



RESEARCH ARTICLE

Anthropometric Assessment Of Classroom Ergonomics In Public Primary Schools In Ilorin Metropolis, Nigeria

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Abstract

This study assessed the anthropometric compatibility of classroom furniture and its impact on postural support among public primary school pupils in Ilorin Metropolis, Nigeria. A cross-sectional design was employed, collecting anthropometric data from 1,579 pupils and furniture dimensions from 33 schools. Mismatch rates were calculated using ± 2 cm tolerance criteria. Results indicated a high prevalence of mismatch: seat height (82.4% in Primary 1–3, 53.8% in Primary 4–6), desk height (76.0%), and backrest height (88.7% in younger pupils). Correspondingly, poor postural support was widespread, with 81.0% of younger pupils unable to place their feet flat on the floor and 88.6% lacking backrest contact. Significant negative correlations were found between mismatch variables and postural support indicators ($p < 0.01$). These results indicate a systemic failure of classroom furniture in Ilorin to accommodate pupils' anthropometric diversity, leading to sustained postural strain. Recommendations include adopting anthropometry-based furniture standards and prioritising ergonomic refurbishment in public schools.

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1. INTRODUCTION

Classroom ergonomics has emerged as a critical dimension of educational infrastructure, particularly in primary schools where pupils remain seated for extended periods during formative stages of physical development. Prolonged sitting on furniture that does not correspond to pupils' body dimensions alters postural alignment and reduces biomechanical efficiency during learning activities such as writing and reading. Empirical research demonstrates that children exposed to poorly fitted classroom furniture adopt constrained sitting postures that affect trunk stability, limb positioning, and visual orientation to learning materials (Castellucci, Arezes, & Viviani, 2016; Satır & Erdoğan, 2021).

Anthropometric variation among primary school pupils is pronounced due to rapid growth and differences associated with age, sex, and population characteristics. Fixed-dimension classroom furniture fails to accommodate this variation, particularly in low- and middle-income countries where furniture procurement often prioritises durability and cost over ergonomic fit (Ismaila *et al.*, 2024). Furniture dimensions such as seat height, seat depth, desk height, and backrest height exert direct influence on pupils' sitting posture. Mismatch between these dimensions and pupils' anthropometric measures increases mechanical load on the spine and upper limbs during classroom tasks (Adu *et al.*, 2024).

Evidence from sub-Saharan Africa indicates that classroom furniture used in public primary schools rarely reflects locally derived anthropometric data. Studies conducted in Nigeria and Ghana report high prevalence of seat height and desk height mismatches among primary school pupils, resulting in unsupported feet, forward trunk inclination, and elevated shoulders during writing tasks (Badmos, Alumona, & Adegoke, 2022; Adu *et al.*, 2024). These postural adaptations reflect pupils' attempts to compensate for furniture that does not support neutral sitting.

Urban public primary schools in Nigeria present additional challenges linked to overcrowding, ageing furniture stock, and limited size variation within classrooms. Ilorin Metropolis, despite its administrative status, exhibits many of these structural constraints. Systematic anthropometric assessment of classroom ergonomics in this setting remains limited, particularly studies that integrate pupils' body measurements with furniture dimensions and observable postural support indicators. Visual documentation of classroom settings further supports these findings by illustrating the uniform furniture designs and spatial constraints that contribute to widespread anthropometric mismatch. To address this gap, the present research conducts an anthropometric evaluation of classroom ergonomics in public primary schools in Ilorin Metropolis, focusing on the degree of compatibility between pupils' body dimensions and classroom furniture.

2. LITERATURE REVIEW

2.1 Anthropometry and Classroom Furniture Design

Anthropometry provides the quantitative foundation for ergonomic design through measurement of human body dimensions relevant to specific activities. In classroom settings, anthropometric variables such as popliteal height, buttock–popliteal length, sitting elbow height, hip breadth, and sitting shoulder height inform the design of chairs and desks intended to support seated learning tasks. Compatibility between these body dimensions and furniture dimensions supports neutral posture and reduces unnecessary biomechanical strain (Castellucci *et al.*, 2016).

International ergonomic standards for educational furniture, including BS EN 1729-1:2015, specify functional dimensions for chairs and desks based on anthropometric percentiles across defined age groups. These standards aim to accommodate variation in pupils' body size through graded furniture dimensions rather than uniform sizing (British Standards Institution, 2015). Research evaluating the application of these standards shows that furniture aligned with anthropometric distributions improves postural stability and reduces awkward sitting postures during classroom activities (Satır & Erdoğan, 2021).

Despite the availability of such standards, classroom furniture in many African public schools is produced without reference to anthropometric distributions. Empirical studies reveal that furniture design often relies on inherited specifications that do not correspond to the body dimensions of current pupil populations (Ismaila *et al.*, 2024). This disconnect between furniture design and pupils' anthropometry represents a structural ergonomic deficiency rather than an individual behavioural issue.

2.2 Anthropometry–Furniture Mismatch in Primary Schools

Mismatch occurs when furniture dimensions fall outside acceptable tolerance ranges relative to corresponding anthropometric measures. Seat height mismatch arises when the seat height exceeds or falls below pupils' popliteal height, preventing stable foot contact with the floor. Desk height mismatch occurs when desk height does not align with sitting elbow height, altering shoulder and upper limb posture during writing tasks. Excessive seat depth relative to buttock–popliteal length limits effective use of backrests and promotes forward trunk inclination (Adu *et al.*, 2024).

Studies conducted in Nigerian public primary schools report high prevalence of anthropometry–furniture mismatch across multiple dimensions. Badmos *et al.* (2022) documented mismatch rates exceeding 80 per cent for seat height among primary school pupils in Ibadan, indicating that most pupils used chairs that did not support stable lower limb posture. Similar findings have been reported in Lagos and other urban centres, with desk height mismatch frequently observed during writing activities (Ismaila *et al.*, 2024).

Comparable patterns appear in studies from other regions. Research conducted in Turkey identified widespread mismatch between classroom furniture and pupils' anthropometry, particularly for seat depth and seat-to-desk height relationships (Satır & Erdoğan, 2021). Studies from Ghana also reported limited compatibility between classroom furniture dimensions and pupils' body measurements, despite variation in pupil age and stature within classrooms (Adu *et al.*, 2024). These findings demonstrate that anthropometry–furniture mismatch represents a persistent challenge across diverse educational systems.

2.3 Postural Support and Classroom Sitting

Postural support during classroom sitting depends on the interaction between furniture dimensions and pupils' body proportions. Neutral sitting posture involves stable foot contact with the floor, appropriate pelvic positioning, contact between the lower back and backrest, and comfortable positioning of the upper limbs relative to desk surfaces. Furniture that does not support these conditions alters joint angles and increases muscular demand during sustained sitting (Castellucci *et al.*, 2016).

Seat height that exceeds popliteal height prevents pupils from placing their feet flat on the floor, reducing lower limb stability and increasing pressure on the posterior thighs. This condition shifts pelvic orientation and promotes lumbar flexion during sitting. Excessive seat depth forces pupils to perch forward on the seat, eliminating backrest contact and increasing forward trunk inclination during writing and reading tasks (Adu *et al.*, 2024).

Desk height mismatch affects shoulder and upper limb posture. Desks positioned above sitting elbow height require pupils to elevate their shoulders while writing, increasing muscular demand in the neck and upper back. Desks positioned too low encourage trunk flexion and forward head posture, altering visual alignment with learning materials. Observational studies of classroom posture consistently document these compensatory strategies in pupils using mismatched furniture (Satır & Erdoğan, 2021).

2.4 Classroom Ergonomics in Nigerian Public Primary Schools

Research on classroom ergonomics in Nigeria highlights persistent gaps between ergonomic principles and actual classroom conditions. Public primary schools frequently rely on fixed-dimension desks and benches that are used across multiple age groups within the same classroom. Limited variation in furniture sizes restricts pupils' ability to select furniture appropriate to their body dimensions (Badmos *et al.*, 2022).

Urban public schools face additional pressures related to enrolment growth and infrastructure ageing. Furniture replacement cycles remain irregular, resulting in prolonged use of worn or outdated furniture designs. Empirical assessments conducted in Nigerian urban schools indicate that ergonomic inadequacy is shaped more by procurement and design practices than by pupils' behaviour or awareness (Ismaila *et al.*, 2024).

Existing Nigerian studies have largely focused on descriptive mismatch rates without integrating anthropometric data, furniture dimensions, and postural support indicators within the same analytical framework. Limited research addresses how classroom ergonomics manifests across different Local Government Areas within a single metropolitan setting. This study extends existing scholarships by providing an anthropometric assessment of classroom ergonomics in public primary schools in Ilorin Metropolis, linking pupils' body dimensions directly to furniture characteristics and observable postural support.

3. Methodology

3.1 Study Design and Setting

The research employed a cross-sectional design to examine classroom ergonomics in public primary schools within Ilorin Metropolis, Kwara State, Nigeria. Ilorin Metropolis comprises Ilorin East, Ilorin South,

and Ilorin West Local Government Areas. Public primary schools within these administrative units operate under similar state-level education policies but differ in classroom age, furniture stock, and enrolment density. This design enabled assessment of anthropometric characteristics, classroom furniture dimensions, and ergonomic compatibility at a single point in time.

3.2 Study Population and Sampling

The study population comprised pupils enrolled in public primary schools within the three Local Government Areas. A multistage sampling procedure was used. Public primary schools were first stratified by Local Government Area. Schools were then selected proportionally from each stratum to reflect enrolment distribution. Classrooms within selected schools were sampled, and all pupils present on the day of data collection were invited to participate.

A total of 1,579 pupils from thirty-three public primary schools participated in the study. The sample size exceeded minimum recommendations for anthropometric and ergonomic field studies involving children and provided adequate statistical power for correlation and regression analyses involving multiple ergonomic variables (Castellucci *et al.*, 2016; Satır & Erdoğan, 2021).

3.3 Anthropometric Measurements

Anthropometric measurements relevant to seated classroom posture were collected during regular school hours. Measurements included stature, popliteal height, and buttock–popliteal length, hip breadth in sitting, sitting elbow height, and sitting shoulder height. Standardised anthropometric procedures were followed to ensure measurement validity and comparability with international ergonomic research.

Calibrated measuring tapes and anthropometers were used. Each measurement was taken twice by trained assessors. Inter-rater reliability was assessed using intraclass correlation coefficients, which exceeded 0.95 for all anthropometric variables, indicating excellent agreement. Mean values of repeated measurements were used for analysis. These anthropometric variables correspond directly to functional furniture dimensions such as seat height, seat depth, seat width, desk height, and backrest height, as established in ergonomic literature (Castellucci *et al.*, 2016; British Standards Institution, 2015).

3.4 Classroom Furniture and Spatial Measurements

Classroom furniture dimensions were measured to the nearest millimetre. Chair dimensions included seat height, seat depth, seat width, and backrest height. Desk height was measured from the floor to the upper surface of the writing plane. Classroom spatial characteristics such as aisle width, seating density, and desk arrangement patterns were also recorded to characterise classroom layout.

Measurements were taken directly on furniture in active use by pupils. Repeat measurements were conducted on a subset of furniture to minimise observer error. Recorded dimensions were compared against pupils' anthropometric measurements using established ergonomic compatibility criteria.

3.5 Postural Support Indicators

Postural support during classroom sitting was assessed using direct observation and pupil self-report. Indicators included ability to place feet flat on the floor, contact between the lower back and the backrest, and ability to rest elbows comfortably on the desk during writing activities. These indicators reflect functional outcomes of anthropometry–furniture compatibility rather than subjective comfort alone and are widely used in classroom ergonomics research (Satır & Erdoğan, 2021).

3.6 Ergonomic Compatibility Assessment

Anthropometry–furniture compatibility was evaluated using difference-based criteria between furniture dimensions and corresponding anthropometric measures. Acceptable tolerance ranges of ± 2 cm were applied, consistent with ergonomic studies involving school furniture (Castellucci *et al.*, 2016). Measurements outside this range were classified as a mismatch. The following relationships were assessed:

Seat height relative to Popliteal height

Seat depth relative to buttock–popliteal length

Seat width relative to hip breadth

Desk height relative to sitting elbow height

Backrest height relative to sitting shoulder height

Mismatch prevalence was calculated for each furniture dimension.

3.7 Ethical Considerations

Ethical approval was obtained from the relevant institutional ethics committee. Authorisation was secured from Kwara State education authorities and school administrators. Written informed consent was obtained from parents or guardians, and verbal assent was obtained from pupils. Participation was voluntary, and all data were anonymised before analysis.

3.8 Data Analysis

Data were analysed using SPSS version 26. Descriptive statistics summarised anthropometric characteristics, furniture dimensions, postural support indicators, and mismatch prevalence. Pearson correlation analysis examined associations between ergonomic mismatch variables and postural support indicators. Multiple linear regression analysis identified furniture dimensions that independently predicted inadequate postural support. Statistical significance was set at $p < .05$.

4. Results

A total of 1,579 pupils from thirty-three public primary schools participated in the study. Results are presented across socio-demographic characteristics, anthropometric profiles, classroom furniture characteristics, ergonomic mismatch prevalence, and postural support indicators.

4.1 Socio-Demographic Characteristics of Pupils

The bar chart in Figure 1 illustrates the distribution of pupils by gender, class level, and age. Female pupils constituted a slightly higher proportion of the sample (52.6%) than males (47.4%), indicating a balanced gender representation in the study. Class level distribution was relatively uniform, ranging from 15.7% in Basic 1 to 18.7% in Basic 3, suggesting consistent enrolment across the primary school grades. Most pupils fell within the 10–13-year age group (43.7%), reflecting typical upper primary enrolment patterns, while younger pupils (<6 years) comprised a small minority (5.9%). This distribution supports meaningful comparisons of ergonomic conditions and anthropometric measurements across age groups and class levels.

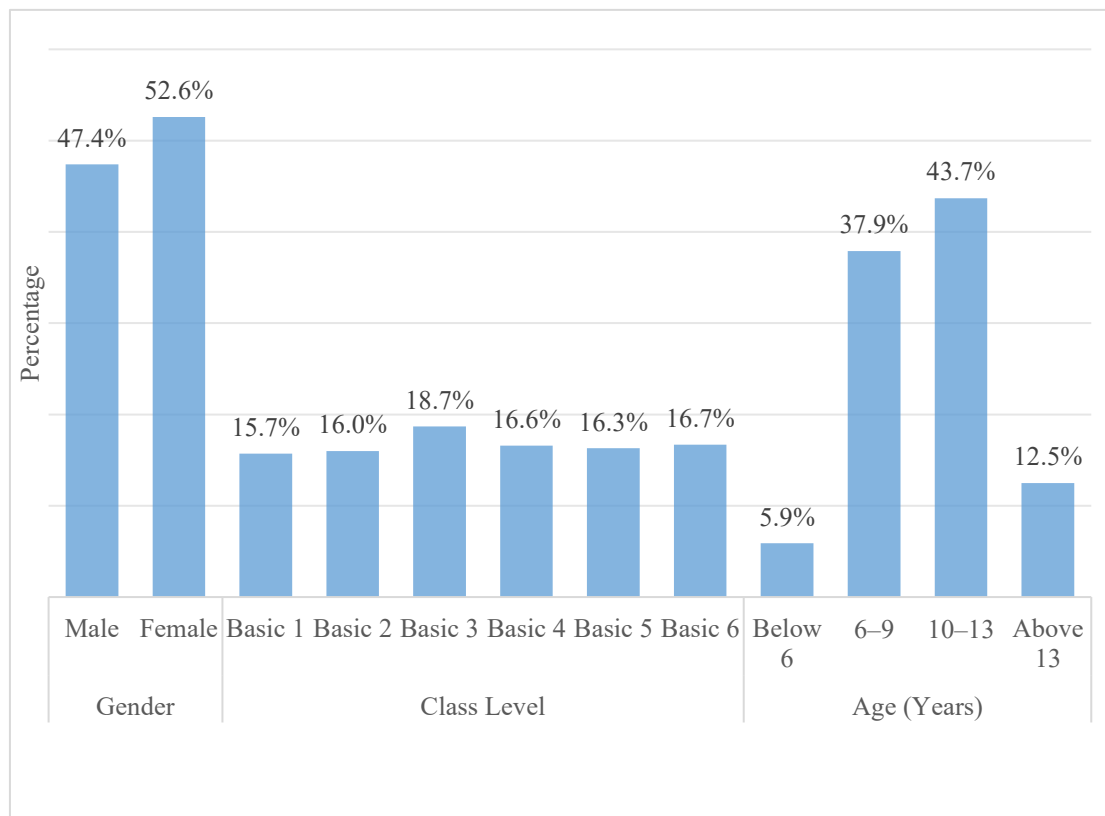


Figure 1. Socio-demographic characteristics of pupils in public primary schools in Ilorin Metropolis
Source: Author's Field Survey (2025)

4.2 Anthropometric Characteristics of Pupils

Anthropometric data in Table 1 indicates considerable variability in pupil body dimensions. Stature ranged from 108.0 cm (5th percentile) to 162.5 cm (95th percentile), with a mean of 132.4 cm (SD = 15.8), demonstrating wide height dispersion across pupils. Sitting height averaged 70.8 cm (SD = 8.5), while popliteal height, a critical measure for seat height design, averaged 38.5 cm (SD = 4.2). Elbow height and buttock–popliteal length, key determinants of desk–seat compatibility, averaged 53.2 cm (SD = 5.6) and 42.7 cm (SD = 4.9), respectively. Thigh thickness averaged 10.5 cm (SD = 1.7). The progressive increase in popliteal height, buttock–popliteal length and sitting elbow height with age highlights the limitations of fixed-dimension furniture, as a single desk or chair height cannot accommodate the anthropometric variation observed across multiple class levels. The data suggests the necessity of age- and size-appropriate furniture designs in primary schools.

Table 1. Anthropometric Measurements of Pupils (cm) (N = 1,579)

Variable	5th Percentile	Median	95th Percentile	Mean	SD
Stature (Standing Height)	108.0	132.0	162.5	132.4	15.8
Sitting Height	56.2	71.0	86.3	70.8	8.5
Popliteal Height	31.0	38.0	46.5	38.5	4.2
Elbow Height	42.5	53.0	63.8	53.2	5.6
Thigh Thickness	7.8	10.5	13.5	10.5	1.7
Buttock–Popliteal Length	32.0	42.0	53.5	42.7	4.9

Source: Author's Field Survey (2025)

4.3 Classroom Furniture Characteristics and Layout

Table 2 presents the mean dimensions and standard deviations of classroom furniture by class level. Desks for lower primary classes (Primary 1–3) had a mean height of 38.34 cm (SD = 3.58), while upper primary classes (Primary 4–6) had desks with a mean height of 59.17 cm (SD = 2.45). Seat heights were 19.27 cm (SD = 1.93) for Primary 1–3 and 38.25 cm (SD = 1.67) for Primary 4–6. Seat depth averaged 23.34 cm (SD = 1.71) for lower primary, compared with 30.00 cm (SD = 0.00) for upper primary. Backrest heights were similar, with 25.98 cm (SD = 2.02) in Primary 1–3 and 25.00 cm (SD = 0.00) in Primary 4–6, suggesting limited ergonomic adjustment across class levels.

Table 2. Classroom Furniture Dimensions (cm) by Class Level

Variable	Pry 1–3 (Mean ± SD)	Pry 4–6 (Mean ± SD)
Desk Height	38.34 ± 3.58	59.17 ± 2.45
Seat Height	19.27 ± 1.93	38.25 ± 1.67
Seat Depth	23.34 ± 1.71	30.00 ± 0.00
Backrest Height	25.98 ± 2.02	25.00 ± 0.00

Source: Author's Field Survey (2025)

The standardised desk-seat configurations observed across surveyed classrooms are illustrated in Images 1a and 1b. These units, characterised by metal frames and wooden surfaces, represent the typical furniture design supplied to public primary schools in Ilorin Metropolis (see Image 1a). As shown in the images, furniture units maintain uniform dimensions regardless of the anthropometric variability among pupils within the same classroom. This one-size-fits-all approach to classroom furniture procurement contributes substantially to the mismatch rates documented in this study. Image 1b presents a typical classroom setting within the study area, illustrating the spatial arrangement of furniture, whiteboard positioning, and general infrastructural conditions characteristic of public primary schools in Ilorin Metropolis. Classrooms varied in size, lighting quality, and furniture condition, though the basic configuration of rows of desk-seat units facing a front-mounted whiteboard remained consistent across surveyed schools. These physical characteristics of the classroom environment formed the context within which anthropometric measurements and ergonomic assessments were conducted.



Image 1a: Typical uniform desk and seat dimensions in a public primary school classroom in Ilorin Metropolis, illustrating the 'one-size-fits-all' procurement approach.

Source: Fieldwork (2025)



Image 1b: Classroom setting in a public primary school in Ilorin Metropolis, showing furniture layout, whiteboard positioning, and spatial arrangement typical of the study environment.

Source: Fieldwork (2025)

4.4 Prevalence of Anthropometry–Furniture Mismatch

High levels of anthropometry–furniture mismatch were evident across multiple classroom furniture dimensions (see Figure 2). Seat height mismatch was the most prevalent, affecting 82.4% of pupils in Primary 1–3 and 53.8% in Primary 4–6. Desk height and backrest height mismatches were also prominent, with desk height mismatch affecting 76% of pupils in both lower and upper primary classes, and backrest height mismatch affecting 88.7% of Primary 1–3 pupils and 76% of Primary 4–6 pupils. Seat depth mismatch was less frequent but remained notable, particularly among younger pupils (57% in Primary 1–3 and 25.3% in Primary 4–6). This pattern reveals limited correspondence between pupils' anthropometric measurements and classroom furniture dimensions, suggesting potential postural strain and discomfort.

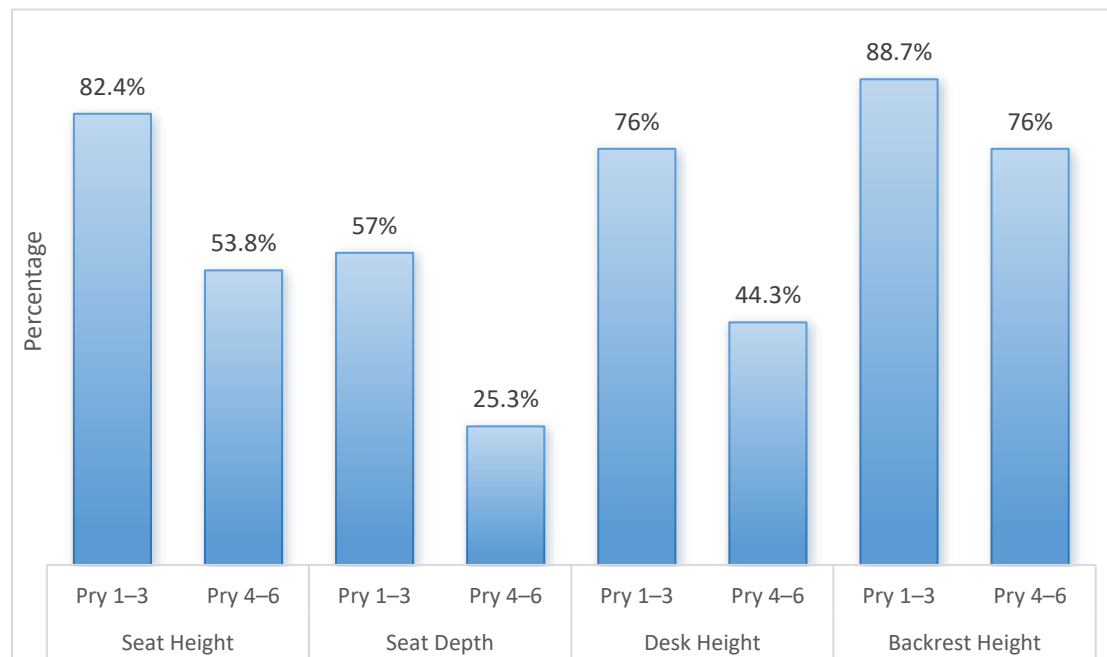


Figure 2. Prevalence of anthropometry–furniture mismatch by furniture dimension.

Source: Author's Field Survey (2025)

High levels of postural inadequacy were evident across the three measured support indicators (see Figure 3). Most pupils in Primary 1–3 (81.0%) and more than half of pupils in Primary 4–6 (55.7%) were unable to place their feet flat on the floor while seated. The absence of consistent lower back contact with the backrest was similarly prevalent, reported by 88.6% of younger pupils and 68.4% of older pupils. Furthermore, difficulty resting elbows comfortably on the desk during writing tasks affected 77.8% of pupils in Primary 1–3 and 49.3% of those in Primary 4–6. Together, these results point to a widespread failure of classroom furniture to support fundamental seated postures, reflecting the functional consequences of anthropometric–furniture mismatch across lower and upper primary levels.

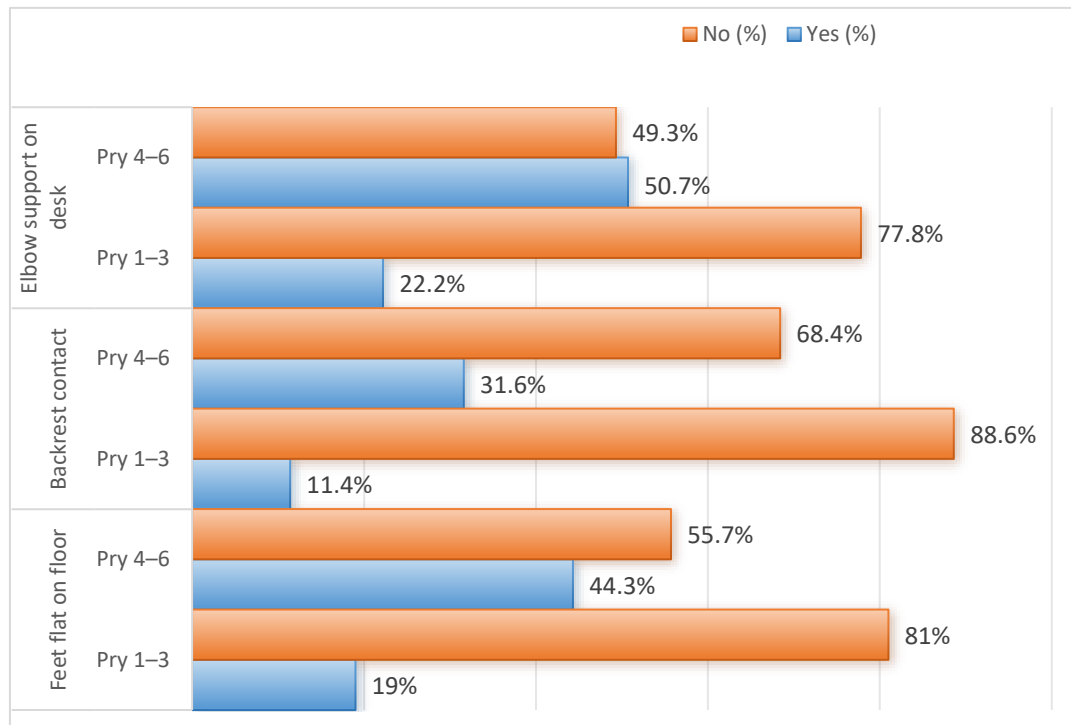


Figure 3: Distribution of postural support indicators among pupils.

Source: Author's Field Survey (2025)

4.6 Variation across Local Government Areas

Table 3 presents the prevalence of anthropometry–furniture mismatch and postural support indicators across the three Local Government Areas. Seat height mismatch was high in all LGAs, with Ilorin East at 82.0% (n = 420), Ilorin West at 81.8% (n = 450), and Ilorin South at 82.5% (n = 280), resulting in an overall prevalence of 82.3% (n = 1,150). Seat depth mismatch ranged from 54.5% (n = 300) in Ilorin West to 58.9% (n = 200) in Ilorin South, with a combined prevalence of 56.0% (n = 790). Desk height mismatch was slightly lower in Ilorin West (72.7%, n = 400) than in Ilorin South (82.5%, n = 280), with Ilorin East at 74.5% (n = 380). Backrest height mismatch followed a similar pattern, ranging from 76.4% (n = 420) in Ilorin West to 84.3% (n = 430) in Ilorin East.

Postural support indicators were consistently low. The proportion of pupils able to keep their feet flat on the floor was 35.3% in Ilorin East (n = 180), 36.4% in Ilorin West (n = 200), and 35.4% in Ilorin South (n = 120), yielding an overall prevalence of 35.2% (n = 500). Backrest contact was limited, with 23.5% (n = 120) in Ilorin East, 25.5% (n = 140) in Ilorin West, and 23.5% (n = 80) in Ilorin South. Elbow support ranged from 38.2% (n = 210) in Ilorin West to 41.2% (n = 140) in Ilorin South, with an overall proportion of 39.2% (n = 550), indicating widespread postural strain.

Table 3. Anthropometry–furniture mismatch and postural support indicators by Local Government Area.

Indicator / LGA	Ilorin East (n, %)	Ilorin West (n, %)	Ilorin South (n, %)	Total (n, %)
Seat Height Mismatch	420 (82.0)	450 (81.8)	280 (82.5)	1,150 (82.3)
Seat Depth Mismatch	290 (56.6)	300 (54.5)	200 (58.9)	790 (56.0)
Desk Height Mismatch	380 (74.5)	400 (72.7)	280 (82.5)	1,060 (73.7)
Backrest Height Mismatch	430 (84.3)	420 (76.4)	350 (82.0)	1,200 (80.1)
Feet Flat on Floor	180 (35.3)	200 (36.4)	120 (35.4)	500 (35.2)
Backrest Contact	120 (23.5)	140 (25.5)	80 (23.5)	340 (21.5)
Elbow Support	200 (39.2)	210 (38.2)	140 (41.2)	550 (39.2)

Notes: Percentages are calculated per LGA total; totals sum across LGAs.

Source: Author's Field Survey (2025)

4.7 Association between Ergonomic Mismatch and Postural Support

Correlation analysis revealed significant associations between anthropometry–furniture mismatch variables and postural support indicators (Table 4). Seat height mismatch showed a strong negative correlation with the ability to keep feet flat on the floor ($r = -0.68$, $p < 0.01$), indicating that greater seat height mismatch was associated with poorer lower limb support. Desk height mismatch was negatively correlated with elbow support ($r = -0.43$, $p < 0.01$), suggesting that pupils experiencing desk height mismatch were less able to rest their elbows comfortably during writing tasks. Backrest height mismatch had the strongest association with backrest contact ($r = -0.66$, $p < 0.01$), reflecting reduced lower back support when mismatch increased. Seat depth mismatch also showed significant negative correlations with all postural support indicators, though these were weaker (ranging from -0.28 to -0.35 , $p < 0.01$).

These results indicate that higher levels of mismatch in seat, desk, or backrest dimensions were consistently associated with poorer postural support, highlighting the ergonomic risks faced by pupils during classroom activities.

Table 4. Correlation between anthropometry–furniture mismatch variables and postural support indicators.

Mismatch Variable	Feet Flat on Floor (r)	Backrest Contact (r)	Elbow Support (r)
Seat Height Mismatch	-0.68**	-0.54**	-0.61**
Seat Depth Mismatch	-0.32**	-0.28**	-0.35**
Desk Height Mismatch	-0.41**	-0.38**	-0.43**
Backrest Height Mismatch	-0.57**	-0.66**	-0.49**

**Correlation significant at $p < 0.01$

Source: Author's Field Survey (2025)

5. Discussion of Findings

The correlation analysis conducted in this study demonstrates a clear and statistically significant association between anthropometry–furniture mismatch and inadequate postural support among primary school pupils in Ilorin. The consistently negative correlations observed across all mismatch variables indicate that increasing incompatibility between pupils' body dimensions and classroom furniture is associated with progressive deterioration in seated posture. This finding supports existing ergonomic evidence that physical

mismatch between users and seating systems directly influences postural behaviour and musculoskeletal loading (Castellucci *et al.*, 2015; Dianat *et al.*, 2016).

Seat height mismatch correlated most strongly with the inability to place feet flat on the floor, a finding consistent with ergonomic principles. Inappropriate seat height disrupts lower limb support and pelvic stability, often forcing pupils to suspend their feet or slide forward (Karimi *et al.*, 2019). These adaptations increase muscular demand in the thighs and lower back and are also linked to early discomfort during prolonged sitting (Hammond *et al.*, 2021). Given the magnitude of this correlation, seat height appears to be a critical determinant of stable sitting posture in Nigerian primary school classrooms.

Desk height mismatch showed a significant negative association with elbow support during writing tasks. When desk height exceeds elbow height in the seated position, pupils are required to elevate their shoulders or lean forward to maintain contact with the writing surface. This posture increases static load on the neck and shoulder musculature and has been linked to upper limb fatigue and reduced task endurance in school environments (Mwangi *et al.*, 2015; Mousavi, Dianat, & Karimi, 2020). The findings of this study reinforce concern that desk height incompatibility interferes with fine motor tasks central to classroom learning, particularly handwriting.

Backrest height mismatch demonstrated the strongest association with lack of backrest contact, indicating reduced lumbar support during sitting. Ergonomic research consistently shows that backrests that do not align with the lumbar region fail to provide effective spinal support, encouraging forward trunk inclination and sustained flexion postures (Castellucci *et al.*, 2017). The strong negative correlation identified in this study suggests that mismatched backrest height plays a substantial role in limiting backrest utilisation among pupils, thereby increasing spinal loading during prolonged classroom activities.

Seat depth mismatch was associated with all postural support indicators, though with comparatively weaker correlations. This suggests that while seat depth influences posture, its effects may be mediated by other dimensions such as seat height and backrest design. Excessive seat depth has been shown to prevent effective backrest use, while insufficient depth reduces thigh support, both contributing to postural instability (Rakhudu & Ntloko, 2020). The present findings are consistent with these mechanisms and indicate that seat depth mismatch contributes to, but does not solely determine, postural outcomes.

Overall, the results confirm that classroom furniture mismatch exerts a measurable and systematic influence on pupils' seated posture. The convergence of significant associations across multiple mismatch variables indicates that ergonomic strain arises from the combined effects of poorly fitted seating and work surfaces rather than from isolated design flaws. These findings strengthen the evidence base for ergonomically informed furniture design in Nigerian primary schools and underscore the importance of aligning classroom furniture dimensions with pupils' anthropometric characteristics to support healthy posture and reduce musculoskeletal risk.

6. Conclusion

The findings from this investigation establish that classroom furniture supplied to public primary schools in Ilorin does not align with the body dimensions of enrolled pupils. Seat height, seat depth, and desk height frequently exceeded key anthropometric measurements, particularly among lower primary pupils, and these disproportions contributed to postural adaptations that increased physical strain during routine classroom activities. Environmental limitations related to lighting, acoustics, and circulation space further intensified these effects by reducing visual comfort and restricting opportunities for posture variation.

Differences observed across Local Government Areas indicate that procurement practices, building age, and maintenance patterns influence ergonomic quality within the metropolis. Schools operating with older infrastructure and irregular furniture replacement cycles recorded the highest ergonomic burden. The evidence generated in this study provides dimension-specific guidance for furniture redesign and underscores the need for improved classroom environments that support stable posture, visual clarity, and effective engagement during instructional activities.

7. Recommendations

Primary school furniture in Ilorin should be designed to match the anthropometric characteristics of pupils aged six to twelve years, with grade-specific seat height, seat depth, and desk height. Existing wooden and metal furniture can be adapted using the measurements generated in this study at minimal cost.

Furniture revisions should prioritise seat height, seat depth, and desk height, focusing on the dimensions with the highest mismatch in order to reduce postural strain during routine replacement cycles.

Classroom conditions should support posture and comfort. Lighting levels should meet recommended standards, noise exposure should be minimised, and circulation space should be increased through classroom reorganisation or structural renovation where necessary.

Local government authorities should incorporate ergonomic assessments into routine infrastructure inspections. Schools with the highest levels of mismatch, particularly those operating in older buildings or with irregular furniture replacement cycles, should be prioritised for intervention.

References

- Abolfotouh, M. A., Al-Faris, E. A., Al-Qarni, F. A., & Tamim, H. (2019). Classroom furniture mismatch and back pain among adolescent school children in Abha City, Southwestern Saudi Arabia. *International Journal of Environmental Research and Public Health*, 16(8), 1395. <https://doi.org/10.3390/ijerph16081395>
- Adu, S., Adu, G., Boadi, A. A., & Antwi, K. (2024). Relationship between learning environment design and musculoskeletal disorders in learners. *International Journal of Kinanthropometry*, 4(2), 44–56. <https://doi.org/10.34256/ijk2425>
- Badmos, K. A., Alumona, C. J., & Adegoke, B. O. A. (2022). Mismatch between classroom furniture dimensions and anthropometric measures of public primary school children in Ibadan, Nigeria. *Ergonomics SA*, 33(1), 1–11. <https://doi.org/10.4314/esa.v33i1.2>
- British Standards Institution. (2015). *BS EN 1729-1:2015 Furniture. Chairs and tables for educational institutions – Functional dimensions*. BSI. <https://shop.bsigroup.com>
- Castellucci, H. I., Arezes, P. M., & Viviani, C. A. (2016). School furniture design: An anthropometric perspective. *Applied Ergonomics*, 52, 52–60. <https://doi.org/10.1016/j.apergo.2015.06.001>
- Ismaila, S. O., Akanbi, O. G., Ngassa, C. N., & Oriolowo, K. T. (2024). Ergo-analysis of school furniture in use by secondary school students in South Western Nigeria. *Journal of Natural Sciences, Engineering and Technology*, 10(1). <https://doi.org/10.51406/jnset.v10i1.1358>
- Ismaila, S. O., Alkan, O. G., Ngassa, C. N., & Oriolowo, K. T. (2024). Anthropometric perspective to classroom furniture ergonomics and the need for standards in Nigerian schools. *Journal of School Health*, 94(3), 245–255. <https://doi.org/10.1111/josh.13412>
- Romli, Z., & Abdul Aziz, M. A. (2022). Effects of mismatch of anthropometric measurements on school furniture among primary school children in Petaling Jaya, Selangor. *Environment-Behaviour Proceedings Journal*, 7(SI9), 299–303. <https://doi.org/10.21834/ebpj.v7iSI9.4278>
- Satir, B., & Erdoğan, F. Ç. (2021). Comparison of classroom furniture to anthropometric measures of Turkish middle school students. *Work*, 70(2), 493–508. <https://doi.org/10.3233/WOR-213587>
- Soares, M., Simões, J., & Carvalho, R. (2015). Match between classroom dimensions and students' anthropometry: Re-equipment according to European educational furniture standard. *Ergonomics*, 58(5), 839–848. <https://doi.org/10.1080/00140139.2014.1000397>
- Straker, L. M., Jones, R., & Miller, J. (2009). The effects of ergonomically designed school furniture on pupils' attitudes, symptoms and behaviour. *International Journal of Industrial Ergonomics*, 39(1), 237–242. <https://doi.org/10.1016/j.ergon.2008.10.003>
- Šarabon, N., Stanković, N., & Ule, M. (2022). Ergonomic evaluation of school furniture in Slovenia: From primary school to university. *Applied Ergonomics*, 104, 103813. <https://doi.org/10.1016/j.apergo.2022.103813>