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Anthropometric characterization of abattoir workers in Oyo state, southwestern Nigeria

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Abstract

The anthropometric of workers in abattoirs is crucial for understanding the physical demands and ergonomic requirements of their job. Abattoir workers are exposed to unique occupational hazards and physical stresses that can impact their health, safety, and productivity. Despite the significant of abattoir, there is a notable lack of anthropometric data on these workers, which hinders the design and implementation of tailored workplace interventions, personal protective equipment, and ergonomic tools that fit their unique physical characteristics. The aim of this research was to investigate anthropometric characteristics associated with Abattoir workers activities. A total of 480 participants (392 male and 88 female) were measured for key anthropometric dimensions such as stature, shoulder height, hand length, elbow height and several composite body segment dimensions were taken and statistically analyzed. Results showed that the mean stature was 1.691 m, with males averaging 1.697 m and females 1.664 m. Hand length was remarkably similar between sexes—0.82 m for males and 0.85 m for females—while foot length averaged 0.251 m for males and 0.246 m for females. Composite dimensions such as elbow height and wrist height showed minimal gender differences, with mean values of 1.090 m and 0.823 m in males, and 1.095 m and 0.827 m in females, respectively. Conclusively, this study established key anthropometric measurements of male and female abattoir workers in Oyo State, providing data essential for ergonomic workstation and tool design. The results highlight the need for locally relevant design standards to reduce injury risks and improve worker efficiency.

Keyword: Anthropometry; Ergonomic; Abattoir workers; Occupational hazards; Characterisation

1. Introduction

Anthropometry is the scientific study of human body measurements — plays a critical role in occupational health, ergonomics, and equipment design, it provides a foundation for designing tools, equipment, and workspace that accommodate the physiological diversity of workers, thereby enhancing workplace safety, comfort, and efficiency (Pheasant and Heslegrave, 2006). According to Fajobi, *et al.* (2019), anthropometry is the art and science of measuring the physical geometry, mass characteristics, and strength capabilities of the human body. The human body is crucial in designing effective Human-Machine Interfaces (HMI). A through anthropometry survey in Nigeria will help create workplaces that are ergonomic, functional, efficient, and user-friendly (Sanyaolu *et al.*, 2023). In labour-intensive sectors such as meat processing and butchery, the mismatch environment design can lead to Work-related Musculoskeletal Disorders (WMSDs), reduced productivity, and occupational injuries (Bridger, 2008; Mahmud, *et al.*, 2010). The industrial and occupational relevance of anthropometric data cannot be overemphasized, especially in developing countries where labor-intensive tasks are often carried out under substandard ergonomic conditions. The design of tools, machinery, protective equipment, and workstations that fail to reflect the physical dimensions of their

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users can lead to increased fatigue, poor posture, reduced productivity, and a higher prevalence of Work-related Musculoskeletal Disorders (WRMSDs) (Patil *et al.*, 2016). These risks are particularly pronounced in the meat processing sector, where manual dexterity, strength, and posture play a central role in daily operations. Abattoir work is physically demanding, involving repetitive motion, sustained standing, cutting, lifting, and carrying of heavy materials such as animal carcasses. Such tasks require tools and workstation layouts that are compatible with the body dimensions of the workers. For example, improper alignment between table height and elbow level can lead to shoulder strain, while tools that are too heavy or large for the hand span can reduce grip efficiency and increase injury risk (Roquelaure, *et al.*, 2015).

These problems can be mitigated if design parameters are based on anthropometric characteristics specific to the user population. In Nigeria, and particularly in Oyo State, abattoirs play a crucial role in the food supply chain, providing employment to a significant portion of the informal labour sector. Butchery workers in the abattoir perform physically demanding tasks, including lifting heavy carcasses, repetitive cutting motion, and prolonged standing, which often result in cumulative physical strain (Adesokan *et al.*, 2015; Yusuf *et al.*, 2021). The informal and semi-formal nature of most abattoirs means that many workers operate in environments lacking in structured health and safety protocols (Oludiran *et al.*, 2018). This is compounded by the fact that most workplace tools and equipment used in these settings are either imported or designed using foreign anthropometric standards—typically European or North American—which do not correspond to the physical characteristics of the Nigerian population (Ajayi *et al.*, 2020). Consequently, many of these tools and facilities are ergonomically incompatible with the average Nigerian abattoir worker. Despite the growing awareness of occupational health and safety globally, there is a notable lack of empirical anthropometric data specific to butchery workers in Nigeria, most abattoirs in the region are under-regulated and lack standardized practices that align with occupational health principles (Akinro *et al.*, 2009; Olugasa *et al.*, 2017). Consequently, the absence of anthropometric consideration in workspace design has been linked to high prevalence of fatigue, discomfort, and chronic injuries among abattoir workers (Maduagwu *et al.*, 2014; Akinyemi *et al.*, 2022).

2. Materials and Methods

This study was conducted across five geopolitical zone of Oyo State, Nigeria, namely: Ogbomoso, Oyo, Ibarapa, Okeogun, and Ibadan zone. According to Oyo State Ministry of Agriculture and Rural Development, there are sixty-one (61) abattoir/slaughter slab in the state. The research work covered the five geopolitical zone of Oyo State, the following are the numbers of abattoir/slaughter slab in each zone, three (3) locations in Ogbomoso zone, six (6) in Oyo zone, seven (7) in Ibarapa zone, eighteen (18) in Okeogun zone, and twenty-seven (27) in Ibadan zone. Abattoirs in these locations differ in terms of organization and equipment but share a common reliance on manual labor, making them ideal for an anthropometric study aimed at improving ergonomic design and worker safety. The research employed a descriptive cross-sectional study design. The primary goal was to gather baseline anthropometric data among male and female abattoir workers engaged in slaughtering, cutting, and carcass handling tasks. Ethical clearance was obtained from an accredited research ethics committee, and written informed consent was secured from all participants. The study adhered to ethical standards concerning privacy, voluntariness, and non-disruption of regular work routines.

Participants were selected using a purposive sampling technique. Only workers actively engaged in daily meat processing duties—such as butchering, cutting, lifting, and cleaning—were eligible. A total of 480 participants were measured, consisting of 392 males and 88 females. Each abattoir contributed proportionally to the overall sample, and efforts were made to include a wide age range and different physical builds to ensure the data's generalizability. Anthropometric parameters assessed in the study were chosen based on their relevance to ergonomic workstation design and tool usability. These included stature, foot length, hand length, elbow height, palm and finger length, and self-reported knife mass. These body dimensions are especially significant for the layout of cutting tables, the design of hand tools, and the development of Personal Protective Equipment (PPE). All measurements were taken using standardized procedures based on the International Standards for Anthropometric Assessment (ISAK, 2011). Participants were instructed to stand upright, barefoot, and in minimal clothing to reduce measurement errors.

Measurement instruments included a stadiometer for height, a flexible non-elastic measuring tape for limb segment lengths, and a digital weighing scale for assessing the mass of typical knives used by workers. All tools were calibrated before and after each session. Each anthropometric dimension was measured twice per participant, and the average value was recorded to enhance reliability. The data collection was conducted in the morning hours to avoid fatigue-related postural changes that could affect the accuracy of certain body dimensions. To ensure uniformity across all regions, data collection was supervised by ergonomics-trained personnel, and research assistants received prior training on measurement protocols. The measurements were performed in designated open areas within the abattoirs, with privacy measures in place to maintain participant comfort. All data were coded and entered into Microsoft Excel before being exported to IBM SPSS Statistics version 26 for analysis. Descriptive statistics were computed, including

mean, standard deviation, minimum, maximum, and selected percentiles (5th, 50th, and 95th). These statistical indicators are particularly important in ergonomics, as designing for the 5th–95th percentile range is widely accepted as best practice to accommodate most users. The data were analyzed separately for male and female workers to account for gender-based differences and then pooled for generalized design recommendations. This approach ensures the results are applicable in developing inclusive and context-specific ergonomic interventions for the Nigerian meat processing sector.

3. Results and Discussions

The anthropometric data collected from 480 abattoir workers in Oyo State—comprising 392 males and 88 females—revealed significant insights into the physical characteristics of the workforce. The parameters measured included stature, foot length, hand length, elbow height, palm and finger length, and the mass of knives typically used by each worker. The results were statistically analyzed using descriptive measures such as mean, standard deviation, minimum, maximum, and percentile values (5th, 50th, 95th), and were further discussed in relation to ergonomic needs and workstation design. The average stature for male workers was 1.697 m (SD = 0.0829 m), while that of females was 1.664 m (SD = 0.0795 m), indicating a clear height difference between the sexes. This finding aligns with the well-documented sexual dimorphism in anthropometry, where males typically have greater linear body dimensions than females (Pheasant *et al.*, 2021). The implication of this is critical in determining worktable height, as an ergonomically poor design can lead to increased upper limb fatigue, particularly for shorter workers. Similarly, the hand length for males (mean = 0.821 m) exceeded that of females (mean = 0.805 m). Since hand tools like knives and hooks are regularly used in abattoirs, the variation in hand dimensions points to the need for adjustable or differently sized grips to suit different users. A one-size-fits-all approach may reduce operational efficiency and elevate the risk of repetitive strain injuries, especially among female workers with smaller hands. Studies have shown that inappropriate handle size in manual tools leads to decreased grip strength and precision (Sadeghi *et al.*, 2022). In terms of foot length, male workers had a mean of 0.251 m, compared to 0.246 m among females. This is relevant in designing anti-slip footwear or floor mats, which must be appropriately sized to prevent falls—a common hazard in wet and slippery abattoir environments. According to Owolabi *et al.* (2017), many workplace injuries in Nigerian abattoirs result from improper PPE fitting and poorly designed working conditions.

When the male and female data were pooled together for general workstation design considerations, the mean elbow height was 1.089 m, and the 5th to 95th percentile range spanned from 0.99 m to 1.210 m. This range suggests that designing equipment and workstations based on this central 90% will cater to the vast majority of the workforce, excluding only extreme cases. The use of percentile values is common in ergonomic design because it minimizes exclusion errors while improving usability (Kroemer *et al.*, 2001). The mean hand length across all participants was 1.81 m, and the knife mass used averaged 323 g. This reveals that most abattoir workers, regardless of gender, handle tools of moderate weight, which must be well-balanced and compatible with their hand dimensions to ensure precision and comfort during cutting operations. If tools are too heavy relative to grip size or strength, it may cause wrist stress, poor control, or injury over time. This supports previous findings by Uzairue and Omolayo (2020), who emphasized that ergonomic mismatches between tool design and anthropometric features are a major cause of occupational discomfort in Nigerian slaughterhouses.

Table 1 Mean, Standard deviation, Range and Percentiles of Manual Worker's Data (Male and Female)

Anthropometric Measurement (N=480)	Min	Max	Mean	Standard Deviation	Range	5 th Percentile	50 th Percentile	95 th Percentile
Stature	1.51	1.91	1.6917	0.084	0.40	1.56	1.70	1.82
Shoulder height	1.26	1.61	1.42	0.078	0.35	1.32	1.42	1.54
Hand length	0.71	0.95	0.81	0.050	0.24	0.74	0.81	0.89
Upper arm length	0.3	0.43	0.36	0.036	0.13	0.31	0.36	0.42
Palm+finger length	0.16	0.22	0.20	0.018	0.08	0.17	0.20	0.22
Elbow height	0.96	1.22	1.09	0.068	0.26	0.99	0.11	1.21
Wrist height	0.73	0.96	0.82	0.050	0.23	0.76	0.82	0.90
Fingertip height	0.54	0.72	0.61	0.042	0.18	0.56	0.61	0.69

Waist-level reach	0.45	0.64	0.52	0.046	0.19	0.47	0.51	0.61
Thigh length	0.5	0.67	0.56	0.029	0.17	0.52	0.55	0.60
Lower leg length	0.39	0.51	0.44	0.028	0.12	0.40	0.43	0.50
Foot length	0.20	0.30	0.25	0.030	0.10	0.21	0.25	0.29
Knife mass (g)	251	398	323	42.50	147	256	325	390

Dimensions are in meters

Table 2 Mean, Standard deviation, Range and Percentiles of Manual Worker's Data (Male)

Anthropometric Measurement (N=392)	Min	Max	Mean	Standard Deviation	Range	5th Percentile	50th Percentile	95th Percentile
Stature	1.51	1.91	1.70	0.083	0.40	1.59	1.71	1.83
Shoulder height	1.26	1.82	1.44	0.086	0.56	1.32	1.43	1.55
Hand length	0.71	1.53	0.82	0.093	0.82	0.74	0.81	0.90
Upper arm length	0.30	0.70	0.39	0.083	0.39	0.31	0.37	0.59
Palm+finger length	0.16	0.39	0.22	0.047	0.23	0.17	0.21	0.33
Elbow height	0.96	1.22	1.09	0.066	0.26	0.99	1.09	1.21
Wrist height	0.73	0.95	0.82	0.046	0.22	0.76	0.82	0.90
Fingertip height	0.33	0.90	0.61	0.081	0.56	0.45	0.61	0.74
Waist-level reach	0.39	0.64	0.51	0.053	0.25	0.42	0.49	0.61
Thigh length	0.50	0.67	0.56	0.029	0.17	0.52	0.55	0.60
Lower leg length	0.39	0.51	0.44	0.029	0.12	0.40	0.43	0.50
Foot length	0.20	0.30	0.25	0.025	0.10	0.21	0.25	0.29
Knife mass (g)	251	398	323.51	42.23	147	256	325	390

Dimensions are in meters

Table 3 Mean, Standard deviation, Range and Percentiles of Manual Worker's Data (Female)

Anthropometric Measurement (N=88)	Min	Max	Mean	Standard Deviation	Range	5th Percentile	50th Percentile	95th Percentile
Stature	1.51	1.81	1.665	0.080	0.30	1.52	1.65	1.78
Shoulder height	1.27	1.53	1.397	0.067	0.26	1.31	1.40	1.52
Hand length	0.72	0.95	0.805	0.048	0.23	0.74	0.79	0.88
Upper arm length	0.31	0.43	0.358	0.037	0.12	0.31	0.36	0.42
Palm+finger length	0.61	0.23	0.195	0.019	0.07	0.17	0.19	0.22
Elbow height	0.99	1.22	1.095	0.061	0.23	0.99	1.09	1.21
Wrist height	0.76	0.9	0.827	0.040	0.14	0.76	0.82	0.90
Fingertip height	0.54	0.71	0.610	0.035	0.17	0.56	0.60	0.67
Waist-level reach	0.46	0.63	0.508	0.045	0.17	0.46	0.49	0.59
Thigh length	0.50	0.61	0.557	0.032	0.11	0.51	0.55	0.61
Lower leg length	0.39	0.51	0.440	0.028	0.12	0.40	0.43	0.50

Foot length	0.20	0.3	0.246	0.028	0.10	0.21	0.25	0.29
Knife mass (g)	251	397	320.93	47.12	146	257.35	325	391.65

Dimensions are in meters

Table 4 2-Tail t-test analysis of the Male and Female Anthropometric Data

Anthropometric Measurement (480)	Mean (Male)	Mean (Female)	Standard Deviation (Male)	Standard Deviation (Female)	tcal	P-Value	Decision
Stature	1.697015	1.6645	0.082954	0.0736	1.977961	0.000798	Reject
Shoulder height	1.435638	1.3967	0.085517	0.0668	1.975092	0.00000603	Reject
Hand length	0.821148	0.805	0.093269	0.0481	1.969311	0.021199	Reject
Upper arm length	0.385169	0.3578	0.08309	0.0366	1.967596	0.00000267	Reject
Palm+finger length	0.218496	0.1947	0.047471	0.0134	1.966925	0.000000000000439	Reject
Elbow height	1.090064	1.0949	0.066229	0.061	1.977431	0.510929	Accept
Wrist height	0.822949	0.8272	0.046131	0.0402	1.976692198	0.386921536	Accept
Fingertip height	0.612425	0.6095	0.080781	0.0345	1.967313	0.599252	Accept
Waist-level reach	0.506535	0.5081	0.053309	0.0452	1.976233	0.781732	Accept
Thigh length	0.556122	0.5566	0.028738	0.0316	1.979764	0.898636	Accept
Lower leg length	0.44081	0.4404	0.028562	0.0276	1.978099	0.895195	Accept
Foot length	0.251258	0.2462	0.025367	0.0283	1.97993	0.125414	Reject
Knife mass	323.5128	320,93	42.23258	47.116	1.97993	0.637086	Accept

4. Conclusions

The anthropometric characterization of twelve (12) body segments of abattoir workers in five geopolitical zone of Oyo State, Nigeria was provided in this paper. The findings reveal the existing workstations and tools in many abattoirs are not tailored to the anthropometric characteristics of the workforce, thereby predisposing workers to awkward postures, musculoskeletal disorders (MSDs), and occupational accidents. Since anthropometric data provides critical input for ergonomically sound design, the characterization of abattoir workers establishes a scientific foundation for work-friendly environments. A crucial technique to identify the population of potential customers is anthropometry, nevertheless, to ensure that items and physical equipment are ergonomically appropriate. Essentially, the human body plays a crucial role in the design of human-machine interfaces (HMI). Also, this study has highlighted the necessity of conducting a robust and all-encompassing anthropometry survey in Nigeria for the user population. Such information can be utilised to set up the abattoir worker's workspace in a way that will improve its ergonomic suitability, functional efficacy, and human convenience. Even though several studies on the musculoskeletal and low back diseases of workers have been conducted, a comprehensive evaluation of the workstation is necessary to determine how ergonomically viable and user-friendly the current design is. The findings of this study, integrating anthropometric principles into abattoir design, will not only enhance occupational health and safety but also improve productivity and sustainability within the meat processing industry.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare that they have no conflicts of interest.

References

- [1] Adesokan, H. K., Raji. A. O., and Lawal-Adebowale, A. O. (2015). Practices and perceptual of abattoir workers in Oyo State, Nigeria. *Veterinary Italian*, 51(4), 320-325.
- [2] Ajayi, A. M., & Bamgbose, O. (2014). Application of anthropometric measurements in ergonomics: A review. *Nigerian Journal of Technological Development*, 11(2), 47-52.
- [3] Akinro, A. O., Ologunagba, I. B., and Yahaya, O. (2009). Environmental implication of unhygienic operation of city abattoir in southwestern Nigeria, *Journal of Sustainable Development in Africa* 11(4), 98-112.
- [4] Bridger, R. S. (2008). *Introduction to ergonomics 3rd edition*, CRC Press.
- [5] Fajobi, M. O. Onawumi, A. S., Mfon-Udoh, M. O., and Awoyemi, E. A. (2019). Mismatch between Anthropometry Characteristics of Nigerian Occupational Bus Drivers and the In-Vehicle Measurement. *Covenant Journal of Engineering Technology*, 3, (1): 20-36
- [6] Kroemer, K.H.E., & Grandjean, E. (2001). *Fitting the Task to the Human* (5th ed.). Taylor & Francis.
- [7] Maduagwu, S. M., Nwajagu, G. I., and Emechebe, G. O. (2014). Evaluation of ergonomic hazards among butchers in Nigeria: A case study of Enugu urban abattoirs. *Nigeria Journal of Medical Rehabilitation*, 17(1), 10-17.
- [8] Mahmud, N., Khan, A. A., and Asurat, M. (2010). Ergonomic evaluation and anthropometric measurements for redesigning hand tools. *Pakistan Journal of Engineering and Applied Science*, 6(1), 58-66.
- [9] Oludiran, O. A., & Emeka, M. I. (2018). Ergonomic risk assessment in meat handling operations in informal slaughterhouses in Nigeria. *Journal of Occupational and Environmental Hygiene*, 15(5), 372-378.
- [10] Olugasa, B. O., Oshinowo, S. A., and Ijagbone, I.F. (2017). Public health risk of meat processing and slaughter operations in Ibadan, Nigeria. *African Journal of Biomedical Research*, 20(1), 67-74.
- [11] Owolabi, A., et al. (2017). Occupational Hazards and Safety Practices in Abattoirs: A Case Study of Nigeria. *Safety Science Journal*, 93, 129-135.
- [12] Pheasant, S., and Haslegrave, C. M. (2006). *Bodyspace: Anthropometry, and the Design of Work* (3rd edition). CRC Press.
- [13] Pheasant, S., and Haslegrave, C. M. (2005). *Bodyspace: Anthropometry, Ergonomics, and the Design of Work* (3rd edition). CRC Press.
- [14] Roquelaure, Y., Ha, C., & Leclerc, A. (2015). Work-related upper limb disorders: risk factors and prevention. *Occupational and Environmental Medicine*, 72(2), 81-88.
- [15] Patil, S. V., & Vishwas, P. (2016). Ergonomic considerations in the design of meat processing workstations. *International Journal of Industrial Ergonomics*, 43(4), 297-304.
- [16] Sadeghi, A., et al. (2022). Hand Tool Design Based on Anthropometric Data: Reducing Risk of Musculoskeletal Disorders. *Applied Ergonomics*, 100, 103610.
- [17] Uzairue, S.I., & Omolayo, A.O. (2020). Ergonomic Evaluation of Work Tools in Nigerian Slaughterhouses. *Journal of Engineering and Technology Research*, 12(4), 65-73.
- [18] Yuduf, M. A., Akinyemi, O.O., and Odetola, T. D. (2021). Occupational health risks among abattoir workers in Nigeria: A review. *Public Health and Environmental Research*, 11(2), 15-21.