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IMPACT OF PHYSICAL AND ERGONOMIC HAZARDS ON WORKERS' HEALTH IN MEDIUM-SCALE FACTORIES IN NNEWI-NORTH L.G.A., ANAMBRA STATE, NIGERIA

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ABSTRACT

Occupational environments in rapidly industrializing settings expose workers to significant physical and ergonomic risks. This study aimed to evaluate the exposure and health impacts of physical and ergonomic hazards among factory workers in Nnewi-North Local Government Area (L.G.A.), Anambra State, Nigeria. Utilizing a descriptive cross-sectional design, structured self-administered questionnaires were gathered from $n = 272$ respondents across three medium-scale factories (A, B, and C) alongside qualitative interviews and sound-level measurements. Descriptive statistics and Chi-square tests of independence were utilized for data analysis. The sample mean age was 39.10 ± 12.87 years, with 61.4% male respondents and 40.1% possessing over 10 years of work experience. Environmental sound level monitoring recorded the highest average noise in Factory C (85.7 dB). Dominant reported physical exposures included noise (87.1%), slips/trips/falls (86.4%), and extreme temperatures (83.1%), while work stress (78.3%) and awkward postures (52.6%) constituted the principal ergonomic hazards. Prevailing health outcomes were skin irritation (74.9%), musculoskeletal disorders (67.3%), and mechanical cuts (66.9%). Statistical analysis confirmed significant associations between department type and hearing difficulty ($X^2 = 86.628$, $p < 0.001$), years of experience and hearing difficulty ($X^2 = 68.928$, $p < 0.001$), as well as department type and musculoskeletal disorders ($X^2 = 263.240$, $p < 0.001$). Enhanced regulatory oversight, engineering controls, and structured ergonomic interventions are imperative.

Keywords: Ergonomic Hazards; Musculoskeletal Disorders; Noise Exposure; Nnewi-North; Occupational Health; Physical Hazards.

1 INTRODUCTION

The manufacturing sector is an important contributor to Nigeria's industrialization and economic development and provides employment for a substantial proportion of the working population. However, manufacturing workers may be

exposed to a range of occupational hazards, including excessive noise, vibration, heat, manual material handling, repetitive movements, awkward postures, and other physical and psychosocial stressors. These exposures can contribute to occupational injuries, fatigue, hearing problems, and work-related musculoskeletal disorders (WMSDs). Evidence from manufacturing industries in Anambra State indicates that workers in small- and medium-scale industries are exposed to several occupational hazards, with noise, dust, psychosocial hazards, and accident risks representing important concerns [1].

Ergonomic hazards are particularly important because prolonged exposure to awkward postures, repetitive movements, forceful exertion, manual handling, and inadequate recovery time can contribute to musculoskeletal symptoms. In South-Eastern Nigeria, [2] reported a substantial burden of work-related musculoskeletal disorders among commercial milling-machine operators in Enugu and identified the physically demanding nature of their work as an important occupational concern. Similarly, [3] found a high prevalence of work-related musculoskeletal symptoms among domestic gas workers and workers in works departments in Enugu. Their findings indicated important relationships between musculoskeletal symptoms and occupational factors such as work duration, lifting training, personal protective equipment use, and inadequate recovery.

Recent evidence from Nigeria further demonstrates the importance of ergonomic risks in industrial and manual-handling occupations. [4], in a study of selected textile industries in Lagos State, found substantial exposure to uncomfortable working postures, excessive heat, noise, dust, and manual material handling. The study also reported high levels of fatigue, back pain, headaches, and work-related musculoskeletal problems among textile workers. In another Nigerian study, [5] reported a very high prevalence of injuries and musculoskeletal discomfort among workers involved in manual material handling in Sabon Gari Market, Zaria. The authors also identified limited ergonomics and health-risk awareness as an important concern and recommended improved ergonomic practices and engineering interventions.

Noise exposure is another important occupational hazard in manufacturing environments. A systematic review and meta-analysis conducted as part of the WHO/ILO Joint Estimates found that occupational exposure to excessive noise remains an important global occupational-health concern [6]. Local evidence is also available from Nnewi. [7] investigated noise pollution and hearing loss among workers in selected industries in Nnewi, Anambra State, and reported occupational noise exposure as an important potential threat to workers' hearing health. The health implications of occupational hazards extend beyond individual injuries. The International Labour Organization estimates that millions of workers worldwide die each year from work-related injuries and diseases, while excessive workplace heat alone affects billions of workers globally [8]; [9]. Consequently, effective occupational health programmes require a combination of hazard identification, engineering controls, administrative measures, worker education, personal protective equipment, health surveillance, and appropriate ergonomic design.

Evidence concerning ergonomic interventions supports the use of multiple complementary control measures rather than relying exclusively on worker education. [10], in a systematic review of workplace ergonomic interventions, identified training, participatory ergonomics, and workstation redesign among commonly implemented approaches and concluded that multicomponent interventions may provide greater benefits for worker health and system productivity. More recently, [11], in a systematic review and meta-analysis of 24 randomized controlled trials involving more than 4,086 workers, found that ergonomic interventions were associated with reductions in work-related musculoskeletal pain, particularly lower-back pain.

Nnewi-North Local Government Area of Anambra State is an important industrial centre with numerous manufacturing and commercial activities. Despite previous research on occupational hazards in Anambra State and emerging evidence on industrial noise in Nnewi, there remains a need for current, factory-level evidence examining the combined burden of physical and ergonomic hazards and their associated health outcomes among workers in medium-scale manufacturing facilities.

Therefore, this study assessed the exposure to physical and ergonomic hazards and their health impacts among workers in selected medium-scale factories in Nnewi-North Local Government Area, Anambra State, Nigeria. The study also examined the relationships between selected occupational characteristics and reported hearing difficulties and musculoskeletal symptoms among the workers.

2 DISCUSSION

This study assessed physical and ergonomic occupational hazards and their health impacts among 272 workers in three medium-scale factories in Nnewi-North Local Government Area, Anambra State. The findings demonstrate that workers were exposed to multiple physical and ergonomic hazards, with noise, slips/trips/falls, extreme temperatures, work

stress, and awkward postures being particularly prominent. These findings are consistent with evidence from Nigerian manufacturing and other physically demanding occupational settings.

The demographic characteristics of the study population indicate a relatively experienced workforce. More than 40% of respondents had over 10 years of work experience, suggesting prolonged exposure to workplace conditions. The predominance of male workers may partly reflect the distribution of workers in production and engineering activities, which often involve physically demanding tasks. Similar male predominance has been reported in studies of physically demanding occupational groups in Nigeria, including commercial milling-machine operators and manual material handlers [2]; [5].

A relatively high level of awareness of physical and ergonomic hazards was observed among the respondents. However, awareness alone does not necessarily eliminate occupational risk. This is important because [5] found that workers may experience substantial musculoskeletal injury and discomfort despite workplace awareness and that barriers to appropriate ergonomic practices can remain. Similarly, systematic evidence indicates that ergonomic training is most effective when combined with workplace redesign, participatory approaches, and other interventions rather than being used as a stand-alone measure [10].

Noise was the most frequently reported physical hazard in the present study, affecting 87.1% of respondents. Factory C recorded the highest average sound level at 85.7 dB. This finding is important because [1], in a study of small- and medium-scale manufacturing industries in Anambra State, also identified occupational noise as an important hazard and reported higher average noise levels in medium-scale industries. The present finding is further supported by [7], who specifically investigated industrial noise and hearing loss among workers in selected industries in Nnewi.

The high prevalence of reported noise exposure is also consistent with international evidence. [6], using the WHO/ILO Joint Estimates framework, demonstrated that occupational exposure to excessive noise is a widespread workplace hazard. The relatively high noise level recorded in Factory C therefore warrants engineering controls, routine noise monitoring, hearing conservation programmes, appropriate hearing protection, and periodic audiometric assessment.

Slips, trips, and falls were the second most frequently reported physical hazard, affecting 86.4% of respondents. This high prevalence indicates the importance of housekeeping, floor maintenance, safe access routes, appropriate footwear, machine-area organization, and prompt removal of spills and obstructions. The finding also reinforces evidence from Anambra manufacturing industries that accident and injury risks constitute an important component of occupational health problems in small- and medium-scale factories [1].

Extreme temperatures were reported by 83.1% of workers. This finding is particularly relevant to manufacturing environments where machinery, furnaces, metal processing, enclosed production areas, and inadequate ventilation can increase thermal exposure. [9] identifies occupational heat stress as an increasing occupational-safety and health concern and notes its potential to cause acute illness and contribute to longer-term health consequences. Appropriate ventilation, heat shielding, hydration, rest breaks, work scheduling, and thermal monitoring should therefore form part of the occupational health programme in affected departments. Work stress was the most frequently reported ergonomic/psychosocial hazard, affecting 78.3% of workers. This finding suggests that occupational health interventions should address not only physical workstation characteristics but also work organisation and psychosocial conditions. Long working hours, inadequate rest, excessive workload, and limited recovery can increase workers' vulnerability to physical and musculoskeletal problems. [3], for example, reported associations between work duration and musculoskeletal symptoms among occupational groups in Enugu and recommended adequate breaks, appropriate work organisation, and ergonomic measures.

Awkward postures affected 52.6% of workers, while repetitive actions affected 34.6%. These findings are consistent with the Nigerian textile-industry study by [4], which documented significant exposure to uncomfortable working postures, repetitive activities, manual material handling, heat, noise, and dust among textile workers in Lagos. The results are also consistent with [2], who identified physically demanding occupational activities as important contributors to work-related musculoskeletal disorders among milling-machine operators in Enugu.

The high prevalence of musculoskeletal disorders observed in this study (67.3%) is therefore plausible in view of the reported ergonomic exposures. Similar occupational populations in Nigeria have demonstrated substantial musculoskeletal burdens. [3] reported a 62% overall 12-month prevalence of work-related musculoskeletal symptoms among domestic gas workers and works-department staff in Enugu, with substantially higher prevalence among domestic gas workers. [5] likewise reported a very high prevalence of musculoskeletal discomfort and injuries among manual material handlers in Zaria.

The present study also found high proportions of workers reporting skin irritation (74.9%), cuts (66.9%), chronic pain (34.6%), and sprains (32.7%). These findings demonstrate that occupational health risks in the factories are

multidimensional and extend beyond ergonomic disorders. The coexistence of mechanical injuries, skin problems, thermal exposures, noise, and ergonomic stressors reinforces the need for comprehensive occupational health and safety programmes rather than interventions directed at a single hazard.

The significant association between department and hearing difficulty ($\chi^2 = 86.628$, $p < 0.001$) suggests that hearing-related risk may differ substantially according to the tasks and equipment used in individual departments. This interpretation is supported by the high noise exposure recorded in the factories and by the Nnewi-specific study [7], which examined occupational noise and hearing loss among workers in selected Nnewi industries. Similarly, the significant association between years of work experience and hearing difficulty ($\chi^2 = 68.928$, $p < 0.001$) suggests that cumulative occupational exposure may be relevant to hearing outcomes. However, because the present study used reported hearing difficulty rather than clinical audiometric diagnosis, this finding should be interpreted as an association with self-reported symptoms rather than confirmed occupational hearing loss.

The significant association between department and musculoskeletal disorders ($\chi^2 = 263.240$, $p < 0.001$) indicates that ergonomic risk is likely to vary according to job task and workplace location. Production and engineering departments may involve greater exposure to manual handling, repetitive movements, forceful exertion, vibration, prolonged standing, and awkward postures than administrative departments. This interpretation is consistent with Nigerian evidence showing relationships between occupational demands and musculoskeletal symptoms [2]; [3]; [4].

The findings have important implications for workplace intervention. Evidence from systematic reviews indicates that ergonomic interventions can reduce musculoskeletal symptoms, particularly when physical and organisational measures are combined. [10] identified ergonomic training, participatory ergonomics, and workstation redesign as important intervention approaches, while [11] reported significant reductions in work-related musculoskeletal pain following ergonomic interventions. Consequently, the factories should prioritise engineering controls, workstation redesign, task modification, appropriate job rotation, adequate rest periods, manual-handling aids, and continuous ergonomic education.

Overall, the findings indicate that occupational health risks in the studied factories are characterized by the interaction of physical hazards, ergonomic stressors, and cumulative occupational exposure. The high prevalence of reported skin irritation, musculoskeletal disorders, cuts, and other injuries despite relatively favorable safety awareness suggests that knowledge alone is insufficient to control workplace hazards. Stronger engineering controls, management commitment, systematic hazard assessment, worker participation, and routine occupational health surveillance are therefore required.

3 MATERIALS AND METHODS

A descriptive cross-sectional survey design combining quantitative measurements and qualitative insights was conducted in Nnewi-North L.G.A., Anambra State, Nigeria. The L.G.A. covers 72.52 km^2 across four primary villages: Otolo, Uruagu, Umudim, and Nnewi-ichi. A descriptive cross-sectional survey design was employed across three medium-scale manufacturing facilities (Factories A, B, and C). Stratified random sampling yielded a sample of $N = 272$ full-time workers (61.4% male, 38.6% female; mean age = 39.10 ± 12.87 years).

Quantitative data were collected using structured, self-administered questionnaires, complemented by one-on-one qualitative interviews. Objective sound pressure levels (in decibels, dB) were measured in production units using a calibrated Benetech GM1351 digital sound level meter. Categorical variables were analyzed using descriptive statistics, and bivariate associations were evaluated using Chi-square (χ^2) tests of independence ($\alpha = 0.05$) via SPSS version 25.0.

Ethical clearance for this study was obtained from the Research and Ethics Committee of the Nnamdi Azikiwe University Teaching Hospital, Nnewi. Participating industries were informed of the scope, demand and benefits of the study. They were also assured of confidentiality with the information they provided. Furthermore, to ensure confidentiality, codes were used instead of names on the questionnaire.

4 RESULTS

Three (3) medium-scale factories were studied for this research, all amounting to the valid 272 respondents used in the analysis.

Table 1, showed that 76 (27.9%) of the respondents were within the ages of 41-50 years, 60 (22.1%) were within the ages of 21-30 years, 57 (20.9%) were within the ages of 31-40 years, 54 (19.9%) of the respondents were more than 50 years, and 25(9.2%) were at most 20 years old. The mean of all the ages is 39.10 ± 12.87 years. Importantly, 167 (61.4%)

of the respondents were males, while 105 (38.65%) were females. The male/female staff ratio in the factories was about 3:2. Of the 272 respondents, 109 (40.1%) had more than 10 years of working experience, 64 (23.5%) had between 1-5 years of working experience, 62 (22.8%) had less than one (1) year, and 37 (13.6%) had between 6-10 years of work experience. Based on level of education, 133 (48.9%) had secondary education, 130 (47.8%) of the respondents had up to tertiary level of education, while only 9 (3.3%) had primary education as their highest level of education. Most of the respondents (44.7%) worked in the production department, 76 (27.9%) worked in the engineering department, 48 (17.6%) worked in quality control department, 16 (5.9%) worked in the finance department while 10 (3.7%) worked in other departments like marketing, maintenance and logistics. Finally, 142 (52.2%) of the respondents worked at Factory C, 67 (24.6%) worked at Factory A while 63 (23.2%) worked Factory B.

Table 1: Socio-demographic characteristics of subjects in medium-scale factories in Nnewi-North L.G.A.

Items	Category	Frequency	Percentage (%)	Mean
Age group (years)				39.10±12.87
	≤20	25	9.2	
	21-30	60	22.1	
	31-40	57	20.9	
	41-50	76	27.9	
	> 50	54	19.9	
Gender				
	Female	105	38.6	
	Male	167	61.4	
Years of work experience				
	< 1	62	22.8	
	1-5	64	23.5	
	6-10	37	13.6	
	>10	109	40.1	
Level of education				
	Primary	9	3.3	
	Secondary	133	48.9	
	Tertiary	130	47.8	
Department				
	Production	122	44.7	
	Quality control	48	17.6	
	Engineering	76	27.9	
	Finance	16	5.9	
	Others	10	3.7	
Factory				
	Factory A	67	24.6	
	Factory B	63	23.2	
	Factory C	142	52.2	
Total		272	100.0	

Source: Researcher's Fieldwork (2024).

Table 2 showed that the majority of respondents (65.4%) strongly agreed that they knew what physical hazards were. Similarly, a significant proportion (58.5%) strongly agreed that they were aware of ergonomic hazards. Since beginning their jobs, most respondents (44.9%) received training on hazards and control measures. This training was perceived as useful in their work experience by a majority (39.3%). Additionally, 65.4% of the respondents reported knowing how to perform their work safely. Respondents affirmed taking necessary precautions while performing their jobs. The knowledge acquired from training assisted them in addressing safety concerns within their workspace. In summary, the data indicates a positive trend in hazard awareness, training effectiveness, and safety-conscious behaviour among the surveyed workers.

Table 2: The level of awareness and training about physical and ergonomic hazards in the work environment.

Items	SD F (%)	D F (%)	N F (%)	A F (%)	SA F (%)	Mean	Decision
I know what physical hazards are.	19(7.0)	6(2.2)	8(2.9)	65(23.9)	174(64.0)	4.36	SA
I know what ergonomic hazards are.	26(9.6)	33(12.1)	30(11.0)	56(20.6)	127(46.7)	3.83	A
Since I began work here, I have received training on hazards and their control.	0(0.0)	22(8.1)	10(3.7)	92(33.8)	148(54.4)	4.35	SA
If yes, the knowledge from the trainings have proved useful so far in my work experience.	0(0.0)	13(4.8)	30(11.0)	107(39.3)	122(44.9)	4.24	SA
I know how to perform my job in a safe manner.	1(0.4)	3(1.1)	6(2.2)	84(30.9)	178(65.4)	4.60	SA
I know what the necessary precautions are that I should take while doing my job.	4(1.4)	3(1.1)	23(8.5)	83(29.7)	159(58.5)	4.43	SA
I have the knowledge to assist in responding to safety concerns in my workspace.	1(0.4)	1(0.4)	36(13.2)	152(55.9)	82(30.1)	4.15	A

*SD- Strongly disagree, D- Disagree, N- Neutral, A-Agree, SA-Strong agree; Source: Researcher's Fieldwork, 2024

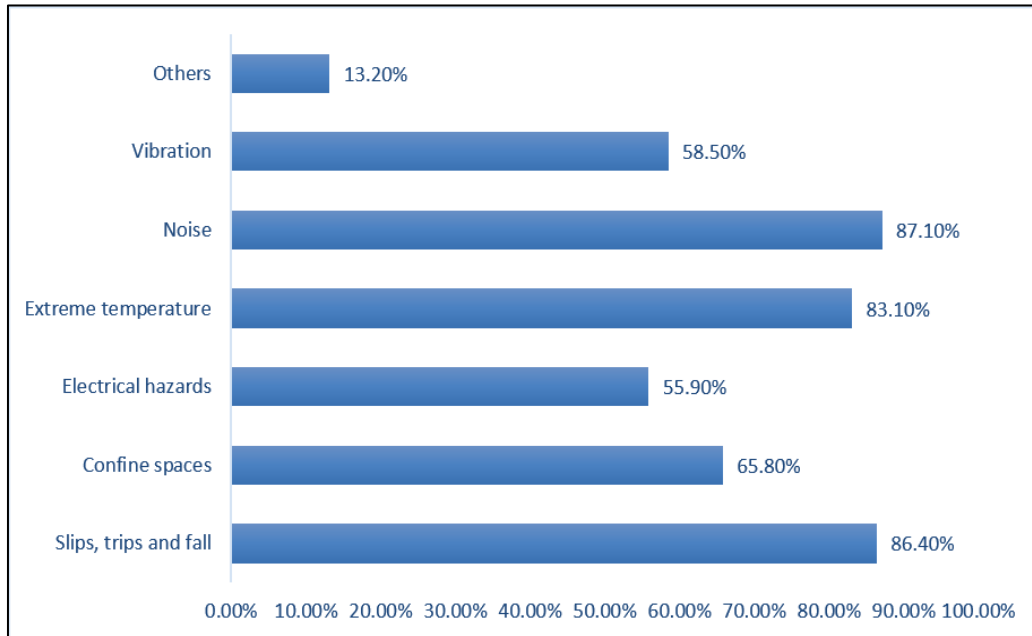
Table 3 showed that Respondents were mostly neutral regarding having taken time off work due to health issues related to their job. This suggests that the impact on absenteeism due to health concerns is not strongly pronounced. Respondents expressed a neutral stance regarding whether their work environment affected their overall health. Despite this neutrality, it is important to note that they agreed that they often experience musculoskeletal pains due to their work. Respondents disagreed that they had experienced hearing difficulties since starting their current job. This indicates that hearing-related issues are not commonly reported among the surveyed workers. In summary, while the work environment's impact on overall health remains neutral, musculoskeletal pains are acknowledged. Hearing difficulties, however, are not a prevalent concern.

Table 3: Impact of physical and ergonomic hazards on the health and safety of workers in medium-scale factories in Nnewi-North L.G.A.

Items	SD F (%)	D F (%)	N F (%)	A F (%)	SA F (%)	Mean	Decision
I have had a time off work due to work-related health issues.	47(17.3)	82(30.1)	28(10.3)	64(23.5)	51(18.8)	2.96	N
I often experience musculoskeletal pain.	30(11.0)	21(7.7)	27(9.9)	118(43.4)	76(27.9)	3.69	A
I have experienced hearing difficulties after starting my current job.	148(54.4)	72(26.5)	21(7.7)	20(7.4)	11(4.0)	1.80	D
I believe that my work environment has affected my overall health.	66(24.3)	60(22.1)	64(23.5)	42(15.4)	40(14.7)	2.74	N

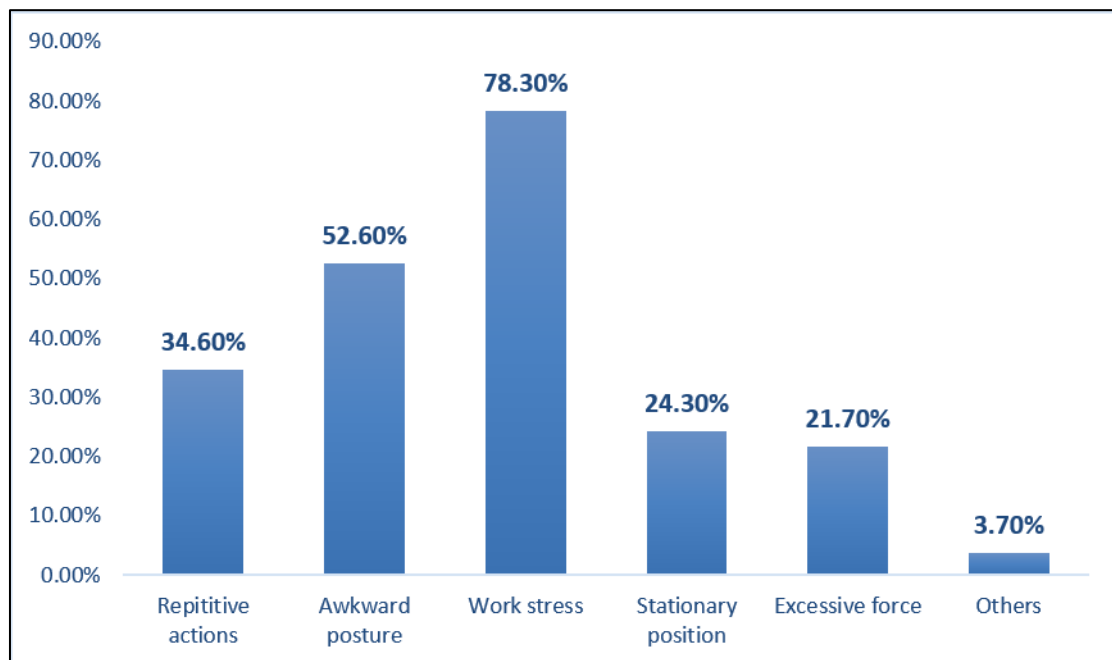
*SD- Strongly disagree, D- Disagree, N- Neutral, A-Agree, SA-Strong agree; Source: Researcher's Fieldwork, 2024

Figure 1, which illustrates the physical hazards that workers in medium-scale factories in Nnewi North L.G.A. are exposed to shows that noise is the highest exposure the workers experience (87.1%), followed by slips, trips and falls (86.4%). About 65.80% of workers consented to facing or having faced confined space hazards. These areas may lack proper ventilation and pose risks during maintenance or repair work. Roughly 55.90% of workers encounter electrical risks. A significant 83.10% of workers experience extreme temperature conditions. This includes both heat stress (high temperatures) and cold stress (low temperatures). An alarming 87.10% of workers are exposed to noise hazards. Approximately 58.50% of workers face vibration-related risks. This can occur from operating heavy machinery or tools that transmit vibrations. 13.20% of the sample population account for other physical hazards including fire hazards. In summary, noise and slips, trips, and falls are the most prevalent hazards, affecting over 85% of workers.



Source: Researcher's Fieldwork (2024)

Figure 1: The physical hazards that the workers in medium-scale factories in Nnewi North L.G.A. are exposed to.



Source: Researcher's Fieldwork, 2024

Figure 2: The ergonomic hazards that the workers in medium-scale factories in Nnewi North L.G.A. are exposed to.

Figure 2 illustrates that work stress emerges as the most significant concern, affecting a substantial 78.30% of workers. The demands of their roles, coupled with organizational pressures, contribute to this high exposure rate. Awkward posture follows closely, impacting 52.60% of workers. Maintaining uncomfortable positions during tasks can strain muscles and joints, leading to long-term health issues. Repetitive actions, though less prevalent at 34.60%, still pose a considerable risk. Stationary position, with an exposure rate of 24.30%, highlights the dangers of prolonged sitting or standing without breaks. Excessive force, affecting 21.70% of workers, underscores the importance of proper lifting techniques and equipment usage to prevent strain and injury. Lastly, the “Others” category, constitutes a minimal exposure rate of 3.70%.

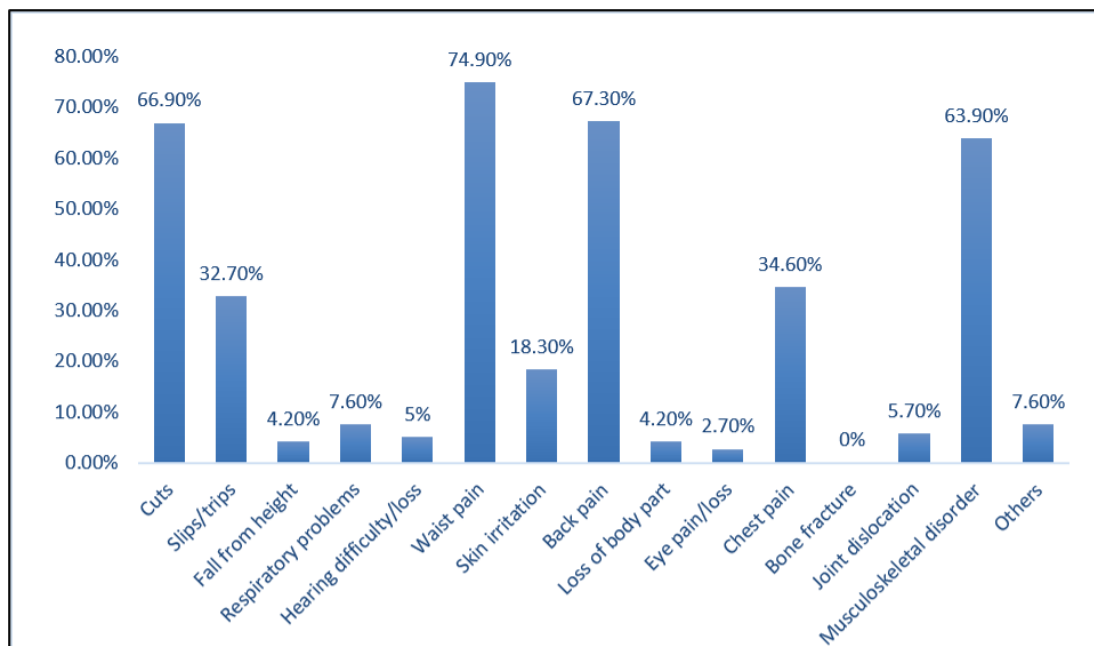
Table 4 showed that Factory C had the highest average sound level at 85.7 dB. Factory A follows at a distance with an average sound level of 63.25 dB, and Factory C represents the lowest sound level at 61.95 dB.

Table 4: Maximum, Minimum, and average values of sound level at the factories

Factory	Max sound level (dB)	Min sound level (dB)	Average (dB)
Factory A	74.8	51.7	63.25
Factory B	72.6	51.3	61.95
Factory C	86.5	84.9	85.7
Average			70.3

Source: Researcher’s Fieldwork, 2024

Figure 3 illustrated that approximately 66.9% of workers reported experiencing cuts due to hazards in their work environment. About 32.7% of workers suffered from sprains related to their job. A smaller percentage (7.6%) reported fractures or broken bones. The majority (74.9%) experienced skin irritation due to workplace hazards. A significant proportion (67.3%) faced musculoskeletal disorders. Eye injuries or blindness affected 18.2% of workers. Only 4.2% reported hearing difficulties or deafness. Burns were reported by 7% of workers. Approximately 34.6% suffered from chronic pain syndrome. A smaller percentage (5.7%) experienced respiratory issues. Miscellaneous health impact (7.6%) was also reported. This data highlights the various health risks faced by workers in these factories. Skin irritation, musculoskeletal disorders, and cuts are particularly prevalent. It underscores the importance of workplace safety measures and awareness.



Source: Researcher’s Fieldwork, 2024

Figure 3: A bar chart showing the health impact of physical and ergonomic hazards on the workers of medium-scale factories in Nnewi North L.G.A.

Table 5: Cross-tabulation between the department of workers and if they have experienced hearing issues after starting their jobs.

	I have experienced hearing issues after starting my job							
Department	SD	D	N	A	SA	Total	X²	p-value
Production	45(36.9)	27(22.1)	21(17.2)	19(15.6)	10(8.2)	122(44.9)	86.628	0.000*
Quality control	29(60.4)	19(39.6)	0(0.0)	0(0.0)	0(0.0)	48(17.6)		
Engineering	48(63.2)	26(34.2)	0(0.0)	1(1.3)	1(1.3)	76(27.6)		
Finance	16(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	16(5.9)		
Others	10(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(3.7)		
Total	148(54.4)	72(26.5)	21(7.7)	20(7.4)	11(4.0)	272(100.0)		

Chi-square test, * significant relationship at p<0.05; Source: Researcher's Fieldwork, 2024

Table 6 showed the Cross tabulation of the relationship between years of work experience and the experience of hearing difficulties used in testing hypothesis two.

Table 6.: Cross-tabulation between the years of working experience (YOWE) and if they have experienced hearing difficulty since after starting their jobs.

	I have experienced hearing difficulty since after starting my job							
YOWE	SD	D	N	A	SA	Total	X²	p-value
< 1	0(0.0)	0(0.0)	0(0.0)	31(50.0)	31(50.0)	62(22.8)	68.928	0.000*
1-5	10(15.6)	9(14.1)	11(17.2)	22(34.4)	12(18.8)	64(23.5)		
6-10	10(27.0)	0(0.0)	0(0.0)	22(59.5)	5(13.5)	37(13.6)		
>10	10(9.2)	11(10.1)	16(14.7)	52(47.7)	20(18.3)	109(40.1)		
Total	30(11.0)	20(7.4)	27(9.9)	127(46.7)	68(25.0)	272(100.0)		

Chi-square test, * significant relationship at p<0.05; Source: Researcher's Fieldwork, 2024

Table 7: Cross-tabulation between the department of workers and their experience of musculoskeletal pains after starting their jobs.

	I often experience musculoskeletal pains.							
Department	SD f(%)	D f(%)	N f(%)	A f(%)	SA f(%)	Total f(%)	X²	p-value
Production	0(0.0)	0(0.0)	9(7.4)	56(45.9)	57(46.7)	122(44.9)	263.240	0.000*
Quality control	0(0.0)	19(39.6)	9(18.8)	11(22.9)	9(18.8)	48(17.6)		
Engineering	20(26.3)	1(1.3)	9(11.8)	44(57.9)	2(2.6)	76(27.6)		
Finance	0(0.0)	0(0.0)	0(0.0)	16(100.0)	0(0.0)	16(5.9)		
Others	10(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	10(3.7)		
Total	30(11.0)	20(7.4)	27(9.9)	127(46.7)	68(25.0)	272(100.0)		

Chi-square test, * significant relationship at p<0.05; Source: Researcher's Fieldwork, 2024

5 DISCUSSION

This study assessed physical and ergonomic occupational hazards and their health impacts among 272 workers in three medium-scale factories in Nnewi-North L.G.A., Anambra State.

The mean age of respondents was 39.10 ± 12.87 years, with 61.4% male and 40.1% having >10 years of experience. This finding reflects the presence of an established workforce within the industrial sector, consistent with evidence

from brewery workers in South-East/South-South Nigeria [12]. The male predominance aligns with the concentration of males in physically demanding production and engineering roles, while females were mainly in QC and administrative roles [1]. The low educational attainment, with 48.9% having only secondary education, reflects the reliance on semi-skilled labour in manufacturing [13].

A high level of safety awareness was observed: 44.9% strongly agreed they knew how to work safely, and 65.4% knew necessary precautions. This supports evidence that OHS training improves knowledge and safety behaviours [14]; [15]. However, the effectiveness of training is limited by lack of interactive, practical methods, which are critical for hazard application in real settings [16].

Noise was the most prevalent physical hazard [87.1%], with Factory C recording 85.7 dB, exceeding the 85 dB(A) TLV [17]. The overall mean of 70.3 dB is comparable to 76.2 dB reported for medium-scale industries in Anambra [1]. This was followed by slips/trips/falls [86.4%] and extreme temperatures [83.1%]. The high noise exposure is consistent with manufacturing settings in Nigeria [18].

Work stress was the leading ergonomic strain [78.3%], followed by awkward postures [52.6%] and repetitive motions [34.6%]. These findings align with recent studies on MSDs and ergonomic risks in Nigerian factories [19]; [20]. Awkward postures and repetitive tasks are major contributors to MSDs in industrial settings.

The most reported health consequences were skin irritation [74.9%], MSDs [67.3%], and cuts/lacerations [66.9%]. Chronic pain [34.6%] and joint sprains [32.7%] were also significant. This confirms that physical and ergonomic exposures translate directly to morbidity and reduced productivity, as documented in similar industrial studies [21]; [22].

This indicates cumulative noise exposure and department-specific risks are key determinants of health outcomes, supporting the need for targeted interventions [23].

Study Limitations

Low response rate due to poor industry cooperation and fear of regulatory indictment limited generalizability. Only 3 of the medium-scale factories participated.

6 CONCLUSION

Factory workers in Nnewi-North L.G.A. face critical exposure to physical hazards, particularly noise, and ergonomic stressors, especially work stress and awkward postures. These exposures have resulted in a high prevalence of skin irritation, MSDs, and injuries. Statistically significant associations between department, experience, and health outcomes confirm that both job location and duration of exposure drive risk. Despite moderate safety awareness, the burden of occupational morbidity remains high due to inadequate engineering controls and ergonomic design.

Recommendations

To Medium-Scale Factories

- **Strengthen OHS Training:** Adopt interactive and practical training methods including simulations, role-play and regular refresher courses to improve hazard recognition and safe work practices.
- **Ergonomic Interventions:** Conduct regular ergonomic assessments, redesign workstations, and implement job rotation to reduce awkward postures and repetitive strain. Provide training on proper posture and manual handling.
- **Stress Management:** Promote work-life balance through flexible hours and adequate rest breaks to reduce work-related stress.
- **Health Surveillance:** Institute periodic medical check-ups including audiometry and MSD screening for early detection of occupational illnesses.
- **Leadership Commitment:** Management should demonstrate visible commitment to safety to foster a culture of safety and compliance among workers.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

There is completely no conflict of interest between the authors, workers and people around the operating sites, but the interest of this study is for the advancement of knowledge. Authors have declared that no competing interests exist.

Statement of ethical approval

Ethical clearance for this study was obtained from the Research and Ethics Committee of the Nnamdi Azikiwe University Teaching Hospital, Nnewi. Participating industries were informed of the scope, demand and benefits of the study. They were also assured of confidentiality with the information they provided. Furthermore, to ensure confidentiality, codes were used instead of names on the questionnaire.

Statement of informed consent

Participants were informed with consent letter and purpose of the research was understood by them before taking part in the study.

Disclaimer

There is completely no conflict of interest between the authors, workers and people around the operating sites, but the interest of this study is for the advancement of knowledge. Also, the research was not funded by the producing body or company rather than personal efforts of the authors.

Author Contributions

- **Ihekwoaba Ebelechukwu Nwaoma:** Conceptualization, Funding acquisition, Resources, Supervision.
- **Ihekwoaba Ebelechukwu Nwaoma:** Writing–original draft, Data curation, Writing–review and editing, Supervision.
- **Okoronkwo Wisdom Amarachukwu, Nwachukwu Mathew Chinwemadu:** Resources, Conceptualization.
- **Nwankwo Joy Chidiebere, Onyenekwe Joy Amala:** Conceptualization, Writing–review and editing.

Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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