

## **Comparative Analysis Of Ergonomic Knowledge And Implementation Among Sofa Producers In Kano State Nigeria**

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**Abstract:** Awareness of ergonomics in the manufacturing industry is necessary for survival in a highly competitive business world. For the first time, this study aims to assess the ergonomics knowledge of sofa producers and conduct a comparative analysis of the knowledge of the sofa producers and implementations of ergonomics using Kano State, Nigeria, as a case study.

Also, this study considered the factors hindering ergonomics implementation in sofa production. Using the descriptive research design, the questionnaire consisted of close-ended questions and Likert-scale type and was distributed to members of Sofa Producers' Association in Kano State. The study's result showed that only 43.61% of the respondents displayed good awareness and knowledge of ergonomics.

The study also showed that only 42.5% of the respondents always implement ergonomic knowledge in the design and production of Sofa producers. Furthermore, Spearman's correlation analysis showed a coefficient value of 0.08, implying a weak positive correlation between the level of awareness and implementation of this knowledge in the design and production among Sofa producers in Kano.

**Keywords:** Ergonomics, Sofa, Knowledge, Implementation, Furniture



## تحليل مقارن للمعرفة الهندسية والتنفيذ بين منتجي صوفا في ولاية كانو في نيجيريا

**الملخص:** الوعي ببيئة العمل في الصناعة التحويلية ضروري للبقاء في عالم أعمال شديد التنافسية. لأول مرة ، تهدف هذه الدراسة إلى تقييم معرفة بيئة العمل لمنتجي الأرائك وإجراء تحليل مقارن لمعرفة منتجي الأرائك وتطبيقات بيئة العمل باستخدام ولاية كانو ، نيجيريا ، كدراسة حالة.

أخذت هذه الدراسة بعين الاعتبار العوامل التي تعيق تنفيذ بيئة العمل في إنتاج الأريكة. باستخدام تصميم البحث الوصفي ، يتكون الاستبيان من أسئلة مغلقة ونوع مقياس ليكرت وتم توزيعه على أعضاء جمعية منتجي الأرائك في ولاية كانو. أظهرت نتيجة الدراسة أن 43.61٪ فقط من المستجيبين أظهروا وعياً ومعرفة جيدة ببيئة العمل.

أظهرت الدراسة أيضاً أن 42.5٪ فقط من المستجيبين يطبقون دائماً المعرفة المريحة في تصميم وإنتاج منتجي الأرائك. علاوة على ذلك ، أظهر تحليل ارتباط سبيرمان قيمة معامل قدرها 0.08 ، مما يدل على وجود علاقة إيجابية ضعيفة بين مستوى الوعي وتنفيذ هذه المعرفة في التصميم والإنتاج بين منتجي الأرائك في كانو.

## **1. Introduction**

In the fiercely competitive corporate world, understanding ergonomics is essential for survival in the industrial sector [1]. Ergonomics is a technique for designing safe, healthy, and comfortable work environments, with innumerable advantages for both the systems and the components of the systems [2], [3]. The entire company must be involved in creating, designing, executing, controlling, evaluating, and redesigning processes. Managers are crucial in raising ergonomic awareness since implementing a participatory ergonomics culture is a top-down approach [4]. Implementing an ergonomics culture may cause managers anxiety if they are unaware of the benefits and drawbacks [5]. According to studies, managers of a company that needs ergonomics as one of its outputs may only support the ergonomics concept at their workplaces when informed of its costs and advantages [1]–[3].

To achieve objectives like safety, health, and ergonomics management, knowledge is the primary source [6]; transferring ergonomics expertise, however, might be difficult in industrial enterprises, particularly in underdeveloped nations. Industries in these nations frequently lack the instruments essential to acquire information swiftly; therefore, knowledge providers lack the assistance needed for knowledge transfer [7]. Because of these circumstances, knowledge recipients are presumably less motivated to comprehend knowledge transfer ideas and less able to identify actual knowledge transfer challenges. Researchers contend that to implement ergonomic treatments more successfully, it is vital to use suitable tactics to facilitate information transmission and highlight its significance [8], [9].

Due to the high prevalence of stresses that lead to occupational injury and sickness, the furniture manufacturing sector must build a culture based on human factors and ergonomics [10]. Additionally, from another angle, the manual handling of numerous heavy, bulky, and uncomfortable materials and manual, labour-intensive procedures like sanding, rubbing, stapling, and spraying result in significant physical work demands for the furniture manufacturing business [11]. While ergonomics is greatly needed in furniture production, it is not utilised to its fullest potential. A few variables constrain the use of ergonomics expertise in furniture production. Stakeholder self-interest, illiteracy, employee acceptability, regulatory agency/union, material cost, and accessibility to contemporary equipment are a few of them [10].

Adedeji *et al.* [10] conducted a study evaluating the ergonomics of carpentry and furniture-making enterprises in Port Harcourt, Nigeria. The study found that while there is a growing awareness of ergonomic difficulties, there is not enough information accessible regarding the ergonomic settings of Nigerian carpentry and furniture-making (CFM) businesses. The study's findings revealed a weakly positive correlation between the heights of tables built by CFM firms and the necessary heights, indicating that a significant portion of the tables utilised were not anthropometrically matched. The CFMs regularly experienced the following occupational hazard outcomes: hand cuts, bruises, back discomfort, and infections of the nose, muscles, and eyes. Yun [12] studied integrating ergonomics in the design of contemporary kitchens and electric appliances. For monitoring the modelled systems, the study used pure numerical control charts. However, it was noted that when general data complexity and dimensionality increased, the employment of the numerical conversion approach was considered illogical.

Additionally, Gerding et al. [13] carried out a study on the ergonomic issues in the home offices of university employees sent home due to the COVID-19 pandemic. The study found that moderate to severe discomfort in the eyes, neck, head, upper back, and shoulders, and severe low and middle back pain, were all reported by more than 40% of the participants. According to the survey, less than 45% of seating arrangements were observed to have movable armrests. The study concluded that as teleworking in temporary offices grows more prevalent, poor static postures may increase the risk of considerable pain and maybe more serious musculoskeletal problems.

Previous studies have highlighted the importance of management commitment and employee participation for successfully integrating ergonomics into manufacturing processes [1], [5]. However, there is a lack of research focusing on ergonomic knowledge and implementation practices among sofa producers. Therefore, this study aims to compare ergonomic knowledge and implementation among sofa producers in Kano State, Nigeria. By examining the factors hindering ergonomics implementation in sofa production, this study seeks to contribute valuable insights into improving ergonomics practices in the furniture manufacturing industry.

## **2. Research methodology**

A descriptive survey research method was adopted to adequately carry out the comparative analysis of ergonomic knowledge and implementation among Sofa producers in Kano State, Nigeria. This is because the survey method is suitable for collecting mass raw data from many respondents to facilitate a clear understanding of the subject matter under investigation [14]–[17]. The population of this study comprises the owners of Sofa producing businesses, managers, engineers, and technicians. As obtained from the Sofa Producers' Association in Kano State, there are about 1,250 members in Kano State. This comprises Local Government Areas (LGA) such as Kano Municipal, Dala, Gwale, Fagge, Tarauni, Nassarawa, Ungogo, Kumbotso, and others.

Using 's formula [18] given in Equation 1) for determining sample size from a large population, a sample was drawn from the population size of 1,250 members in the study comprising mostly small and medium enterprises businesses. Applying Equation (1) at a confidence level or significance level of 95% while the precision level was taken to be 5%, the sample size was obtained approximately 300 members of the Sofa Producers' Association in Kano State.

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

Where, n= sample size, N =Population size and e =Margin error/ level of precision (0.05).

Similarly, the researchers used structured questionnaires to obtain the required information from the respondents. The questionnaire items were a combination of close-ended questions and Likert-scale type questions, allowing the respondents to choose from alternatives provided by the researcher.

The questions were obtained and modified from previous literature. The researchers administered the questionnaire personally, in which this exercise took approximately four (4) days. Taking into account the research questions associated with this study, the questionnaire had 4 sections:

- **Section A:** Socio-economic/demographic information of respondents such as age group, educational qualification, number of employees in the business, work duration/years of experience, and position in the business.
- **Section B:** Knowledge-based questions on ergonomics to help assess the level of ergonomic awareness among the respondents.
- **Section C:** Implementation of the knowledge of ergonomics in the design and production of Sofa by the respondents.
- **Section D:** Identification of factors that hinder/limit the use of ergonomic knowledge in the design and production of Sofa by the respondents.

Furthermore, data obtained were analysed using descriptive statistics to facilitate a clear understanding of the subject matter under investigation. In contrast, Spearman's rank correlation statistical method was used to compare the relationship between ergonomic knowledge and implementation by the respondents. In the descriptive statistics data analysis method, data obtained were expressed in percentages and displayed in tables and charts. On the other hand, based on the mean responses of the respondents on ergonomic knowledge and implementations, the variables were ranked such that  $R_1$  denotes the level of awareness, and  $R_2$  denotes the level of implementation. The Spearman's rank correlation formula is given in Equation (2) [19]:

$$R = 1 - \frac{6 \sum d^2}{n(n^2 - 1)} \quad (2)$$

Where  $d$  = Difference in the rank of each variable and  $n$  = number of variables.

### **3. Results and discussion**

#### **3.1 Socio-Economic/Demographic**

The socio-economic distribution of the respondents whose ergonomics knowledge was analysed in terms of age group, education qualification, number of employees under them, work duration/years of experience, and current position in the sofa industrial sub-sector, as given in Figures 1 and 2.

Figure 1(a) shows the age range of the respondents, 16% of respondents are between the ages of 18 to 20 years, 8% belong to the age range of 21 to 25, 10% are between the ages of 26 to 30 years, 26% belong to the age range of 31 to 35 while the most of the respondents (40%) are of the ages of 36 and above. This implies that most of this study's responses come from respondents with experience in the field of sofa production and the use of ergonomics while designing their output or products. Similarly, Figure 1(b) shows the educational qualifications of respondents under study, in which 26% of respondents have informal education, 25% have a primary school education, 15% have secondary school qualifications, and 34% have a tertiary education range.

This result implies that most of the respondents of this study come from sofa producers with tertiary education levels (NCE, ND, B.Sc., and others), which shows that most of the respondents are aware of the use and importance of ergonomics in sofa production.

Figure 1(c) shows the number of employees within the organisation or factory of each study area. 40% of respondents have a population within zero to nineteen in their factories, 8% have 20-49 employees, 10% have 50-99, 10% have 250-249 employees in their factories, 16% have 100-249 employees, and 16% also have above 500 employees in the factories. This result implies that the majority of the respondents of this study come from respondents with 0-19 workers or employees within their factories, which denotes a small-scale enterprise. Figure 1(d) shows how long respondents have stayed in the business of sofa production. 10% of respondents have zero-to-one-year years of experience in sofa making, 24% have 1-3 years of experience in sofa making, 26% have 4-10 years of experience in sofa making, and 40% have above 10 years of experience in sofa making. This result implies that the majority of the respondents of this study come from respondents who have stayed in the furniture-making business for over ten years, suggesting that they have gained huge experience over time.

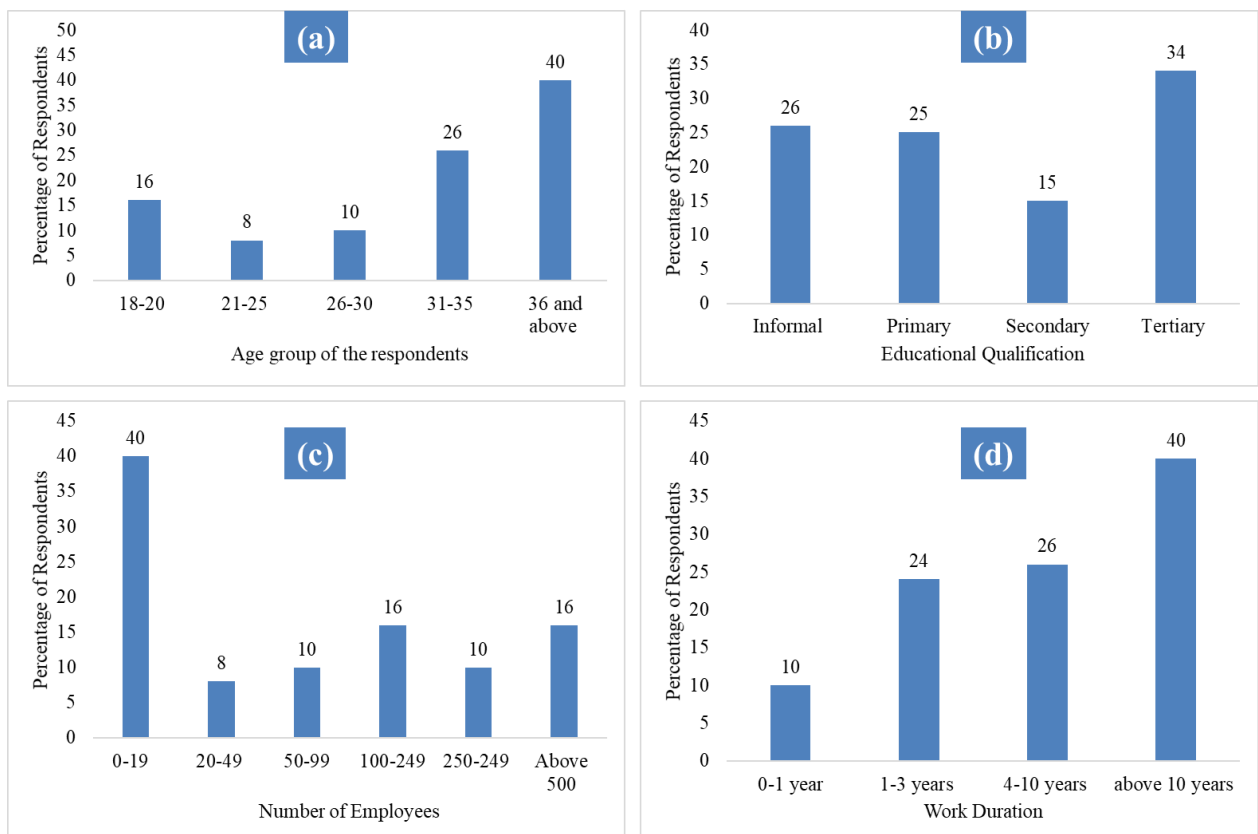


Figure 1: Distribution of the respondents by (a) age group, (b) educational qualification, (c) number of employees, and (d) work duration/years of experience

Furthermore, Figure 2 shows the current position of each respondent as it relates to the business of furniture production. 40% of respondents are the owners of the factories, 8% are Managing Directors in the business, 10% belong to the Production department and technicians, and they only determine the number of outputs to be produced, 40% are engineers and other categories in the factories. This result implies that most respondents have sufficient knowledge, exposure, and authority to implement ergonomics in sofa production.

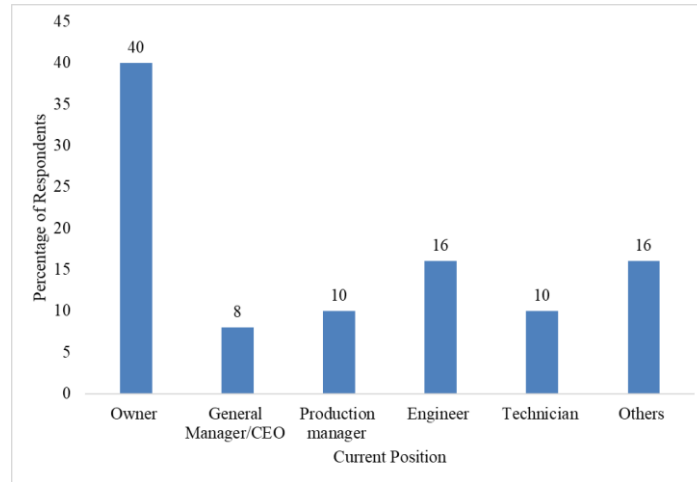


Figure 2: Current Position Distribution of Respondents

### 3.2 Level of Ergonomics Awareness among Sofa Producers in Kano

In accessing the level of ergonomics awareness among Sofa producers in the study area, questions with regard to ergonomics were asked. These questions were based on anthropometric data in the design and construction of sofa, the importance of posture, sofa material's comfort provision ability, workspace safety, manual material handling equipment, and the effect of lighting and temperature on the comfort of end-users. Table 1 gives the percentage response to these questions based on the Likert scale, the mean score, and the ranking of these knowledge-based questions.

From the result obtained in Table 1, it was observed that only 43.61% of the respondents displayed a good knowledge of ergonomics. The result is related to the findings of Oladeinde *et al.* [20], who carried out awareness and knowledge of ergonomics among medical laboratory scientists in Nigeria and observed that the ergonomics awareness among medical laboratory was poor among the medical laboratory scientists in the study area. Furthermore, Table 1 shows that knowledge of workstation evaluation toward the clean and safe environment, equipment and ease of movement in the workspace as it relates to workers' health and comfort is the most ranked knowledge-based awareness among the Sofa producers. This is followed by the knowledge that bad sitting posture results in bad health conditions, and then suitable manual handle equipment provision for routine activities to promote the health and comfort of workers. It was observed from the result that the use of anthropometric data for the design and construction of seating room chairs had the lowest ranking score, which denotes poor awareness among the Sofa producers in the study area. The reason for this is not farfetched from the fact that there is the inadequacy of proper anthropometric databases and societal health care system considerations in countries such as Nigeria.



Table 1: Response on the level of ergonomics awareness among Sofa producers in Kano and their rankings.

S/N	Questions	SA	A	N	D	SD	Mean Score	Ranking
1	Do you believe the use of anthropometric data in the design and construction of seating room chairs can improve users' comfort and health?	40%	30%	10%	6%	14%	3.70	6 <sup>th</sup>
2	Do you believe bad sitting posture can result in any bad health condition?	48%	30%	15%	5%	2%	3.82	2 <sup>nd</sup>
3	Do you believe some materials used (i.e., form, material) in seating room furniture affect users' comfort and health?	40%	28%	16%	8%	8%	3.75	5 <sup>th</sup>
4	Do you believe workstation evaluation toward a clean, safe environment, equipment and ease of movement in the workspace is related to workers' health and comfort?	40%	30%	10%	6%	15%	3.87	1 <sup>st</sup>
5	Do you believe that Suitable manual material handling equipment provision for routine activities can promote the health and comfort of workers?	50%	26%	6%	8%	10%	3.81	3 <sup>rd</sup>
6	Do you believe good lighting and comfortable temperature affect the health and comfort of workers?	40%	30%	10%	6%	14%	3.79	4 <sup>th</sup>

SA: Strongly Agreed; A: Agreed; N: Neutral; D: Disagree, SD: Strongly Disagree

### 3.3 Implementation of Ergonomic Knowledge

Furthermore, to evaluate the level of implementation of knowledge of ergonomics by the Sofa producers in the study area, questions about the implementation of ergonomics in Sofa production were asked. These questions were in line with the questions asked on the level of ergonomics awareness. Table 2 gives the percentage response to these questions based on the Likert scale, the mean score, and the ranking of the level of implementation of this ergonomic knowledge.

Table 2: Response on the level of implementation of ergonomic knowledge among Sofa producers in Kano and their rankings.

<b>S/ N</b>	<b>Questions</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>Mean Score</b>	<b>Ranki ng</b>
1	Do you use anthropometric data to determine the optimum size, shape, and form of a product to make it easier for the people that will use your seating room chairs?	43%	35.3 %	10%	3.3%	8.3 %	4.01	3 <sup>rd</sup>
2	Do you provide chairs that will give a good seating posture in your design process?	45%	28.3 %	8.3%	10%	8.3 %	3.91	4 <sup>th</sup>
3	Do you ensure the safety, health and comfort of users in selecting materials for your living room chairs?	46.7%	31.7 %	10%	6.7%	5%	4.11	2 <sup>nd</sup>
4	Do you continuously evaluate the level of comfort, safety and health of your workplace by getting the workers' opinions in relation to the work they perform?	35.3%	33%	10%	10.7 %	11%	4.15	1 <sup>st</sup>
5	Do you have any material handling system that will reduce manual lifting and transportation of	41.7%	30%	13.3 %	8.3%	6.7 %	3.91	4 <sup>th</sup>

	materials within your organisation?							
6	Do you ensure that comfortable working temperature and good lighting in your workstations?	43.3%	28.3%	11.7%	8.3%	8.3%	3.90	6 <sup>th</sup>

A: Use it always; B: Very often; C: Sometime; D: Really; E: Never

From Table 2, it was observed that only 42.5% of the respondents always implement the ergonomic knowledge they have to design and produce sofa. This result aligns with the findings of [21], who conducted a study on ergonomics awareness and employee performance and discovered that among employees in production organisations. However, the knowledge of ergonomics is high, and there is an inadequate implementation of this knowledge in the production process. Furthermore, Table 2 shows that the implementation of the continuous evaluation of the level of comfort, safety and health of the workplace by getting the workers' opinions in relation to the work they perform is the most ranked ergonomic knowledge that is implemented in the design and production for ergonomics by the sofa producers. This is followed by the implementation of the knowledge of ensuring the safety, health and comfort of users in selecting materials for their living room chairs and also by the use of anthropometric data for the design and construction of seating room chairs. However, observed from the result that the design of the sofa based on good working temperature and good lighting in the workstation had the least implementation.

### 3.4 Factors that Hinder the Use of Ergonomic Knowledge

In evaluating the factors that hinder the implementation of knowledge of ergonomics in the production of Sofa in the study area, questions on the possible factors that influence the implementation were asked. These questions were based on stakeholders' self-interest, illiteracy, acceptance by employees, regulatory agency/union, cost of materials, and modern tools were considered. Table 3 gives the percentage response to these questions based on the Likert scale, the mean score, and the ranking of the factors hindering ergonomics implementation in Sofa production.

From Table 3, it was observed that the majority of the respondents, an average of 68.05%, agreed that the highlighted factors hinder the use of ergonomic knowledge in producing Sofa. The obtained result is in line with the findings of Karuppiyah *et al.* [22], who carried out a study on the role of ergonomic factors in the production of leather garments in small and medium-scale enterprises in India and discovered that outdated machinery, vibration, operational setup, fatigue, and poor ventilation and lighting are the top five factors inducing ergonomic-related problems. Similarly, Table 3 shows that the lack of modern tools and equipment is the most ranking factor that hinders the use of ergonomic knowledge in design and production among the producers of living room chairs in the study area. Inadequate acceptance by employees follow this, then illiteracy. It was, however, observed from the result that the self-interest of the stakeholder (customers, regulators and unions) had the least implementation.

Table 3: Response on the factors that hinder the use of ergonomic knowledge in producing Sofa and their rankings.

<b>S/N</b>	<b>Questions</b>	<b>SA</b>	<b>A</b>	<b>N</b>	<b>D</b>	<b>SD</b>	<b>Mean Score</b>	<b>Ranking</b>
1	Do you believe stakeholder (customers, regulators and unions) self-interest hinders ergonomic awareness and implementation in Kano State?	50%	26%	6%	8%	10%	3.80	6 <sup>th</sup>
2	Do you believe illiteracy also contributes heavily to hindering ergonomic awareness and implementation in the seating chairs furniture industry?	40%	30%	10%	6%	14%	3.96	3 <sup>rd</sup>
3	Inadequate acceptance by employees hinders the implementation of ergonomics in living room chair production.	50%	26%	6%	8%	10%	3.98	2 <sup>nd</sup>
4	Do you believe the lack of a strong regulatory agency or union that can oversee activities can also hinder the use of ergonomic knowledge in design and production?	40%	30%	10%	6%	14%	3.93	4 <sup>th</sup>
5	Do you believe high costs in material and equipment can hinder ergonomic implementation in the design of seating room chairs?	48%	30%	15%	5%	2%	3.86	5 <sup>th</sup>
6	Lack of modern tools and equipment?	50%	26%	6%	8%	10%	4.03	1 <sup>st</sup>

SA: Strongly Agreed; A: Agreed; N: Neutral; D: Disagree, SD: Strongly Disagree

### 3.5 Correlation between the Level of Awareness and the Implementation of Ergonomics

Based on the results obtained earlier in Table 1 and Table 2, the correlation between the level of awareness of ergonomics and the level of implementation of this knowledge in the design and production was determined by the Spearman's rank correlation given in Equation (2), based on the mean with rank  $R_1$  denoting the level of awareness. Rank  $R_2$  denotes the level of implementation. The obtained result of this computation is given in Table 4.

Table 4: Spearman correlation computation on the level of awareness and implementation of ergonomics by Sofa producers.

S/N	Factors of Ergonomics	LA	$R_1$	LI	$R_2$	d	$d^2$
1	Do you believe the use of anthropometric data in the design and construction of seating room chairs can improve users' comfort and health?	3.70	6	4.01	3	3	9
2	Do you believe bad seating posture can result in bad health conditions?	3.82	2	3.91	4.5	-2.5	6.25
3	Do you believe some materials used (i.e., form, material) in seating room furniture affect users' comfort and health?	3.75	5	4.11	2	3	9
4	Do you believe workstation evaluation toward a clean, safe environment, equipment and ease of movement in the workspace is related to workers' health and comfort?	3.87	1	34.15	1	0	0
5	Do you believe that Suitable manual material handling equipment provision for routine activities can promote the health and comfort of workers?	3.81	3	3.91	4.5	-1.5	2.25
6	Do you believe good lighting and comfortable temperature affect the health and comfort of workers?	3.79	4	3.90	5	-1	1
Total							27.5

LA: Level of awareness; LI: Level of implementation

Using Equation (2), Spearman's rank correlation is 0.08. The result implies a weak positive correlation between the level of awareness and implementation of this knowledge in the design and production among sofa producers in the study area. Though sofa producers have an idea of ergonomics, they tend not to implement these ideas in practice, probably due to factors such as a lack of modern tools and equipment due to high cost, the inadequate standard by a regulatory agency that oversees their activities, low cost of living among the end-users, and even the poor knowledge of ergonomics among the end-users.

The obtained result is in line with the findings of previous works [7], [10], [23], which indicated that there is a low level of ergonomic knowledge awareness in society, as well as poor implementation of the ergonomic knowledge that is known. In these studies, most workers or end-users operate with an extra effort of unknown stress due to inadequate ergonomic knowledge in design and production at workstations or workplaces to compensate and meet their organisation's employees' expected performance.

#### **4. Conclusion**

This study considered the comparative analysis of ergonomic knowledge and implementation among Sofa producers in Kano State, Nigeria. From the results obtained:

- Averagely, only 43.61% of the respondents displayed a good knowledge of ergonomics awareness.
- Averagely, only 42.5% of the respondents always implement ergonomic knowledge in the design and production of the sofa.
- Spearman's correlation analysis showed a coefficient value of 0.08, implying a weak positive correlation between the level of awareness and the level of implementation of this knowledge in design and production among Sofa producers in Kano.
- The lack of modern tools and equipment is the most ranking factor that hinders the use of ergonomic knowledge in design and production among the producers of Sofas in Kano state. Other significant factors are inadequate acceptance by employees and illiteracy.

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#### **Conflicts of Interests**

The authors declare no competing interests

#### **Authors' Contributions**

HSA is responsible for collecting data, methodology, and writing the original draft. UAU is responsible for the conceptualisation, supervision, methodology and writing of the original draft. ANO is responsible for the data analysis, formal analysis and writing of the original draft.

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