

Knowledge of Chemical Hazards and Safety Practices among Furniture Makers Exposed to Organic Solvents in Ile-Ife Nigeria

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Abstract

Background: Furniture making industries commonly operate on small scale in Nigeria and their practices are poorly regulated. There has been less focus on the work practice and level of knowledge of related chemical hazards among people working in this sector.

Objectives: This study aimed to assess the furniture makers' level of knowledge on health effect of related chemical hazards and assess the factors affecting their use of personal protective equipment (PPE).

Methods: A descriptive cross-sectional study design was employed. 108 participants were enrolled using a multi-stage sampling technique. A semi-structured interviewer-administered questionnaire was used to obtain data from participants while checklist was used to assess their workshop. A p-value of <0.05 was considered to be statistically significant.

Result: Good level of knowledge of chemical hazard was observed among 65% of the respondents. The levels of knowledge of PPE use and health effect of exposure to these chemicals were, 64.4% and 54% respectively. Common factors affecting the use of PPE among furniture makers were lack of felt need, awareness and discomfort. None of the workshops inspected met the specifications stipulated for spray painting.

Conclusion: Furniture makers are at risk of the health effects of chemical hazards. Majority of the respondents had poor knowledge of the effect of this hazard and did not use PPE, thus putting them at risk. There is a need for health education intervention to improve their level of knowledge which may also serve as motivating factor to improve on the use of appropriate PPE among these artisans.

Ethics Approval: Ethical approval was granted by the Health Research and Ethics Committee of the Institute of Public Health, Obafemi Awolowo University.

Keywords: Knowledge, Safety practices, Chemical hazards, Awareness, PPE use, Wood furniture makers.

Introduction

Furniture making industry is one of the most common small-scale industries in Nigeria. It is also one of the small-scale industries where chemicals especially organic solvents are commonly used. The solvents have various components such as volatile organic compounds (VOCs) which are hazardous to the health of handlers. (Posniak, Kowalska, & Makhniashvili, 2005; Ratnasingam, Natthondan, Ioras, & McNulty, 2010) The common reasons for the use of these chemicals are to preserve finished products from wood pest and make them attractive to the consumers. Exposure to these volatile organic compounds (VOCs) has been linked with various acute and chronic health effects on most organ-systems of the body. Some examples of the acute toxic effects include headaches, dizziness, loss of consciousness and respiratory tract symptoms like difficulty with breathing among others. Notable among the chronic effects of exposure to VOCs include damage to organs and systems like the lungs and nervous system. VOCs also have carcinogenic properties hence, a risk factor for the development of cancers of various organs on long-term exposure. (Occupational Safety and Health Branch, 2009; ToxTown, 2017).

The exposure is more in these small and medium scale industries due to poor compliance with basic occupational safety and hygiene requirements. Common occupational safety issues identified from a few available local studies include poor use of personal protective equipment and sub-standard workshop structures.(Adei, Adei, & Osei-Bonsu, 2011; Agu, Umeokonkwo, Nnabu, & Odusanya, 2016; Ojo, Onayade, Akinyemi, & Adesanmi, 2017; Osonwa, Eko, & Ozah, 2015) Though there are limited studies that assessed the level of awareness of chemical hazards among wood furniture makers, numerous studies had been conducted among related artisans and other artisans operating in small scale with varying outcomes. For example, a study conducted among wood and metal workers in Ethiopia showed that 99.4% of the respondents used chemicals in their workplace during spray painting. However, only 30.5% were aware that exposures to these chemicals could have adverse health effects. A high level of awareness was observed among study artisans in Accra, Ghana where 96% of the respondents were aware of hazards associated with their work and the importance of PPE use.(Okwabi, Agyemang, & Nyanor, 2016) Their use of safety measures like PPE was however poor because only 12% reported the use of PPE while working.(Okwabi, et al., 2016).

In addition to the aforementioned studies, the level of awareness and knowledge of chemical hazards were also high among spray painters in Kumasi Ghana(Adei, et al., 2011) and workers in timber processing firms.(Mitchual, Donkoh, & Bih, 2015) Also, a high level of awareness of the occupational hazard was recorded among the timber workers in Imo State Nigeria(Diwe et al., 2016) and from a study conducted among timber workers in Edo State Nigeria.(Onowhakpor, Abusu, Adebayo, Esene, & Okojie, 2017) The study conducted among the timber workers in Ilorin, Nigeria to assess their knowledge and attitude towards occupational hazards, however, reported a poor level of knowledge. About 3 out of 5 had poor level of knowledge of hazards related to their job.(Agbana, Joshua, Daikwo, & Metiboba, 2016) Predictors of the poor level of awareness and knowledge include the level of education, ethnicity and being a divorcee.(Agbana, et al., 2016) Other factors that have been identified to affect the level of awareness protective measures against the hazards were the age of the worker,(Onowhakpor, et al., 2017) years of experience on the job,(Diwe, et al., 2016; Onowhakpor, et al., 2017) and duration of work per day or duration of exposure to hazard.(Agbana, et al., 2016; Lombardi, Verma, J Brennan, & Perry, 2009; Tagurum et al., 2018).

The pattern of employment, that is, if the employment is casual, based on contract or permanent job has also been identified as a major factor affecting the attitude of workers to protective measures against the occupational hazards.(Tagurum, et al., 2018) Inadequate provision of PPE by the employer was the major identified as a barrier to usage of PPE among wood factory workers in Calabar Nigeria(Osonwa, et al., 2015) while forgetfulness was a major factor among timber workers in the south-eastern part of Nigeria.(Diwe, et al., 2016) Other common factors identified were the cost of PPE, inconvenience, lack of felt need,(Diwe, et al., 2016; Osonwa, et al., 2015; Top, Adanur, & Öz, 2016) and perception of being invincible.(Lombardi, et al., 2009).

Another important factor in the control of chemical hazards exposure in furniture making workshop is the mode of construction of the workshop. There are standards expected to be met by spray painting workshops to ensure adequate ventilation and protect against other hazards like fire outbreak that could result due to high flammability of most organic solvents. The common guideline specifying criteria of standard spraying booth was that developed by the American National Fire Protection Agency (NFPA).(NFPA, 2015) Apart from the fact that the siting of the booth should be located away from the residential area, the spray booth should be located minimum of 3 feet away from the other parts of the workshop.(NFPA, 2015) This is aimed at controlling exposure to the toxic solvents. The spray booth should be built with fire-resistant materials, equipped with mechanical ventilation with separate storage and mixing area.(NFPA, 2015).

Awareness of the existence of occupational hazards is an essential step to the protection of workers against the hazards. Awareness and practice of PPE use among other protective measures have been assessed among allied profession like timber workers and other artisans like welders and auto spray

painters. There is however a paucity of study on the work practice of the furniture makers and their level of awareness of chemical hazards related to their work. The findings from this study will guide the intervention programme to improve their knowledge of related occupational hazards and improve their work practices to ensure adequate protection and optimal health.

Methods

Study location

This study was conducted in Ile-Ife, an ancient town located in Osun State, South-Western Nigeria. The town has two local government areas namely Ife Central and Ife East local government areas with a population of 167,204 and 161,246 respectively from the 2006 national population census. Most of the furniture makers in Ile-Ife operate on open land or locations within the residential areas with no specialized spraying booths. Furniture makers carry out their work in open space or under make-shift sheds. This, therefore, exposes not only the workers but also their neighbors to the hazards from their work. The furniture makers are organized under well-structured associations namely Association of Furniture Makers and Carpenters.

There are very few industries in the town but many small and medium scale enterprises exist such as sachet water factories and sawmills. There exists no formal occupational health service scheme for the artisans in the town. Also, artisans in the metropolis do not have any formal health notification and compensation systems; there is scarce information on occupational accidents and diseases arising from hazardous working conditions.

Study design and population

The study was conducted using a comparative cross-sectional study design. The cross-sectional data were collected from the furniture makers and the electronic technicians who serve as the comparison group. The data was collected over three months between June and August 2018.

Sample Size and sampling technique

A sample size of 108 was calculated for enrolment into this study. The participants in the study were selected through a multistage sampling technique. The association of the furniture makers operates at the zonal level based on the geographical location and usually has weekly meetings. Six out of fourteen zones were selected through simple random sampling, balloting technique. The list of the artisans and the address of their workshops were collected and the workshops were selected using systematic random sampling technique. At the selected workshop, a master and an apprentice were recruited. Where there was no apprentice, more than one apprentice was selected from the next workshop with more than one apprentice using simple random sampling, balloting technique. All the workshops selected were assessed using checklist for presence of personal protective equipment, safety and sanitary facilities.

Data collection

Data were collected using semi-structured interviewer-administered questionnaire, and a checklist for workshop assessment. The questionnaire assessed the socio-demographic variable of the respondents, knowledge of organic solvents related health hazards and safety measures. The questionnaire also assesses the work practice of the respondents which include the assessment of common chemicals used in their practice, the frequency of usage, cumulative period of use, and means of application of the chemicals to their finished products. Other sections in the questionnaire were the pattern of PPE use, factors affecting usage of PPE, and history of smoking and substance abuse.

Workshop inspection: workshop inspection was conducted using a checklist. The checklist was developed to assess the main determinants of exposure like the structure of the workshop in term of ventilation, type of spray gun used for spray painting, inspection of available PPE, sanitation and hygiene facilities including means of disposal of the remnants of organic solvents.

Data analysis

Data were analysed using SPSS version 22. Mean and standard deviation were used to summarize continuous variables like age, year of work experience and monthly income. Categorical variables were summarized using frequencies and proportions. Association between years of experience and use of PPE was assessed using analysis of variance (ANOVA). The common determinants of PPE use were assessed by binary logistic regression. A p-value of <0.05 was considered to be statistically significant.

Results

The study was a descriptive cross-sectional study among wood furniture makers. The study projected the sample size of 106. The number of furniture makers studied was 101 with a response rate of 95.3%. All the participants were male. The socio-demographic characteristics of the participants are as shown in Table 5 and 6 below.

Table 1. Socio-demographic variables

Variables	Furniture Makers N (%)
Level of Education	
No formal education	2 (2.1)
Primary	42 (43.3)
Secondary	42 (43.3)
Post-secondary	11 (11.3)
Tribe	
Yoruba	95 (94.1)
Hausa	0 (0.0)
Ibo	1 (1.0)
Other	5 (5.0)
Religion	
Islam	20 (19.8)
Christianity	80 (79.2)
Others	1 (1.0)
Marital Status	
Single never married	28 (27.7)
Married	72 (71.3)
Separated or Divorced	1 (1.0)
Types of living apartment	23 (22.8)
1 room	11 (10.9)
1 bedroom flat	22 (21.8)
2 bedroom flat	31 (30.7)
3 bedroom flat	14 (13.9)
Others	

Table 2. Socio-demographic variables

Study factor	Furniture Makers
Age (mean±SD), yrs	38.2± 13.9
Height in centimeter (mean±SD),	169.7±10.6
Weight (mean±SD), Kg	67.9±11.7

Years of work experience (mean±SD)	19.0 ±15.4
Average monthly Income (mean±SD)	26561.0± 18607.1
Smoking status	
Ex-smoker n (%)	7 (6.9)
Non-smoker n (%)	94 (93.1)

An assessment of the level of knowledge of the health effects of chemical hazards to which the furniture makers are exposed showed that more than half of the respondents (65.0%) had good knowledge. The level of knowledge was broken down to the knowledge of the health effect of the occupational hazards and the knowledge of the various PPE needed to reduce exposure. It was observed that 54.0% and 64.4% of the respondents had good knowledge of the health effects of organic solvent and good knowledge of PPE respectively. The proportions with a poor and good level of knowledge are as shown in Table 3 below

Table 3. Knowledge of related occupational hazards

Level of Knowledge	N (%)
Knowledge of the health effects of organic solvents	
Poor	46 (46.0)
Good	54 (54.0)
Knowledge of PPE	
Poor	36 (35.6)
Good	65 (64.4)
The overall level of Knowledge of occupational hazards	
Poor	35 (35.0)
Good	65 (65.0)

The use of PPE was poor among the participants as only 33.3% of them used at least 1 form of PPE.

Table 4. Practice of PPE use

	N (%)	%
Safety goggles		
Regularly	9	9.1
Occasionally	18	18.2
Never	72	72.7
Respirator with filter		
Regularly	5	5.0
Occasionally	9	9.0
Never	86	86.0
Respirator with airline		
Regularly	2	2.0
Occasionally	0	0.0
Never	98	98.0

Face shield		
Regularly	0	0.0
Occasionally	6	6.1
Never	92	93.9
Nose mask		
Regularly	22	22.2
Occasionally	35	35.4
Never	42	42.4
Hand gloves		
Regularly	9	9.1
Occasionally	20	20.2
Never	70	70.7
Safety boot		
Regularly	7	7.1
Occasionally	13	13.3
Never	78	79.6
Waterproof overall		
Regularly	20	20.2
Occasionally	8	8.1
Never	71	71.7
Hearing protector		
Regularly	1	1.0
Occasionally	2	2.1
Never	93	96.9

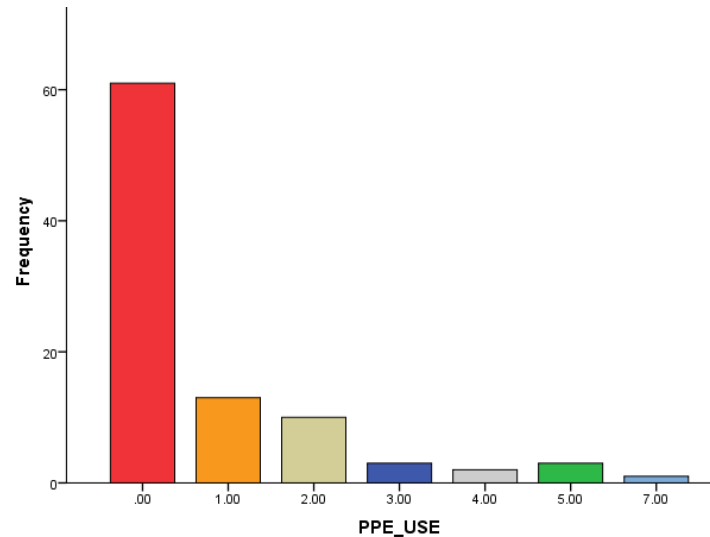


Figure 1. Number of required PPE use regularly by furniture makers

The use of PPE among the furniture makers was found to be most affected by the level of awareness of the importance of PPE. The level of awareness was followed by discomforts that usually result from PPE use (36.0%). For example, excessive sweating and reduced vision due to fogging of the safety goggles were identified as the major form of discomfort experienced. Another major factor identified among the respondents was the availability of the PPE as 35.0% responded in affirmative that unavailability of PPEs

was a major barrier to their usage. Many respondents were not using the PPEs because they were not trained to use them while working with their bosses while learning the art.

Table 5 showed the factors affecting the use of PPE use

Table 5. Factors affecting the use of PPE

	N	%
Availability of PPE		
Yes	35	35.0
No	65	65.0
Cost of PPE		
Yes	23	23.0
No	77	77.0
Awareness of PPE		
Yes	47	47.5
No	52	52.5
Discomfort while working		
Yes	36	36.0
No	64	64.0
Peer influence		
Yes	8	8.0
No	92	92.0
Influence of the boss		
Yes	35	35.0
No	65	65.0
Effect on the quality of work		
Yes	15	15.3
No	83	84.7

Years of experience on the job was found to be significantly associated with the use of most PPE. The only exception to this was in the use of a face shield ($P= 0.323$) and nose mask ($P= 0.121$). The association between years of experience and the use of some PPEs are as shown in the Table 6 below.

Table 6. Association between years of experience and use of PPE

Personal Protective Equipment	F	P-Value
Safety goggle	1.810	0.005
Respirator with filter	2.160	<0.001
Respirator with airline	5.756	<0.001
Face shield	1.108	0.323
Nose mask	1.315	0.121
Hand gloves	2.076	0.001
Safety boots	2.439	<0.001
Waterproof Overall	2.035	0.001
Hearing protector	9.893	0.000

A walk-through inspection of the workshops of the furniture makers showed poor availability of the personal protective equipment. The most common PPE sighted was nose mask (9.0%). This was followed by safety goggle which was present in 7.0% of the workshops inspected. The respirator with filter was not

sighted in any of the workshops. The use of a surgical mask was a common practice among the furniture makers instead of the recommended nose mask for their profession. This was sighted in 28% of the workshops visited.

Table 7. Availability of personal protective equipment across furniture makers' workshops

Type of PPE	Number of workshops where PPE was sighted (N=101)	Percentage (%)
Safety goggle	7	7.0
Respirator with filter	0	0.0
Respirator with airline	1	1.0
Face shield	1	1.0
Waterproof apron	3	3.0
Nose (dust) mask	9	9.0
Hand gloves	3	3.0
Safety boots	1	1.0
Hearing protector	1	1.0

Sanitary practices of most workshops were very poor. Very few (5.0%) of the workshops had changing (cloak) room separated from where spraying took place. Also, availability of separate eating area and hand washing facility were in 2.0% and 1.0% of the workshops respectively. Virtually all workshops use open dumping and burning as means of refuse disposal despite having highly flammable substances as their raw materials for wood painting and it was shown that 97.0% of the workshops were littered with flammable substances. Safety measures against fire outbreak were unavailable as the majority of the workshops, 97.0%, had no fire extinguishers. It is worth noting that none of the workshops inspected had first aid box.

Table 8. Sanitation, hygiene, and safety facilities in furniture making workshop

Characteristics	Frequency n=101	Percentage
Changing room available		
Yes	5	5.0
No	96	95.0
Eating area available		
Yes	2	2.0
No	99	98.0
Hand washing facility		
Yes	1	1.0
No	100	99.0
Method of refuse disposal		
Open dumping and burning	100	99.0
Burning in a pit	0	0.0
Sell for reuse	1	1.0
Type of toilet in use		
Pit latrine	4	4.0
Pour-flush	5	5.0
None	92	91.0

Fire extinguisher		
Yes	3	3.0
No	98	97.0
Presence of flammable substance littering the workshop	98	97.0
Yes	3	3.0
No		

Discussion

This study assessed the level of awareness and knowledge of wood furniture makers about chemical hazards related to their work with a focus on organic solvent used during spray painting. The study further assessed the practice of PPE use and factors affecting PPE use.

The level of knowledge about the health effect of chemical hazard associated with painting was low among the furniture makers as only 54% scored above half of the total score. The level of knowledge of PPE use for protection against occupational hazards was moderate, about 3 out of 5 furniture makers scored above average. The findings were in contrast to the findings from similar study among timber workers in Edo and Imo State Nigeria where the respondents demonstrated a high level of knowledge about hazards related to their work.(Diwe, et al., 2016; Onowhakpor, et al., 2017) The proportion with good level of knowledge about protective measures against chemical hazards was also higher among wood and metal workers studied in Ethiopia (83.1%) as against 64.4% of the furniture makers in this study.(Esaiyas, Nagawo, & Mekonnen, 2018) The proportion of respondents with good level of knowledge about health effect of these chemicals used in furniture making was however higher relative to the furniture makers in Ethiopia(Esaiyas, et al., 2018) The high level of awareness of protective measures among the Ethiopians despite the lower proportion with good knowledge of health effect of chemical hazard could be due to variation in enforcement and compliance with the standard operating procedure and occupational health laws between both countries where the studies were conducted.

The proportion of respondents with good overall level of knowledge in this study was found to be higher than the findings from the study conducted among the timber workers in Ilorin Nigeria where about 3 out 5 respondent had poor knowledge of hazards related to their job.(Agbana, et al., 2016) Age was observed in this study to be a significant factor associated with the level of knowledge of the health effect of organic solvent exposure among furniture makers ($p=0.002$). Majority of the respondents with good level of knowledge were in the age group of 21- 40 years. The proportion with good level of knowledge was observed to be low at the extremes of ages. This finding could be due to the fact that the majority of the participants at the lower extreme of the age are apprentices or newly graduated furniture makers with little experience on the job. The significant association between the age and level of knowledge of the effect of chemical hazards is in agreement with the findings from a similar study conducted among lumbering workers in Edo State, Nigeria where it was observed that the level of knowledge declined with age.(Onowhakpor, et al., 2017).

The use of PPE among the furniture makers was poor. Majority of the respondents did not use PPE while painting. Only 33.3% of the furniture makers used at least one PPE. This finding is in agreement with most previous studies where workers had high level of awareness but still had poor use of PPE.(Agbana, et al., 2016; Diwe, et al., 2016; Okwabi, et al., 2016) The practice of PPE use was however higher in the study conducted among the Ethiopians wood furniture makers.(Esaiyas, et al., 2018) This could be due to variation in the enforcement of occupational health law and safety policies.

The leading cause of poor use of PPE among the furniture makers was poor awareness or lack of felt need. This is closely followed by discomfort arising from the use of PPE. These are similar to the findings from previous studies where perceived need and discomfort were major factors affecting the use of PPE.(Diwe, et al., 2016; Osonwa, et al., 2015; Top, et al., 2016) The similarity in findings could be due to

the fact the studies were carried out in Sub-Saharan Africa which is a region characterized by hot and humid climate.

The years of experience was found to be a significant factor for the use of most PPE in this study with the exception of the face shield and nose mask. There was no significant association between years of work experience and the use of nose mask and face shield. This could be due to the fact that majority of the respondents identified respiratory symptoms like catarrh and cough as the major symptoms associated with their profession. The organic solvent causes acute respiratory symptoms which may be severe enough to disturb their activities hence, the need for the adoption of protective measures irrespective of their work experience. (Occupational Safety and Health Administration, 2014; Rutchik & Ramachandran, 2014) This is in agreement with past studies conducted among the timber workers in Imo and Edo State Nigeria. (Diwe, et al., 2016; Onowhakpor, et al., 2017).

None of the workshops inspected complied with the standards expected of the workshop where spray painting takes place. (NFPA, 2015) Virtually all the furniture makers painted in open spaces under the shed where they carry out other activities with few of the workshops having one form of PPE or the other. It was also observed that most of the artisans who claimed to use nose mask while painting were actually using a surgical face mask which is not the specified PPE for spray painting. Very few of the workshops had hygiene and sanitation facilities, 99% of them use open dumping as means of waste disposal and an almost similar proportion had no changing room, separate eating area, toilet facility and facility for fire outbreak control like the fire extinguisher. The findings are similar to findings in the study conducted among car spray painters in the same study area, Ile-Ife. (Ojo, et al., 2017).

Conclusion

Furniture makers are exposed to hazards daily in their work. The art of painting finished wood products exposed them to chemical hazards and a high proportion of them have little knowledge of its health effects. The limited knowledge of occupational health hazards associated with their job, influenced their use of PPE and practice of other occupational health safety measures, thus exposing them more to the hazards. There is, therefore, the need for health education intervention programs for furniture makers to improve their knowledge of the occupational hazards associated with their work. Making the personal protective equipment available at subsidized rate will also motivate the workers to the PPE. There is also need for enforcement of necessary legislation and policies to ensure compliance with occupational health safety practices and prevent indiscriminate siting of substandard workshops within the residential areas.

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