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Prevalence of Musculoskeletal Pain and Body-Chair Mismatch among Junior High School Students in Ghana: A Risk Factor for the Young

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Authors' contributions

This work was carried out in collaboration between all authors. Authors AM and OYB designed the study, wrote the protocol and wrote the first draft of the manuscript. Author BH managed the analyses of the study and transformed it into intellectual context. Author BA performed the statistical analysis. Authors AE and OYC managed the literature searches and editing. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To determine the prevalence of musculoskeletal pain and body-chair mismatch among Junior High School (JHS) students in Ghana.
Study Design: This was a cross sectional study.
Place and Duration of Study: The study was conducted at the Ministry of Health Basic School (MoH), Korle-Bu, Accra Ghana, in May 2016.
Methodology: Two hundred and fifty-five (255) students were recruited for this study. The modified Nordic questionnaire was used to obtain the prevalence of musculoskeletal (MSK) pain information from the participants; a retractable tape measure was also used to measure the body and chair dimensions. All measurements were taken with the participants in T-shirt and shorts and in an erect -sitting position with feet (only socks) flat on the floor. The match-mismatch decisions

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were taken based on existing rules. SPSS version 22.0 and Microsoft excel 2010 were employed to analyze all the study variables.

Results: Two hundred and fifty-five (255) participants were recruited for this study, out of which 133 (52.6%) were males. The mean age of the participants was 13.11±0.98 years. The study comprised of 103 (40.4%) Junior High School one (JHS 1). The prevalence of musculoskeletal pain was 57.5%. There was a significant association between the students' body-dimension and classroom furniture mismatch (p=0.001). Pain intensity level and the forms/level of the students were significantly associated. There was no significant difference between the prevalence of musculoskeletal complaints and the sexes (p=0.522) and forms (p=0.895).

Conclusion: The result of this present study suggests that, there is a high prevalence of musculoskeletal pain among JHS students in Ghana. The high mismatch of the school chairs implies that, they were acquired without ergonomic considerations which could be a risk factor for development of musculoskeletal pain in the young.

Keywords: Mismatch; musculoskeletal; prevalence; junior high school.

1. INTRODUCTION

Musculoskeletal health of young children of school going age is currently a point of global concern [1]. Prevalence of musculoskeletal pain in schoolchildren, as young as 7 years of age, has been reported [2]. Furniture mismatch is thought to contribute to the high prevalence of reported musculoskeletal disorders and MSK pain amongst adolescents [3].

According to the Hazard Identification Risk Assessment and Risk Control study by Nurul et al. [4], universal factors that influence the incidence of musculoskeletal pain in schoolchildren can be divided into three groups; a heavy schoolbag (weighing more than 10% of body weight), ergonomically unsuitable furniture, and incorrect sitting posture [5]. The detrimental effects of improper classroom furniture on the spine have been known for long time [6].

Therefore, matched furniture design and correct sitting posture are important factors for the prevention of musculoskeletal symptom [6-8].

Ghanaian schoolchildren spend about five hours per day sitting down while doing their school work. Considering this, as well as potential use of mismatch school furniture, it is likely that some anatomo-functional changes and problem in the learning process may occur [9].

Popliteal height, knee height, buttock-popliteal length and elbow height are important measurements in determining the dimensions of school furniture that enable schoolchildren to maintain the correct sitting posture [10-12], thereby preventing the health detrimental outcomes [8].

A relationship between furniture mismatch and postural overload has been reported. This is because, when the seat height is low, students increase upper back left inclination and right upper arm elevation, and when the seat is short, students decrease the upper back flexion velocity and upper arm elevation [13]. Studies have implicated mismatch between school furniture and body dimensions as a causative factor for musculoskeletal disorders among students of all ages across the countries [8,14].

Despite the above, there is still no specific legislation or standard for definition of the appropriate furniture characteristics to be used by students in Ghana. This could be attributed to the scarcity of anthropometric database of the studied population and/or inadequate knowledge about ergonomics by policy makers.

Based on extensive literature search, it seems Ghanaian schoolchildren are using school furniture that has been acquired without any ergonomic consideration, which most likely will result in some changes and problems in their musculoskeletal system, as well as a possible decrease in their education performance. This view adds credence to collating adequate data in Ghanaian population to be used in designing classroom furniture to prevent associated health problems. Therefore, the present study seeks to ascertain the prevalence of musculoskeletal pain and body-chair mismatch among Junior High School (JHS) students in Ghana.

2. MATERIALS AND METHODS

2.1 Participants and Study Site

The study was carried out at the Ministry of Health Basic School-Korle-Bu, Accra, Ghana in

May 2016. The school is located at Ablekuma south district in the Greater Accra Region. It was formerly established for the wards of staff of Korle-Bu Teaching Hospital, Ministry of Health and the children around its environs. The site was selected due to its large student number and encompasses students from different socio-economic and ethnic background. All the available classes were considered. There were three classes per form (form ones and twos). The form/level three students were not available for the study because of their busy examination schedule.

Two hundred and fifty-five (255) students who gave their assent and returned a signed consent from a population of three hundred students participated in the study.

The study included students in the selected school who are regular users of the school's chair and excluded students with structural deformities (scoliosis, hyperkyphosis) that can elicit compensatory posture which might interfere with MSK pain.

2.2 Study Instruments

2.2.1 The Nordic musculoskeletal pain questionnaire

This is standardized questionnaire allowing comparison of low back pain, neck, shoulder and general complaints for use in epidemiological studies [15].

The questionnaire concentrates on anatomical areas in which musculoskeletal symptoms are most common. The questionnaire probe more deeply into analysis of the respective symptoms and contain questions on the duration of symptoms over past time (past 12-months and 7-days. The reliability test with the re-test method of preliminary version showed that the number of non-identical answers varied from 0 to 23%. The validity test against clinical history showed that the number of non-identical answers varied from 0 to 20% [16].

2.2.2 Numerical Rating Scale (NRS)

This scale was used to determine the intensity of the students' pain. The end points represent pain experience. The scale ranged from 0-10, with pain intensity 0=''no pain at all'' to pain intensity=10 ''worst possible pain''. Preliminary data suggest that the NRS has good construct validity in a sample of children with acute postsurgical pain aged 7 to 17 years [17].

2.2.3 Tape measure

A 7.5 m measuring tape calibrated in feet and centimeters was used to measure the dimensions of four identical chairs at the study site.

Anthropometric tape calibrated in centimeters was used to take the anthropometric dimensions of the participants.

2.3 Procedure for Data Collection

Ethical approval was obtained from the Ethics and Protocol Review Committee of School of Biomedical and Allied Health Sciences, College of Health sciences, University of Ghana. Permission was sought and obtained from the authorities of the school. Accompanied by a consent form and an information sheet explaining the protocol, the self-administered questionnaires were given to the students who met the inclusion criteria and had returned signed consent forms from their parents.

The students were also given the numerical rating scale to rate their pain after they have sat on the school chair for one to two hours for a class.

The following measures were taken:

2.3.1 Body and chair dimensions

All measurements were taken with the participants in T-shirt and shorts and in an erect-sitting position with feet (only socks) flat on the floor.

2.3.1.1 Sitting popliteal height

This was measured from the vertical distance from the floor to the popliteal angle at the underside of the knee.

2.3.1.2 Gluteal-popliteal length

This was measured from the horizontal distance from the back of the uncompressed gluteal at the back of the knee where the back of the lower legs meets the underside of the thigh.

2.3.1.3 Shoulder sitting height

With the participants seated and their trunk in an upright position, the distance from the seated surface to a position on the spine at the level of

the shoulder (acromion process) was measured and recorded.

From observation in the school, it was found that fixed dual desks made of table-chair combination were used in the school. After measuring the sizes of the furniture, it was observed that there were no variations and all the sizes of the furniture were closely identical thus four similar chairs at the study site were measured and recorded.

2.3.1.4 Seat height

The chair seat height was measured from the vertical distance from the floor to the highest point on the front of the seat.

2.3.1.5 Seat depth

The chair seat depth was measured from horizontal distance of the sitting surface from the back of the seat, at a point where it is assumed that the buttocks begin, to the front of the seat.

2.3.1.6 Backrest height

This was measured from the base of the seat to the top of the shoulder.

2.3.2 Match or mismatch decision

These match-mismatch decisions were taken based on existing rules [6,9,13].

Popliteal height and seat height:

A mismatch or match were recorded and determined if

0.88PH≤SH≥PH0.95

Gluteal popliteal height and seat depth: A mismatch or match were recorded and determined if

0.80GPL≤SD≥GPL0.95

Shoulder height and back rest height**:** A mismatch or match were recorded and determined if

0.60SH≤BH≥SH0.80

2.4 Data Analysis

Statistical Package for Social Sciences (SPSS) version 22.0 software and Microsoft excel 2010 were employed to analyze the data. Descriptive statistic such mean, standard deviation, percentile was used to summarize the data. Inferential statistics of paired t-test was used to determine the mismatches and Mann-Whitney test was to determine the pain intensity level among the JHS ones and twos and chi-square was also used to determine the prevalence of musculoskeletal pain among the forms and sexes. Level of significance was set 0.05.

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Demographic characteristics

A total of two hundred and fifty-five (255) participants were recruited for this study, out of which 133 (52.6%) were males. The mean age of the participants was 13.11±0.977 years. The other demographic characteristics of the participants are summarized in Table 1. The summary of the fixed classroom chair dimensions is presented in Table 2. The body dimensions of the students in erect-sitting position are presented in Table 3.

Table 1. Demographic profile of the participants

Variable	Frequency	Percentage (%)
Age		
11-13	163	63.9
14-16	92	36.1
Total	255	100.0
Gender		
Male	134	52.5
Female	121	47.7
Total	255	100.0
Forms		
JHS 1	103	40.4
JHS 2	152	59.6
Total	255	100.0

3.1.2 Prevalence of musculoskeletal pain

The prevalence of musculoskeletal pain encountered during the last 12 months indicates that the highest 160(62.7%) MSK pain occurred in the shoulder while the least 85(33.3%) MSK pain was occurred in the ankle/feet as presented in Table 4. The point prevalence in this study was 57.5% for all the participants. There was no significant association between musculoskeletal complaints and sexes, musculoskeletal complaints and forms/level as shown in Table 5.

Table 2.Chair dimensions in the school

Dimension/cm	Chair A	Chair B	Chair C	Chair D	Mean	SD
Seat depth	22	22	22.5	21.8	22.08	0.01
Seat height	40	40	40	40	40.00	0.00
Backrest height	34	34	34	35	34.25	0.00

Table 3. Summary of students' anthropometry (cm)

Anthropometry	Mean	SD	5^{th} percentile	95^{th} percentile	minimum	maximum
PH	42.58	2.84	39.00	47.00	22.00	54.00
GPL	45.33	3.85	40.00	51.42	22.00	53.00
SH	52.43	3.38	45.50	58.00	28.00	62.00

Note: SD, Standard Deviation, PH, Popliteal Height, GPL, Gluteal Popliteal, SH, Shoulder Height

Table 4. Prevalence of MSK problems for the last 12 months

Body part	Present	Percentage (%)
Neck	159	62.4
Shoulder	160	62.7
Elbow	141	56.1
Wrist	155	60.8
Upper back	132	51.8
Lower back	143	56.1
Hip/thigh	154	60.4
knees	132	51.8
Ankle/feet	85	33.3
Prevalence rate	1261	57.5

3.1.3 Mismatch comparisons of the chair dimension and students' anthropometric measures

3.1.3.1 Gender

One hundred and eighty-eight (73.7%) had their sitting popliteal mismatching the seat heights, 67 (26.3%) matched heights. Only 42 (16.5%) of the male will find a compatible seat height as against 25 (9.8%) female with matched seat height in the site.

A total of 254 (99.6%) had their gluteal-popliteal length (GPL) higher than the seat depths of the chairs at the site and 1 (0.4%) had their gluteal-popliteal length lower than the seat depth. None of the male had a suitable matched GPL as compared to 1 (0.4%) female matching the GPL in the site.

Two hundred and fifty-four (99.6%) participants had their sitting shoulder height higher than the backrest height of the chairs. Both the male and female did not find a compatible backrest in the site.

3.1.3.2 Forms /levels

Thirty-five (13.8%) of the JHS ones had their sitting popliteal height matching whilst 32 (12.6%) had a suitable popliteal height with the seat height.

All the form ones had their GPL mismatching the chair except 1 (0.4%) had a suitable seat depth.

The backrest of the chair at the site was shorter than the shoulder height of all the form ones and twos.

3.1.4 Comparison of body-chair mismatch

The comparison between the students' body and chair dimensions mismatch was compared using paired t-test. There was significant difference (SH vs. PH, p=0.001, SD vs. GPL, p=0.001, BH vs. Shoulder Height, p=0.001) between the variables as shown in Table 7.

Table 5. Chi-square analysis of prevalence, sex and forms (level)

Variable	Present	Absent	X^2	P-Value	OR (CI 95%)	RR (CI 95%)
Sex						
Male	57	78	0.410	0.522	0.85(0.518-1.397)	0.91(0.684-1.194)
Female	55	64				
Form						
JHS 1	52	51	0.018	0.895	0.97 (0.574-0.934)	0.98(0.869-1.484)
JHS 2	77	73				

JHS: Junior High School, CI: Confidence Interval, OR: Odd risk, RR: Relative Risk

Table 6. Comparison of the pain intensity between the forms/levels

	N	Mean Rank	U	Sig.
JHS one	100	137.60	6290	**0.02***
JHS two	150	117.44		

Table 7. A paired t-test comparison of Body-Chair Mismatch

Body-chair dimension	Mean±SD	t-value	p-value	Eta square
PAIR 1				
Seat height	40.0±0.00	-14.513	**0.001***	0.453
Popliteal height	42.58±2.83			
PAIR 2				
Seat depth	22.08±0.01	-96.556	**0.001***	0.973
Gluteal popliteal length	45.33±2.85			
PAIR 3				
Back rest height	34.25±0.00	-76.140	**0.001***	0.958
Shoulder height	52.43±3.81			

**Significant at p<0.05, SH=Seat Height, PH = Popliteal Height, SD=Seat Depth,*

3.2 Discussion

The purpose of the study was to investigate prevalence of musculoskeletal pain and body-chair mismatch among Junior High School students in Ghana. Classroom furniture are typically acquired and selected without any previous ergonomic considerations which will most likely result in its mismatch. This will intend stress biological tissues hence resulting in MSK problems and complains. This study was encouraged due to limited studies evaluating prevalence of musculoskeletal complaints and body-chair mismatch among Junior High School students in Ghana.

3.2.1 Demographic of the participants and chair characteristics

The current study observed that, the participants were within the age range 11 to 16 years. This was not unexpected as the participants recruited for the study were in Junior High School, where most of the students are in their early adolescent age. This was confirmed by Gouvali et al. [18] where they observed that most of students were in their teens.

With regards to the furniture used by the students, we realized there were no variations and all the sizes of the furniture were closely identical. This vouches with previous studies [8, 19].

3.2.2 Prevalence of musculoskeletal pain

The current study observed a high prevalence rate (57.5%) of musculoskeletal complaints among the Junior High School students. The high prevalence rate could be attributed to multifactorial sources such as static and incorrect posture assumed by the students [20,21], psychosomatic factors [22] and the mismatch furniture [20]. The prevalence rate of MSK pain among students have varied according to previous studies but have been generally high. A study conducted by Ingrid et al. [23] among Brazilian adolescent reported a higher prevalence rate of 72.1%. However, the current study reported a higher prevalence rate as compared to that of Selma et al. [24] which reported a prevalence rate of 48% in primary schoolchildren in Bosnia and Herzegovania and Syazwan et al, [5] which reported a prevalence rate of 36.6% in Malaysian school children.

The part of body with highest prevalence MSK pain among students has been noted to vary slightly across national boundaries. A study conducted among Malaysian students indicated that, the three most affected body parts with MSK pain were the neck, upper back and lower back [25] while Yanto et al. [26] reported that the shoulder, neck and leg were the highest reported MSK pain among Indonesian students. However, this present study showed that the shoulder, neck and wrist were the dominant pain locations. The variations could be due to the type of the body-chair mismatch.

Although there was no significant difference in the prevalence of musculoskeletal complaints among the sexes and forms/level, Odd Ratio (OR) and relative risk (RR) analysis revealed that males have lower risk of MSK pain than their

female counterparts and the form 1 have lower risk of MSK pain compared to the form 2. This is consistent with previous studies [8,27].

3.2.3 Test comparison of participant pain intensities

With regards to the difference in pain intensities between the JHS 1 and 2, the present study showed that the lower form (JHS 1) experienced higher pain intensities than the form 2. This could be explained by anatomical, physiological, physical stress and psychological adaptations by the JHS 2 resulting from prolong use of the school chair as compared to their lower form counterpart. This corroborates the findings of Bello and Sepenu [8]. However, this result is inconclusive as MSK pain in students has been described as multifactorial and therefore, assessment beyond one contact report could have been more informative.

3.2.4 Mismatch comparison of the chair dimension and students' anthropometric measures

3.2.4.1 Shoulder height and back rest height mismatch

A backrest helps in carrying the weight of the body and keeps the pressure on the vertebral disc low [28]. However, the results of the current study showed a significant mismatch in the students' shoulder height and chair back rest height. This could increase the flexed posture of the lumbar spine and as a result increase the compressive load. A back rest matching the natural spinal curve stabilizes the spine, facilitates lumbar lordosis and reduce kyphotic postures [28,29]. According to the current study, the back rest of the chair did not support the entire backs of the students. They supported only the mid-upper back leaving the upper and lower back unsupported. This result in lower back muscles having too much weight to carry thereby leading to MSK pain as experienced by the students as also observed by Bello and Sepenu [8].

3.2.4.2 Sitting popliteal height and seat height mismatch

A match seat height to a sitting popliteal height significantly reduces the tension in the upper and lower back muscles [26]. The result of this study revealed a considerable and significant mismatch between the seat height and sitting popliteal height. The sitting popliteal height was higher than the seat height. This would encourage the students to extend their leg and sit in a forward position hence depriving the students of stability. Also, the low seat height deprives the students back from the back rest which is supposed to be proper for the students' lumbar region hence might significantly put physical stress on the back muscles especially those at the lumbar region and the trapezius muscle at the upper back. The findings of this study also showed that the seat height was appropriate for 16.5% and 9.8% of the male and females respectively which are clearly below the lower limit of acceptable range. These findings corroborate the result of previous studies in which most sampled students were observed to be sitting on a chair with a seat that is too low or too high [8,11,14,29].

3.2.4.3 Gluteal-popliteal height and seat depth mismatch

From the results of the current study, there was a significant mismatch in the seat depth and the gluteal-popliteal height in students' body-chair dimension. The gluteal-popliteal height was higher than the seat width. This may cause students to have sensation of falling off the front of the chair as well as lack of support of lower the thigh as confirmed by Parcell et al. [3,29].

4. LIMITATION

Although the high mismatch between the students' anthropometric data and the class room furniture dimensions is an indicative of the source of the MSK pain among students, we did not assess the other possible risk factors that could contribute to pain in their daily activities. The results of the study were also limited to one school and therefore the findings cannot be generalized.

In future research, it is important to sample more schools and other reported risk factors such as school bag mismatch, ergonomics and home activities should be considered.

5. CONCLUSION

The result of this present study suggests that, there is a high prevalence of musculoskeletal pain among JHS students in Ghana. The high mismatch of the school chairs implies that, they were acquired without ergonomic considerations which could be a risk factor for development of musculoskeletal pain in the young.

Findings from this study could be used as a guide by policy makers and stakeholders of health and education in considering proper ergonomics in the acquisition of school furniture to prevent serious musculoskeletal disorders in the future.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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