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Longitudinal Study: Furniture Mismatch and Student Health in Ghana

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Abstract

Introduction: Mismatch between lecture theatre table and chair and the students' anthropometry have been identified as a major cause of musculoskeletal health issues and academic performance among students. This study tracks students over time by avoiding the cross-sectional measurement of the mismatch. Present study was aimed at investigating the mismatch between students' anthropometry and lecture theatre furniture dimensions on musculoskeletal well-being and academic engagement in a Ghanaian University. **Methods:** With the use of standard equations, matched and mismatched associations experienced by students were confirmed through calculations on the data. Standardised musculoskeletal health issues and academic performance results were recorded with the administration of questionnaires that were carried out at different periods (beginning of semester, mid-semester, and before end of semester examination) in one academic year due to the contribution of cumulative effects of poorly designed furniture. **Results:** Total mismatches recorded 100 % seat-to-table height and table length in both genders, 53.1% (females) and 38.6% (males) in seat height, 92.9 % (females) and 86.3 % (males) in poor backrest. Males' neck pain rises from 42.1 % to 62.9 % at the start to the end of semester, respectively. Pain significantly reduces students' academic engagement at the shoulders (2.97 – 2.27), lower back (2.96 – 2.26), and thigh (3.04 – 2.28). **Conclusion:** The fixed "one-size-fits-all" furniture in Ghanaian university lecture halls causes chronic physical discomfort that leads to increased musculoskeletal pain and a drop in academic performance for students throughout the semester.

Keywords: Academic Engagement, Anthropometric Mismatch, Ghana, Longitudinal Study, Musculoskeletal Health, University Students.

Resumen

Introducción: La discrepancia entre el mobiliario (mesas y sillas) de las aulas universitarias y las características antropométricas de los estudiantes se ha identificado como una causa importante de problemas de salud musculoesquelética y de afectación al rendimiento académico. Este estudio realiza un seguimiento de los estudiantes a lo largo del tiempo, evitando así las mediciones transversales de dicha discrepancia. El objetivo del estudio fue investigar cómo la falta de ajuste entre la antropometría de los estudiantes y las dimensiones del mobiliario de las aulas influye en el bienestar musculoesquelético y el compromiso académico en una universidad de Ghana. **Métodos:** Mediante ecuaciones estándar y cálculos basados en los datos recopilados, se verificaron las situaciones de ajuste y desajuste experimentadas por los estudiantes. Se registraron datos estandarizados sobre salud musculoesquelética y rendimiento académico a través de cuestionarios administrados en distintos momentos de un mismo año académico (inicio del semestre, mitad del semestre y antes de los exámenes finales), con el fin de evaluar los efectos acumulativos de un mobiliario mal diseñado. **Resultados:** La estatura media de los hombres (171,3 cm) es mayor que la de las mujeres (163,4 cm). Se registraron discrepancias totales (100 %) en la relación entre la altura del asiento y la mesa, así como en la longitud de la mesa, en ambos sexos; asimismo, se observaron desajustes en la altura del asiento (53,1 % en mujeres y 38,6 % en hombres) y en el diseño del respaldo (92,9 % en mujeres y 86,3 % en hombres). La prevalencia de dolor cervical en los hombres aumentó del 42,1 % al 62,9 % entre el inicio y el final del semestre. El dolor reduce significativamente el compromiso académico de los estudiantes, afectando zonas como los hombros (puntuación de 2,97 a 2,27), la zona lumbar (2,96 a 2,26) y los muslos (3,04 a 2,28). Conclusión: El mobiliario fijo de talla única utilizado en las aulas universitarias de Ghana provoca molestias físicas crónicas, lo que deriva en un aumento del dolor musculoesquelético y en una disminución del rendimiento académico de los estudiantes a lo largo del semestre.

Palabras Clave: Compromiso Académico, Discrepancia Antropométrica, Ghana, Estudio Longitudinal, Salud Musculoesquelética, Estudiantes Universitarios.

Introduction

Students' working environment, which includes the furniture in lecture theatres, has a great impact on their school performance. School and university furniture have not been given proper attention by ergonomists, whereas the school environment forms a 'working' environment for billions of students (Gouvali & Boudolos, 2006). Universities are made up of students mostly aged 17-30 years of age, who are a working group. Therefore, their anthropometry measurements and furniture dimensions would be evaluated with possible prevalence of musculoskeletal disorders (MSDs) to affect their academic performance, efficiency, and productivity (Torgbenu *et al.,* 2017). Since students spend a lot of time sitting on their tables and chairs, their furniture would need to be designed according to their anthropometric measurements. Omitting students' anthropometry from school furniture design would result in discomfort and poor learning outcomes (Califano *et al.,* 2021; Rosyidi *et al.,* 2016). It is therefore important to ergonomically design school furniture to improve the study environment of the students.

The theoretical basis of this study is ergonomics and anthropometry, which are the design of environments and products to accommodate human capabilities and limitations, and the measures of human body sizes applicable for the fundamental component design of ergonomic furniture, respectively (Bridger, 2017; Dul & Weerdmeester, 2003; Panero & Zelnik, 1979; Pheasant & Haslegrave, 2016). Poor posture and prolonged sitting in ill-fitting lecture theatre furniture are known as risk indicators for MSDs like back pain, neck pain, and shoulder pain (Bello & Sepenu, 2013; Torgbenu *et al.,* 2017).

Literature highlights that anthropometric data vary among populations and cultures (Chung & Wong, 2007). It is therefore imperative to research into Ghanaian university furniture since the populations' anthropometry of other countries makes the use of furniture unsuitable. This study reveals that university students use lecture theatre furniture for studying. When this furniture fails to fit their body dimensions, it can lead to poor sitting posture (Geldhof *et al.,* 2007; Koskelo *et al.,* 2007; Lueder & Rice, 2008; Thariq *et al.,* 2010), lack of concentration, absenteeism, incidence of MSDs, and poor well-being (Dianat *et al.,* 2013).

MSDs have a multifaceted and significant relationship with many aspects of academic engagement (such as behavioural, emotional, and cognitive engagement), affecting students' ability to participate fully in their studies. The subject of this study is significant because the prevalence of MSDs is gaining ground among young people (Ayaz *et al.,* 2023; Harithasan *et al.,* 2022). The study is aimed at investigating students' body and furniture measurements mismatch in one academic year in a lecture theatre in a Ghanaian University. It focuses on health issues and academic engagement.

This study addresses gaps in research by providing longitudinal evidence on the impact of mismatch seating on musculoskeletal health and academic engagement of university students, a subject that may be under-researched (Adeyemi *et al.,* 2020; Parvez *et al.,* 2019). The study responds to the understudied anthropometric needs of university students in Ghana (Bello & Sepenu, 2013) and strives to quantify the long-term effect of furniture mismatch on their academic engagement (Bazaluk *et al.,* 2023).

In Hong Kong, studies have indicated that MSDs are one of the top 10 health problems (Chung & Wong, 2007). Different studies have identified MSDs in people as being caused by poor design of furniture in the working environment (Hoque *et al.,* 2014; Kurban *et al.,* 2015; Vlaović *et al.,* 2008). Reports have also indicated that these MSDs primarily have an impact on the active working population (Vlaović *et al.,* 2008). If the active working population is predominantly impacted by MSDs, productivity would be compromised. The problem must be addressed as a prerequisite to higher efficiency and productivity.

A longitudinal study involves repeated observations of the same variables over extended periods and is appropriate for examining changes over time (Bell & Waters, 2018). In the present study, this design is used to explore the long-term effects of poorly fitted furniture and anthropometric mismatches (Pheasant & Haslegrave, 2018) on the musculoskeletal health and learning activity of Ghanaian university students. Observing potential differences in body size and furniture dimensions in Ghana (Bridger, 2017), the research focuses on the ergonomic importance of integrating furniture design with student anthropometry (Panero & Zelnik, 1979) to improve their physical well-being and learning. The longitudinal design supports repeated data collection for the same cohort of students at Kwame Nkrumah University of Science and Technology (KNUST) over a significant period, allowing assessment of changes and cumulative effects associated with anthropometric mismatches.

Materials and Methods

Study Site

The study was conducted at the Natural Resources Lecture Theatre in the College of Agriculture and Natural Resources of the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi. The College is an amalgamation of two (2) faculties in KNUST that train agricultural and natural resources professionals.

Cohort Design

The cohort in the longitudinal study was undergraduate students sampled from departments within the College of Agricultural and Natural Resources, KNUST. Cohort who were randomly selected and included in the study were those who had their lectures in the theatre, without physical disabilities and prior history of musculoskeletal disorders. We calculated the sample size of 310 students for this study with a population size of 1378 students, as determined by Equation 1 (Taifa & Desai, 2017).

$$n = \frac{N}{1+N(e^2)} \quad (1)$$

Where; n = sample size, N = population size, e = error margin at 5% and at 95% confidence level.

Longitudinal study participants were approached if they were regular attenders of lectures in the sample lecture theatre and available to participate in multiple data collections over the study period (beginning of the semester, mid-semester, and before the end of semester examination) for one academic year. Longitudinal recruitment was necessary to identify changes in musculoskeletal well-being and academic attendance following their ongoing exposure to lecture theatre seating (Bell & Waters, 2018).

Instruments for Data Collection

Standard anthropometric tools such as stadiometer, a measuring tape, and an adjustable chair assisted in recording seven (7) important body measurements (popliteal to floor height, width of bitrochanter, buttock to popliteal length, elbow to seat height, thigh thickness, buttock to knee length, and subscapular height) relevant to furniture fit (Figure 1). These measurements were taken by well-trained staff to ensure consistency and minimise measurement error (Agyapong Afrifah & Glalah, 2021).

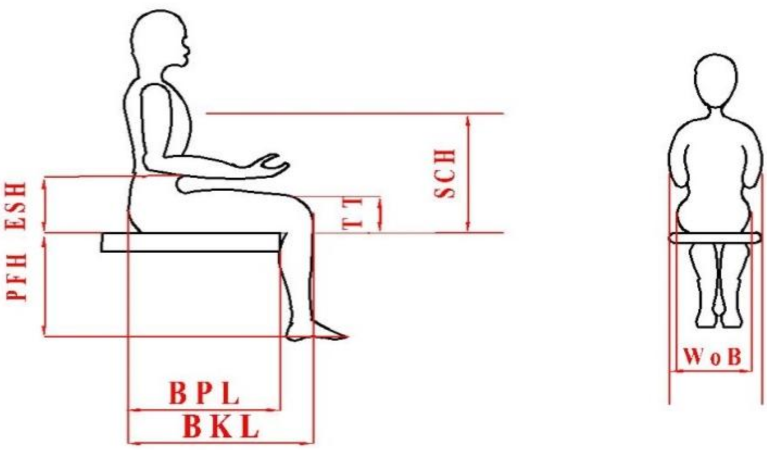

Figure 1. ESH = Elbow-seat height, PFH = Popliteal-floor height, BPL = Buttock_popliteal length, BKL = Buttock knee length, TT = Thigh thickness, SCH = Subscapular height, WoB = Width of bitrochanter.

Furthermore, seven critical dimensions of the lecture theatre table and chairs is shown in Figure 2.

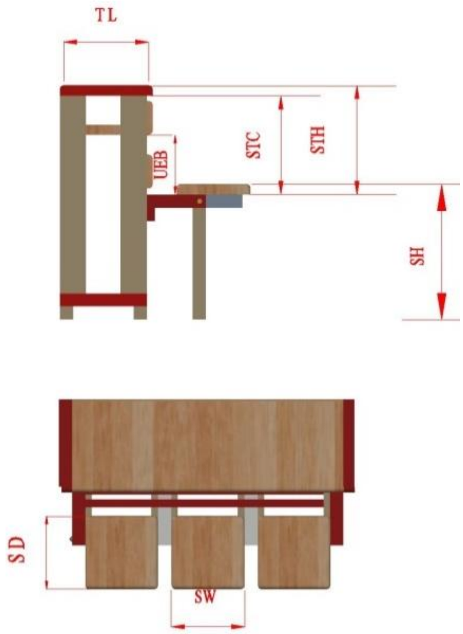

Figure 2. SH = Seat Height, SW = Seat Width, SD = Seat Depth, STC = Seat to Table Clearance, STH = Seat to Table Height, UEB = Upper Edge Backrest, TL = Table Length.

The Standardised Nordic Musculoskeletal Questionnaire (NMQ; Crawford, 2007) was applied to assess the prevalence and severity of musculoskeletal symptoms across eight (8) body regions (neck, shoulders, upper back, lower back, wrists/hands, waist/hips, thighs, and ankles/feet) (Abledu & Offei, 2015; Kuorinka et al., 1987). The NMQ is highly validated and a self-reported questionnaire with high reliability was used to evaluate musculoskeletal disorders in Ghanaian populations (Abledu & Offei, 2015; Kuorinka et al., 1987). A longitudinal approach was adopted to monitor changes in symptoms over the course of the study.

Academic Engagement:

When students are actively involved in their learning - through their actions, feelings, and thoughts (Fredricks et al., 2004) - they tend to achieve better grades and feel more motivated (Kuh, 2009). A comfortable learning environment fosters engagement (Gouvali & Boudolos, 2006), whereas discomfort hinders it. This study examined how furniture fit impacts student engagement by analysing concentration and the physiological effects of discomfort. To measure the various dimensions of academic engagement - behavioural (e.g., participation, attendance), emotional (e.g., interest, belonging), and cognitive (e.g., self-regulation, effort) - a validated Student Engagement Scale was utilised (Cebrián Cifuentes & Guerrero Valverde, 2024; Fredricks *et al.,* 2004; Reeve & Tseng, 2011).

Procedure for data collection

Informed consent was obtained from all participating students, who were assured that their data would remain anonymous and confidential. The procedure began with a detailed, simplified explanation of the study provided to all potential participants.

At the start of the semester, researchers collected students' anthropometric data and measured the dimensions of the lecture theatre furniture. Subsequently, participants' musculoskeletal disorders - including pain in the neck, shoulder, upper back, lower back, waist, wrist/hand, thigh, and ankle/feet were assessed using the Standardized Nordic Musculoskeletal Questionnaire. Academic engagement was simultaneously measured using an engagement checklist covering behavioral, emotional, and cognitive dimensions. These baseline data were used to establish initial "match or mismatch" percentages for every student-furniture pair.

To account for the cumulative effects of poorly designed furniture, researchers conducted repeated measures of musculoskeletal health and academic engagement at mid-semester and again before the end-of-semester examinations. This longitudinal approach utilized serial measurements to document changes in well-being and engagement over the academic year, allowing the researchers to assess whether these shifts correlated with the degree of anthropometric mismatch. Each questionnaire and checklist session took approximately 20 minutes to complete.

Comparison of Sizes between Student's Anthropometry and Lecture Theatre Furniture

Once the anthropometric values and furniture dimensions were obtained, the degree of match or mismatch was calculated for each student at each time point using standard anthropometric and ergonomic formulas (Altaboli *et al.,* 2015; García-Acosta & Lange-Morales, 2007; Khoshabi *et al.,* 2020; Osquei-Zadeh *et al.,* 2012; Parvez *et al.,* 2019; Pérez-Gosende, 2017; Taifa & Desai, 2017). This methodology allowed researchers to monitor whether match and mismatch levels fluctuated or stabilized throughout the course of the study (Table 1).

Table 1. Formulas for calculating the match or mismatch of students' body measurements with furniture dimensions

Furniture dimensions	Corresponding body measurements	Formula
Seat Height (SH)	Popliteal-Floor Height (PFH)	$(PFH + 3)Cos\ 30^o \leq SH \leq (PFH + 3)Cos\ 5^o$
Seat Width (SW)	Width of Bitrochanter (WoB)	$1.10\ WoB \leq SW \leq 1.30\ WoB$
Seat Depth (SD)	Buttock-Popliteal Length (BPL)	$0.80\ BPL \leq SD \leq 0.95\ BPL$
Seat-Table Height (STH)	Elbow-Seat Height (ESH)	$ESH \leq STH \leq ESH + 5$
Seat-Table Clearance (STC)	Thigh Thickness (TT)	$TT + 2 < STC$
Table Length (TL)	Buttock Knee Length (BKL)	$TL \geq BKL$
Upper Edge Backrest (UEB)	Subscapular Height (SCH)	$UEB \leq SCH$

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 25. Descriptive statistics included frequencies, means, standard deviations, and minimum and maximum values.

Results

Descriptive statistics for the seven body dimensions - popliteal-to-floor height (PFH), buttock-to-popliteal length (BPL), Width of bitrochanter (WoB), thigh thickness (TT), elbow-to-seat height (ESH), subscapular height (SCH), and buttock-knee length (BKL) and the furniture dimensions measured at the onset of the study are presented in Tables 2 and 3, respectively. These data were necessary to establish a baseline profile for both the student population and the classroom furniture.

Table 2. Summary of Anthropometric Measurements by Sex in Centimetres

Variable	Mean		SD		Min		Max	
	Male	Female	Male	Female	Male	Female	Male	Female
PFH	46.6	45.2	2.68	2.78	39.0	38.0	53.0	53.0
BPL	49.2	47.8	3.74	3.84	39.0	40.0	59.0	56.0
WoB	36.7	37.4	3.55	4.04	29.5	29.0	46.0	48.0
TT	17.2	17.2	2.59	2.39	12.5	12.5	24.0	23.0
ESH	19.3	19.0	1.59	1.47	15.0	15.0	23.0	22.5
SCH	34.8	34.5	3.56	3.42	28.0	26.0	49.0	45.0
BKL	53.5	52.0	3.79	4.06	45.0	43.0	66.0	61.0

Table 3. Dimensions of the Lecture Theatre Furniture in Centimetre

Variable	Dimensions in centimetres
Seat height (SH)	48.5
Seat depth (SD)	35.0
Seat width (SW)	43.0
Upper edge backrest (UEB)	40.0
Seat to table height (STH)	37.0
Seat to table clearance (STC)	21.0
Table length (TL)	33.0

Anthropometric Match and Mismatch Percentages

Table 4 presents the results of the match and mismatch computations for the lecture theatre chair and table sets, categorised by gender (male and female) based on the extent to which the furniture supported the students' body dimensions.

Table 4. Percentage of Mismatch in Furniture Dimensions by Sex

Furniture dimension	Sex	Match (%)	Low mismatch (%)	High mismatch (%)	Total Mismatch (%)
Seat height	M	61.4	0.5	38.1	38.6
	F	46.9	0.0	53.1	53.1
Seat width	M	55.8	24.9	19.3	44.2
	F	60.2	26.5	13.3	39.8
Seat depth	M	6.6	93.4	0.0	93.4
	F	17.7	82.3	0.0	82.3
Seat to table height	M	0.0	0.0	100.0	100.0
	F	0.0	0.0	100.0	100.0
Seat to table clearance	M	71.1			28.9
	F	73.5			26.5
Table length	M	0.0			100.0
	F	0.0			100.0
Upper edge backrest	M	13.7			86.3
	F	7.1			92.9

Musculoskeletal Disorder (MSD) Prevalence over Time

Table 5 is essential to the longitudinal design of the study, as it reports the prevalence of musculoskeletal symptoms at each of the three time points: the beginning of the semester, mid-semester, and the end of the semester.

Academic Engagement

Table 6 presents the relationship between musculoskeletal pain and students' academic engagement - specifically behavioural (BE), emotional (EE), and cognitive engagement (CE) - across the three time points: the beginning of the semester (1), mid-semester (2), and before the end-of-semester examination (3).

Table 5. Prevalence of Musculoskeletal Disorders (MSDs) Among Male and Female Students Across the Semester

Body region	Beginning of semester (%)		Mid-semester (%)		Before end of semester examination	
	Male	Female	Male	Female	Male	Female
Neck pain	42.1	42.5	51.8	52.2	62.9	64.6
Shoulder pain	34.0	34.5	44.7	46.0	45.2	50.4
Upper back pain	39.1	39.8	48.7	47.8	57.4	57.5
Lower back pain	42.1	45.1	51.3	51.3	60.9	59.3
Waist pain	41.1	41.6	52.8	52.2	61.4	61.1
Wrists/Hand pain	18.8	25.7	41.6	37.2	40.6	42.5
Thigh pain	32.5	34.5	40.6	39.8	48.7	50.4
Ankles/Feet	28.4	28.3	37.6	28.3	45.2	44.2

Table 6. Academic Engagement Scores by Pain Location and Time Point

Pain position	Time point	AverageBE score	Average EE score	Average CE score	Overall academic engagement score
Neck	1	2.85	2.88	3.14	2.96
	2	3.03	2.93	2.94	2.97
	3	1	1	2.97	1.66
Shoulder	1	3.02	2.88	3.00	2.97
	2	3.00	2.84	2.96	2.93
	3	1	2.90	2.90	2.27
Upper back	1	2.90	2.78	3.02	2.90
	2	2.96	2.86	3.00	2.94
	3	1.00	2.88	2.98	2.29
Lower back	1	3.06	2.83	3.00	2.96
	2	2.90	2.87	2.97	2.91
	3	1	2.79	3.00	2.26
Waist	1	2.92	2.84	3.00	2.92
	2	2.94	2.87	2.94	2.92
	3	1	2.90	2.81	2.24
Wrist/Hand	1	2.88	1.00	3.00	2.29
	2	2.91	2.99	3.00	2.97
	3	1	2.84	3.00	2.28
Thigh	1	3.02	3.21	2.90	3.04
	2	2.98	2.81	3.00	2.93
	3	1	2.83	3.00	2.28
Ankle/Feet	1	3.15	2.90	3.00	3.02
	2	1.00	2.79	3.00	2.26
	3	1	2.93	2.88	2.27

Discussion

Table 2 illustrates anthropometric dimensions of Ghanaian male and female university students, which provides the basic reference for the determination of the ergonomic problems with lecture theatre seats. Measured variable such as BKL (buttock-knee length) clearly provides the description of the physical characteristics of the student population. This data is important to the establishment of the solution to the level of anthropometric mismatch between the students and the standard lecture theatre furniture size.

Popliteal-to-floor height (PFH) and buttock-knee length (BKL) sizes are highly significant to chair seat height. Feet of students will dangle if the chair seat height is too high for a student, thereby serving as tourniquet to restrict blood circulation. On the other hand, if the chair seat height is very low, students feel uncomfortable leading to pain at the lower back and the neck.

The problems are further aggravated with higher values of standard deviation (SD), minimum (Min), and maximum (Max). The end results of all the ergonomic mismatches end up in pain at the neck, shoulders, and lower back, as revealed in a follow-up analysis.

Anthropometric data play important role when designing learning space. When static old continuous use of furniture by many university lecture halls is the source of students' discomfort and resulting poor performance. Therefore, this research advocates for reassessment of current furniture standards and the application of more usage of flexible or adjustable furniture to address various measurements of students' body. The outcome will not only be happier and students healthier, but rather improve their concentration, attention to schoolwork, and better educational results.

Ergonomic Analysis of University Lecture Theatre Furniture in Ghana

The Table 3 is about the lecture theatre furniture sizes that are relevant for evaluating their ergonomic fitness for varied student population. The information showed sizes of variables such as seat height, seat depth, and table length. They confirm a "one-size-fits-all" design philosophy that is going to accommodate the diverse range of students' anthropometric measurements.

The one-size-fits-all furniture's dimensions are the basis for anthropometric mismatches, causing poor posture and the incidence of musculoskeletal pain. To some students, seat height of 48.5 cm may be too high for smaller students which can result in dangling feet, pressure at the back of their thighs, discomfort, and retard blood circulation. On the other hand, students who are tall, may find the seat to be too low and as such will force them to take a hunch posture leading to lower back pressure.

In addition, seat depth of 35.0 cm is another important measurement. A deeper seat will not help a shorter student users of the chair to benefit fully from the use of the seat backrest. In the situation where the student wants to benefit from the use of the backrest, seat edge would press into the back of their knees. This scenario will force them to sit with a forward-leaning posture, resulting in an increased pressure on the upper part of the body. Also, the seat to table height of 37.0 cm fixed measurement can result in student experiencing discomfort. However, if this distance is too large, students have no option than to raise their shoulders to write, resulting in strain in the neck and shoulder regions. Furthermore, when this distance is too small, students' knees may be constrained, forcing them into a cramped and awkward positions.

Finally, the data from this table outline a central design shortfall in the lecture theatre furniture: its deficiency of adjustability. This is in direct divergence to modern ergonomic principles where it proposes for furniture that can be designed to accommodate the individual user. The static dimensions not only consider turned blind eye to students' comfort and well-being but also contribute to musculoskeletal pain and reduced academic engagement. To correct this problem, it is important that universities in Ghana as a matter of urgency, embrace ergonomically-sound furniture with adjustable feature attachments to support various students' body measurements and promote a healthier and more favourable learning environment.

Anthropometric Match and Mismatch Percentages

Table 4 reports a detail analysis of the mismatches between students' body measurements and the lecture theatre furniture sizes according to sexes. It is generally clear that significant mismatch, implies that the patronised furniture is particularly not appropriate for the students' body dimensions, leading to self-reported musculoskeletal health issues and reduction in academic engagement.

In this table, majority of students poorly matched their patronised furniture. The most shocking revelation is the 100% total mismatch of male and female students in both seat to table height (STH) and table length. Thus, none of the students' body measurements fit these furniture sizes amounting to bad ergonomic failure. This sharp difference in STH causes students to study in uncomfortable postures leading to pressure on the upper back and neck. Also, shorter table length squeezes space for books, laptops, difficulty in taking notes, and inadequate working environment.

The comparison process also reveals that distinct differences in gender occurred in certain dimensions. Firstly, seat height total mismatch is more in female students (53.1%) than in male students (38.6%). The outcome is that the chairs are too high for the representative female student and resulting in dangling feet and hunching. Secondly, total mismatch for upper edge backrest for the female students (92.9%) compared to the male students (86.3%) also endorses that the backrests are not cushioning the students, especially the females. This lack of support can worsen back ache and sitting pain during long lectures.

The broad and gender different mismatches reported in this table provide straight contributory clarification for the musculoskeletal pain faced by students. The big percentage of students with a way-out fit for basic dimensions like seat height, seat depth, and seat-to-table height explains the occurrence of pain on the lower back, neck, and shoulders. Very serious pain conditions are widely known to be effective distractors, and such pain makes it hard for students to concentrate.

The findings agree with ergonomics guidelines that give an acceptable fit between a human being and the workplace to be a requirement to both health and productivity (Grandjean, 1988; Vimalanathan & Jayachandran, 2016). The findings clearly show the lecture theatre's ergonomic insufficiencies' furniture to be a measurable and fundamental source of discomfort for students. This discomfort is more than just a bother; it is a significant barrier to effective learning and seeking for a scholarship. These differences are highly lessened through the use of properly sized or adjustable furniture to improve the health and academic success of Ghanaian university students.

Musculoskeletal Disorder (MSD) Prevalence over Time

What is worth noting is that percentage of pain in all parts of students' body increases longitudinally from the beginning to the end of the semester. This format supports clearly that prolonged exposure to wrongly sized lecture theatre seating and tables is a key cause of start and continuation of musculoskeletal discomfort.

Neck, upper back, lower back, and waist pains have a regular and vivid increase. For example, male students' neck pain, increases from 42.1% at the start of the semester to 62.9% towards the end-of-semester test. This is high degree of mismatch is demonstrated in seat-to-table height, which end up in students taking up incorrect postures such as forward bending, when reading and writing.

The findings reported in this table are important. The growing pains reported earlier in students can impact directly on their ability to focus in class, take salient notes, and actively engage in the learning process. It is worth noting that the detractors to reduction in students' focusing on teaching and less performance in class are pain and physical discomfort. In fact, not only does the table that forms part of the university lecture theatre furniture offers health risk, it also acts as barrier to effective academic communication. This implies that the study could intensely recommend the adoption of ergonomically optimised and adjustable furniture to alleviate these health risks and enhance the process of learning.

Academic Engagement

Table 6 provides a longitudinal analysis of how anthropometric differences between students and lecture theatre seating affect musculoskeletal health and student participation. Three points in time have data recorded on them, and the findings reveal that there is an interesting trend where deteriorating pain over time is related to declining academic participation as it is measured through three subscales of Behavioral Engagement (BE), Emotional Engagement (EE), and Cognitive Engagement (CE).

With respect to pain and engagement, the results show a robust inverse pattern between reported pain and academic engagement at the three time points. Students reported high average ratings of academic engagement in Time Point 1, ranging from 2.9 to 3.0 at all sites of pain, indicating peak engagement at the beginning of the observation period. However, at Time Point 3, there is a significant fall in the overall academic engagement score for almost all pain positions. For instance, the overall academic engagement score for neck pain fell from 2.96 during Time Point 1 to 1.66 during Time Point 3. Lower back pain also registered a fall from 2.96 to 2.26. This constant decrease is as a result of longer periods of time spent sitting on ill-fitting furniture leading to more discomfort, finally impacting a student's ability to concentrate on his or her studies negatively.

A quicker look at the variables of academic engagement such as Behavioral Engagement (BE), Emotional Engagement (EE), and Cognitive Engagement (CE) reveal a subtler impact. For most of the sites of pain (e.g., neck, shoulder, lower back), the BE score reduces the most by Time Point 3. This could be due to pain producing restlessness and an inability to maintain attention, leading to fidgeting, position change, or a rampant need to stand up.

Finally, the results stressed the need of a review of ergonomic design standards for Ghanaian universities lecture theatre furniture. The execution of ergonomic interventions like adjustable seats and desks or making available furniture in different sizes to fit a varied student population, can minimize negative effects reported. This in effect is beyond a comfort matter but an important factor in students' health and academic achievement. The study strongly proposes that zero pain and comfortable learning environments are the key to effective academic engagement and success.

Conclusions

The continuous failure of "one-size-fits-all" furniture in the various universities in Ghana creates a serious ergonomic mismatch that goes beyond ordinary discomfort. However, it acts as a straight catalyst for increasing musculoskeletal pain and a significant barrier to holistic academic engagement. By failing to give reason for the anthropometric variety of the student body, these rigid environments bring about physical strain that degrades behavioral, emotional, and cognitive participation over time. Therefore, the research outlines that traversing to adjustable or varied-dimension furniture is not an elective upgrade but a necessary institutional intervention to safeguard student health and optimise educational outcomes.

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