Occupational and Health Risks of Hazardous Chemicals on Chemistry Laboratory Workers in Tertiary Institutions in Lagos State, Nigeria.

Akintunde, Daniel Gbadesere, Olumide-Adu, Mosunmola Omolewa & Akpovwovwo Efetobore Ifeanyichuckwu
Department of Chemistry. Federal College of Education (Technical) Akoka Lagos Nigeria
Corresponding author: **danakinbest2000@ymail.com** Telephone: +2347084604506, +2347033333982.

ABSTRACT

The study assesses occupational and health risks of hazardous chemicals on chemistry laboratory workers in tertiary institutions in Lagos state. Six major federal and state tertiary institutions were chosen comprising of two universities, two polytechnics and two colleges of education. Validated questionnaires were administered to twenty- four chemistry laboratory workers. The hazardous implication to health and attitude of workers was determined by weighted mean. The result shows that years of experience ($\bar{x}_w$=3.2) and exposure to hazardous chemicals ($\bar{x}_w$=2.6) are contributing factors to risk in the laboratory. Risk in the laboratory also affects the attitude of the laboratory staff towards work ($\bar{x}_w$=3.3) as well as their health ($\bar{x}_w$=2.7). The results further shows that no significant relationship exists between years of experience, duration of exposure to hazardous chemicals, gender and diseases encountered. This paper recommends that regular training and seminars on how to handle hazardous chemicals should be organized for laboratory staff and safety materials should also be provided to minimize direct contact.

KEY WORDS: *hazardous chemicals, health risks, occupation, laboratory staff, diseases, exposure,*

INTRODUCTION

Teaching and learning of chemistry are best understood by laboratory experiments. In higher institutions of learning, majority of chemistry courses are purely practical while others are practical-oriented hence the use of chemical reagents are indispensable. The users especially laboratory workers, by reason of their daily routine job, are wittingly and or unintentionally prone to hazards and injuries inherent in the chemicals or occasioned by them. These are traceable to long hours of exposure, inhalation, ingestion and absorption. Majority of these laboratory chemicals are inherently and characteristically toxic, corrosive, explosive, flammable and even radioactive (Maazza, 2008). Their shelf and half lives as well as dose and exposure of a target organism often determine their impact.

The effects of hazardous chemicals may be immediate or long term and range from mild skin irritation to chronic heart disease (Health and Safety Authority, 2004). However, when in acute and chronic contact with humans either in pure forms or combined, their impact are grave (Maazza, 2008).Poisons and related health effects mainly resulted from the acute and chronic contacts of human to a chemical, either as a pure substance, or as an ingredient in a product.

Treatment of these health effects is possible if the entire ingredients in the product are known. However, the knowledge about the ingredients of the chemicals is one of the important basis for poison centers as well as its importance for general risk assessment (Maazza, 2008). If the exposure is not prevented or properly controlled, it can cause serious illness, sometimes even death. Laboratory staff are exposed sequentially to a large number of chemicals by various routes of exposure and from a variety of sources which increases the demand for chemical mixtures assessment. Risk assessments of chemical mixtures or chemical reactions are complex, due to the physical and chemical changes which occur during the formulation or the chemical reactions. The physical transformations, chemical reactions, as well as the processing among ingredients are suspected to modify the characteristic and hazard of the final products of the mixtures (Hamilton *et al*. 2006). Risk assessment has been described as a process of calculating and estimating the risk of an agent to a target organism, system or population following exposure to that agent (Organisation for Economic Co-operation and Development, 2003). The primary purpose of risk assessment is to avoid injury as well as to reduce risk (Maazza, 2008). However, research on risk assessment of chemistry laboratory staff is insufficient and database of chemistry laboratory staff is scarce. Therefore, for optimal efficiency, it is imperative to determine the magnitude and frequency of hazards experienced by laboratory staff on the job definite impacts on their health as well as overall attitude towards work.

Objectives of the study

The study seeks to:

identify the experience of laboratory workers in handling hazardous chemicals

determine how year of experience and exposure of laboratory workers contribute to the risk of hazardous chemicals

determine the effect of hazardous chemicals on the health and attitude of laboratory workers towards work

Research Questions

The following research questions were raised to give meaningful direction to the study:

1.What are the contributing factors to risk in the laboratory?
2.What are the effects of risk on the laboratory staff?
3.How do the risks from hazardous chemicals affect gender?

Research Hypotheses

H_{o1}: there is no significant relationship between gender and diseases encountered by laboratory staff.

H_{o2}: there is no significant relationship between years of experience and diseases encountered by laboratory staff.

H_{o3}: there is no significant relationship between duration of exposure and diseases encountered by laboratory staff.

MATERIALS AND METHODS

Validated questionnaire were randomly administered to 24 laboratory staff. The questionnaire was designed to elicit information about hazard encountered 0n the job. There were five parts to the questionnaire: Part A seeks information about sex, age and years of experience on the job. Part B and C zero on years of experience and duration of exposure as contributing factors to risk in the laboratory respectively. Lastly, part D and E elicit information on effect of risk on the health and attitude of the laboratory staff towards work respectively. Laboratory staff workers were contacted in person at their various laboratories to respond to questionnaire and ready assistance was given where further clarifications were needed. All questionnaires were collected back and the results were analyzed using frequency, percentage, mean, weighted mean and standard deviation. According to decision rule, if the mean value is greater than 2.5, then the statement is accepted.

RESULTS AND DISCUSSIONS

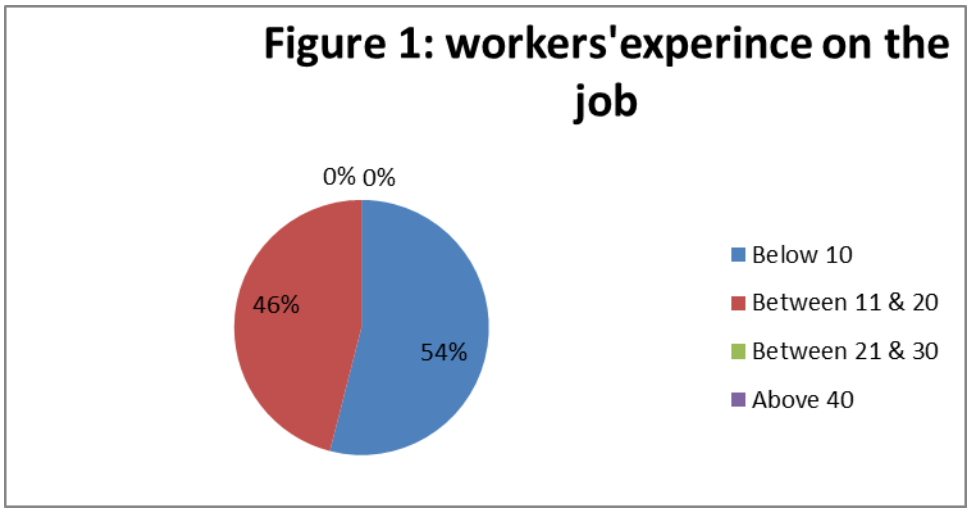

Table 1: Workers' years of experience as a contributing factor to risk

ITEMS	SA (%)	A (%)	D (%)	SD (%)	MEAN	REMARK
Years of experience has effect on risk in the laboratory	17 (70.8)	7 (29.2)	0 (0)	0 (0)	3.71	Accepted
Risk is minimized as my years of experience increases	12 (50.0)	11 (45.8)	1 (4.2)	0 (0)	3.46	Accepted
Risk is not common with people of more years of experience	13 (54.2)	9 (37.5)	2 (8.3)	0 (0)	3.46	Accepted
T hose with lower years of experience are the most affected by risk	3 (12.5)	4 (16.7)	7 (29.2)	10 (41.7)	3.25	Accepted

I encounter risk more often than those that are not as experienced as I am.	8 (33.3)	14 (58.3)	2 (8.3)	0 (0)	2.00	Rejected
Weighted mean = 3.2						

Figure 1 and Table 1 show years of experience as contributing factor to risk in the laboratory. The weighted mean is 3.2 hence the statement is accepted. Therefore years of experience contributes to risk of laboratory workers in the laboratory. Cognate job experience is necessary in understanding the nature of job and minimizing risk (UNEP, 1996). In agreement with the results obtained from this study, NIOSH, (1997) and An et al., (1999) had reported that workers with many years of experience suffered fewer hazards. Also, it was stated that workers with longer years of experience suffer less diseases (Akintunde & Taiwo, 2013).

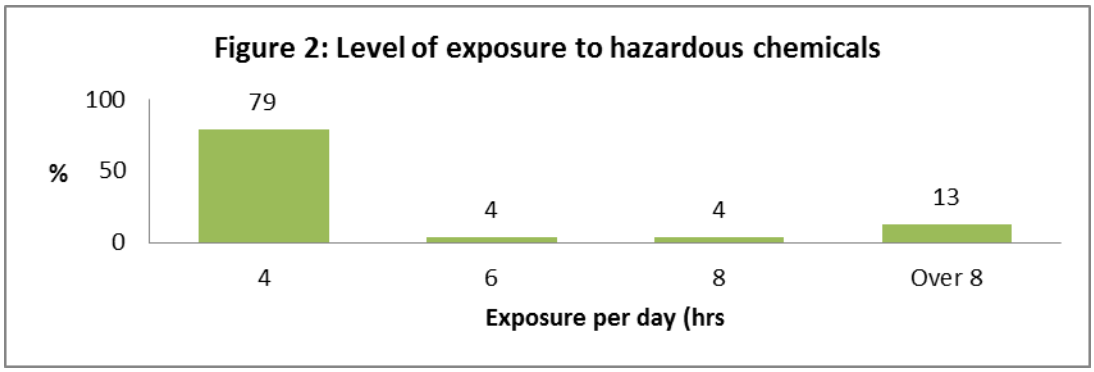

Table 2: workers' exposure to hazardous chemicals as a contributing factor to risk

ITEMS	SA (%)	A (%)	D (%)	SD (%)	MEAN	REMARK
Rate of exposure has effect on risk in the laboratory.	17 (70.8)	7 (29.2)	0 (0)	0 (0)	3.71	Accepted
I am always exposed to hazardous chemicals.	2 (8.3)	15 (62.5)	6 (25.0)	1 (4.2)	2.75	Accepted
I utilize the hazardous chemicals more often.	12 (50.0)	5 (20.8)	7 (29.7)	0 (0)	3.21	Accepted
I exceed the Permissible Exposure Limit (PEL) of using hazardous chemicals.	2 (8.3)	9 (37.5)	13 (54.2)	0 (0)	2.54	Accepted

I usually have direct contact with hazardous chemicals.	0 (0)	3 (12.5)	11 (45.8)	10 (41.7)	1.71	Rejected
Weighted mean = 2.6						

In Figure 2 and Table 2 exposure to hazardous chemicals is a contributing factor to risk in the laboratory with weighted mean of 2.6. Although many of the laboratory workers do not usually have direct contact with the chemicals (1.71) which might be due to use of safety materials, however, high exposure contributed immense risk on them (3.71). This might be due to high inhalation and absorption phenomena occasioned by long hours of exposure to chemicals This is in agreement with Schenker & Jacobs(1996) findings which stated that exposure of users to hazardous chemicals caused many health hazards including central nervous system toxicity and respiratory effects.

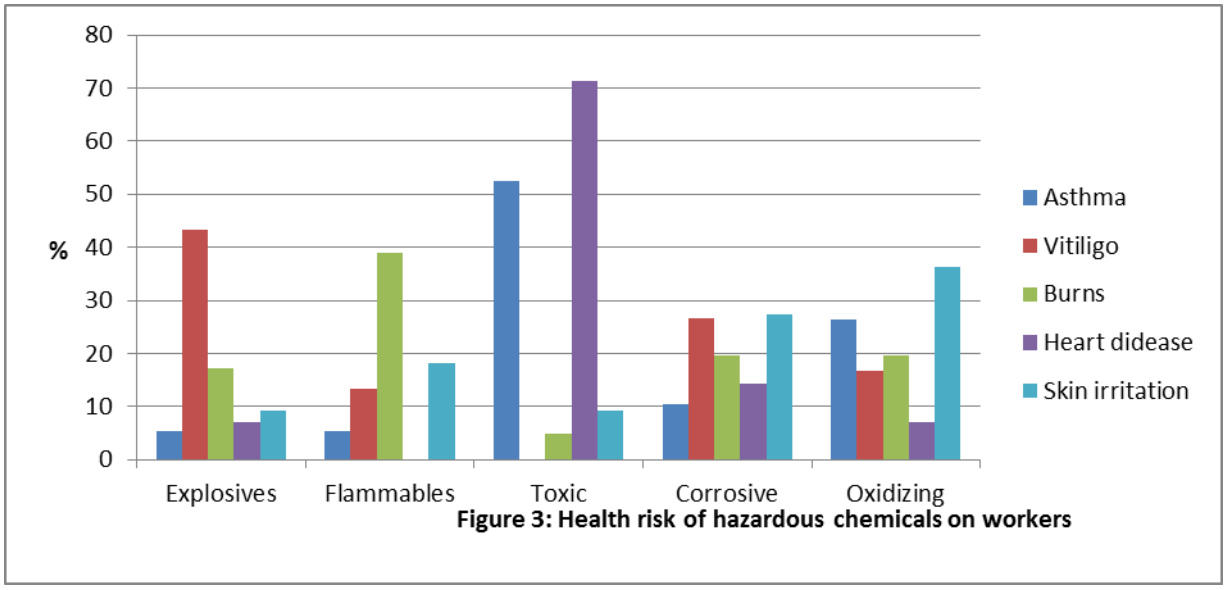

Figure 3: Health risk of hazardous chemicals on workers

Table 3: Health risk by nature of hazardous chemicals on laboratory workers.

Diseases / **Nature of chemicals**	**Asthma**	**Vitiligo (skin discoloration)**	**Burns**	**Heart disease**	**Skin disease/ Irritation**	**MEAN**	**REMARK**
Explosives	1 (4.2)	13 (54.2)	7 (29.2)	1 (4.2)	1 (4.2)	2.48	Rejected
Flammables	1 (4.2)	4 (16.7)	16 (66.7)	0 (0)	2 (8.3)	2.91	Accepted
Toxic	10 (41.7)	0 (0)	2 (8.3)	10 (41.7)	1 (4.2)	2.65	Accepted
Corrosive	2 (8.3)	8 (33.3)	8 (33.3)	2 (8.3)	3 (12.5)	2.83	Accepted

Oxidizing	5 (20.8)	5 (20.8)	8 (33.3)	1 (4.2)	4 (16.7)	2.74	Accepted
Weighted mean = 2.7							

From Figure 3 and Table 3, the effects of different hazardous chemicals on the health of the laboratory staff are grave ranging from burns, asthma, vitiligo, skin disease to heart disease. Burns (66.7%) are more often incurred than other diseases and injuries. This might be due to higher risks associated with flammable (2.91) and corrosive (2.83) chemicals. Related reports, in tandem with this study, stated that exposure to hazardous chemicals could affect the body in different ways such as skin burns and irritation, losing consciousness, nausea, headache, poison, asthma, dermatitis, cancer, genetic damage to offspring (Health and Safety, 2004)

Table 4: Risk of chemicals on the attitude of laboratory workers towards work

ITEMS	SA (%)	A (%)	D (%)	SD (%)	Mean	Remark
I usually encounter risk in the laboratory and this has affected my attitude towards my job.	9 (37.5)	2 (8.3)	8 (33.3)	5 (20.8)	2.71	Accepted
I follow the Material Safety Data Sheet (MSDS) and it has helped to improve my attitude towards work.	9 (37.5)	15 (62.5)	0 (0)	0 (0)	3.38	Accepted
Risk in the laboratory does not make any difference in my attitude towards work.	10 (41.7)	11 (45.8)	3 (12.5)	0 (0)	3.29	Accepted
I use my experience of past accident in the laboratory to work effectively and efficiently in the laboratory without any risk encounter.	9 (37.5)	13 (54.2)	2 (8.3)	0 (0)	3.25	Accepted
I will not enjoy my job even if I don't encounter risk.	18 (75.0)	3 (12.5)	1 (4.2)	2 (8.3)	3.67	Accepted
Weighted mean = 3.3						

Table 4 shows that risk of laboratory chemicals, affects the attitude of the laboratory staff towards work. The attitudes of laboratory staff to work are grossly influenced by lesson from experience of past accident (3.25) as well as availability of safety guides (3.38). These help them to take necessary precautions and reduce hazards from chemicals. Safety guide such as Material Safety Data Sheet is necessary to safeguard frequency of risks and boost interest on the job as reported in previous study ( ).

Hypotheses I

H_{o1}: there is no significant relationship between years of experience and diseases on laboratory staff.

Table 5 Test for Hypotheses I

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Asthma	Between Groups	1.339	1	1.339	2.536	.126
	Within Groups	11.619	22	.528		
	Total	12.958	23			
Vitiligo	Between Groups	.006	1	.006	.005	.944
	Within Groups	25.619	22	1.165		
	Total	25.625	23			
Heart Disease	Between Groups	1.524	1	1.524	1.370	.254
	Within Groups	24.476	22	1.113		
	Total	26.000	23			
Burns	Between Groups	.024	1	.024	.028	.868
	Within Groups	18.476	22	.840		
	Total	18.500	23			
Skin disease/irritation	Between Groups	1.006	1	1.006	.964	.337
	Within Groups	22.952	22	1.043		
	Total	23.958	23			

Table 5 shows how year of experience relates with frequency of incurring diseases. The table reveals that there is no significant relationship between year of experience and diseases on the laboratory staff. The F ratio at $\alpha = 0.05$ (1, 22) =2.536, 0.005, 1.370, 0.028, 0.964 for items 1, 2, 3, 4, 5 respectively. Furthermore, the calculated p-value is greater than 0.05 ($p > 0.05$). Hence, the null hypothesis was accepted and the alternative hypothesis was rejected. Although years of experience counts a lot in influencing risks of laboratory staff yet the relationship between the experience and frequency of incurring diseases is not a trend or permanent occurrence but mere coincidence or by chance.

Hypotheses II H_{o2}: there is no significant relationship between gender and diseases on laboratory staff.

Table 6 Test for Hypotheses II

		Sum of Squares	df	Mean Square	F	Sig.
Asthma	Between Groups	.049	1	.049	.084	.775
	Within Groups	12.909	22	.587		
	Total	12.958	23			
Vitiligo	Between Groups	.758	1	.758	.670	.422
	Within Groups	24.867	22	1.130		
	Total	25.625	23			
Heart Disease	Between Groups	2.685	1	2.685	2.534	.126
	Within Groups	23.315	22	1.060		
	Total	26.000	23			
Burns	Between Groups	.850	1	.850	1.059	.315
	Within Groups	17.650	22	.802		
	Total	18.500	23			
Skin disease/irritation	Between Groups	.182	1	.182	.169	.685
	Within Groups	23.776	22	1.081		
	Total	23.958	23			

Table 6 shows how gender relates with frequency of incurring diseases. The table reveals that there is no significant relationship between years of experience and diseases on the laboratory staff. The F ratio at $\alpha = 0.05$ (1, 22) =0.084, 0.670, 2.534, 1.059, 0.169 for items 1, 2, 3, 4, 5 respectively. Furthermore, the calculated p-value is greater than 0.05 ($p > 0.05$). Hence, the null hypotheses was accepted and the alternative hypotheses was rejected. Gender does not influence the frequency of incurring diseases. This antagonizes popular belief workers are more prone to diseases than their male counterpart but in tandem with related report from previous finding (Akintunde & Taiwo,2013)

Hypotheses III H_{o3}: there is no significant relationship between duration of exposure and diseases on laboratory staff.

Table 7 Test for Hypotheses III

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
Asthma	Between Groups	.292	3	.097	.154	.926
	Within Groups	12.667	20	.633		
	Total	12.958	23			
Vitiligo	Between Groups	.993	3	.331	.269	.847
	Within Groups	24.632	20	1.232		
	Total	25.625	23			
Heart Disease	Between Groups	4.842	3	1.614	1.526	.239
	Within Groups	21.158	20	1.058		
	Total	26.000	23			
Burns	Between Groups	.816	3	.272	.308	.820
	Within Groups	17.684	20	.884		
	Total	18.500	23			
Skin disease/irritation	Between Groups	6.871	3	2.290	2.681	.074
	Within Groups	17.088	20	.854		
	Total	23.958	23			

Table 12 shows how duration of exposure to hazardous chemicals relates with frequency of incurring diseases. The result reveals that there is no significant relationship between duration of exposure and diseases on the laboratory staff. The F ratio at $\alpha = 0.05$ (1, 22) =0.154, 0.269, 1.526, 0.308, 2.681 for items 1, 2, 3, 4, 5 respectively. Furthermore, the calculated p-value is greater than 0.05 ($p > 0.05$). Hence, the null hypotheses were accepted and the alternative hypotheses was rejected. Effect of duration of exposure to chemicals on frequency of diseases is not due to any permanent factor but mere coincidence.

CONCLUSION AND RECOMMENDATIONS

Years of experience on the job and duration of exposure are contributing factors to risk of the laboratory staff. Also, risk in the laboratory affects the health of the laboratory staff as well as their attitude towards work. The most common diseases of the laboratory workers are burns occasioned by flammable and corrosive chemicals. It is therefore recommended that training on how to handle hazardous chemicals, in form of seminars and workshops should be organized for laboratory staff. Laboratory staff should also minimize their exposure to hazardous chemicals. However, the role of management of each institution in providing complete safety materials for the laboratory staff should not be downplayed.

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