Health Risks Prevalent among Workers in Tank Farms in Niger Delta, Nigeria

Grace Eyo Attih, John Ugbebor, Ejikeme Ugwoha

Abstract—The study evaluated the health risks prevalent among workers in selected tank farms in Niger Delta, Nigeria by adopting a cross-sectional design where data were collected from 182 tank/depot workers purposively using questionnaire. A total of 200 copies of a closed ended questionnaire were administered to all cadres of staff which comprised of senior staff, middle and junior staff. Data were coded and analyzed at 95% confidence level. Most respondents agreed that workers sometimes inhale, and ingest hazardous chemicals, which spill-over their skin. This was further supported by the weighted mean result which criterion mean and grand mean scores is over 3.00 and 4.26 respectively for each company. Workers are exposed to diverse OHS risks at work, the most prevalent of which is inhalation of fumes from petroleum products during loading. Workers are also at risk of tripping and falling while climbing tanks on daily-basis to load and haul petroleum products; they may inhale or ingest hazardous chemicals that spill onto their skin; they face psychosocial hazards such as hypertension, boredom, anxiety; they are also exposed to flammable, noxious, and corrosive gases that are harmful to their health. The study recommends frequent inspection of machines; turn around maintenance of facilities and promotion of healthy work environment within the tank farms.

Index Terms—Exposure, Niger-Delta, Risks, Severity.

I. INTRODUCTION

Risk has been considered as the chance that someone or something that is valued will be adversely or negatively affected by the hazard (Woodruff, 2005), while "hazard" is any unsafe condition or potential source of undesirable event with potential for harm or damage (Reniers, 2009). Moreover, risk is defined as measure of the probability and severity of adverse or negative effects (Haimes, 2009). Risk is also defined as the combination of the severity of the harm and the occurrence probability of this harm (Guneri and Gul, 2016; Guneri *et al.*, 2015). Risk assessment is an essential tool for the safety policy of a company (Marhavilas *et al.*, 2011). It includes identifying and evaluating all possible risks, reducing

them and documenting the results, respectively (Main *et al.*, 2012). It is an essential and systematic process for assessing the impact, occurrence and the consequences of human activities on systems with hazardous characteristics (Van Duijne *et al.*, 2008) and constitutes a needful tool for the safety policy of a company.

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Ejikeme Ugwoha, Centre for Occupational Health Safety and Environment, University of Port Harcourt, Port Harcourt, Nigeria Risk simply means the likelihood of hazard to cause harm (or injury) to a person (Tang *et al.*, 2018). It is the measure of both the hazard and probability of harm to occurrence. Reducing risk is based on minimizing exposure to hazards. Mathematically, risk is a function of; hazard and exposure; exposure is a Function of dose and exposure time; therefore, Risk is a function of hazard, dose and exposure time. Some of the risks found in oil and gas plants have the potential to damage employees. The majority of accidents/hazards at oil and gas facilities result in employees' temporary or permanent inability to perform their duties, possibly caused by poor occupational health practices among oil and gas facilities or their personnel. Employees are exposed to health risks and dangers, prompting this study.

This study looks into potential health risks in oil and gas facilities. Many of these risks are domicile in the recent state of facilities and activities in Nigeria's petroleum and oil refining and distribution business. The high toxicological qualities of oil/gas components, exploration, extraction and processing makes the process quite complicated and poses health risks to personals involved.

II. RESEARCH METHODOLOGY

A. Research Design

This study utilized a combination of field measurements and analytical cross-sectional research design. This design is relevant as it involved collecting data from respondents and presenting them without manipulation. Consequently, both quantitative and qualitative methods were employed to assess and investigate the risks prevalent in the process industry. In the descriptive-quantitative method, the participants in this study were selected based on their, awareness, characteristics and knowledge of safety, hazards and risks associated in process industry.

B. Study Area

The Niger Delta region is situated in the Gulf of Guinea between longitude $5^{0}E$ to $8^{0}E$ and latitudes $4^{0}N$ to $6^{0}N$ (Opafunso, 2007). ERML (1997) defines the original Niger Delta region (about 29,900 square kilometres) as comprising the area covered by the natural delta of the River Niger and the areas to the east and west, which also produce oil. Its approximate northern boundaries are located close to the bifurcation of the River Niger at Agboh, while the western and eastern boundaries are around the Benin River and the Imo River respectively. It is the largest wetland in Africa and the third largest in the world consisting of flat low-lying swampy terrain that is crisscrossed by meandering and anastomosing streams, rivers and creeks. The Niger Delta



region of Nigeria comprises the nine states; Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo and River States, with an approximate population of 21,014,655 according to the national population census of 2006 (Agbor & Ashabua, 2018). This well-endowed ecosystem, which contains high concentrations of biodiversity on the planet, in addition to supporting the abundant flora and fauna, arable terrain that can sustain a wide variety of crops and economic trees, has more species of freshwater fish than any ecosystem in West Africa. Nigeria oil & gas reserves are situated in the region, contributing to 90% of government revenue.

C. Participants of the Study

The population in this study revolves around oil and gas facilities in the Niger Delta Region and includes all the individuals whose daily work activities exposes them to hazards and risks. It comprises of a group of facility workers of depots and tank farms in the Niger Delta, Nigeria. Male and female between the age range of twenty-one (21) years to sixty (60) years in the oil and gas facilities (Public and Private Depots) whose duties and day to day business are such that they are exposed to hazards and risk in their work place or environment. These individuals comprise staff and contract staff gainfully employed loaders, safety officers, health personnel, production staff, maintenance staff, lab scientist, site surveyors, all managers and supervisor of all cadres.

D. Sample and Sampling Techniques

The study adopted a non-probability purposive-sampling technique. Representative samples were collected via sound judgment from the study population. Oil facility workers that have been duly employed as staff/locum that can provide dependable information were purposely selected for the study. The determined sample size was obtained by utilizing Taro Yamane's formula (1967).

Probalistic stratified sampling was adopted for selecting respondents, as the target population has two groups and cut across all staff. Two separate strata were divided (technical and management staff), and for each stratum or group, those in the departments exposed to hazards and risk were selected. For each stratum, members (such as technical staff) were given a number.

E. Data Collection and Quality Control

The data used was gathered from multiple sources; primary and secondary sources. All the data were reviewed and organized into category that cut-across all the data sources. Primary data was obtained with the aid of self-administered questionnaire and checklist auditing based on the research questions of the study. The data was gathered from all the departments, and from both contract and permanent staff who gave consent to answer the questionnaire.

Personal interviews were engaged in with some workers, which will enhance the worth of information that were derived from the questionnaire concerning occupational hazards and health risks. Before undertaking the data collection process, an official letter was addressed to respective managements in the various studied facility seeking the participant's consent. Each management of the designated depots and tank farms were assured of treating the information from respondents/participant confidentially. Hence, the data collection procedure of the study followed due process and study was done via; walk through survey, structured questionnaire, and review of documents, reports, secondary data, observations and an inspection checklist. The questionnaire was structured and properly evaluated using five-point Likert-Scale format namely; Strongly-Disagree (SD), Disagree (D), Agree (A), Strongly-Agree (SA) and undecided (U).

A total of two hundred (200) copies of questionnaires were distributed to the six selected tank farms. Forty each to tank farm A and D, while 30 each were distributed to tank farm B, C, E and F, out of which 182 were fully filled, completed and returned representing 91%. Thus, the number of response rate was sufficient, which provided enough proportion for data analysis and its interpretation. Generally, 91% of respondents participated in the survey exercise and provided necessary information which formed the basis for data acquisition.

F. Data Analysis

Collected data from copies of questionnaire were processed, coded and analyzed utilizing XLSTAT 2018 premium version software, developed by Addinsoft (2018). The percentage, mean and standard-deviation of respondents were determined.

III. RESULTS

A. Demographic Distribution of Participants

Figure 1 shows the demographic distribution of participants. The socio demographic profile of the respondents considered were employment status, gender, age, educational qualification and marital status. Most respondents (35.7%) were between 41-50 years, very few (13.7%) were between 21 -30 years. Of the 182 respondents, 82.4% were male, while 17.6% were female. Only one (1) respondent making 1.1% had a postgraduate degree, very few (8.8%) had secondary school certificate and over half (50.5%) were university graduates. In all, 91.2% are graduates of higher institution. More than half (66.7%) of the respondents were married, 2.2% divorced, while 1.1% were undetermined.





Figure 1: Demographic Distribution of Respondents B. Number of Respondents in the selected Tank Farms

each company.

Figure 2 indicates the total respondents in each selected depots across the study area. Depot A had 34 (18.7%) respondents, depot- B30 (16.4%), depot - C26 (14.3%), depot-D36 (19.8%), depot- E 28 (15.4%) and depot- F 28 (15.4%); making 182 (100%) in total.



Figure 2: Number of staff for Companies A-F

C. Responses on the Risks prevalent in these Tank Farms

Figure 3 presents respondents' opinion that workers sometimes inhale, and ingest hazardous chemicals, which spill over their skin. In summary, most respondents agreed that workers sometimes inhale, and ingest hazardous chemicals, which spill-over their skin. This was further supported by the weighted mean result which criterion mean and grand mean scores is over 3.00 and 4.26 respectively for



Figure 3: Inhalation and ingestion of hazardous chemicals which spill over their skin

Figure 4 presents respondents' opinion on proper environmental-hygiene in their workplace. In summary, most respondents in company A, B, C, D, E and F disagreed to the statement that 'there is no proper environmental-hygiene in their work place'. These was further supported by the weighted mean scores for companies A, B, C, D and were below the criterion mean of 3, while company F had a weighted mean above 3. Also, the grand mean stands at 2.93, indicating respondents' disagreement to the statement.





Figure 4: Improper environmental sanitation workplace



Figure 5: Exposure to flammable, poisonous and corrosive gases

Table 1 illustrates the summary of the weighted means and grand means of the statements for the Health Risks associated with hazards among Tank Farm Workers. From the table, the weighted mean of all the companies were above the criterion mean of 3.00, which implies that the respondents in each company agree with the statement. A grand mean of 3.65 further indicate a general agreement to the statement.

Table 1: Health Risks associated with Hazards among the Tank Farm Workers

Defenenta	Companies Weighted Mean						Crond Moon	
Kelerents	Α	В	С	D	Ε	F	Grand Mean	
1	1.60	2.33	4.08	4.61	4.54	4.36	3.51	
2	3.70	4.00	4.31	4.67	4.69	4.21	4.24	
3	2.05	1.42	2.77	3.89	4.08	3.38	2.93	
4	2.15	1.92	4.38	4.22	4.15	4.14	3.46	
5	2.63	3.17	4.62	4.61	4.31	3.43	3.76	
6	3.80	4.50	3.15	4.33	3.38	3.71	3.83	
7	4.50	4.67	4.15	4.39	4.15	4.36	4.38	
8	4.55	4.83	4.62	4.28	4.31	4.36	4.48	
9	4.20	4.50	4.38	4.11	4.38	4.50	4.32	
10	1.60	1.25	1.62	2.28	1.08	1.50	1.60	
Total	3.08	3.26	3.81	4.14	3.91	3.80	3.65	

There is no significant difference in the risk exposure to oil and gas workers in the facilities

Table 2 shows the range of risk exposure experienced by oil and gas personnel in facilities from various companies in the area. At the 0.05 level of significance, the table displays an F-score of 48.068, which is higher than the crucial value of 2.21. With a significance level of 0.000, there is no way this divergence could have occurred by coincidence. As a result, the null hypothesis of no substantial difference in risk exposure for oil and gas workers in the facilities is rejected, whereas the alternative hypothesis is supported. This means that the risk of oil and gas employees at facilities varies depending on the study area. Table 3 illustrates the post-hoc test (Duncan statistics) for the variation in risk exposure to oil and gas workers in the facilities from selected companies in the area. It is evident from the table that respondents in companies A, B, C, E, and F recorded lower values, while company D recorded higher values, which indicates higher perceptions in the risk exposure to oil and gas workers in this company. Furthermore, this result indicates that respondents in companies A and B are similar in their perception level; companies C, E and F also share similar perceptions; and the perception of respondents in company E is also similar to those of company D concerning the risk exposure to oil and gas workers in the facilities.



ANOVA								
Risk Exposure								
	Sum of Squares	df	Mean Square	\mathbf{F}	Sig.			
Between Groups	14.180	5	2.836	48.068	.000			
Within Groups	10.464	176	0.059					
Total	24.644	181						
Table 3: Post-hoc Test, Health Risk Exposure								
Duncan								
Company	Ν	Subset for alpha = 0.05						
		1	2	3				
A	34	3.0772						
В	30	3.2583						
F	28		3.7937					
С	26		3.8077					
E	28		3.9077	3.9077				
D	36			4.1389				
Sig.		0.171	0.418	0.082				

Table 2: Health Risk Exposures Associated to Workers in Oil and Gas Facilities

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 14.487.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

IV. DISCUSSION

Staff members are exposed to physical risk such as noise in the workplace, workers are exposed to chemicals that might harm their health, workers are occasionally subjected to psychological hazards such as excessive work load, and workers are exposed to biological hazards such as tuberculosis. Most respondents believed that workers inhale and consume harmful substances that spills on their skin regularly. This was underpinned by the weighted mean, which showed that each company's scores were higher than the criterion mean of 3 and had a grand mean of 4.24.

Also, most respondents in firms A, B, and C disagreed that their workplace lacks sufficient environmental hygiene, whereas the majority of respondents in other companies agreed. The weighted mean result confirmed this, as the scores for firms A, B, and C were all below the criterion mean of 3, whereas the weighted mean of the other companies was above 3. In general, respondents disagreed with the assertion that my workplace lacks sufficient environmental hygiene, as seen by the grand mean of 2.93.

One of the greatest hazards to workers in the tank farm and depot is inhalation of fumes and splashes of product while loading vehicles or taking product samples for analysis. From respondents' views, workers inhale and absorb harmful chemicals that spill onto their skin on occasional basis. Most respondents (90.0%) agreed that workers inhale and absorb hazardous substances that spill on their skin on occasion. A weighted mean of 3.70 indicates that the assertion is generally accepted. This remark backs up a prior study that concluded that "chemical emissions occur when a chemical is released from a wide region, such as an industrial site, or from a container, such as a drum or bottle, into the environment." It is thus possible to be exposed to it in the environment via breathing, eating, or drinking things that contain the



V. CONCLUSION

chemical, alongside via skin contact."

The study concludes that workers are exposed to diverse OHS risks at work, the most prevalent of which is inhalation of fumes from petroleum products during loading. Workers are also at risk of tripping and falling while climbing tanks on daily-basis to load and haul petroleum products; they may inhale or ingest hazardous chemicals that spill onto their skin; they face psychosocial hazards such as hypertension, boredom, anxiety; they are also exposed to flammable, noxious, and corrosive gases that are harmful to their health.

DECLARATION OF INTEREST

The author(s) declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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