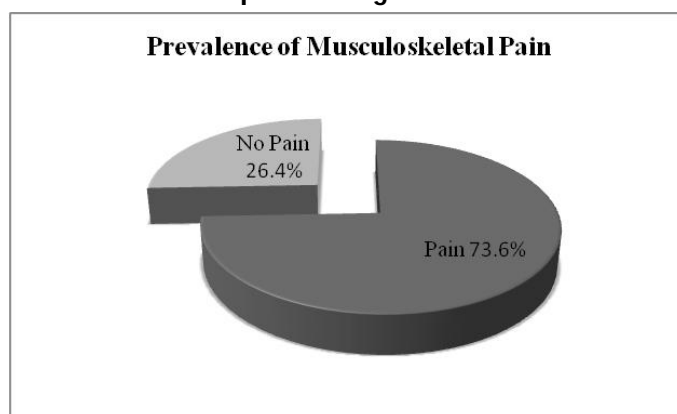
Socio demographic factors: From the total number of 379 school children interviewed, 247 (65%) were from the public primary schools while 132 (35%) were drawn from private primary schools. There were almost equal representation from both gender, 194 (51.2%) of the respondents were males and 185 (48.8%) females. The average age and weight of the participants was 11.97 years and 39.69 kilograms respectively. The maximum age of participants was 16 years and maximum weight was 65 kg. A majority of the participants (21.4%) were aged 13 years while very few (1.8%) were aged 16 years. There was nearly equal distribution of respondents in the four classes (grades) from which they were drawn as shown in Table 1.

Table 1
Socio-demographic Characteristics of Respondents
(N = 379)

Variable	Response	Frequency	Percent
Type of School	Public	247	65
	Private	132	35
Gender	Male	194	51.2
	Female	185	48.8
Age	8 – 11yrs	159	42.0
	12 – 15 yrs	213	56.0
	≥16 yrs	7	2
Class	Class 4	82	21.6
	Class 5	76	20.1
	Class 6	71	18.7
	Class 7	77	20.3
	Class 8	73	19.3
Pupil's weight	26-35 kg	176	46.4
	36-45 kg	62	16.4
	46-55 kg	106	28.0
	56-65 kg	35	9.2

Prevalence of Musculoskeletal Pain: Out of the 379 school children interviewed in this study, majority, 279 (73.6%) reported that they experienced pain when carrying school bag (Figure 1). About a quarter of the respondents (26.4%) did not experience musculoskeletal pain with usage of the backpack.

Figure 1
Proportion of pupils with pain related to backpack carriage



The lower back, neck, and shoulders presented the highest prevalence of musculoskeletal pain while the wrists recorded the lowest prevalence (Table 2).

Most of the participants (25.1%) reported lower back pain while 16.9% had neck pains. The presence of pain in the left shoulder was reported in 14.5% of the respondents while 7.5% experienced pain in the upper back.

Table 2
Prevalence of musculoskeletal pain by site of occurrence (N=379)

Site of pain	Frequency	Percent (%)
Neck	64	16.9
Right shoulder	54	14.2
Left shoulder	55	14.5
Upper back	76	7.5
Lower back	95	25.1
Right Upper arm	31	8.2
Left Upper arm	37	9.8
Right wrist	3	0.8
Left wrist	8	2.1

Exposure to Musculoskeletal pain: The study verified backpack weight as percentage of body weight as a risk factor for musculoskeletal pain. The results indicated that 28% of the pupils carried backpacks weighing more than 15% of their body weight and only 16.4% carried backpacks weighing less than 10% of their body weight (Table 3). More than half (55.7%) of the participants carried bags weighing between 10% and 15% of their body weights.

Table 3
Exposure to risk of musculoskeletal pain (N= 379)

Variable	Description	Frequency	Percent (%)
BTSW%	Less than 10%	62	16.4
	Between 10% and 15%	211	55.7
	More than 15%	106	28
		379	100

Associations between socio-demographic factors and musculoskeletal pain: There was no significant association between gender and presence of musculoskeletal pain ($p>0.05$). However, age was significantly associated with pain ($p<0.05$) as shown in Table 4. The results also showed that majority of the school going children who experienced pain were in the age category of 11-13 years. Most of the respondents who had musculoskeletal pain were of the lowest weight category between 26-35 kg.

Table 4
Socio-demographic factors associated with musculoskeletal pain among study respondents (N = 379)

Variable	Category	Presence of Pain		P - Value
		Yes No (%)	No No (%)	
Gender	Male	140 (36.93)	54 (14.25)	$\chi^2=0.430$, df=1 P=0.512
	Female	139 (36.66)	46 (12.14)	
Age	8 – 10 yrs	58 (15.30)	34 (8.97)	$\chi^2= 9.391$, df=2 P=0.009
	11 – 13 yrs	155 (40.90)	53 (13.98)	
	14 – 16 yrs	66 (17.41)	13 (3.43)	

Associations between body weight, bag weight, bag to school child weight percentage (BTSW %) and musculoskeletal pain: Chi square test indicated that backpack weight and pupil's body weight were significantly associated with pain as shown in Table 5. A logistic regression (Table 6) showed a significant association between backpack weight as percentage of body weight (BTSW %) and the presence of musculoskeletal pain ($p<0.05$).

Table 5
Association between backpack weight, pupil's weight and musculoskeletal pain

Variable	Category	Presence of Pain		P-Value
		Yes No (%)	No No (%)	
Backpack weight	1.5-4.4 kg	111 (29.29)	61 (16.09)	X ² =26.22, P=0.001
	4.5-7.4 kg	138 (36.41)	34 (8.97)	
	>7.5 kg	30 (7.91)	5 (1.32)	
Pupil's weight	26-35 kg	116 (30.61)	60 (15.83)	X ² =0.590, P=0.017
	36-45 kg	50 (31.19)	32 (5.80)	
	46-55 kg	86 (22.69)	23 (6.07)	
	56-65 kg	19 (5.01)	3 (0.79)	

Table 6
Association between backpack weight, bag to school child weight percentage (BTSW%) and musculoskeletal pain (N=379)

Variable	SE	Odds	95% CI	P value
Backpack weight	.157	.456	.336-.620	χ ² = 51.95 P = 0.001
BTSW%	.047	1.218	1.107 – 1.339	

DISCUSSION

Studies conducted globally have noted association of school bag use and musculoskeletal injuries, pain and discomfort (9, 12, 13, 14). Some studies have reported prevalence ranging between 30%-50% with others reporting higher prevalence of 65% (4). This study found a prevalence of 73.6%. The high prevalence could be attributed to the heavy school bags carried by pupils. Majority of Kenyan primary schools lack lockers for keeping books and pupils have to carry loads of books to and from school on a daily basis. The education system has necessitated the use of multiple textbooks for the many subjects taught in

primary school that significantly increases the weight of the school bag. The recurring strain from daily carriage of the weighty bag can easily lead to development of musculoskeletal pain.

The lower back, neck, and shoulders presented the highest prevalence of musculoskeletal pain while the wrists recorded the lowest prevalence. This is because more pressure is exerted on the lower back muscles as the weight of the load rests on lower back. Also, the children bend forward in an attempt to support the weight on the back rather than on their shoulders hence development of neck and back pain. The thin unpadded straps of the backpacks strain the shoulders leading to increased pain and aches. Prevalence in the arms and wrists was low because they are infrequent sites for carriage of school bag. The American Academy of Orthopaedic Surgeons (AAOS) and Consumer Safety Commission (CSC) have reported rising cases of children between the ages 5 to 18 with back and shoulder pain related to the use of heavy backpacks seeking medical attention. Similarly, high prevalence of lower back pain and neck pain were reported in other studies (5, 10)

A significant increase in weight and size of the school bags has been thought to contribute to the pain in the school children (8). This study findings indicate a strong association between backpack weight and occurrence of musculoskeletal pain. This is consistent with other studies which, although not finding linear relationship, reported that pupils who carried heavier backpacks were more likely to have back pain (15, 16, 17). Similar findings have been shown by studies that have investigated school-bag carriage variables that influence the risk of musculoskeletal symptoms such as pain and discomfort in different body regions of primary school children (18, 10). Contrarily, other studies did not report any relationship between backpack weight and

back pain (12, 19). In a separate study (20), it was reported that there was no strong relationship between heavy backpack weight and increased future risk of lower back pain. These differences in results across studies may be attributed to other ergonomic features such as bag design, duration of backpack carriage and disparity in age groups studied.

A maximum school bag weight of not more than 10% of the child's body weight has been recommended in other studies due to the deviations in spinal posture observed (6). This study found out that 28% of pupils had backpacks weighing in excess of 15% of their body weight. This was consistent with other studies results, which reported rates beyond 15% (21, 22, 23). Studies have explored whether there is a critical backpack weight-to body ratio that if surpassed have an effect on health. Backpack load weighing more than 15% of body weight have been proven to affect health by increasing trunk forward lean (24, 25), increasing energy consumption and resulting in decreased lung volumes (24).

Literature indicates that school bag weights of more than 10% of the child's body weight can cause the trunk to lean forward, therefore if body inclination causes low back problems, school bags of 10% body weight exceed the recommended carrying weight for the child (26). This study found a strong association between musculoskeletal pain and backpack weight as percentage of body weight (BTSW %). This is consistent with the findings of a similar study in Uganda (10). The high prevalence of musculoskeletal pain among the school going children in this study can be attributed to the fact that over 80% of the study participants carried school bags whose weights were way above 10% of their respective weights. Prolonged backpack use is associated with neck pain among children who carry backpacks weighing more than 8.5% of their body weight (10).

Consequently, most of the respondents who had musculoskeletal pain were of the lowest weight category between 26-35 kg. This can be explained by the disparity between the school bag weight and the body weight of the pupil. This implies that backpack weight among school going children has to be limited to a load not exceeding 10% of their body weight.

CONCLUSION

The prevalence of musculoskeletal pain related to backpack usage in school going children is high. The most prevalent type of musculoskeletal pain experienced is lower back pain and neck pain. Musculoskeletal pain is significantly associated with school bag weight, pupil's weight and bag to school child weight percentage (BTSW %). School children who carry backpacks that weigh more than 15% of their body weight (BTSW %) are at risk of experiencing musculoskeletal pain.

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