Ergonomic disparities in *Bọlẹ* vending: Anthropometric analysis of worker-platform mismatch and health implications in Port Harcourt, Nigeria

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Abstract

Mismatches between worker characteristics and work tools are among the major drivers of many health issues, including musculoskeletal disorders, in long-standing jobs like *Bọlẹ* vending in Nigeria. This study's objectives were to assess the degree to which the anthropometric characteristics of *Bọlẹ* vendors match those of their vending platforms, the impact of gender on that match, the postural discomfort associated with the work, and the safety and well-being of vendors in Port Harcourt, Nigeria. A cross-sectional study design was employed to investigate 116 participants in seven *Bọlẹ* hotspot locations with a complete surveying technique. Data were collected through pre-tested, questionnaire administration and anthropometric measurements. The collected data were analysed using appropriate descriptive and inferential statistical methods. Results showed

that males were significantly taller than females, but female participants had a significantly higher mass, waist circumference (WC), and body mass index (BMI) than males. Overall, 15.5% of the participants who were found to be obese were females. The anthropometric results indicated that 44.4% and 61.8% of vendor-platform height did not match male and female vendors' anthropometric characteristics, respectively. Safety risks reported ranged from bruises (1.7%) to burns (26.7%), and health risks ranged from typhoid (0.9%) to internal heat (18.1%). Long-standing awkward postures and other stressors in the vending of *Bọlẹ* could increase the risk of experiencing back, waist, leg, and shoulder discomforts.

1   Introduction

Over recent decades, the sub-optimal design of workplaces and poor interactions within work systems have become major global concerns due to their significant impact on workers' health, particularly in terms of musculoskeletal disorders. As a result, the International Labour Organisation (ILO) has recommended increased compliance with ergonomic principles to maximise productivity and minimise hazards in industrial settings (Karwowski, Taiar, Rodrick, Sherehiy & Fox, 2021). Additionally, the ILO has included Occupational Health and Safety (OHS) as a key focus area, emphasising the importance of creating safe and healthy working environments across various industries. One principle strongly linked to musculoskeletal disorders is a worker's work-station height matching (Sydor & Hitka, 2023). However, the increasing prevalence of mismatched workstations with worker characteristics can significantly affect the overall well-being of workers, particularly in developing countries like Nigeria (Abdollahpour, Helali, Rasoulzadeh & Hassankhani, 2023). Working under mismatched work conditions is often accompanied by many health concerns, including musculoskeletal disorders, which can lead to disabilities and represent major global workforce health issues (WHO, 2022).

The occupation of public food vendors dates back to ancient times, when markets were central to community life, and have continued to exist today with modifications in consumer preferences, convenience, fast meals, and urbanisation (Fusté-Forné, 2021). Street food plays a major role in the global food market, with the Food and Agriculture Organization of the United Nations estimating that some 2.5 billion people worldwide consume it (FAO, 2023). Due to the conditions under which food is cooked and sold in public, Lamuka (2014) considers eating in public a health risk; nevertheless, it has been recognized that this sector of the economy contributes to economic gains, food security, and improved health (Skinner and Watson, 2020). Most operators in this sector are classified as "informal" as they work under no protection from formal regulations (Chen and Carré, 2020) and usually do not require licenses. They, therefore, face several challenges, such as warrants and fines in India (Agarwala, 2020), informal employment terms for workers (Breman, 2020; Carré, 2020), and unregulated fines and levies by state and local government enforcers, as found in Nigeria (Adama, 2021; Adeosun, Oosterveer, and Greene, 2023; Adisa, Ayobade, and Shittu, 2023).

Furthermore, access to quality healthcare and medical services is a significant challenge for informal workers. They might not receive regular medical check-ups or health insurance, which could result in undiagnosed and untreated health problems since they do not receive non-wage benefits such as health care and social protection (Agarwala, 2020; Staab, 2020). This is the case even though informal workers are exposed to occupational health and safety risks due to inadequate access to sanitary facilities, water supplies, and appropriate environmental health practices (Onyenechere et al., 2022), pollutants and respiratory risks (Sepadi and Nkosi, 2023), and fire risk in informal street food vending (Sepadi and Nkosi, 2022).

Bọlẹ is a delicacy comprising roasted yam, plantains, sweet potatoes, fish, and sauce often garnished with vegetables and onions, and its vending is widely spread in the Niger Delta, Nigeria (Aiyeloja, Adedeji & Oliver, 2018; Eke-Ejiofor & Maxwell, 2019; Vanguard, 2019). *Bọlẹ* vending involves the preparation, marketing and sale of *Bọlẹ*, and this business mainly operates in the informal sector due to consumer preferences for *Bọlẹ* prepared over hot coal as opposed to modern electrical grilling. The preparation and sale are done on a constructed platform providing vendors with a standing workspace. Prolonged standing conditions while working are associated with varying challenges (Nagaraj et al., 2019; Rathore et al., 2020). However, this standing design has not been given adequate research attention in Nigeria. Knowledge of matching human stature to their workspace is central to ergonomic practices and workplace design (Dianat, Molenbroek & Castellucci, 2018; Nagaraj, Jeyapaul & Mathiyazhagan, 2019; Rathore, Pundir & Iqbal, 2020), specifically in the food industry, where standing posture are common, like *Bọlẹ* vending in Nigeria.

Beyond the protracted standing durations involved, a mismatch in platform height relative to vendors' anthropometric dimensions may engender lumbar discomfort attributable to postural misalignment and upper limb discomfort arising from suboptimal arm reach conditions. Aside from the implications of mismatching working platform height with the vendor's anthropometry, *Bọlẹ* vending may also predispose vendors to health and safety risks such as respiratory issues due to smoke inhalation, cuts and burns from handling knives and hot food. Food vending procedures that involve using open fire for food preparation expose vendors to air pollutants, which increase the risk of respiratory infections and urinary illnesses and adversely affect the reproductive health of female vendors (Sepadi and Nkosi, 2022). Investigating the safety and health risks in food vending is important in identifying and mitigating the risks faced by the workers (Liu et al., 2014).

Thus, this study aimed to evaluate the ergonomic match between the anthropometric characteristics of *Bọlẹ* vendors and their vending platforms in Port Harcourt, Nigeria. Specifically, the objectives were to: (1) assess the extent of mismatch between vendor height and platform height; (2) analyse gender disparities in anthropometric measurements and their implications for ergonomic design; (3) identify the prevalence of postural discomfort; (4) identify safety and health risks experienced among *Bọlẹ* vendors.

2   Materials and methods

2.1   Study design and area

A descriptive and quantitative cross-sectional study design was employed from March to July 2019 to investigate seven selected *Bọlẹ* hotspot locations (Alakahia, Elekahia Stadium Road, Mgbuoba, Rumualogu, Ozuoba, Rumuokwuta, and Rumuola) identified by Aiyeloja et al. (2018). A complete surveying technique was employed, including 116 participants from these locations. At each vending spot, participants' consent was obtained after being informed of the research and data to be collected. All the participants were either owners (n=69) or paid workers (n=47), with 27(23.3%) and 89(76.6%) participants being males and females, respectively (Table S1). The selection of these vendors was based on their willingness to participate, and all participants gave verbal informed consent before the commencement of the survey.

2.2   Data collection

Data collection techniques employed for this study included using a questionnaire, anthropometric measurement tools and field observation to get information on demographics, platform and anthropometric measurements, postural discomfort, and safety and health risks experienced among *Bọlẹ* vendors. Prior to data collection, participants were informed about the study's purpose, the nature of the data to be collected and the procedure of collecting the data. This ensured the voluntary participation of the participants.

The questionnaire used contained self-developed questions which were derived from other studies on hazards resulting from informal workplaces (Akani, Dienye & Okokon, 2011; Dienye, Akani & Okokon, 2016). The questionnaire was divided into sections inquiring about participants' demographic characteristics, working environment, postural discomfort, injuries, and sickness. The instrument was tested before the commencement of the study to ensure the clarity of the questions, the aptness of the responses, and suitability for the study. Pre-tested questionnaires were administered to 116 participants through face-to-face interviews. The questionnaires were retrieved on the spot, and all remained valid after checking to ensure they were adequately filled.

2.2.1   *Demographic data collected*

Demographic characteristics measured included gender, age, marital status, nativity, educational qualification, family size, ownership and years of experience. Each demographic item in the questionnaire was close-ended, with options available for participants to tick from.

2.2.2   *Platform and Anthropometric measurements*

Platform height was measured using a calibrated pole while ensuring that the table was on a flat surface. Anthropometric characteristics of the participants, such as height, mass, and waist circumference (WC), were obtained for determining body mass index (BMI) and body shape index (ABSI) using standard equations 1 and 2 adopted by Zverev and Chisi (2004) and Consalvo et al. (2018), respectively. The mass of participants was measured using a weighing scale after ensuring its placement on a flat surface. During the measurement, participants stood stable and upright with light clothing and free from external loads. Waist circumference was measured by placing a measuring tape around

the participant's waist, and vender height was obtained using a calibrated pole while ensuring a perpendicular angle with the ground. These data were recorded in a data collection sheet. BMI was categorised according to the World Health Organization (WHO) classification reported by Lim et al. (2017).

$$\text{BMI (kg/m}^2) = \frac{Weight}{(Height)^2} \qquad (1)$$

$$\text{ABSI} = \frac{WC}{(BMI^{2/3} \; x \; Height^{1/2})} \qquad (2)$$

Where;
> BMI is body mass index of the participants
> ABSI is a body shape of the participants
> WC is waist circumference of the participants

The anthropometric match between the participants' standing height and the height of the platforms used for preparing and selling *Bọlẹ* was computed using the method adopted by Baharampour et al. (2013) with a minor modification considering its sitting position. The upper and lower limits were modified using the recommended height to desk height (standing) by Karle (2022).

3. $1.53 \leq [\text{VH/PH}] \leq 1.65$ **(3)**

Where;
> 4. VH = Vendor height
> PH = Platform height

Mismatches were identified when the vendor height to platform height ratio fell outside the upper and lower limits calculated in Equation 3 and categorised into a low mismatch, match and high mismatch. A high mismatch is recorded when the vendor-to-platform height ratio falls at or below the established threshold of 1.53. This scenario indicates that the table height exceeds anthropometrically optimal levels. Conversely, low mismatch is observed when the vendor-to-platform height ratio equals or surpasses the threshold of 1.65. This implies that the table height falls below anthropometrically optimal levels. Thus, low mismatch occurs when the table is too low and high mismatch occurs when the table is too high for the vendor's use.

2.2.3 *Postural Discomfort*

A section of the questionnaire was dedicated to eliciting information on the postural discomfort experienced by *Bọlẹ* vendors. This section contained open-ended questions where respondents were asked about the postural discomfort they experienced while working. This allowed the participants to fully express the various types of discomfort they experienced with various body parts. Their responses were adequately grouped based on similarities and given suitable generic terms for easy coding and analysis.

2.2.4 *Safety and health risks*

Information on safety and health risks was also obtained using an open-ended questionnaire. The questions enquired about injuries and sicknesses encountered by the participants due to their working conditions. Participants commented freely on the injuries and sicknesses they encountered while working, which were subsequently grouped under safety or health risks.

2.2.5 *Working factors and environment*

The field observation focused on observing the preparation and marketing procedures of *Bọlẹ* vendors. Consent was obtained, and observations were made while the participants naturally engaged in their vending activities. Observations included their preparation procedures, materials used, marketing procedures, platform type and shade type. Data on working factors such as duration of work period, workdays per week, fanning rate and on-the-job breaks were obtained using a semi-structured questionnaire. Participants responded "yes" or "no" regarding taking breaks on the job, "so often", "more often", or "not often" on fanning rate while working duration and workdays per week were made open-ended.

2.3   Statistical analysis

Data entry was performed using MS Excel (v. 2010) and analysed using SPSS (v. 23). Categorical data were descriptively analysed and presented in percentages. T-test analysis was conducted to check for differences between the anthropometric measurements of male and female vendors, while Pearson correlation statistics tested the relationship between anthropometric measures. Chi-square analysis was used to check for a significant association between gender and mismatch, owner type and mismatch, and BMI and gender. The significance level was identified at 95% level. The match between platform height and vendor's height was computed using standard measurement percentage matching scales.

3   Results

Of the 116 participants, 23.3% were males and 76.7% were females, with 59.5% and 40.5% being owners and paid workers, respectively (Table S1). About 66.4% of participants worked 6–10 hours daily, and 68.1% worked 6 days weekly (Table S2). *Bọlẹ* vending setups usually occur under a corrugated sheet (48.3%) or an umbrella (47.4%), while only 4.3% use a tarpaulin or banner for shade. The dimensions of the platform, which are made from combinations of wood, metal, and stone (Table S2), on which the *Bọlẹ* preparation and marketing are carried out are self-constructed based on the vendor's design, and as such, various working spaces, cabinet inclusions, and heights were observed. The stone mainly served as a heat-insulating barrier between the wood or metal table surface and the roasting chamber. It was observed that preparation usually involved maintenance of the heat from coal fire by intermittent fanning and turning of plantains and yams to ensure even roasting. At the same time, at the point of marketing, knives are used to scrape off excess char and cut the food into chunks, even at hot temperatures.

3.1   Anthropometrics of the participants and their relationships

The participants showed significant differences between the genders in anthropometric measures and their derivatives, except for ABSI (Table 1). About 15.5% of participants

who were found to be obese were females, with a significantly lower proportion of overweight participants being males (Table 2). The correlation results indicated significant positive correlations for weight-WC, weight-BMI, and WC-BMI, while weight-ABSI and BMI-ABSI revealed significant negative correlations for both genders. However, low positive height-ABSI and negative height-BMI relationships were found only for females (Table 3).

Table 1. Mean anthropometric measurements and their derivatives

Anthropometric measures	Mean±SD			T-Stat
	Overall (N = 116)	Male (n = 27)	Female (n = 89)	
Height (cm) ± SD	163.29±6.64	167.33±6.62	162.07±6.18	3.68*
Weight (kg) ± SD	67.01±10.02	63.59±6.02	68.05±10.77	-2.73*
WC (cm) ± SD	36.22±5.06	31.78±2.65	37.56±4.84	-7.99*
BMI (kgm^{-2}) ± SD	25.22±4.14	22.76±2.31	25.97±4.28	-5.05*
ABSI ± SD	0.0022±0.0005	0.0022±0.0004	0.0022±0.0005	0.96

P-value is significant at α = 0.05 (*P<.05)

Table 2. BMI results and their classifications according to the WHO (n with % in brackets)

Classification	Male	Female	Total	Remark	χ^2	Sig
<18.5	0(0.0)	0(0.0)	0(0.0)	Underweight	10.239	0.006*
18.5-24.9	21(77.8)	41(46.1)	62(53.4)	Normal		
25-29.9	6(22.2)	30(33.7)	36(31.0)	Overweight		
≥30	0(0.0)	18(20.2)	18(15.5)	Obese		
Total	**27(23.3)**	**89(76.7)**	**116(100.0)**			

** p<0.01

Table 3. Correlation coefficients between anthropometric measurements and their derivatives

	Weight	Height	WC	BMI	ABSI
Weight	1	0.156	0.786**	0.884**	-0.815**
Height	0.328	1	0.020	-0.318**	0.299*
WC	0.628**	0.002	1	0.743**	-0.487
BMI	0.674**	-0.475	0.596**	1	-0.881**
ABSI	-0.640**	0.364	-0.201	-0.875**	1

** p<0.01; * p<0.05; Values below and above the diagonal represent male and female correlation analysis results, respectively

3.2 Participants and market platforms height match

The results indicated a considerable mismatch between the vendor-platform height of 44.4% and 61.8% for male and female vendors, respectively (Table 4). Specifically, 7.4% and 14.6% had low mismatches, while 37.0% and 47.2% had high mismatches for male

and female vendors, respectively. Based on ownership, a higher percentage of the workers (53.2%) are matched compared to owners (34.8%). Both gender and ownership status did not show any significant association with the mismatch category.

Table 4. Match and mismatch results between vendor and platform heights (n, with % in brackets)

Category	Frequency			χ^2	P- Value
	Low mismatch	Match	High mismatch		
Male	2(7.4%)	15(55.6%)	10(37.0%)	2.784	0.249
Female	13(14.6%)	34(38.2%)	42(47.2%)		
Total	**15(12.9%)**	**49(42.2%)**	**52(44.8%)**		
Owner	12(17.4%)	24(34.8%)	33(47.8%)	5.204	0.074
Worker	3(6.4%)	25(53.2%)	19(40.4%)		
Total	**15(12.9%)**	**49(42.2%)**	**52(44.8%)**		

Significant at P < 0.05

3.3 Postural discomfort and occupational risks among the participants

Back, waist, leg, and shoulder pain were the most prevalent areas reported that the participants experienced postural discomfort, with these areas accounting for 80.2% of the complaints by participants (Table 5). Though 22.4% indicated that they do not encounter any safety risks, burns and lacerations were expressed as the most prevalent safety risks by 65.6% of the participants; 78.5% of vendors reported internal heat (heat stress), headaches, eye problems, body pain, respiratory problems, and fatigue as the most frequent health risks associated with their work (Table 6). All the participants perceived that the work affected their well-being and gave varying reasons for how the work affected their well-being. Notable concerns were frequent body pain (51.7%), always being on medications (11.2%), frequent sickness (7.8%), internal heat (6.9%), eye problems and body sickness 6.0% each (Table 6).

Table 5. Postural discomforts of vendors among the participants

Discomfort	Variables	Frequency (n)	Percentage
Postural discomfort	Back pain	30	25.9
	Waist pain	29	25.0
	Leg pain	21	18.1
	Shoulder pain	13	11.2
	Neck pain	7	6.0
	Knee pain	5	4.3
	Toes pain	4	3.4
	Hand pain	4	3.4
	Ankle pain	3	2.6
	Total	**116**	**100.0**

Table 6.   Safety and health risks associated with roasting and marketing of Bọlẹ in Port Harcourt

Risks factors	Variables	Frequency (n)	Percentage
Safety risks	Burns	31	26.8
	Lacerations	26	22.4
	None	26	22.4
	Lacerations and burns	19	16.4
	Lacerations and bruises	7	6.0
	Burn and bruises	5	4.3
	Bruises	2	1.7
	Total	**116**	**100.0**
Health risks	Internal heat	21	18.1
	Headache	19	16.4
	Eye problem	15	12.9
	Body pain	14	12.1
	Respiratory problem	11	9.5
	Fatigue	11	9.5
	Rheumatism	8	6.9
	Swollen legs	5	4.3
	None	5	4.3
	Fever	4	3.4
	Chest pain	2	1.7
	Typhoid	1	0.9
	Total	**116**	**100.0**
Work affects well-being	Yes	116	100.0
	No	0	00.0
	Total	**116**	**100.0**
How does work affect well-being	Frequent body pain	60	51.7
	Always on medication	13	11.2
	Frequent sickness	9	7.8
	Internal heat	8	6.9
	Eye problems	7	6.0
	Body weakness	7	6.0
	Skin discolouration	4	3.4
	Leg and joint weakness	4	3.4
	Swollen legs	2	1.7
	Rapid aging	2	1.7
	Total	**116**	**100.0**

4   Discussion

The preponderance of females among the participants suggested that *Bọlẹ* preparation and marketing requirements are female-dominated tasks in Nigeria. This is congruent with previous studies (Alade & Eniola, 2012) tha*t* women participate more to food preparations and sales in public spaces than men in southwestern Nigeria. However, compared to

previous findings in the same study locations (Aiyeloja et al., 2018), the current study showed an increasing number of males in the *Bọlẹ* business. The increasing number of males entering this business indication indicates that males are more likely to perform female-related tasks for enhancing quality of life and economic development. The proportion of owners and paid workers as vendors found in this study showed the direct employment strength of the business, but risk prevention and health problems could likely have informed the employment of paid workers by certain or some owners as the results indicated a higher percentage of mismatch of owner's height and platform height compared to workers employed by owners. Several previous studies (Ali, Kamat & Mohamed, 2018; Andersen, Haahr & Frost, 2007; Chambers, Robertson & Baker, 2019; Han, Choi & Shin, 2016) have implicated prolonged standing work posture as a high-risk factor for many health issues, the working periods in this study, which were typically 6-10 hours per day and 6 days per week in standing postures (Table S2), are an indication of more significant risks to the health and well-being of the workers.

4.1 Anthropometrics of the participants and their relationships

Significant differences were found in anthropometric measurements between the genders, with females having significantly greater body weight and waist circumference while also being shorter in stature than males. This is consistent with previous findings (Zverev & Chisi, 2004) indicating that men were generally taller and lighter than women in rural southern Malawi. However, the findings in this study are dissimilar from those of Balogun, Olawoye and Oladipo (1994), who reported that males were significantly taller and heavier than females in Oyo and Osun States, Western Nigeria.

Based on BMI classifications, the results considered about half of the participants to be 'normal', with no nutritionally undernourished participants. However, 15.5% of the total participants who were found to be obese were females, with a significantly lower proportion of overweight participants being males. This could be attributable to the higher BMI and particularly the higher WC found in females, which are linked with total body fatness and central obesity or abdominal fatness (Farajian, Renti & Mannios, 2008; Onat et al., 2004). Differences in eating habits and lifestyles might contribute to females being obese and more overweight than males (Hamam et al., 2017; Hassan et al., 2015; Moschonis & Trakman, 2023). This is consistent with several previous reports indicating that females are more overweight and obese than males in Nigeria (Adeloye et al., 2021; Egbe, Asuquo, Ekwere, Olufemi & Ohwovoriole, 2014; Hussean & Ayokunle, 2018; Ijoma et al., 2019; Olatunbosun, Kaufman & Bella, 2011), and an extensive study by Chukwuonye et al. (2022) considered the prevalence of overweight and obesity to be highest in this study region in Nigeria. In addition to height and weight, WC is also a significant factor, as it showed a significant correlation with BMI. Compared to ABSI, BMI is a better anthropometric derivative owing to the order of significant relationships with other anthropometric measurements. The implications are that female participants in this study are likely to be vulnerable to the prevalence of illnesses related to obesity reported in Port Harcourt, such as metabolic syndrome (Unamba, 2017), and more likely to suffer from the risks of illnesses related to being overweight, such as type 2 diabetes (Nyenwe, Odia, Ihekwaba, Ojule & Babatunde, 2003). Considering the requirement to stand for extended periods of time in this work, being obese can increase pressure on the veins of the legs and impede proper blood circulation in the legs making it hard for fluids

to be reabsorbed causing swollen legs (Singh & Revand, 2022), a challenge reported by participants in this study.

4.2   Postural discomfort and occupational risks among the participants

Bọlẹ production and marketing are linked with specific postural outcomes (Table 5). Back, waist, leg, and shoulder pain were more prevalent among the participants and are known risks that come with prolonged standing (Waters & Dick, 2015). These prevalent postural outcomes could be attributed to awkward standing postures adopted and long work hours by a considerable proportion of the participants. Mismatches between vendor height and table height could also be a causal factor of the reported discomfort, as vendors would need to raise the arm or bend to carry out marketing activities. This aligns with studies on improper working platform heights indicating postural discomfort such as neck pain, back pain and lower arm pain (Anandakumar et al., 2021). The results are comparable to those of similar food industry subsectors reported in the literature (Abaraogu, Okafor, Ezeukwu & Igwe, 2015; Haffejee & Wolff, 2020; Iqbal et al., 2023; Khalaji, Yalfani & Gandomi, 2020; Shankar, Shanmugam & Srinivasan, 2015).

About 26.4% of the participants (Table 6) reported that they had never suffered from safety risks in recent times compared to only 4.3% who indicated not experiencing any health risks, implying that participants were more vulnerable to job-related illnesses than injuries. The preparation and marketing of *Bọlẹ* exposed the participants' hands to direct charcoal fire flames and heat from hot roasted products. Therefore, the frequent engagement of hands and fingers to add more charcoal, the turning of roasted products, and the testing and pressing of hot products likely contribute to the prevalence of hand burns found in this study. Further, the frequent manual peeling and cutting of yam, plantains, and sweet potatoes into small sizes could be attributed to the prevalence of lacerations recorded in the study.

Concerning health risks, the results indicated that the participants suffered from various health problems, including heat stress referred to as "internal heat", headaches, eye problems, body pain, respiratory infections, fatigue, rheumatism, swollen legs, fever, chest pain, and typhoid (Table 6). Internal heat expressed by the participants is a feeling of hotness inside the body, which could be a result of fever, metabolic activity, stress, anxiety, etc. Internal heat could be attributable to the frequent contact with charcoal fire. At the same time, headaches could likely be the result of the strenuous effect of the business or dehyrdation, and body pain and fatigue could be attributed to the use of mismatched roasting platform designs and prolonged standing reported in Tables 4 and S2. Various researchers (Akani, Dienye & Okokon, 2011; Dienye, Akani & Okokon, 2016) have reported the respiratory effects of wood biomass smoke exposure during fish smoking. Thus, eye and respiratory problems could likely be due to the participant's exposure to charcoal smoke produced while roasting, especially fish. The results are comparable to occupational risks reported by Bindu and Reddy (2016) and Jahangiri, et al. (2019) among commercial food workers in India. Amongst informal street food vendors in South Africa, similar fire risks and respiratory risks are experienced, with an indicating impact on the reproductive health of women working in this informal space (Sepadi and Nkosi, 2022).

As the work affected participants' wellness, they faced many challenges in sustaining their well-being. They reportedly mentioned that it caused them body pain, that they were always on medication, and reported experience of being sick frequently, frequent sickness, skin discolouration, leg and joint weakness, swollen legs, and rapid ageing (Table 6). Prolonged standing working condition is known to cause swelling of legs (Halim & Omar, 2011). For these challenges, it may be useful to create awareness towards addressing ergonomic and human issues such as awkward postures, long work hours, exposures to unsafe work conditions, use of unsafe food preparation, and marketing practices found in this study.

4.3 Participants and market platforms height match

A substantial proportion of female participants adopted awkward working postures that either allowed raising of the body from the chest or bending the back and waist to reach the working platform compared to their male counterparts. These awkward positions were frequently seen during field observations. The mismatches found between the worker height and vendor platform in this study implied that more females were exposed to the effects of awkward postures. While commercial food service work is hazardous owing to the intense rhythm of food production and the work conditions that can cause discomfort, debility, and occupational risks (Abdelsalam, Wassif, Eldin, Abdel-Hamid & Damaty, 2023; Ferreira et al., 2022; Park, Lee & Lee, 2021; Sojobi, Olatubi, Faremi, Oyewole & Ogunlana, 2023), hazards can occur at risk levels whenever the worker-work platform matching exceeds the lower and upper limits (Ahmad, Gaikwad, Kumar & Anurag, 2017; Kahya, 2019; Parvez, Rahman & Tasnim, 2019). For the preparation and marketing of *Bọlẹ*, the proportion of participants using mismatched platforms obtained in this study indicated that they performed their tasks at unsuitable conditions. The tasks performed included lighting and repetitive/intermittent fanning of charcoal fire inside the platforms, cutting of yam, plantains, sweet potatoes, and fish, frequent turning of products, and pressing, cutting, packaging, and serving of products. Thus, more female participants were required to work from awkward postures stretching or bending their back and waist, performing these tasks for 6–10 hours, and even 33.6% of the total participants worked for more than 10 hours (Table S2). Compared to paid employees, business owners displayed a more significant mismatch to platform height. This suggests that the platform's design is more in line with employees' heights than with owners'. This highlights the important role of employees in developing match platforms for food preparation and marketing. The employees were more likely to have acquired a range of skills and personal dispositions developed through experiences before engaging in a job.

5 Limitations

This study's first limitation is that it only covers seven major hotspot streets in Port Harcourt, Nigeria, which are well-known for *Bọlẹ* vending. The second limitation is that the study used a cross-sectional design, which could skew the results regarding the relationship between reported safety and health problems and ergonomic mismatch. Instead, a longitudinal study might provide stronger evidence of the causal relationships between risk factors and platform design. The last limitation is that while the sample population complied with established statistical standards, making the data collected significant at the sample level, it lacks statistical significance at the national level. As a result, it should not be generalised nationally for all *Bọlẹ* vendors in Nigeria.

6   Conclusions

The study showed that 57.8% of the study's participants worked in awkward postures due to the mismatch between workers' stature and platform height, with the majority working with higher platforms, which caused various reports of postural discomfort in different parts of the body. Anthropometric measurements differed based on gender as females were more overweight, obese and shorter than males. In general, *Bọlẹ* preparation and marketing posed the risk of experiencing postural discomfort in several body regions that affected the well-being of all the participants. The results obtained in this study demonstrate that the negative impacts of using mismatched marketing platforms coupled with other stressors in the vending of *Bọlẹ* likely had a significant influence on the health and well-being of the participants. Vendors experience frequent body pain, body weakness, internal heat, eye problems and swollen legs, while cuts and burns were common safety hazards. The *Bọlẹ* vendors need urgent awareness to adopt strategies to enhance healthy work lifestyles and prevent occupational hazards. While this study focuses on working conditions and health implications, further research can be done to investigate the policies and social security among vendors in this industry. Additionally, efforts should be made to raise awareness, evaluate, and monitor compliance among workers to effectively address and reduce the ergonomic-related challenges they face. Furthermore, work platforms should be designed with consideration for the users' anthropometrics and equipped with adjustable features to enhance ease of use and customisation.

Conflict of interest

All authors declare no conflict of interest.

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