Archives of Occupational Health | Volume 3 | Issue 4 | October 2019 | 416-21.

Original

Knowledge and Practice of Battery Technicians about Lead Poisoning in the Workplace

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Abstract

Background: Utilization of self-protective equipment at the workplace of battery technicians could consequently protect the health of the artisans 'and prevent lead-related occupational hazards. This study assessed the knowledge of lead poisoning hazards and the rate of utilization of personal protective equipment (PPE) among battery technicians in Lagos, Nigeria. **Methods:** This study was a quantitative, cross-sectional survey design. Multistage and systematic sampling technique was used to select N=384 adult battery technicians aged 18 years old and higher. The questionnaire was validated and the reliability established through pilot study. Data were collected and analyzed with chi-square and multiple logistic regressions statistical model using SPSS version 24.No missing N value and hypotheses were tested at $p < 0.05$ and 95% confidence interval. **Results:** Few participants, 9.9% had good knowledge of lead poisoning hazards, and it indicates a poor level. The rate of utilization of PPE at the workplaces was 18 % which is low. Chi-square analysis of the knowledge of lead poisoning hazard and PPE utilization for battery technicians in the organized and roadside settings were X2=0.1481, p=0.7003, and X^2=3.2607, p=0.0709, respectively which isnot statistically significant. **Conclusion:** Knowledge of lead poisoning hazard influenced the rate of utilization of PPE at the workplace of battery technicians. So, an effort to improve the use of PPE could be done through implementation of occupational safety policy, training and dissemination of information on the threat of lead poisoning for battery technicians to achieve positive behavioral change.

Keyword: Knowledge; Lead poisoning hazard; Battery technicians; PPE utilization; Nigeria

Introduction

Lead poisoning is considered as one of the occupational diseases recognized in the earliest time in the manual workers, but, barely considered by physicians in the pre-industrial era.[1, 2]Battery technicians are among the occupational groups exposed to lead poisoning hazards because battery cells are made of lead.[3, 4]According to World Health Organization (WHO) and Center of Disease Prevention and Control (CDC), the global burden of diseases caused by lead poisoning is high, and it is estimated as 9 out of the 106 categories of diseases.[5, 6] Once lead absorbed into the human body through ingestion, inhalation and dermal absorption, it would get into the bloodstream, binds with the erythrocytes and causes toxic effects.[7] Lead may be stored in the bone and teeth for a long period before it could be released into the bloodstream.[8] Lead which is in the bone accounts for more than 95% of the lead burden in adults and is a major contributor for workers in lead-related occupations.[9] Virtually, lead toxin affects every organ in the human body, and crosses blood-brain barrier to access the central nervous system.[10, 11]As a

Citation: Olusegun Rasheed T. **Knowledge and Practice of Battery Technicians about Lead Poisoning in the Workplace.** Archives of Occupational Health. 2019; 3(4): 416-21.

Article History: Received: 23 July 2019; Rivised: 28 August 2019; Accepted: 18 September 2019

result, it inflicts brain damage, causes nervous system disorder, deteriorate cell functions and become a host of neurological disorder.[12, 13]

The annual work-related diseases caused by exposure to lead are major significant public health problems throughout the world, particularly in developing countries like Nigeria.[14-16] The lack of knowledge of lead poisoning hazards and the symptoms of acute lead intoxication compounded the problem of battery technicians as most cases are not recognized or reported, and the individuals do not seek medical treatment.[17] Therefore, supporting battery technicians to know and recognize lead poisoning hazards could encourage utilization of self-protective apparatus at workplaces.[18] The Dejoy's model was applied in this study.[19]The significant application of this model is that it focuses on the interaction of an individual with environmental condition combined with the behavioral, psychosocial factors, and expectations that influence the reaction to various hazardous threats at the workplace.[19] Hence, the knowledge, perception of risk, characteristic of the individuals and values placed on life may determine the predisposing concepts that will provide motivation for utilizing self-protective equipment at workplaces.

Studies on the knowledge of the lead poisoning hazards, importance of utilizing PPE at the workplace of battery technicians to protect them from lead threat and to improve the rate of utilization of self-protective apparatus has dearth in literature. Hence, this study was conducted to fill the gap in the knowledge on lead poisoning hazards among battery technicians. The objectives of this study include: to assess battery technicians' knowledge of lead poisoning hazards and the awareness of the importance of utilization of PPE, to know the rate of utilization of PPE and the availability of the self-protective apparatus at workplaces. Furthermore, the rate of utilization of PPE was compared among battery technicians in the organized and roadside settings. The justification for this study is that a cognitive appreciation and understanding of the lead hazards and the importance of self-protective behavioral practices could lead to compliance with the use of PPE at the workplaces. The significance of this study is to achieve positive behavioral change among battery technicians and improve the rate of utilization of self-protective equipment at the workplaces and reduce lead poisoning threat.

Methods

Research design

This study was a quantitative, cross-sectional survey design and the participants studied aged 18 years old or higher. The study was conducted in the year 2018, and 384 male and female adults battery technicians participated in this study who had their workshops located in the organized and roadside settings of the two selected Local Government Councils Areas (LGAs: Alimosho and Mushin) of Lagos, Nigeria. Data were collected by a self-developed close-ended questionnaire. The validity and reliability of the tool were established prior to the study and the value of the Cronbach's Alpha was 0.85.

Sample size and study population

The sample size for this study was determined using LaMorte[20] formula N= p (1- p) (Z/E) 2. This formula was adapted to calculate the study population because the responses in the questionnaire were in binary variables (YES/NO).The calculated number of subjects was N=384and the study statistical power was 0.90, which is high and appropriate due to the large sample size studied.[21] The sampling procedure used was a multistage sampling method and a systematic technique to select the final participants. The sample intervals were calculated to be 4.020, 17.020, 30.020, 43.020 and 56.020 using the formula K=N/n.[21] It implies choosing subsequent Kth subject after the first sample subject, until the total number of the required sample was collected. The rationale for choosing the sampling method was to ensure true representation of the target population.

Data collection, variable measurement and analysis

Questionnaires were distributed among technicians and data were collected within a month, Monday to Friday each week. Questions were categorized into demographic and occupational characteristics of the participants, knowledge of lead poisoning hazards, knowledge of the importance of utilization of self-protective equipment against lead poisoning hazards and the rate of utilization of the PPE in the workplaces. Codebook was prepared and data were imported into the computer for analysis, and no missing N value. Data were analyzed with SPSS software version. The descriptive analysis was done to examine the distribution of each variable. The method of scoring adopted for the level of knowledge of the participants was that those who scored < 3 points (<50%) out of the 6 questions on knowledge section were rated to have poor knowledge of lead poisoning hazards, and the participants who scored 5 points or above (≥ 70%) were rated to have good knowledge of lead poisoning hazards. The section on rate of utilization of PPE (Primary Outcome Variable) was defined as those who wore protective clothing, hand gloves, respirators, goggles, nose masks, and protective shoes. All variables were coded "0" or "1" for [No] and [Yes] answer, respectively. Chi-square test was used to establish the association that exists between the categorical variables, while multiple logistic regressions examined the independent variables that were related to the outcome variable at $p< 0.05$ and 95%CI.

Ethical procedures and protection of participants' rights

The procedures performed when conducting this study followed the standard stipulation in the studies involving human participants. The study was approved by the IRB of Walden University, and the approval number is 12-05-16-0462777. The consent form was given to the participants to read, understand and filled freely without any interference before participation in the study. Participants were assured that the survey would not bring any harm, but could improve the rate of utilization of PPE at workplaces. Personal identifiers were not collected and confidentiality was maintained throughout the study.

Results

The mean age of the N=384 participants was 43.6 + 10.5 and 40.5+ 7.6 years for the organized and roadside groups, respectively. There were 194(50.5%) battery technicians from the organized setting, while 190(49.5%) were from the roadside setting. Thirteen females (3.4%), and 371(96.6%) males were surveyed as shown in Table 1.

In Table 2, 47(12.3%) battery technicians reported that they had the PPE that could protect them from lead poisoning hazards. Majority of the battery technicians 318(82.8%) reported the lack of PPE at workplaces due to low monthly income.

Table 3 illustrated the results of the knowledge of protection against the lead poisoning hazards that were significantly associated with the utilization of PPE at the workplace.

Model adjusted for covariate variables (age, education, year of experience, monthly income, availability of safety equipment and workshop setting). Table 4 illustrated the output that accounts for the independent variables; it gives information on the knowledge of lead poisoning hazards and compared the rate of the utilization of PPE by battery technicians in the organized and roadside settings.

Table 1. Descriptive analysis results of the battery technicians' demographic and occupational characteristics

Variable	Subgroup	Battery technicians workshop: Organized n=194 (%)	Battery technicians workshop: Roadside n=190 (%)	Total N=384 (%)	*P*-value
Age (years)	≤ 19	08(4.1)	09(4.7)	17(4.5)	p<0.000
	20-29	30(15.5)	35(18.4)	65(16.9)	
	30-39	56(28.9)	52(27.4)	108(28.1)	
	40-49	68(35.1)	65(34.2)	133(34.6)	
	≥50	32(16.4)	29(15.3)	61(15.9)	
Gender (sex)	Male	186(95.9)	185(97.4)	371(96.6)	p=0.418
	Female	08(4.1)	05(2.6)	13(3.4)	
Education level	No formal education	13(6.7)	17(8.9)	30(7.8)	p<0.000
	Elementary school	43(22.2)	50(26.3)	93(24.3)	
	Some high school	26(13.4)	30(15.8)	56(14.6)	
	High school graduate	90(46.4)	75(39.5)	165(42.9)	
	University/college grad	22(11.3)	18(9.5)	40(10.4)	
Monthly income (Naira)	≤ 20,000	27(13.9)	32(16.8)	59(15.4)	p=0.042
	21,000-40,000	104(53.6)	106(55.8)	210(54.7)	
	41,000-60,000	44(22.7)	33(17.4)	77(20.1)	
	61,000-80,000	11(5.7)	10(5.3)	21(5.5)	
	≥ 81,000	08(4.1)	09(4.7)	17(4.3)	
Years of experience	≤ 5	22(11.3)	18(9.5)	40(10.4)	p=0.923
	5-9	24(12.4)	26(13.7)	50(13.1)	
	10-14	63(32.5)	65(34.1)	128(33.3)	
	15-19	47(24.2)	44(23.2)	91(23.7)	
	≥ 20	38(19.6)	37(19.5)	75(19.5)	

X_2=Chi-square Test, P<0.05 significant at 95% CI = Confidence Interval, Freq= frequency, % = percentage.

Table 2. Availability, training and usage of personal protective equipment at workplaces of battery technicians

Variable	YES	NO
N=384	Freq. (%)	Freq. (%)
Have personal protective equipment	47(12.3)	337(87.7)
PPE is not available due to lack of money to procure	318(82.8)	66(17.2)
Have training about the importance of utilizing PPE	47(12.3)	337(87.7)
PPE is available at the workplace of auto technicians		
Protective clothing (overall)	333(86.7)	51(13.3)
Protective hand gloves	53(13.8)	331(86.2)
Respirators for breathing	47(12.3)	337(87.7)
Protective eye goggles	70(18.2)	314(81.8)
Protective nose masks	54(14.1)	330(85.9)
Protective shoes/boots	51(13.3)	333(86.7)

N=384, YES= positive responses, NO= negative response, Freq= frequency, % =percentage

Table 3. Chi-square analysis results of battery technicians' knowledge of lead poisoning hazards and the utilization of PPE

Variable	Subgroup	Utilization of PPE (N=384)		*P*-value
		YES (%)	NO (%)	
Respirator is important for protection against lead poisoning hazard	YES	101(26.30)	87(22.66)	X_2=10.860
	NO	77(20.05)	119(30.99)	p<0.000
Ventilator provides protection against lead poisoning hazard	YES	80(20.84)	113(29.43)	X_2=33.990
	NO	37(09.63)	154(40.10)	p<0.000
Knowledge of PPE provides protection against lead poisoning hazard	YES	94(24.48)	98(25.52)	X_2= 7.752
	NO	71(18.49)	121(31.51)	p=0.005
Knowledge of common lead poisoning symptoms	YES	99(25.78)	88(22.92)	X_2= 7.367
	NO	81(21.09)	116(30.21)	p=0.006
Knowledge of diseases associated with lead poisoning hazard	YES	36(09.38)	79(20.57)	X_2= 5.381
	NO	98(25.52)	171(44.53)	*p*=0.020

P< 0.05 was considered as significant at 95% CI= confidence interval, **YES = positive, ***NO = negative,

Table 4. Comparison analysis results of battery technicians' knowledge of lead poisoning hazards and the utilization of PPE in the organized and roadside settings

Variable	Subgroup	Rate of utilization of PPE		X^2	df	*P*-value
N=384		Good practice (Utilize PPE) (≥ 70%)	Poor practice (Did not utilize PPE)(<50%)			
Organized setting	Good knowledge of lead poisoning (≥ 70%)	34	102	0.1481	1	p=0.700
	Poor knowledge of lead poisoning (<50%)	13	45			
	Total (n=194)	47	147			
Roadside setting	Good knowledge of lead poisoning (≥ 70%)	22	127	3.2607	1	p=0.070
	Poor knowledge of lead poisoning (<50%)	11	30			
	Total (n=190)	33	157			

Note. Table was derived from 2ndclassification output that accounts for the independent variable's and give information for the percentage gained, *P*-value is significant at *P*< 0,05 and 95% CI

Discussion

The population based cross-sectional survey was conducted to address the multilevel factors that influence the utilization of self-protective apparatus at the workplace of battery technicians in Lagos Nigeria. 87.7% of the participants showed lack of knowledge about lead poisoning hazards. This outcome showed that battery technicians did not understand the danger and the health problems associated with the accumulation of lead toxin in the body system. The implication of this finding is that there was a knowledge deficit of the threat of lead poisoning among battery technicians. The rate of the utilization of PPE at the workplace of battery technicians is currently 18.0% which is low. Lack of information on the safety apparatus and its usage could have negative influence on the compliance with the utilization of self-protective equipment at the workplaces.[22] The commonly used PPE among battery technicians is the protective overall clothing. The finding of this study is consistent with the study conducted in Ghana among 100 workers exposed to lead poisoning.[23]

The study revealed that vehicle repairer artisans had a lower rate of utilization of PPE, and just 27% of the participants complied with the use of PPE at the workplace.[23] This study also revealed lack of money to purchase PPE among battery technicians. The finding is consistent with the cross-sectional survey conducted in Nnewi, South EasternNigeria.[24]The participants' rate of utilization of PPE was low (12.4%) and the common reasons for not using PPE was lack of money to purchase PPE.[24] The implication of this finding is that there is a need to communicate the threat of lead toxicity, the associated health problems to battery technicians to encourage them to acquire the PPE from their low income.[25-27]The classification of the knowledge of lead poisoning hazards and utilization of PPE at workplaces of battery technicians was not significant for the participants either in the roadside or organized setting.[28]Therefore, poor knowledge of lead poisoning hazards could have affected their perception about the risks associated with lead poisoning and consequently results in low utilization of the PPE in the study settings.[29] The implication of this finding is that occupational experts could use the rate of the utilization of PPE at workplaces to know the safety practices status attainment on lead poisoning among battery technicians.[29]

The limitation of this study included the source of data, which were primarily self-report. The self-report is prone to recall bias, as it may be difficult for battery technicians to remember their PPE utilization history correctly. This kind of situation could result in either underestimation or overestimation of the events. Furthermore, the responses used for measuring PPE utilization and knowledge of lead poisoning hazards were scored. The responses were scaled from 0-1 using Guttman scale of response. The responses were coded in which "1" meant the correct answer, while "0" meant the wrong answers. The standard for determination of code "0" and "1" could be high to exclude a few weak probable positive responses and this is also a limitation of this study. All these factors could limit the generalization of the study findings to the entire population of battery technicians in Nigeria.

Implementation of occupational safety policy is recommended along with the monitoring and enforcement by the occupational inspectors. Adequate dissemination of information on lead poisoning hazards to battery technicians is necessary to improve the rate of the utilization of PPE. An intervention study is recommended to determine the level of compliance of battery technicians' with the utilization of PPE at workplaces.

Conclusion

The findings of this study show that knowledge of lead toxicity predicts utilization of the PPE at the workplaces of battery technicians. The outcome also shows that there is no significant difference between battery technicians in the organized and roadside settings considering knowledge and the rate of utilization of the PPE at the workplaces. The positive social change implications of this study is that it could stimulate knowledge of lead poisoning hazards, which is presently low, and increase the rate of utilization of the self-protective equipment among battery technicians.

Conflict of Interests

Author declared that there is no conflict of interests associated with this study

Acknowledgement

The author is grateful to the reviewers, publisher and battery technicians who participated in this study for their time and cooperation throughout the duration of the study.

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