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OCCUPATIONAL HAZARDS IN TWO AUTOMOBILE ASSEMBLY PLANTS IN NIGERIA: WHAT DO THE WORKERS KNOW?

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Occupational hazards are recognized as a major threat to the health of workers in all manufacturing industries, including the automobile assembly industry. There is need to document what workers in the vehicle assembly plants in Nigeria know regarding hazards in their workplace. This study was conducted in two automobile assembly companies in Nigeria. The study assessed the level of knowledge of the workers regarding occupational hazards and appropriate safety measures in their workplace. This is a cross-sectional descriptive study. Data were collected using quantitative methods. A semi-structured, pre-tested, interviewer-administered questionnaire was used to obtain information on knowledge of occupational hazards and safety measures. The respondents were all the production staff in the two automobile assembly companies. Data was analysed with SPSS version 20 software and summarized using proportions and means, and were presented in tables for easy appreciation. A total of 318 respondents participated in this study; 268 workers in Plant A and 50 workers in Plant B. Males constituted 96.9% of the respondents while females constituted 3.1% of the respondents. The mean age of the respondents was 27.88±7.28 years. Among the respondents 72.0% were single, 94.0% had secondary education. Of all the respondents, 44.3% have worked for 1 to 2 years, while the mean years of working in the companies was 3.62 ± 4.07 years. The body shop section had the highest number of workers (32.1%), followed by the final finishing section (25.8%). A high proportion of the respondents (95.6%) knew that there were hazards in their workplace and 78% of the respondents were able to identify at least one hazard in their workplace. Also 76.7% of the respondents were able to identify at least one occupational illness/injury that can occur in their workplace. Among the respondents 77.7% were able to identify at least one measure to prevent occupational illnesses/injuries in their workplace. All the respondents (100%) believed that the use of Personal Protective Devices (PPDs) was necessary and 76.7% were able to identify at least one PPD that is necessary in their workplace. This study concluded that the level of knowledge of the workers regarding occupational hazards was high. Appropriate intervention should be put in place to maintain and even improve the knowledge of the workers regarding occupational hazards in their workplace.

KEYWORDS: Occupational hazards, Safety measures, Automobile assembly companies.

INTRODUCTION

According to World Health Organization and International Labour Organization(1950) as cited by Park (2005) occupational health is "The promotion and maintenance of the highest degree of physical, mental and social well being of workers in all occupations; the prevention among workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the workers in an occupational environment adapted to his physiological and psychological equipment, and to summarize, the adaptation of work to man and of each man to his job. In the automobile industry, workers are exposed to several hazards including: high noise levels, excessive heat, physical injuries like cuts, lacerations and amputations, inhalation of chemicals which cause respiratory problems and cancers, chemical burns, inhalation of welding fumes, heavy metals poisoning such as lead, musculoskeletal problems, eye problems from welding, skin problems etc (Shukor, 2010; Zhang et al, 2010; Lilies, 1982). Several studies have highlighted the occupational hazards of the automobile industry: A study done in an automobile manufacturing company in China reported that the noise level exceeded the standard and 35.58% of the workers had hearing impairment and 15.05% had pneumoconiosis (Liu, 2008). Another study in an automobile assembly plant in Iran reported that 31.4% of the

Workers had acquired colour vision defect due to exposure to neurotoxicchemicals (Attarchi et al, 2009).

In Nigeria there are very few studies on automobile industry. This is understandable because there are very few automobile assembly plants in country. After extensive literature search only one study on occupational hazards in automobile assembly plant in Nigeria was found. This study was done at Peugeot Automobile Nigeria Limited (PAN) Kaduna, Nigeria. The study reported that the workers were exposed to chemical fumes, noise pollution, chemical burns, injury by metal chips, cuts, eye irritation, dry cough etc (Aliyu, Shehuand Singha, 2009).One of the measures of prevention and control of occupational diseases and injuries is health education of workers about the hazards in their workplace. This is necessary because a worker that has adequate knowledge of hazards in his workplace is more likely to take precautions to protect his health. Besides, one of the Leggs' aphorisms states that "All workmen should be told something of the danger of the material with which they come into contact, and not to be left to find out for themselves - sometimes at the cost of their lives".This highlights the importance of workers' knowledge of occupational hazards they are exposed to.

In the automobile industry, researchers have explored the knowledge of workers regarding occupational hazards in their workplace. A study done in South Korea reported that 95% of workers in an automobile manufacturing plant demonstrated adequate knowledge of the hazards in their workplace (Liu, 2008). In Iran a study in an automobile assembly plant reported that all the welding workers had knowledge of the hazards the welding fumes posed to them (Sharifian et al, 2011).Similarly all the workers in the body shop of an automobile assembly plant in the USA were aware that the lead they were exposed to was hazardous to their health (Lilies, 1982).A study done in Britain also reported a high level of knowledge among the workers in an automobile manufacturing company (Zheng et al, 2002).

This Study was carried out to assess the level of knowledge among the workers regarding occupational hazards and appropriate safety measures intheir workplace in the automobile assembly companies.

METHODS

This study was done at two Vehicle assembly plants in Nigeria. These plants will be designated as Plant A and Plant B because of an agreement of anonymity reached with the managements of the 2 plants. The location of the 2 plants will also be anonymous because they are the only vehicle assembly plants in their respective locations, hence any mention of their location will inadvertently reveal the vehicle assembly plants.

Plant A produces heavy duty vehicles, middle level buses and high level buses. The production department of the company is made up of the following sections: Body shop, Spray shop, Final finishing, Chassis assembly and Auto electrical section. There are 268 staff in the production department. The breakdown is as follows: Body shop (79), Spray shop (45), Final finishing (82), chassis assembly (40), Auto electrical section (22).

Plant B's main line of business is assembly and production of commercial vehicles including Trucks, buses and utility vehicles.The production department of Plant B is divided into the following sections: Body shop, Trimeline, Rectification, Paint Shop and Chassis assembly. There are 50 staff in the production department, broken down as follows: Body Shop (23), Time line(7), Rectification(9), Paint shop(7), Chassis assembly(4).

Study Design

This study was a Cross-sectional, descriptive study.

Study Population

The study population comprises all the staff in the production department of the two companies. This is because the study is interested in the hazards that are experienced in the automobile assembly process such as high temperatures, chemicals, ergonomic issues, high noise levels, metal dusts, fumes, electrocution, etc and it is the production staff that are directly exposed to these hazards. This is in tandem with several other studies that studied automobile assembly hazards and safety measures (Aliyu, Shehu and Singha, 2009; Vena et al, 1985;Lilies, 1982;Sharifian et al, 2011;Attarchi et al, 2013; Warner et al, 1998).

Inclusion Criteria

Eligible respondents were workers in the production department of the automobile assembly companies who have worked in the production department for at least 6 months, because they were considered to have had enough exposure to the hazards and also would be able to give information on the situation of things in the companies. Only such workers who gave their consent were administered the questionnaire.

Exclusion Criteria

Production staff who have not worked for at least 6 months, production staff that denied consent and production staff that were on leave during the period of the data collection.

Sample Size Determination

Using the formula for determination of minimum sample size in a cross sectional study (Araoye, 2003).

For population > 10,000

$$n = \frac{z^2 pq}{d^2}$$

n = the minimum sample size
z = the standard normal deviate = 1.96
p = the proportion of the target population that have a particular characteristic. In this case p = 0.46 (proportion of workers in an automobile assembly plant in Kaduna that are exposed to the commonest occupational hazard (chemical fumes) in the plant according to the study (Aliyu, Shehu and Singha, 2009).
q = 1 - p = 1 - 0.46 = 0.54

d = degree of accuracy =0.05

$$n = \frac{1.96^2 \text{ X } 0.46 \text{ X } 0.54}{0.05^2}$$

$$n = \frac{3.84 \text{ X } 0.25}{0.0025}$$

$$n = \frac{0.96}{0.0025}$$

n = 384
But the population of the workers is 318 which is less than 10,000, hence a step further is taken to calculate for population less than 10,000 as stated in the formula thus:

$$nf = \frac{n}{1 + \frac{(n)}{N}}$$

where nf = minimum sample size when population is less than 10,000
n = minimum sample size when population is greater than 10,000
N = the population size
Applying the respective values:

$$nf = \frac{384}{1 + \frac{(384)}{318}}$$

$$= \frac{384}{1 + 1.21}$$

$$= \frac{384}{2.21}$$

nf = 174
Hence the minimum sample size is 174. But in order to increase the power of the study, all the 318 production workers in the two automobile assembly companies were sampled.

Sampling Technique

Total population sampling was used because all the production staff (318), in the two automobile assembly companies

Table 1 Socio-demographic characteristics of respondents

Variables	Frequency (N =318)	Percentage
Company		
Plant B	50	15.7
Plant A	268	84.3
Sex		
Male	308	96.9
Female	10	3.1
Age (years)		
≤20	36	11.3
21-25	96	30.2
26-30	119	37.4
31-35	35	11.0
36-40	5	1.6
>40	27	8.5
Mean (SD)	27.88 (7.28)	
Marital status		
Single	229	72.0
Married	86	27.0
Widowed	2	0.6
Separated	1	0.3
Highest level of Education		
No formal education	0	0
Primary education	0	0
Secondary education	299	94.0
Tertiary education	19	6.0
Duration of employment (yrs)		
1-2	141	44.3
3-4	141	44.3
5-6	3	0.9
7-8	4	1.3
9-10	10	3.1
>10	19	6.0
Mean (SD)	3.62 (4.67)	

Were administered questionnaires.

Instruments of Data Collection

A semi-structured interviewer-administered questionnaire was purposely designed for this study. It was pre-tested and appropriate corrections made.

Data Entry and Analysis

Data collected was analysed with the aid of the computer software: Statistical Package for Social Sciences (SPSS) Version 20. Frequency distributions and percentages of all relevant variables were represented in tables and charts for easy appreciation. Relevant means and standard deviations were calculated.

Ethical Consideration

Ethical approval was obtained from the Nnamdi Azikiwe University Teaching Hospital Ethical Committee (NAUTHEC). Permission to carry out this study was obtained from the management of the companies. Before the questionnaire was administered to each respondent, the concept and purpose of the study was carefully explained to the respondent. The respondents were also assured of confidentiality. Only consenting workers were administered questionnaires.

RESULTS

Three hundred and eighteen questionnaires were distributed and all were retrieved, giving a response rate of 100%. Table 1 shows the socio-demographic characteristics of the respondents. Out of the 318 respondents, 50 (15.7%) were workers in Plant B, while 268 (84.3%) were workers in Plant A. There were 308 (96.9%) males and only 10 (3.1%) females. The commonest age group was the 26-30 years age group, 119 (37.4%) while the least common age group

Continuation of Table one

Section (Department)		
Body shop	102	32.1
Trimeline	7	2.2
Paint/Spray shop	52	16.4
Chassis assembly	44	13.8
Final finishing	82	25.8
Rectification	9	2.8
Auto electrical	22	6.9
Work hours (daily)		
8 hours	318	100.0

Table 2 Respondents knowledge of hazards in their workplace

Variables	Frequency (N =318)	Percentage
Aware of hazards in workplace		
Yes	304	95.6
No	14	4.4
Occupational hazards workers identified in their workplace (N=304)		
Machine accidents	248	81.6
Metal Dust	184	60.5
Excessive noise	169	55.6
Gases & Fumes	166	54.6
Bad working positions	148	48.7
Electrocution	146	48.0
Excessive heat	166	38.2
Foreign body in the eye	87	28.6
Corrosives	65	21.4
Falling objects	55	18.1
Hot liquid	32	10.5
Slippery floor	29	9.5

***Multiple Responses**

was the 36-40 years age group 5 (1.6%). The mean age was 27.88 years with a standard deviation of ± 7.28 years. There were 229 (72.0%) single respondents, while 86 (27.0%) were married. Majority of the respondents had secondary education 299 (94.0%), while 19 (6.0%) had tertiary education. None of the respondents had no formal education. Majority of the respondents were from the Igbo ethnic group 295 (92.8%), followed by the Yoruba ethnic group 20 (6.3%), and then the Hausa ethnic group 2 (0.6%). Majority of the respondents were Christians 314 (98.7%). Only 3 (0.9%) were Moslems and 1 (0.3%) was practicing African Traditional Religion.

Table 1 continued is a continuation of the socio-demographic characteristics of the workers. It shows the different sections the workers were working in. The body shop section had the highest number of workers 102 (32.1%), followed by the final finishing section 82 (25.8%), the paint/spray shop section 52 (16.4%), the chassis assembly 44 (13.8%), the auto electrical section 22 (6.9%), the rectification section 9 (2.8%), and finally the timeline section 7 (2.2%).

Table 2 shows the respondents' knowledge of hazards in their workplace. Among the respondents, 304 (95.6%) were aware of hazards in their workplace, while 14 (4.4%) were not aware of hazards in their workplace. The table also shows the proportions of the respondents who identified the different hazards in their work place. Among the 304 respondents that were aware of hazards in their workplace, majority (81.6%) identified machine accidents as a hazard in their workplace. Metal dusts was identified by 60.5%, while excessive noise was identified by 55.6%. Gases and Fumes, bad working positions, electrocution and excessive heat were identified by 54.6%, 48.7%, 48.0% and 38.2% respectively. Foreign body in the eye, corrosives, falling objects, hot liquid and slippery floor were identified by 28.6%, 21.4%, 18.1%, 10.5% and 9.5% respectively.

Table 3 shows the respondents' knowledge of occupational illnesses/injuries that can occur in their workplace. The commonest occupational illness/injury identified by the respondents was waist pain (76.7%), followed by cut/laceration (63.8%), eye problems (63.2%), hearing problems (46.9%). Respiratory problems, sprain, electrocution, burns and skin disease were identified by 44.7%, 38.7%, 28.3%, 23.9% and 6.6% respectively. While fracture, lead poisoning, cancers, traumatic amputation of a digit, were identified by 3.5%, 3.5%, 3.1% and 2.2% respectively.

Table 4 shows the knowledge of the respondents regarding measures that can be taken to prevent occupational illnesses/injuries in their workplace. Provision of medical/first aid services was the commonest measure identified by the

Table 3 Respondents' knowledge of occupational illnesses/injuries that can occur in their workplace

Occupational illnesses/injuries that can occur in their workplace	Frequency (N=304)	Percentage
Waist pain	244	76.7
Cut or laceration	203	63.8
Eye problem	201	63.2
Hearing problems	149	46.9
Respiratory problems	142	44.7
Sprain	123	38.7
Electrocution	90	28.3
Burns	76	23.9
Skin disease	21	6.6
Fracture	11	3.5
Lead poisoning	11	3.5
Cancers	10	3.1
Traumatic	7	2.2

Multiple Responses

Table 4 Respondents' knowledge of measures that can be taken to prevent occupational illnesses/injuries in their workplace

Measures that can be taken to prevent Occupational illnesses/injuries	Frequency (N =304)	Percentage
Provision of medical/first aid services	247	81.3
Use of PPDs	239	78.6
Warning signs at strategic locations	56	18.4
Pre-employment medical examinations	41	13.5
Periodic medical examinations	36	11.8
Good house keeping	28	9.2
Periodic trainings on occupational safety& health	26	8.6
Isolation of dangerous areas	25	8.2
Periodic inspection of workplace	25	8.2
Substitution of harmful raw materials with harmless ones	21	6.9

Multiple Responses

Table 5 Respondents' knowledge of personal protective devices

Variables	Frequency (N =318)	Percentage
Respondents who think the use of PPDs is necessary		
Yes	318	100.0
No	0	0.0
PPDs the workers considered necessary in their workplace		
Aprons/overalls	244	76.7
Eye goggles	241	75.8
Boots	238	74.8
Hand gloves	225	70.8
Face mask	183	57.5
Helmets	87	27.4
Ear plugs/muffs	61	19.2
Respirators	37	11.6

Multiple responses

Respondents (81.3%), followed by the use of PPDs (78.6%). Warning signs at strategic locations, pre-employment medical examinations, periodic medical examinations and good house-keeping were identified by 56%, 41%, 36%, and 28% respectively. Also periodic training on occupational safety and health, isolation of dangerous areas, periodic inspection of workplace and substitution of harmful raw materials with harmless ones were identified by 26%, 25%, 25%, and 21% respectively.

Table 5 shows the respondents' knowledge regarding Personal Protective Devices (PPDs). All the respondents

(100.0%) believed that the use of PPDs was necessary. Majority of the respondents (76.7%) identified Apron/overall as a necessary PPD in their workplace. Eye goggles, boots, hand gloves and face masks were identified by 75.8%, 74.8%, 70.8% and 57.5% respectively. While, helmets, ear plugs/muffs, and respirators were identified by 27.4%, 19.2%, and 11.6% respectively.

DISCUSSION

This cross-sectional descriptive study was carried out among production workers in two automobile assembly companies in Nigeria.

In this study, there were more male respondents (84.3%) than female respondents (15.7%). This is similar to the sex distribution in a study at a car assembly plant in Kaduna, Nigeria by Aliyu, Shehu and Singha (2009), where 71.8% were males and 28.2% were females. Also in a petroleum refinery at Kaduna, Nigeria 90% of the workers was males (Aliyu and Saidu, 2011). Also a study among automobile industry workers in the United States reported 74.1% males and 25.9% females.[17] this male predominance among factory workers may be because factory jobs are physically tasking hence females tend to avoid them.

In this study the commonest age group was the 26-30 years age group (37.4%). This is different from the finding at an automobile assembly company in Kaduna, Nigeria where the commonest age group was the 30-39 years age group (Aliyu, Shehu and Singha, 2009). Also a study at a refinery in Kaduna reported that the commonest age group was the 35-39 years age group (Aliyu andSaidu, 2011). However a similar finding was reported among stone quarry workers in Zaria, Nigeria where the commonest age group was the 25-29 years age group (37.8%) (Aliyu and Saidu 2006). It must be noted that though there were differences in the commonest age groups, they all fell within the young and productive age groups.

In this study, majority of the respondents were single (72.0%). This is similar to the finding among welders in Kaduna, Nigeria where majority of the workers (63.3%) were single (Sabitu, Iliyasu and Dauda, 2009). In contrast, a study reported that majority of the workers (52.7%) in an automobile assembly plant in Kaduna, Nigeria were married (Aliyu, Shehu and Singha, 2009) also majority of the workers (72.0%) in a refinery at Kaduna were married. Similarly, majority of the workers (67.0%) in a sawmill in Ile-Ife, Nigeria were married (Faremi et al, 2014). The preponderance of single respondents in this study may be explained by the fact that majority of the respondents are males and they are in the younger age group compared to the older age groups in the other studies cited.

In this study, majority of the respondents had secondary education (94.0%) similarly majority of the welders in Kaduna (62.7%) had secondary education (Sabitu, Iliyasu and Dauda, 2009). Also majority (44.37%) of the welders in Benin city, Nigeria had secondary education (Isah and Okojie, 2006). In contrast, majority (50.0%) of the workers in an automobile assembly plant in Kaduna had tertiary education (Aliyu, Shehu and Singha, 2009).This is also the situation in a refinery in Kaduna, where majority (78.0%) of the workers had tertiary education (Aliyu and Saidu, 2011). The preponderance of secondary school certificate holders in this study may be because the production workers are semi-skilled staff who are employed with senior school certificate and then trained to work under the supervision of few engineers.

In this study, majority (44.3%) of the respondents had worked for 3-4 years. This contrasts the finding among welders in Kaduna, Nigeria where majority (36.4%) have worked for 5-9 years(Sabitu, Iliyasuand Dauda, 2009).Also majority (28.6%) of the welders in Benin city Nigeria have worked for 16-20 years (Isah and Okojie, 2006). Similarly, majority (47.3%) of the workers in a stone quarry in Kaduna, Nigeria have worked for 12-59 years (Aliyu and Saidu, 2006). The relatively short duration of service of the respondents in this study is because majority of the workers are employed in a new automobile assembly company which started operations just a few years ago.

In this study majority (32.1%) of the respondents work in the Body shop section. This is unlike the situation at an automobile assembly plant in Kaduna, Nigeria where majority (25.5%) of the respondents was in the assembly unit (Aliyu, Shehu and Singha, 2009). This difference is probably due to the differences in the organization of the companies and the mix of mechanization of processes.

In this study 95.6% of the respondents knew that occupational hazards exist in their workplace (Aliyu and Saidu, 2011).This is consistent with the level of knowledge (94.9%) reported among sawmill workers in south-west Nigeria (Fatusi and Erhabor, 1996). Also a study done in Benin city, Nigeria reported that 91.6% of the welders in Benin City knew of the hazards in their workplace (Isah and Okojie, 2006) but a lower level of knowledge (77.9%) was reported among welders in Kaduna, Nigeria(Sabitu, Iliyasu and Dauda, 2009). The high level of knowledge of the respondents is probably because of the high level of literacy. Literacy could facilitate understanding and appreciation of basic safety measures.

In this study, the commonest hazards the workers knew that exist in their workplace were machine accidents (81.6%), metal dusts (60.5%), excessive noise (55.6%), gas and fumes (54.6%), bad working positions (48.7%), electrocution (48.0%), excessive heat (38.25).The respondents also knew the occupational illnesses/injuries that can occur in their workplace including: waist pain (76.7%), cuts/lacerations (63.8%), eye problems (63.2%), hearing problems (46.9%), respiratory problems (44.7%), sprain (38.7%), etc. These are similar to the hazards reported in an automobile assembly

plant in Kaduna, Nigeria (Aliyu, Shehu and Singha, 2009). Workers in the automobile painting industry in Kumasi, Ghana also knew that chemical fumes were hazards in their workplace (Adei , Adei and Osei-Bonsu, 2011). In the same vein welders in Benin City, Nigeria recognized the following hazards: gases and fumes, electrocution, bad working posture, excessive noise, foreign body in the eye, etc (Isah and Okojie, 2006).

The respondents also had knowledge of measures to prevent occupational illnesses/injuries in their workplace. The commonest measures they identified included: provision of medical/first aid services (77.7%), use of PPDs (75.2%), and the placement of warning signs at strategic locations (17.6%) etc. All the respondents (100.0%) responded that PPDs were necessary and they identified PPDs that were necessary in their workplace including aprons/overalls (76.7%), eye goggles (75.8%), boots (74.8%), face masks (57.5%) etc. The high level of knowledge of the respondents regarding hazards in their workplace and preventive measures was probably because of the high literacy level of the respondents and the training on occupational safety and health they received when they were employed.

CONCLUSION

This study which is part of a bigger study revealed that the level of knowledge of the respondents regarding occupational hazards in their workplace was high. Also the respondents had a fairly high level of appropriate safety measures. We therefore recommend continuous occupational safety and health program for the workers to sustain and even improve the level of knowledge of the respondents regarding occupational hazards and safety measures in their workplace in vehicle assembly plants.

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