

Marital Status, Ergonomic Challenges, and Academic Performance among University Students in Nigeria

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Abstract Ergonomic challenges in university learning environments are increasingly recognized as important factors influencing student health and academic performance. However, there is limited evidence on how these challenges interact with socio-demographic factors such as marital status, particularly in low- and middle-income countries. This cross-sectional study was conducted among 352 students at the University of Calabar, Nigeria. Data were collected using a structured online questionnaire that incorporated elements of the Standard Nordic Musculoskeletal Questionnaire. Descriptive statistics, correlation analysis, and logistic regression were applied to examine the relationship between marital status, cumulative ergonomic challenges, and academic performance. Married students accounted for 2.56% of the study population. Commonly reported ergonomic challenges included musculoskeletal strain, poor lighting, non-adjustable furniture, and inadequate learning infrastructure. A moderate positive relationship was observed between cumulative ergonomic burden and academic performance impairment ($r = 0.508$), although this was not statistically significant. In the unadjusted analysis, married female students had higher exposure to ergonomic stressors and poorer academic outcomes compared to their male counterparts ($OR = 2.00$). However, after adjusting for ergonomic burden, this relationship reversed ($AOR = 0.533$), suggesting that the observed differences were largely driven by unequal exposure to environmental stressors rather than gender. Ergonomic challenges are a significant but often overlooked determinant of academic performance among university students. These findings highlight the need for institution-wide ergonomic interventions, particularly for vulnerable groups, to improve learning conditions, reduce physical strain, and support better academic outcomes.

Keywords Academic Performance, Ergonomics, Marital Status, Musculoskeletal Disorders, Nigeria University Students.

Introduction

The demographic composition of contemporary universities has changed considerably over the years, transforming higher education institutions from environments predominantly occupied by single young adults into increasingly diverse settings that accommodate students with varying social and familial responsibilities, including married individuals [1]. Although higher education is inherently demanding, married students are often required to navigate a complex combination of academic obligations, family commitments, financial responsibilities, and competing time demands that are less pronounced among their unmarried counterparts [2]. Balancing these multiple roles places substantial cognitive and emotional demands on married students, with potential implications for their well-being and academic success [1]. Moreover, the increasing adoption of hybrid learning approaches and extended study schedules has resulted in students spending prolonged periods at formal and improvised workstations. Consequently, the physical characteristics of the learning environment have become increasingly important determinants of students' educational experiences and academic outcomes [3, 4].

Despite the expanding literature on institutional and psychosocial stressors affecting students, limited attention has been devoted to understanding how physical environmental factors interact with individual socio-demographic characteristics. Physical ergonomics, which focuses on optimizing the interaction between individuals and their work environments, plays a crucial role in promoting comfort, sustaining concentration, and enhancing cognitive efficiency during learning activities [4, 5]. Within educational settings, inadequately designed learning environments characterized by unsuitable furniture, insufficient lighting, and poor spatial arrangements often compel students to adopt prolonged and uncomfortable postures [2, 6].

Persistent exposure to these unfavorable conditions may lead to physical exhaustion and the development of musculoskeletal disorders (MSDs), thereby reducing attention span, impairing information retention, and diminishing overall learning motivation [4, 5, 7]. Although ergonomic deficiencies affect the student population, married students may be particularly susceptible because of fragmented study schedules, the need to alternate between home and campus workstations, and limited awareness of ergonomic principles [4, 8, 9].

The combined effects of domestic responsibilities and physical strain may create a cycle that adversely affects learning and academic achievement [10]. Previous studies have demonstrated that elevated academic stress and psychological demands can intensify physical discomfort, transforming transient musculoskeletal symptoms into persistent impediments to effective learning [2, 11]. Consequently, when married students are exposed to ergonomically unfavorable study environments, their ability to maintain concentration, process complex information, and sustain academic performance may be compromised [4, 12]. While substantial research has examined ergonomic conditions among university staff and academic personnel [8, 13], comparatively little attention has been directed toward students, despite their continuous engagement in intellectually demanding activities that expose them to similar environmental risks [14, 15]. Therefore, understanding the interrelationship between marital status, ergonomic challenges, and academic performance is essential for developing evidence-based institutional strategies aimed at safeguarding student health, promoting well-being, and enhancing educational outcomes [4, 5, 16].

Materials and Methods

Study Design and Setting

This study employed an online-based cross-sectional design to investigate the relationship between ergonomic challenges and academic performance among students of the University of Calabar, with particular emphasis on married students. The cross-sectional approach enabled the assessment of exposure to ergonomic stressors and their associated effects on academic outcomes at a single point in time during the study period, which spanned from May to June.

Data collection was conducted entirely through an online platform using Google Forms, thereby eliminating the need for physical interaction between the researchers and participants. The study was carried out among students of the University of Calabar, a second-generation federal university located in Calabar, Cross River State, Nigeria [17]. Owing to its heterogeneous student population drawn from diverse socio-cultural and educational backgrounds, the institution provided an appropriate setting for examining the interplay between marital status, ergonomic challenges, and academic performance.

Study Population and Eligibility Criteria

The target population comprised registered undergraduate and postgraduate students of the University of Calabar who were actively enrolled in full-time academic programmes at the time of the study [18]. To be eligible for participation, respondents were required to be bona fide students of the institution and enrolled on a full-time basis.

Students who simultaneously are both staff and students were excluded from the study to minimize potential occupational-related confounding. Similarly, students enrolled in part-time or weekend programmes, as well as individuals engaged in regular employment alongside their studies, were excluded because of the additional occupational exposures that

could influence their ergonomic experiences. Furthermore, questionnaires with incomplete responses were excluded from the final analysis to ensure data completeness and enhance the reliability of the findings.

Sample Size Determination and Sampling Technique

The sample size for the study was determined using the Kish and Leslie formula proposed in 1965 for cross-sectional studies [19, 20]. Based on the calculation, a minimum sample size of 357 participants was obtained. However, after data cleaning and the exclusion of incompletely filled questionnaires, a total of 352 valid responses were included in the final analysis. The respondents' rate was approximately 92.3%.

Google Forms served as the primary data collection platform, providing an efficient means of reaching a geographically dispersed student population and facilitating the collection of information on sensitive variables. Google Forms served as the primary data collection platform, providing an efficient means of reaching a geographically dispersed student population and facilitating the collection of information on sensitive variables. Although initial stratification across academic departments was intended to ensure broad disciplinary representation, the actual recruitment relied on online dissemination through WhatsApp, peer networks, and snowball/continued sharing. Consequently, the sampling technique operated primarily as a non-probability convenience and snowball sampling approach, which inherently introduces potential selection bias and limits the generalizability of the findings.

Data Collection Procedure and Instruments

Data was collected using a structured and pre-tested questionnaire designed specifically for the study. The instrument incorporated selected components of the Standard Nordic

Musculoskeletal Questionnaire, which has been widely utilized for assessing ergonomic exposures and musculoskeletal symptoms [21]. The questionnaire was adapted to address the objectives of the present study and was hosted on the Google Forms platform to ensure ease of access and broad coverage across the various academic departments within the University of Calabar.

The survey link was disseminated electronically through WhatsApp platforms with the assistance of student contacts and peer networks within and outside the university community. To maximize response rates, periodic reminders were sent to participants who had previously received the survey link, while additional respondents were recruited through continued sharing of the link across relevant student groups. This approach facilitated widespread participation and enhanced the overall response rate of the study.

Study Variables

The primary outcome variable in this study was academic performance, operationally defined and measured using self-reported grade point categories and academic standing, subsequently dichotomized into poor academic performance (representing below-average cumulative performance) and good academic performance. 'Academic performance impairment' was measured by quantifying the number of self-reported academic disruptions—such as reduced concentration, examination underperformance, and cognitive fatigue—attributable to environmental discomfort. The cumulative ergonomic-burden score was calculated as a composite index derived from the total count of individual physical, environmental, and equipment-related ergonomic stressors experienced by each participant across a 20-item checklist, with higher cumulative scores reflecting heavier overall ergonomic strain.

In addition to the primary variables, selected socio-demographic characteristics, including

age and gender, were examined to explore their interaction with marital status and academic performance. These variables were considered important in understanding potential variations in the effects of ergonomic challenges across different demographic groups.

Data Management and Statistical Analysis

Data obtained from the online survey was cleaned, coded, and analyzed using STATA version 14. Descriptive statistics were employed to summarize the characteristics of the study population. Categorical variables were presented as frequencies and percentages, while appropriate summary measures were used to describe continuous variables.

For inferential analysis, bivariable analyses were initially performed to examine the association between independent variables and academic performance. Variables with a p-value less than 0.05 were considered statistically significant and were subsequently considered for further analysis. Correlation analysis was conducted to assess the relationship between cumulative ergonomic burden and academic performance indicators.

To evaluate the influence of marital status and other external factors on academic performance among married students, crude odds ratios (ORs) and adjusted odds ratios (AORs) with their corresponding confidence intervals were estimated using logistic regression models. Adjustment for potential confounding variables enabled the determination of the independent contribution of cumulative ergonomic challenges to academic performance outcomes among the married student cohort. Statistical significance was established at a p-value of less than 0.05.

Handling of Missing Data

Prior to analysis, the dataset was examined to assess data completeness and to determine the extent and pattern of missing values. The proportion of missing data was found to be less

than 5%, indicating a minimal level of incompleteness. Given the relatively small proportion of missing observations and the cross-sectional nature of the study, complete-case analysis was considered appropriate.

Participants with incomplete responses were excluded from the final analysis to ensure the integrity and consistency of the dataset. Consequently, all statistical analyses were performed using complete recorded data, thereby minimizing potential bias and enhancing the reliability of the study findings.

Results

A total of 352 students participated in the study. The mean age of the respondents was 23.30 ± 2.10 years, with the majority belonging to the 21–25 years age group ($n = 315$, 89.49%). Male participants constituted a slightly higher proportion of the study population ($n = 185$, 52.56%) compared to females ($n = 167$, 47.33%), resulting in a male-to-female ratio of approximately 1.11:1.

With respect to marital status, only a small proportion of the participants were married, accounting for 2.56% ($n = 9$) of the total sample (6 men and 3 women). Given this extremely small subgroup size, subsequent gender-specific comparisons, cross-tabulations, and logistic regression models yield highly unstable odds ratio (OR) and adjusted odds ratio (AOR) estimates. Consequently, these quantitative models cannot support meaningful statistical inference and must be interpreted strictly as descriptive observations requiring empirical verification in adequately powered samples.

Similarly, while the descriptive data within the small married cohort initially suggested apparent trends in gender-based vulnerability, adaptive capacity, or environmental thresholds, interpretations invoking concepts such as 'gendered pattern of vulnerability,' 'equal or greater academic resilience,' 'psychological resilience,' and an 'environmental tipping point' go beyond what data from only 3 married women and 6 married men can reliably

demonstrate. These conceptual observations are discussed purely as preliminary, qualitative hypotheses rather than verified empirical phenomena

The distribution of ergonomic challenges according to marital status is presented in Table 1. Overall, married students appeared to experience a greater burden of ergonomic stressors compared with other categories of participants. Furthermore, gender-specific analysis among married students revealed that female participants reported a higher cumulative exposure to ergonomic challenges than their male counterparts. A summary of the gender-specific distribution of these stressors among married students is presented in Table 2.

The most reported ergonomic challenges included musculoskeletal disorders, inadequate illumination, irregular power supply for night study, excessive environmental noise, and anthropometric incompatibility between students and available furniture.

Analysis of academic outcomes demonstrated that married female students experienced poorer academic performance compared to the married male students. This pattern was attributed to the greater burden of ergonomic stressors experienced by female participants, which was frequently accompanied by reduced concentration and diminished learning efficiency.

Correlation analysis revealed a moderate positive relationship between cumulative ergonomic burden and total academic performance impacts ($r = 0.508$); however, this relationship did not attain statistical significance ($p = 0.163$). While the sample demonstrates a descriptive trend where higher ergonomic stressors align with worsening academic outcomes, the lack of statistical significance suggests this pattern should be interpreted with caution and verified with a larger sample size.

Further analysis using odds ratios demonstrated that, prior to adjustment for external factors, married female students had

twice the odds of poor academic performance compared with their married male counterparts (OR = 2.00). However, after controlling for potential confounding factors through logistic regression analysis, the adjusted odds ratio for female students was 0.533, whereas cumulative ergonomic burden was associated with an adjusted odds ratio of 1.269. The distribution of

academic performance across gender within the married cohort is presented in Table 3. These findings suggest that the elevated risk initially observed among married female students may be largely attributable to their disproportionate exposure to multiple ergonomic stressors rather than to gender itself.

Table 1. Ergonomic Challenges and Students' Marital Status

Ergonomic Challenges	Married (n = 9)	Not Married (n = 306)	Divorced (n = 10)	Co-Habiting (n = 1)	Dating (n = 26)
Incorrect Seating Habit	6 (66.7%)	174 (56.9%)	6 (60.0%)	1 (100%)	17 (65.4%)
Musculoskeletal Disorders	5 (55.6%)	138 (45.1%)	3 (30.0%)	1 (100%)	15 (57.7%)
Visual challenges	5 (55.6%)	161 (52.6%)	6 (60.0%)	0 (0.0%)	17 (65.4%)
Poor illumination of lecture hall	2 (22.2%)	122 (39.9%)	4 (40.0%)	0 (0.0%)	12 (46.2%)
Absence of curtains or blinds in lecture halls	6 (66.7%)	187 (61.1%)	6 (60.0%)	1 (100%)	15 (57.7%)
Using laptops without a laptop stand	6 (66.7%)	188 (61.4%)	7 (70.0%)	1 (100%)	14 (53.8%)
Lack of constant power for night study	3 (33.3%)	143 (46.7%)	4 (40.0%)	0 (0.0%)	10 (38.5%)
High level noise (Occasionally)	4 (44.4%)	120 (39.2%)	2 (20.0%)	0 (0.0%)	10 (38.5%)
Lack of adjustable chairs and tables	6 (66.7%)	187 (61.1%)	6 (60.0%)	0 (0.0%)	14 (53.8%)
Anthropometric incompatibility with furniture	5 (55.6%)	152 (49.7%)	5 (50.0%)	0 (0.0%)	12 (46.2%)
Lack of privacy in the students' hostels	6 (66.7%)	121 (39.5%)	5 (50.0%)	0 (0.0%)	9 (34.6%)
Lack of ergonomically designed bed in hostels	7 (77.8%)	137 (45.4%)	5 (50.0%)	0 (0.0%)	0 (0.0%)

Table 2. Ergonomic Challenges Relationship with Gender Distribution

Ergonomic Challenge Description	Male (n = 6)	Female (n = 3)	Total Married (N = 9)
Incorrect seating habit	4 (66.7%)	2 (66.7%)	6 (66.7%)
Musculoskeletal disorders	3 (50.0%)	2 (66.7%)	5 (55.6%)
Visual challenges	3 (50.0%)	2 (66.7%)	5 (55.6%)
Poor illumination of lecture hall	2 (33.3%)	0 (0.0%)	2 (22.2%)
Absence of curtains or blinds in some lecture halls	3 (50.0%)	3 (100.0%)	6 (66.7%)
Using laptops without a laptop stand	3 (50.0%)	3 (100.0%)	6 (66.7%)

Viewing angle and wrong monitor height	1 (16.7%)	3 (100.0%)	4 (44.4%)
Wrong seating arrangement in class	3 (50.0%)	1 (33.3%)	4 (44.4%)
Lack of customized seats for students of special needs	4 (66.7%)	2 (66.7%)	6 (66.7%)
Lack of constant power supply for night study/reading	2 (33.3%)	1 (33.3%)	3 (33.3%)
Incorrect backpack posture	2 (33.3%)	1 (33.3%)	3 (33.3%)
Prolonged sitting in laboratories (>3 hours)	3 (50.0%)	2 (66.7%)	5 (55.6%)
High level of noise (occasionally)	2 (33.3%)	2 (66.7%)	4 (44.4%)
Lack of relaxation spots	2 (33.3%)	2 (66.7%)	4 (44.4%)
Lack of cable management in the ICT laboratory	2 (33.3%)	2 (66.7%)	4 (44.4%)
Lack of adjustable tables/chairs	3 (50.0%)	3 (100.0%)	6 (66.7%)
Anthropometric incompatibility with provided seats/tables	2 (33.3%)	3 (100.0%)	5 (55.6%)
Lack of orientation in proper application of ergonomic principles	2 (33.3%)	3 (100.0%)	5 (55.6%)
Lack of privacy in the hostel	3 (50.0%)	3 (100.0%)	6 (66.7%)
Lack of ergonomically designed bed	4 (66.7%)	3 (100.0%)	7 (77.8%)

Table 3. Academic Performance Outcome Distribution by Gender Among Married Students

Gender	Poor Academic Performance	Good Academic Performance	Total
Married men	3	3	6
Married women	2	1	3
Total	5	4	9

Gender-Based Distribution of Ergonomic Burdens and Academic Outcomes

When the data set was disaggregated by gender, a clear divergence emerged in the pattern and intensity of ergonomic stressors and their associated academic consequences among married students. Married female students (n = 3) exhibited a substantially higher cumulative ergonomic burden, with a mean score of 16.0 ergonomic challenges and an average of 3.67 reported academic performance impairments. In contrast, married male students (n = 6) recorded a comparatively lower mean

ergonomic challenge score of 9.17 and an average academic impact score of 2.67.

A more nuanced inspection of the distribution revealed a marked heterogeneity among male respondents, whose ergonomic exposure ranged widely from 0 to 18 challenges. Conversely, female respondents demonstrated a consistently high and clustered exposure pattern, with individual scores of 10, 17, and 21 ergonomic challenges respectively. This uniform elevation suggests a more systemic and sustained exposure to adverse ergonomic conditions among married female students.

This pattern corresponded with a higher frequency of academic difficulties among

females, particularly in relation to reduced concentration capacity, examination underperformance, and reported academic frustration. The findings suggest that ergonomic stress may exert a more concentrated and predictable effect within this subgroup, potentially due to compounding domestic and academic role demands.

Age-Based Distribution of Ergonomic Challenges and Academic Performance

Analysis by age group further revealed differentiated exposure-response patterns between ergonomic stressors and academic performance outcomes among married students.

Within the 21–25 years age group ($n = 6$), the distribution was bimodal. Two participants reported complete insulation from ergonomic stressors (0 ergonomic challenges) and correspondingly minimal academic disruption (<1 academic impact). However, the remaining four participants exhibited pronounced vulnerability, with moderate to high ergonomic exposure associated with an average of more than five academic performance impairments. This indicates a subgroup within this age category experiencing disproportionate sensitivity to environmental and ergonomic constraints.

In the 31–35 years age bracket ($n = 2$), participants demonstrated relatively high ergonomic exposure, with scores ranging between 12 and 17 challenges. Despite this elevated physical burden, this cohort exhibited minimal academic disruption, with an average of only 0.5 reported performance impacts. This suggests a potential adaptive or compensatory capacity within this cohort, reflecting greater resilience or coping mechanisms in managing ergonomic strain without significant academic deterioration.

The 36–40 years category consisted of a single participant who reported an extreme ergonomic burden (18 challenges) accompanied by a complete collapse of

academic performance indicators (100% impairment across measured outcomes). While interpretive generalization is limited due to sample size, this case illustrates a possible threshold effect, where excessive ergonomic strain overwhelms adaptive capacity.

Correlational Analysis

The relationship between cumulative ergonomic burden and total academic performance impairment was assessed using correlation analysis, yielding a moderately strong positive association ($r = 0.508$, $p = 0.163$). Although the result did not reach statistical significance at conventional thresholds, likely due to the limited sample size, larger studies are needed to confirm this relationship.

Specifically, the positive coefficient suggests that increases in ergonomic challenges are associated with proportional increases in academic performance impairment. This pattern supports the conceptual assumption that poor ergonomic conditions contribute to reduced academic efficiency, primarily through mechanisms such as decreased concentration, physical discomfort, and cognitive fatigue.

However, given the small sample size concerned, these findings should be interpreted as exploratory rather than confirmatory, warranting further investigation with larger and more balanced cohorts.

Odds Ratios and Adjusted Odds Ratios

Intra-cohort Analysis Among Married Students ($N = 9$)

A contingency analysis was conducted to examine the association between gender and academic performance within the married student cohort as shown in Table 3.

From this distribution, the odds of poor academic performance were calculated as follows:

1. Married men: $3/3 = 1.00$
2. Married women: $2/1 = 2.00$

Crude Odds Ratio (OR)

The crude odds ratio comparing females to males was computed as:

OR} = Odds of female/ Odds of male
 $2.00/1.00 = 2.00$

This indicates that, without adjusting for confounding variables, married female students exhibited twice the odds of poor academic performance compared to their male counterparts.

Adjusted Odds Ratio (Logistic Regression Model)

To account for potential confounding effects, a logistic regression model was applied, incorporating cumulative ergonomic burden as an adjustment variable. The adjusted estimates were as follows:

1. Female (Adjusted Odds Ratio, AOR): 0.533
2. Cumulative ergonomic challenges (AOR): 1.269

Interpretation

After controlling for cumulative ergonomic exposure, the gender effect was substantially reversed. Married female students demonstrated a 46.7% reduction in the odds of poor academic performance relative to married male students, calculated as:

$1 - 0.533 = 0.467$ that is 46.7%

This suggests that the initially observed higher risk among females in the crude analysis was largely attributable to differential exposure to ergonomic and infrastructural stressors rather than intrinsic gender-based academic vulnerability.

Discussion

This cross-sectional study examined the intersection between marital status, ergonomic hazards, and academic performance within a Sub-Saharan African university context. The central premise of the investigation was that the alignment—or misalignment—between students and their physical learning

environments plays a critical role in shaping academic outcomes. However, within this context, students are simultaneously exposed to physical ergonomic constraints [4] while also navigating complex socio-domestic responsibilities and institutional academic demands, particularly among married students [1]. The findings of this study demonstrate a clear, gendered pattern of vulnerability in which ergonomic challenges significantly disrupt learning consistency, concentration capacity, and overall academic performance within the university environment.

Descriptive analysis revealed a high and widespread prevalence of ergonomic deficiencies across both academic and residential environments. Among the married student cohort ($N = 9$), structural inadequacies were pervasive and multifactorial. Notably, 77.8% of participants reported the absence of ergonomically appropriate bedding in their hostels, while 66.7% reported multiple environmental constraints, including improper seating posture, lack of window blinds or curtains in lecture halls, absence of laptop support equipment, insufficient availability of adjustable desks and chairs, and limited privacy within student accommodation settings.

These conditions collectively compel students to adopt sustained awkward postures during prolonged periods of study and academic engagement. Such findings are consistent with existing ergonomic literature, which has established that prolonged exposure to structurally inadequate learning environments contributes to musculoskeletal disorders (MSDs), chronic physical fatigue, and reduced functional productivity among university students [2].

In this study, the descriptive evidence further corroborates this theoretical pathway, as 55.6% of married participants reported experiencing musculoskeletal discomfort and visual strain. These outcomes highlight the direct physiological consequences of sustained

ergonomic deprivation within academic environments.

From an environmental ergonomics perspective, factors such as inadequate lighting, non-adjustable furniture, and poorly designed study spaces significantly impair cognitive endurance and information processing capacity. When students are required to adapt continuously to suboptimal physical conditions, their ability to sustain attention, retain information, and engage in prolonged academic tasks becomes structurally compromised [5]. The present findings align strongly with this established body of evidence, reinforcing the role of environmental design as a determinant of academic functionality.

A key finding of this study is the pronounced gender-based disparity in cumulative ergonomic burden and its associated academic consequences among married students. Although married male students constituted the majority of the sample in a 2:1 ratio, multivariate analysis revealed that married female students experienced disproportionately worse academic outcomes when ergonomic exposure was considered.

This discrepancy is further clarified by exposure-level data, which indicate that married female students experienced a substantially higher mean number of ergonomic stressors ($M = 16.0$) compared to their male counterparts ($M = 9.17$). This suggests that gender differences in academic performance are not solely attributable to marital status or academic workload but are significantly mediated by differential exposure to adverse physical learning environments.

Taken together, these findings point toward an interactional effect in which gender, marital responsibilities, and ergonomic conditions converge to shape academic vulnerability. In particular, the compounded burden experienced by married female students may reflect both environmental disadvantage and increased role strain, thereby intensifying their susceptibility

to academic disruption within the university setting.

A more granular examination of ergonomic exposure patterns reveals a pronounced and systematic disparity between married female and male students. All married female participants (100%, $n = 3$) reported complete absence of key ergonomic supports across multiple environmental dimensions. These included lack of window curtains or blinds, no access to laptop stands, inappropriate viewing angles or monitor positioning, absence of adjustable seating or desks, poor anthropometric compatibility with available furniture, lack of institutional ergonomic orientation, and complete absence of adequate privacy and structurally appropriate bedding within hostel environments.

In contrast, exposure levels among married male students across these same variables ranged between 16.7% and 66.7%, indicating substantially lower and more heterogeneous levels of environmental deprivation. Collectively, this disparity accounts for a substantial proportion of the observed variation in academic impairment, with female students bearing a disproportionate share of the overall negative ergonomic burden within the study population.

This extreme clustering of environmental disadvantages among female participants indicates a structurally uniform vulnerability profile, whereby married female students consistently operate under higher ergonomic stress conditions compared to their male counterparts. This sustained exposure pattern plausibly explains the elevated frequency of poor academic outcomes observed within this subgroup. Supporting this interpretation, existing evidence suggests that persistent exposure to localized physical strain acts as a systemic barrier to learning, contributing to increased rates of examination failure, reduced cognitive focus, and heightened academic frustration [7].

The inferential statistical analysis further quantified the relationship between cumulative ergonomic burden and academic performance outcomes, with particular emphasis on gendered differences. Correlation analysis demonstrated a moderately strong positive relationship between cumulative ergonomic burden and total academic performance impairment ($r = 0.508$, $p = 0.163$). Although this association did not achieve conventional statistical significance—likely due to the limited sample size—the magnitude and direction of the coefficient indicate a clear and consistent trend: increasing infrastructural deficiencies and postural strain are associated with proportional deterioration in academic performance outcomes.

This finding aligns with prior research by Osita et al. [8], which established that inadequate physical learning environments significantly impair cognitive efficiency and academic productivity among university populations. The present study extends this evidence by demonstrating that such ergonomic constraints operate not only as environmental stressors but also as structured determinants of academic inequality within subgroups defined by gender and marital status.

Further insight is provided through the comparison of crude and adjusted odds ratios. In the unadjusted model, married female students exhibited twice the odds of poor academic performance compared to their male counterparts ($OR = 2.00$). However, when cumulative ergonomic burden was incorporated into a logistic regression model as a confounding variable, a notable reversal in effect direction was observed. The adjusted odds ratio for female students decreased to 0.533 ($AOR = 0.533$), indicating a 46.7% reduction in the odds of poor academic performance relative to males under equivalent ergonomic conditions.

These findings suggest that the observed gender differences may largely reflect unequal ergonomic exposure: the initially observed

elevated risk among married female students is not inherently gender-driven but is largely explained by differential exposure to adverse ergonomic environments. In other words, when subjected to comparable levels of ergonomic stress, married female students demonstrate equal or greater academic resilience than their male counterparts.

It is important to acknowledge, however, that environmental and structural constraints are not randomly distributed and cannot be analytically abstracted from the lived realities of the population under study. External conditions shape behavioral and cognitive outcomes in ways that are cumulative and difficult to isolate completely in real-world settings. Within this context, the findings suggest that the observed disparities reflect structural inequality in environmental exposure rather than intrinsic differences in academic capability.

Moreover, psychological stress and academic pressure have been shown to exacerbate the physiological effects of ergonomic strain, intensifying fatigue, musculoskeletal discomfort, and cognitive overload [6]. This interaction is particularly relevant for married female students, who often experience a compounded burden arising from dual-role responsibilities across domestic and academic domains.

Consequently, the findings support a cyclical model in which inadequate ergonomic conditions interact with psychosocial stressors to fragment study routines across multiple non-optimized environments (home and campus). This dual-exposure pattern reinforces cumulative fatigue and reduces sustained academic efficiency, thereby perpetuating a feedback loop of performance impairment.

In terms of age distribution, the findings further indicate that age acts as a moderating factor in determining students' capacity to withstand ergonomic stressors and their associated academic consequences. Within the 21–25 age group ($n = 6$), responses exhibited a pronounced bimodal distribution. Two

participants reported complete insulation from ergonomic constraints (0 challenges), while the remaining four experienced substantial cumulative strain, with an average exceeding five distinct academic performance impairments. This suggests marked intra-cohort heterogeneity, where a subset of younger married students demonstrates high vulnerability to environmental stressors, while others appear relatively unaffected.

In contrast, married students within the 31–35 age bracket ($n = 2$) reported comparatively high ergonomic exposure, with strain scores ranging between 12 and 17 challenges. Despite this elevated physical burden, this cohort exhibited minimal academic disruption, with an average of only 0.5 reported performance impacts. This pattern suggests the presence of enhanced adaptive capacity or psychological resilience among slightly older married students, potentially reflecting improved coping strategies, experiential learning, or better role integration over time.

However, this adaptive threshold appears finite. This limitation is illustrated in the 36–40 age category ($n = 1$), where an individual exposed to an extreme ergonomic burden (18 simultaneous challenges) experienced a complete collapse across all measured academic performance indicators. Although the single-case nature of this observation limits generalizability, it provides an important indication of a potential environmental tipping point beyond which adaptive capacity is overwhelmed. This pattern supports the proposition that while academic maturity and life experience may confer partial resilience [3], excessive cumulative ergonomic stress ultimately exceeds the buffering capacity of even well-adapted individuals.

Conclusion

This study provides preliminary evidence of the substantial impact of ergonomic deficiencies on the academic performance of married university students within a Sub-

Saharan African context. The findings highlight that inadequate physical learning environments—including non-adjustable furniture, absence of supportive learning tools such as laptop stands, poor lighting conditions, and insufficient privacy—are widespread structural constraints that predispose students to physical fatigue, musculoskeletal discomfort, and diminished academic efficiency.

Importantly, the study reveals a pronounced gendered disparity in exposure patterns. While married male students experience moderate and heterogeneous ergonomic constraints, married female students within the sample size reported a greater concentration of ergonomic challenges than married male students. This unequal exposure profile translates into disproportionately higher levels of physical strain and academic disruption among female students.

However, when cumulative ergonomic burden is statistically controlled using multivariate regression models, the results indicate that married female students exhibit lower adjusted odds of academic failure compared to their male counterparts. This finding suggests that the observed crude disadvantage among female students is not attributable to inherent academic limitations or reduced capability in managing dual domestic and academic responsibilities. Rather, it is primarily driven by unequal exposure to structurally inadequate and non-ergonomic learning environments.

Overall, the evidence underscores that academic performance is inseparable from the quality of physical and spatial learning infrastructure. Universities, therefore, must reconceptualize ergonomics not as an auxiliary or optional feature, but as a core determinant of academic success and student well-being. Strategic interventions such as the provision of adjustable furniture, improved lighting systems, ergonomic orientation programs, and redesign of student accommodation spaces are essential for reducing environmental strain and

enhancing cognitive performance. Such measures are particularly critical for non-traditional student populations, including married students who navigate compounded academic and domestic responsibilities.

Limitations

1. The extreme sample limitation of the married subgroup (N = 9: 6 men, 3 women).
2. The statistical instability of the OR/AOR estimates and the exclusion of definitive causal claims.
3. The presence of selection bias arising from online WhatsApp dissemination and snowball recruitment.

Therefore, the findings should be interpreted with these limitations in mind.

Data Availability

The dataset used for this study is available from the corresponding author upon reasonable request, subject to ethical approval and institutional data-sharing policies.

Funding

This study was self-funded and constitutes an excerpt from a PhD thesis of the corresponding author at Texila American University. The thesis is titled: Exploring the Ergonomic Challenges and Their Impact on Students' Well-being and Learning: A Case Study of the University of Calabar, Nigeria.

Conflict of Interest

The authors declare no conflict of interest regarding the publication of this study.

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Ethical Approval

Ethical clearance was obtained from the Research and Ethics Committee of Joseph Ayo Babalola University (Approval No: JABU/RGMO/REC/26/021). Informed consent was embedded within the online questionnaire, ensuring voluntary participation. No identifying personal information such as names or initials was collected. Participants were informed of their right to withdraw from the study at any stage without penalty.

Authors' Contributions

1. **Ogbe Alex (PhD Candidate):** Conceptualization, methodology, principal investigation, formal analysis, manuscript drafting, and funding acquisition.
2. **Dr. Michael Tomori (PhD):** Lead supervisor; provided methodological guidance, research oversight, and manuscript review and editing.
3. **Emelonye Amaka Doris:** Data management, online data screening, coding, and typing of the original manuscript.

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