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Research Article

Assessment of Blood Lead Level and Knowledge of Health Hazards, Safety Practices and Work Habits Amongst Battery Technicians in Nigeria

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Abstract

Battery technicians who repair lead-acid batteries are consistently exposed to elemental lead, which poses a significant occupational health risk. This exposure is associated with an elevated risk of developing serious lead related diseases and long-term disability. Understanding the interplay between occupational practices, knowledge of hazards, and actual lead exposure is critical for developing effective public health interventions in this high-risk occupational group. The primary objective of this study was to comprehensively assess the blood lead levels (BLLs) of battery technicians, and evaluate their current knowledge of lead health hazards, their attitude towards preventive measures, their adherence to safety practices, and their general work habits. This investigation employed a descriptive cross-sectional study design. The study population comprised a total of 150 currently active battery technicians operating within a defined geographical area. Data collection was performed using a structured, pre-tested, self-administered questionnaire. This instrument gathered information on socio-demographics, detailed knowledge of lead's health hazards, specific safety practices utilized, and daily work and personal hygiene habits. The BLLs were concurrently measured for all participants using an appropriate laboratory technique. Statistical analysis, including the Chi-square test, was performed using the Statistical Package for Social Sciences (SPSS), version 20, to test for significant associations, with the significance level set at $p \leq 0.05$. Analysis of the data revealed that a substantial proportion of the technicians exhibited elevated BLLs. Key findings indicated that knowledge regarding the appropriate use of a rubber apron, attitude towards the inhalation of lead fumes, and the crucial habit of face washing before eating/smoking were all significantly associated with the measured blood lead level of the battery technicians ($p \leq 0.05$). These results underscore that specific behavioral practices directly correlate with the biological burden of lead exposure. The study concludes that there is an urgent need to improve occupational hygiene and health literacy among battery technicians. It is strongly recommended that workplaces ensure the provision and mandatory use of personal protective equipment (PPE), particularly rubber aprons and face masks. Furthermore, intensified health education and regular training on the proper use of PPE, the provision of readily available running water at all workplaces for personal hygiene, and targeted behavioral change communication are essential strategies that will promote consistent personal hygiene habits and, ultimately, reduce the significant occupational lead burden for this vulnerable workforce.

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Keywords

Health Hazards, Safety Practices, Work Habits

1. Introduction

Battery technicians dismantle and reassemble (recouple) lead-acid batteries [1]. This work exposes them to inhalation, ingestion, and dermal absorption of lead particles, resulting in a significant risk of diseases affecting the cardiovascular, nervous, urogenital, gastrointestinal, and hematopoietic (blood-forming) systems [2]. Critically, many battery technicians are exposed to lead without adequate knowledge of its toxic effects [3]. This lack of awareness can manifest in various ways, including ignorance of the routes and sources of exposure, maintenance of unhealthy dietary or smoking habits at the worksite, and the non-use of PPE. They are often unaware of effective measures to prevent exposure to this toxic metal. Compounding this issue is the fact that there are currently no dedicated workplace regulations for the protection of workers against lead exposure in Nigeria [3-5]. Existing studies underscore the importance of personal habits and hygiene. A health promotion program conducted in Taiwan among lead-exposed workers demonstrated that habits like smoking and eating at work sites were significantly associated with blood lead concentrations, and intervention led to a significant decrease in BLLs-over five years [6]. Further research has established that poor personal hygiene, such as actions that quickly re-contaminate hands after washing [7], and the presence of lead on the face and fingernails due to smoking at the workplace, are strongly related to elevated BLLs [8]. These findings suggest that lead on the skin readily enters the bloodstream [7]. While studies have noted a decline in knowledge, attitude, and safety practices among artisans generally [9–11], there is a lack of comprehensive, recent data specifically from Nigeria that simultaneously assesses biological lead burden alongside the contributing factors of knowledge, attitude, safety practices, and work habits among battery technicians. The aim of this study is, therefore, to comprehensively assess the blood lead level (BLL) of battery technicians and concurrently evaluate their knowledge of health hazards, their attitude toward prevention, their safety practices, and their general work habits to identify modifiable risk factors for elevated lead exposure.

2. Methods

This study was carried out in the Lagos-Mainland and Ikeja Local Government Areas (LGAs) of Lagos State. Lagos is recognized as the economic center of Nigeria. Battery technicians in this area typically operate along roadsides and are often registered under the Nigerian Battery Technicians' Association, which boasts over 5,000 members. A descriptive cross-sectional study design was employed to assess the knowledge of health hazards, safety practices, and work habits among this community of battery technicians in Nigeria. The study population consisted of battery technicians operating within Lagos State. Workers registered with the Lagos State chapter of the Nigeria Association of Battery Technicians who had worked for at least one year were included in the study. Workers who were ill, absent, or unwilling to participate were excluded. The sample size was determined to be 150 using a formula for estimating cross-sectional studies, which included an addition for non-response [12]. A multi-stage sampling method was utilized to select the battery technicians who participated in this study [13].

2.1. Data Collection Tools and Techniques

A pre-tested, interviewer-administered, structured questionnaire adopted from a previous study [14] was the primary tool used to collect data from the one hundred and fifty participants, gathering essential information across several domains: socio-demographics, occupational history, occupational health history, health-seeking behavior, their knowledge of lead-associated health hazards, their attitude toward occupational hazards, and their safety practices. Concurrently, trained research assistants administered the questionnaires and collected blood specimens. These specimens, intended for lead measurement, were collected into EDTA bottles and immediately stored in cold boxes with ice packs to ensure preservation. The blood lead level was subsequently assayed in the University of Lagos chemistry laboratory using a graphite-furnace electro-thermal atomic absorption spectrophotometer (PerkinElmer-Analyst-200), with results validated by a senior laboratory scientist to ensure quality and validity. A BLL of at least 5 µg/dL, indicative of an elevated BLL for surveillance purposes was used as a cut-off [15]. The collected data were then cleaned, entered, and analyzed using the SPSS version 20. Both quantitative and categorical variables were processed: quantitative variables were summarized, while categorical variables were presented using frequencies and percentages. To test for significant associations, the Pearson Chi-square test, or Fisher's exact test were applied, with the latter reserved for situations where cell sizes were small (expected frequencies less than 5 or more than 20% of the cells). Significance for all tests was

established at the level. Specific scoring protocols were implemented for behavioral and knowledge variables: knowledge and attitude were categorized as "good/positive" or "poor" based on scores at or above the mean, while practice was scored based on frequency of PPE use (always, sometimes, never) and similarly categorized as "good practice" or "poor practice" relative to the mean score.

2.2. Ethical Considerations

Ethical approval to carry out this study was sought and obtained from the Health Research Ethics Committee (HREC) of the Lagos University Teaching Hospital, Lagos. Additionally, permission was obtained from the Nigerian Battery Technician Association before embarking on this research among its members. The study strictly adhered to the ethical principles outlined in the Declaration of Helsinki, including respect for persons, beneficence, non-maleficence, and justice. All data were anonymized and used solely for research purposes.

Consent to Participate

A written informed consent was obtained from all participants before enrolment in the study. Participants were provided with clear information about the study objectives, procedures, potential risks, and benefits, and were informed of their right to withdraw at any time without penalty. Consent was documented by signed forms. For respondents with limited literacy, the forms were read aloud in their preferred language before verbal or thumbprint consent was taken in the presence of a witness. Confidentiality was ensured by anonymizing responses, and data were used strictly for research purposes.

3. Results

Complete data were collected and analyzed from all 150 respondents. The sociodemographic profile revealed that the largest age group was 41–50 years (32.7%). The majority of technicians were married (84.0%), and while a majority had over 20 years of work experience, only 48% had formal education, suggesting a significant portion of the workforce may lack the foundational literacy often needed for effective health communication. About 64% earned above ₦18,000 monthly, and worryingly, only 34.7% had received first aid training. Figure 1 shows a high prevalence of elevated BLLs at 70%. While knowledge of specific hazards was generally high (e.g., 83.3% recognized skin/eye burn risks, 80.0% knew lead is harmful, and 63.3% achieved an overall good knowledge score), this awareness did not consistently translate into a protective attitude or practice. Attitudes towards safety were significantly less favorable. Over half of the respondents strongly disagreed that handwashing prevents lead poisoning (54.0%) or that smoking at the workplace is harmful (52.0%). Consequently, only 50.7% had an overall positive attitude toward hazards and safety practices. Despite having a reasonable level of knowledge, the gap in attitude and practice is noteworthy and presents a safety concern. Ownership of essential PPE was low (e.g., 30.0% had goggles; 50.0% owned rubber aprons), and regular use was even lower (e.g., only 34.0% always used an apron). Overall, fewer than half (46.0%) demonstrated good safety practices, with many believing the gear was unnecessary. The majority reported consistent general hygiene (91.3% washed hands before eating and after work), but the critical habit of washing the face before eating was practiced by only 40.7%; this specific lapse is a known high-risk route for lead ingestion.

The analysis revealed a significant association between age and BLLs (p=0.009), with levels peaking in middle-aged workers (41–50 years) before declining in the oldest group, which may reflect cumulative exposure or survival bias (Table 4). Education (p=0.697) and working hours (p=0.969) showed no significant association. Notably, both face washing before eating and the belief that inhaling lead fumes is harmful were strongly and significantly associated with lead absorption. (Table 5). Paradoxically, technicians who were aware of the importance of rubber aprons had significantly higher BLLs (73.1% vs. 50.0%); this inverse relationship may indicate that while knowledge is present, the consistent use of the apron to prevent dermal/fume exposure may be lacking, suggesting that PPE is either unavailable or its use is poorly enforced. The belief that inhaling lead fumes was harmless was associated with significantly higher BLLs (90.9% vs. 79.0%). Most importantly, the habit of face washing before meals was protective, with a significantly lower BLL recorded among those who practiced it (58.3%) compared to those who never did (81.4%).

Table 1. *Socio-demographic characteristics of respondents.*

Variables	Battery technicians (n=150)
Age group (years)	
21-30	17 (11.3)
31-40	47 (31.3)
41-50	49 (32.7)
51-60	20 (13.3)
>60	17 (11.3)
Level of education	
No formal education	8 (5.3)
Primary	72 (48.0)
Secondary	63 (42.0)
Tertiary	7 (4.7)
Years of work	
0-9	29 (19.3)

Variables	Battery technicians (n=150)
10-19	49 (32.7)
20 and above	72 (48.0)
Daily work hours	
0 -8	43 (28.7)

Variables	Battery technicians (n=150)
>8	107 (71.3)
Had training on first aid	52 (34.7)

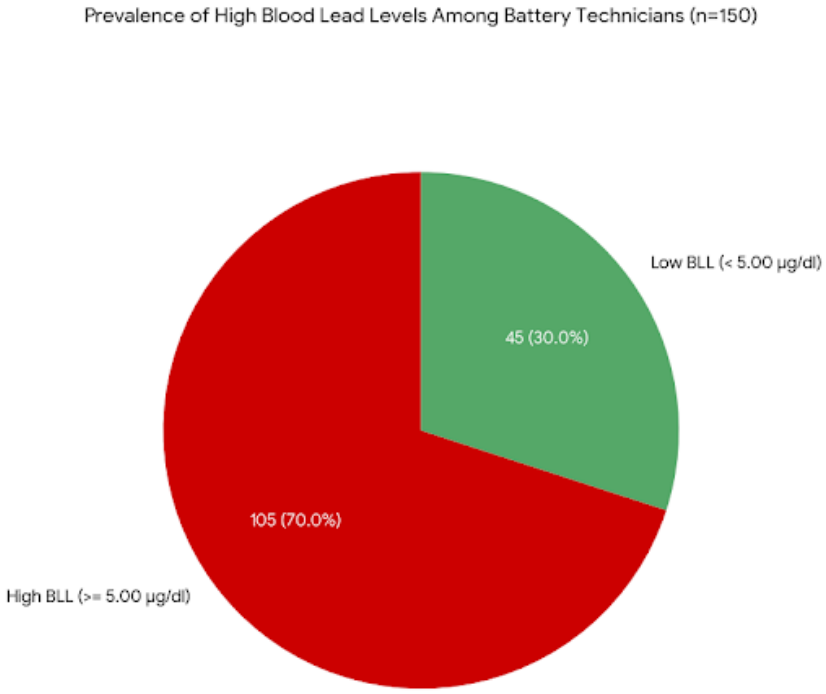

Figure 1. *Prevalence of high lead levels among respondents.*

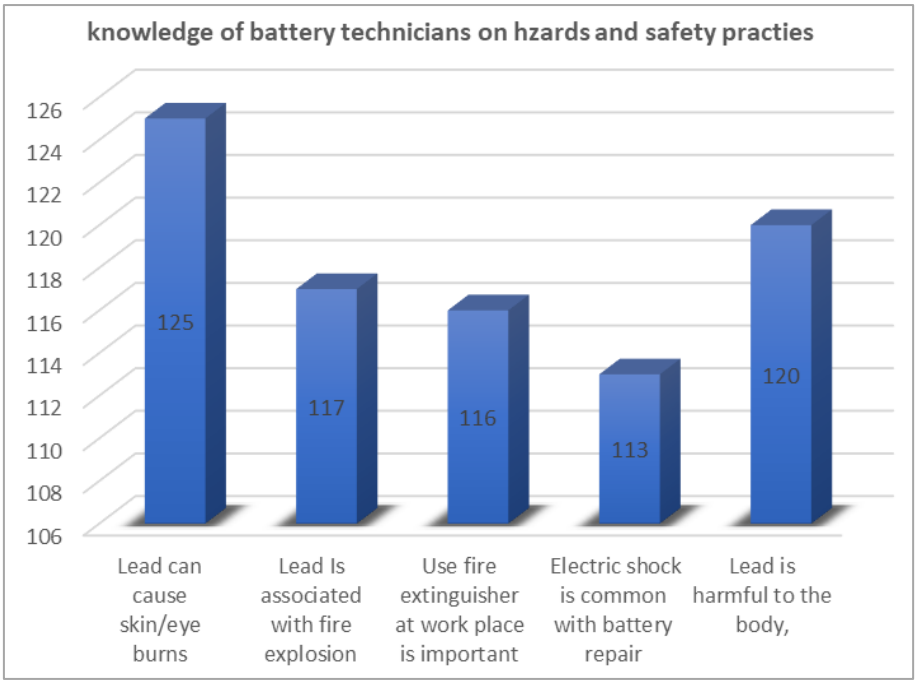

Figure 2. *Knowledge of battery technicians of hazards and safety practices.*

Table 2. Attitude of battery technicians regarding health hazards and safety practices.

Attitude regarding hazards and safety practices	Strongly agree (%)	Agree	Not sure	Disagree	Strongly disagree
Hand washing prevents lead poisoning	2 (1.3)	6 (4.0)	3 (2.0)	58 (38.7)	81 (54.0)
Gloves protect against electric shock	6 (4.0)	11 (7.3)	4 (2.7)	44 (29.3)	85 (56.7)
Breathing in lead fumes is harmful	5 (3.3)	6 (4.0)	8 (5.3)	36 (24.0)	95 (63.3)
Face shield is important during repair	12 (8.0)	17 (11.3)	10 (6.7)	46 (30.7)	65 (43.3)
Smoking at workplace is harmful	12 (8.0)	19 (12.7)	12 (8.0)	29 (19.3)	78 (52.0)
Eating at workplace is harmful	18 (12.0)	33 (22.0)	8 (5.3)	31 (20.7)	60 (40.0)
Overall positive attitude score = 76 (50.7%)					

Table 3. Personal protective equipment: possession, usage, and workplace habits among battery technicians.

Variables	Possession n=150	Usage n=150		
		Always (%)	Sometimes (%)	Never (%)
Personal protective equipment				
Eye goggles	45 (30.0)	29 (19.3)	16 (10.7)	105 (70.0)
Face shield	36 (24.0)	23 (15.3)	13 (8.7)	114 (76.0)
Rubber apron	75 (50.0)	51 (34.0)	24 (16.0)	75 (50.0)
Rubber gloves	73 (48.7)	50 (33.3)	27 (18.0)	73 (48.7)
Workplace habits				
Wash hands before eating		137 (91.3)	12 (8.0)	1 (0.7)
Wash face before eating		61 (40.7)	31 (20.7)	58 (19.7)
Bathe after work		115 (76.7)	27 (18.0)	8 (5.3)
Change clothes before going home		136 (90.7)	8 (5.3)	6 (4.0)
Live/sleep at workplace		22 (14.7)	38 (25.3)	90 (60.0)
Overall practice score = 69 (46%)				

Table 4. Association between socio-demographic factors and blood lead level proportions of battery technicians.

Variables	BLL (µg/dl) n=150		$\chi 2$	df	p
	<5.00	≥5.00			
Age group (years)					
<40	15 (27.3)	40 (72.7)			
40-59	19 (24.7)	58 (75.3)	9.53	2	0.009*
≥60	11 (61.1)	7 (38.9)			
Education					
No formal education	3 (37.5)	5 (62.5)			

Variables	BLL (µg/dl) n=150		χ2	df	p
	<5.00	≥5.00			
At least primary	42 (29.6)	100 (70.4)	0.23	1	0.697
Years of work					
0-9	6 (20.7)	23 (79.3)			
≥10	39 (32.2)	82 (67.8)	1.48	1	0.223
Daily work hours					
0 -8	13 (30.2)	30 (69.8)			
>8	32 (29.9)	75 (70.1)	0.02	1	0.969

Table 5. *Associations between battery technicians' knowledge, attitude, and practice of occupational hazards/safety and their blood lead levels.*

Variables	BLL (µg/dl) n=150		χ2	df	P value
	<5.00	≥5.00			
Cause skin/eye burns					
Yes	38 (30.4)	87 (69.6)			
No	7 (28.0	18 (72.0)	0.06	1	0.811
Cause fire explosion					
Yes	34 (29.1)	83 (70.9)			
No	11 (33.3)	22 (66.7)	0.22	1	0.636
Requires possession of fire extinguishers					
Yes	31 (27.0)	84 (73.0)			
No	14 (41.2)	20 (58.8)	2.52	1	0.113
Associated with electric shock					
Yes	35 (31.0)	78 (69.0)			
No	10 (27.0)	27 (73.0)	0.21	1	0.649
Battery lead is harmful to the body					
Yes	37 (30.8)	83 (69.2)			
No	8 (26.7)	22 (73.3)	0.20	1	0.656
Requires use of rubber aprons					
Yes	35 (26.5)	95 (73.1)			
No	10 (50.0)	10 (50.0)	4.40	1	0.036*
Handwashing prevents lead poisoning					
Strongly agree/agree	42 (30.2)	97 (69.8)			
Not sure	1 (33.3)	2 (66.7)	0.34	2	1.000
Strongly disagree/disagree	2 (25.0)	6 (75.0)			
Gloves protect against electric shock					
Strongly agree/agree	40 (31.0)	89 (69.0)			

Variables	BLL (µg/dl) n=150		χ2	df	P value
	<5.00	≥5.00			
Not sure	1 (25.0)	3 (75.0)	0.44	2	0.908
Strongly disagree/disagree	4 (23.5)	13 (76.5)			
Inhaling lead fumes is harmful					
Strongly agree/agree	35 (21.0)	93 (79.0)			
Not sure	6 (75.0)	2 (25.0)	8.97	2	0.009*
Strongly disagree/disagree	1 (9.1)	10 (90.9)			
Face shields are necessary while working					
Strongly agree/agree	31 (27.9)	80 (72.1)			
Not sure	4 (40.0)	6 (60.0)	0.98	2	0.612
Strongly disagree/disagree	10 (34.5)	19 (65.5)			
Smoking at workplace is harmful					
Strongly agree/agree	34 (31.8)	73 (68.2)			
Not sure	2 (16.7)	10 (83.3)	1.19	2	0.551
Strongly disagree/disagree	9 (29.0)	22 (71.0)			
Eating at workplace is harmful					
Strongly agree/agree	27 (29.7)	64 (70.3)			
Not sure	4 (50.0)	4 (50.0)	1.69	2	0.430
Strongly disagree/disagree	14 (27.5)	37 (72.5)			
Wash hands before eating					
Always	44 (32.1)	93 (67.9)			
Sometimes	1 (8.3)	11 (91.7)	3.285	2	0.130
Never	0 (0.0)	1 (100.0)			
Wash face before eating					
Always	25 (41.7)	35 (58.3)			
Sometimes	22 (71.0)	9 (29.0)	7.53	2	0.023*
Never	11 (18.6)	48 (81.4)			
Bathe after work					
Always	37 (32.2)	78 (67.8)			
Sometimes	6 (22.2)	21 (77.8)	1.13	2	0.568
Never	3 (25.0)	6 (75.0)			
Change clothes before going home					
Always	39 (28.7)	97 (71.3)			
Sometimes	3 (37.5)	5 (62.5)	1.47	2	0.479
Never	3 (50.0)	3 (50.0)			
Live/sleep at workplace					
Always	9 (40.9)	13 (59.1)			
Sometimes	9 (23.7)	29 (76.3)	1.969	2	0.374

Variables	BLL (µg/dl) n=150		χ2	df	P value
	<5.00	≥5.00			
Never	27 (30.0)	63 (70.0)			

*Statistically significant; *Fisher's exact value

4. Discussion

In this research, findings reveal a high prevalence of elevated BLLs among battery technicians, accompanied by poor use of PPE and notable gaps in safety practices, despite generally good levels of knowledge. Importantly, there was a significant association between workers' knowledge and their safety practices, indicating that increased awareness alone does not necessarily translate into consistent protective behaviour. These results underscore the substantial occupational risk faced by workers in this sector and highlight critical deficiencies in workplace safety culture and enforcement. The mean age of the battery technicians in this study was 43.85 years, aligning with findings from Macedonia, Iran, Nigeria, and other countries [16-21]. This consistency suggests that battery repair is an occupation sustained primarily by economically active young and middle-aged adults, highlighting the significant public health impact of lead exposure on a crucial demographic. The educational profile is concerning: almost half of the respondents had only primary education, a trend comparable to reports from Kenya, Ghana, and Bangladesh [20, 22-24]. This lower educational attainment is a critical factor influencing the effectiveness of health communication strategies. While about one-third reported receiving first aid training, a proportion consistent with some Nigerian studies and higher than figures reported from Ghana, variations in occupational training opportunities clearly exist across different regions [20, 23, 24]. Knowledge of occupational hazards was generally high, with 63.3% of respondents achieving good overall knowledge scores. They were aware that battery repair can cause skin/eye burns, that lead exposure is harmful, and that devices like aprons are important. However, this knowledge failed to consistently translate into protective practice. This discrepancy is a central finding of the study, where specific behavioral and perceptual factors override basic understanding.

Attitudes were notably less favorable, with only about half (50.7%) demonstrating a positive attitude toward occupational safety. This finding is consistent with studies from Iran [26], though it is less negative than some reports from Hong Kong [27]. The low utilization rate of PPE, where fewer than half of the workers regularly used protective equipment, is rooted in these poor attitudes. Technicians frequently reported that PPE was unnecessary or caused discomfort perceptions also noted in studies among welders in Nigeria [25]. This may suggest that risk perception is low: workers may acknowledge the hazard abstractly (high knowledge score) but do not believe the risk is immediate or severe enough to justify the discomfort or effort of wearing equipment (poor attitude/practice). This finding is paramount for intervention design, as it indicates a need to move beyond simple knowledge dissemination toward behavioral change communication (BCC) and enforcement.

The study found a severe occupational burden, with 70.0% of the technicians having elevated BLLs, a prevalence consistent with reports from Asia [28]. Analysis revealed that age was significantly associated with higher BLLs (≥5.00 µg/dl), which, given the lack of significance for education, work experience, or daily working hours, likely reflects the cumulative, long-term nature of low-level exposure over a working lifetime rather than short-term intensity. Furthermore, the findings underscore the direct risk posed by poor attitudes: misconceptions, such as believing that inhaling lead fumes is harmless, were strongly associated with elevated BLLs (p=0.009), demonstrating how faulty attitudes translate into risk-taking behaviors (e.g., not wearing a mask) and poor health outcomes. Conversely, while PPE use was low, specific hygienic practices were well-adopted (e.g., 91.3% handwashing), aligning with other studies [9, 24]. Most importantly, face washing before meals emerged as a significant protective behavior (p=0.023), demonstrating its critical role in interrupting the lead-ingestion pathway [2] and highlighting the potential for simple, actionable hygiene measures to mitigate exposure. In summary, the high BLLs, despite fair knowledge, demonstrate that safety interventions must prioritize changing ingrained attitudes and practices, particularly those involving ingestion (like pre-meal face washing) and inhalation (like using face masks). Overall, the results suggest that high BLLs are driven more by cumulative exposure, poor risk perception, and unsafe attitudes than by lack of knowledge or work intensity. Behaviour-focused interventions such as correcting misconceptions, improving PPE uptake, and reinforcing protective hygiene behaviours are crucial to reducing exposure.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, the reliance on self-reported data introduces the potential for social desirability bias, where technicians may overreport safe practices and underreport risky behaviors. Second, the limited access to workshops prevented direct, objective observation of work

habits and safety compliance, necessitating reliance on the technicians' subjective accounts. Third, the cross-sectional study design restricts the ability to establish causal inference between knowledge, attitude, practice, and observed BLLs; the study can only identify associations, not directionality. Furthermore, the confinement of the study population to one Local Government Area (LGA) restricts the generalizability of the findings to the broader population of battery technicians across Nigeria. Finally, the study only measured BLLs, excluding other critical biomarkers of chronic or historical exposure, which limits the comprehensive assessment of the total lead burden.

5. Conclusion

This study revealed a complex and concerning disconnect between awareness and action regarding lead exposure among battery technicians. Despite demonstrating good overall knowledge of occupational hazards, only a minority (46.0%) showed good safety practices. This gap is rooted in poor attitudes and perceptions, exemplified by the similar proportion of workers who lacked PPE or failed to use them consistently, often because the gear was deemed unnecessary or uncomfortable. Furthermore, only about one-third of technicians utilized formal healthcare resources for prevention, relying instead on chemists and self-medication. Critically, the study found that elevated BLLs were significantly associated not with general knowledge, but with specific, modifiable factors: increasing age (reflecting cumulative exposure), a faulty attitude towards inhaling lead fumes, and poor face washing habits before eating. This highlights that specific behavioral and perceptual lapses are the primary drivers of lead absorption in this occupational group. Therefore, comprehensive occupational health training, rigorous enforcement of PPE use, and the immediate provision of workplace hygiene infrastructure are urgently needed to reduce lead exposure among informal battery workers in Nigeria.

Abbreviations

BLLs	Blood Lead Levels
EDTA	Ethylenediaminetetraacetic Acid
HREC	Health Research Ethics Committee
PPE	Personal Protective Equipment
SPSS	Statistical Package for Social Sciences

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Conflicts of Interest

The authors declare no conflicts of interest.

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