LeadPoisoning in Paints Factories: Workers' knowledge and Attitude at Khartoum State, Sudan.

Zaed Sultan Ahmed Sallam[1], Saeeda Alsadeg Mohammed Kagygy[2],Kalthoum Ibrahim Yousif[3]*, Nafisa Ibrahim Abdelgadir[4]

[1]Department of Community Health Nursing, department of Nursing Science,University of Taiz, Yemen
[2]Departmentof Community Health Nursing, College of Nursing Sciences, University of Bahri, Khartoum, Sudan,
[3]*Department of Medical Surgical Nursing, Faculty of Nursing Sciences, Al Mughtaribeen University, Khartoum, Sudan
[4]Department of Community Health Nursing, College of Nursing Sciences, University of Bahri, Khartoum, Sudan

*Corresponding author: Kalthoum Ibrahim Yousif, Faculty of Nursing Sciences, Department of Medical & Surgical Nursing, AlMughtaribeen University,

Abstract
Background: Lead exposure is a significant public health concern; it is estimated to have accounted for 0.90 million deaths from long-term effects and 21.7 million disability-adjusted lives, 82% of these lead related deaths occur in low and middle-income countries.
Aim: The aim of the present study was to assess workers knowledge and attitude about lead poisoning in paints factories in Khartoum state.
Materials and Methods:A descriptive cross-sectional survey was carried out from 23 June 2022 to 25 July 2022. Convenience sampling method was adopted to select 122subjects;   Data were collected through structured interview questionnaire and analyzed by using a statistical package for social sciences (SPSS version 24.0.0).
Results: Workers' general Knowledge about lead poisoning revealed poor resultsThe overall mean of knowledge score was46.The overall mean of workers' attitude about lead poisoning waspositive by 73.6 score. Significant statistic was observed between age, sex, marital status, level of education, and years of experience with level of knowledge (p-value >0.05). Association between the demographic data and the workers knowledge about lead poisoning was statistical significance (P= 0.000*). Relationship between workers' knowledge and attitude was significant for both correlation coefficient (0.334) and (P value 000).
Conclusion: Based on the results, the findings of this study of the workers' knowledge in the paint factories about lead exposure and health-related effect was poor; inadequate knowledge about occupational safety hazards was observed. Attitude of worker about lead poisoning was observed. Workers' knowledge and attitude, association between the demographic data and the workers knowledge about lead poisoning statistically significant.Relationship between workers' knowledge and attitude were statistically significant.
Keywords: Paints'Factories, workers' Knowledge, workers' attitude, lead poisoning.

I.   Introduction

Lead (Pb) is a common material existing on earth and is widely utilized in industry. Elevated lead absorptions are hazardous factors in lead-related workers. Previous studies have found its toxic impacts on nervous, circulatory, and metabolic system1(XU etal., 2017).Lead levels in the environment continue to increase along with human activities in the industrialization process agent2(Lestari and Purwanti,2020). Leadis widely used for various industrial purposes, lead is also very essential in the paint and ink industry as a colorant. The majority of the paint industry uses (Pb) as a pigment.In painting activities, lead can more easily interrelate with and poison paint workers through inhalation, ingestion, and skin 3(Prasetyo and Dwiyanti, 2021). Pb exposure is estimated to account for 0.6% of the world's health problems occur in low and middle-income countries4(OKI, 2018). According to the Institute for Health Metrics and Evaluation (IHME) lead responsible for 1.06 million deaths and 24.4 million disability-adjusted life years (DALYs), lead exposure accounted for 63.2% of the global burden of idiopathic developmental intellectual disability, 10.3% of the global burden of hypertensive, 5.6% of the global burden of ischemic heart disease, and 6.2% of the global burden of stroke, with the highest burden in developing countries5(IHME, 2019).

Low-income countries are more exposed to lead than other countries, with an annual economic loss of $134.7 billion in the African region. In Nigeria Pb poisoning accounts for 1.6 deaths per 100.000 populations and 46.82 DALYS per 100.000 populations 6*(Kassy et al, 2021)*.In Sudan the annual economic loss resulting from lead exposure is usually 4.94 billion dollars per year with 64 % of paints having a lead content greater than 90 parts per million and 28 % having a lead content greater than 10,000 parts per million 7*(IPEN, 2017)*. In Sudan Many people work in paint companies are engaged in activities that expose them to health risk of lead. There are Lack of published studies about lead poisoning among paint workers and systemic data about exposure.A cross-sectional study was done by 8*(Awodele et al, 2014)* in Nigeria to assess the use of available control measures/initiatives in selected paint factories among workers. They noted that once safety laws already exist, there is a need to encourage adherence to these practice guidelines. Study done by9*(Lestari and Purwanti, 2020)*about the Modifying Factor of Lead Exposure Time with Blood Lead Levels on Adulterated Paint Worker, they revealed that positive relationship, the longer a person is exposed to lead, the higher the lead level in his blood. Previous research performed by10(*Gottesfeldet al.*2014),they reported that lead compounds used in paints create a risk to human health and are environmental contamination.Therefore we decided to study the workers knowledge and attitude about lead poisoning in paints factories.

II.   Materials and Methods

Descriptive cross-sectional studies carried out on 122 workers who were adults' age below 50 years, had one-year experience at least obtained elementary to university education. Also those who have direct contact with paints in three paint manufacturing Factories at Khartoum State. A convenience sampling method was adopted to select participants. Data were collected through a structured interview questionnaire which was designed by researchers according to the literature. Then validated and approved by five experts concerning chemical containing lead material for manufacturing the paints who reviewed the instruments for clarity, relevance, comprehensiveness and applicability. The questionnaire consists of three parts:

Part one: Include socio-demographic data (age, sex, and marital status, level of education, years of experience and marital status).

Part two: It contains 10 questions to assess the knowledge variables of the workers about lead poisoning (Awareness about the Lead in paint, usage of PPE , Previous lead tests,complication and prevention) 6 of them labeled as Yes, No and I don't know, and 4 structure questions as MCQS.The scale score is as follows**:**
 Yes =1,No =2and I don't know =0.

Knowledge score of measurement was rated as follows:

Poor knowledge = < 50 %, Moderate knowledge =50-70% and Good knowledge = > 70%

Part three: Include 9 questions about the attitude of workers, and the response of each item was indicated on a 5-point Linker Scale as follows: (strongly agree =5, agree =4, not sure =3, disagree =2, and strongly disagree =1)

Negative attitude= < 50 %Positive attitude= > 50%

The total score was calculated by summating the raw scores of the nine questions which was equal to 45.

The collected data were cleared coded and processed by using the Statistical Package for Social Sciences (SPSS) version 24. Descriptive statistics was carried out using frequency and percent; the means were calculated to find the overall mean value for both knowledge as well as the attitude. A Chi-square test was used to test the association between workers' knowledge, attitude, and demographic data, and a Pearson correlation test was used to find the relationship between workers' knowledge and attitude. P value was set to be > 0.05.

ETHICAL CONSIDERATIONS

The research protocol was examined for Human Subjects (Medical) and approved by the Research Committee of the University of Bahri and College of Nursing Sciences
 Approval was obtained from the director of human resources department in each paint company.

The researchers were properly introduced before the research, and the participants understood the objectives of the research.

A written Consent was obtained from individual participantand they have the right to accept or refuse without any influence. The Questionnaire was filled by the workers at their rest time without any interruption to their work and privacy.They were assured for the confidentiality of the information obtained.

III. Results

Table (1):Demographic Characteristics of Workers (n=122)			
Items	**Characteristics**	**N**	**%**
Age	(18-35)	97	79.5%
	(36-50)	23	18.9%
	Above 50	2	1.6%
Sex	Male	106	86.9%
	Female	16	13.1%
Marital status	Single	73	59.8%
	Married	45	36.9%
	Other	4	3.3%
Level of Education	Illiterate	0	0%
	primary school	13	10.7%
	secondary school	44	36.1%
	University	62	50.8%
	above university	3	2.5%
Years of experience	(1-5)	78	63.9%
	above 5 years	44	36.1%

(Table 1) Socio-demographic data shows 79.5% of the participant's age range between 18 and 35 years. Males'gender was predominantby(86.9%). More than 50% were single,more than 50% are university graduate, and third had secondary education. The majority of the participants work experience range between one to five years.

Table (2):Workers Knowledge about Adequate Information Regarding Lead Poisoning (n=122)			
Question	**Responses**	**N**	**%**
Do you have adequate information regarding lead poisoning?	Yes	39	32%
	No	83	68%
	Total	**122**	**100%**
Source of information			
Workplace		33	27%
Multimedia		6	5%
Health organization and professional		12	9%
I have no information		72	59%
Total		**122**	**100%**

Table (2) describes 59 % of the workers' lackinginformation about lead poisoning, while only 27% of them acquire their knowledge in the work place.This was considered serious to join a risky place without knowledge.

Table (3): Workers Knowledge about occupation hazards and safetymeasure utilization (n=122)			
Questions	**Response**	**N**	**Percent**
Awareness about hazards associated with job	Yes	39	32%
Lead can cause acute respiratory infection.	No	83	68%
	Total	**122**	**100%**

Lead is a toxic metal or chemical element in a variety of products	I don't Know	79	(64.7%)
	Total	122	100%
You are aware about lead is used in paints	Yes	28	23%
	No	94	77.1%
	Total	**122**	**100%**
Using of personal protective devices	Yes	101	82.8%
	No	21	17.2%
	Total	**122**	**100%**

Table (3) shows 32% of the participants had no idea about lead health hazards related to their job. Sixty four percent of them are not aware that lead is a toxic element, and can cause respiratory infection.

Table (3.1): Knowledge about occupation hazards and safety measure utilization (n=122)			
Questions	**Response**	**N**	**%**
Do you have any idea to where you report occupational health problems if any	Yes	2	1.6
	No	32	26.2
	I Don't know	88	72.1
	Total	**122**	**100**
Previous lead tests	Yes	3	2.5
	No	119	97.5
	Total	**122**	**100**

Table (3.1) shows 72.1% of the workers has no ideawhere to report occupational health problems. And 97.5% of them had no previous test for any sensitivity to the paints.

Table (3.2): Workers Knowledge about occupation hazards and safety measures utilization (n=122)			
Questions	Response	N	Percent
Complications of lead poisoning.	heart disease and renal impairment	17	13.9%
	Depression	33	27%
	Anemia and sleep problems	31	25.4%
	infertility and cancer	32	26.2%
	unconscious and death	0	0%
	I don't know	95	77.9%

Table (3.2)shows 77.9% of the workers unaware of the complications that can arise from lead poisoning.This might be due to lack of information.

Table (3.3): Knowledge about occupation hazards and safety measure utilization (n=122)			
Question	**Responses**	**N**	**Percent**
Prevention of Lead poisoning	wash hands with water and soap	121	99.2%
	avoid touching the eyes and nose with hands	119	97.5%
	Using personal protective equipment's	117	95.9%
Periodic medical test.	Yes	0	0
	No	122	100%
	Total	**122**	**100%**

Table (3.3) reflectsmost of the workers followedthe precautions of the infection control except none of the workers had periodic medical test for lead poisoning.

Table (3.4) Over all knowledge of workers about occupation hazards and safety (=122)			
Safety (n=122)			
Dimension of knowledge	**Workers scores**		**Level of knowledge**
	Mean	**%**	
Awareness about hazards associated with job	0.32	32	Poor
Source of information about lead	0.80	80	Good
What is lead	0.30	30	Poor

Lead used in paints	0.23	23	Poor
Usage of personal protective devices	0.80	80	Good
Self-reported occupational health problems	0.16	16	Poor
Previous lead sensitivity tests	0.25	25	Poor
Complications of lead poisoning	1.13	22.6	Poor
Preventions for lead poisoning	3.80	95	Good
Periodic medical blood test	0.03	3	Poor
Over all knowledge	**7.82**	**46%**	**Poor**

Table(3.4)the mean knowledge of workers regarding the occupational hazards and safety variables of most aspects are poor. The overall mean was below 50%. This might need crucial intervention and prior training.

Table (4) Table (4) Association Table (4) Correlation between socio-demographic data and worker's Knowledge about Lead poisoning(n=122)			
Socio-demographic data	**Chi-square Value**	**Df**	**P-value**
Age	37.732	4	0.000*
Sex	61.919	2	0.000*
Marital status	26.966	4	0.000*
Level of education	27.472	6	0.000*
Years of experience	8.337	2	0.015*

Table (4)Association between the demographic data and the workers knowledge about lead poisoning showed statistical significance (P= 0.000*).

Table (5) Workers Attitude about Lead Poisoning in the Paint Factories (n=122)					
Statements	**strongly agree**	**Agree**	**Not Sure**	**Disagree**	**strongly Disagree**
It is important to use PPE while exposure to paints.	79(64.8%)	37(30.3%)	3(2.5%)	3(2.5%)	0%
It is important to wash hands before touching any part of body	84 (68.9%)	32(26.2%)	2 (1.6%)	3(2.1%)	1 (0.8%)
The mask and hand washing are protective tools to decrease lead exposure and poisoning?	28 (22.9%)	22 (18%)	58(47.5%)	13(10.7%)	0%
Some workers have difficulty wearing PPE	12 (9.8%)	22 (18%)	23(18.9%)	50 (41%)	15(12.3%)
Eat, drink, and smoking in the workplace will increase lead transmission?	18 (14.8%)	25(20.5%)	60(49.2%)	17(13.9%)	2 (1.6%)
Eliminate of lead in paints helps to reduce lead exposure	22 (18%)	29 (23.8%)	51(41.8%)	20(16.4%)	0%
Carrying your clothes home can transmit lead to family	22 (18%)	32 (26.2%)	45(36.9%)	22 (18%)	1 (0.8%)
To avoid sleep in workplace can decrease lead exposure?	22 (18%)	27 (22.1%)	47(38.5%)	22 (18%)	4 (3.3%)
Supervisor should provide workers with advice about lead hazards.	47(38.5%)	62 (50.8%)	7 (5.75)	5 (4%)	1 (0.8%)

Table (5)although there was positive attitude of majority of worker regarding their knowledge of lead poising,but some of them ignoreimportant issues of transmission of infection.

Table (6) Over all mean attitude of workers about lead poisoning (n=122)		
Statements	**Mean** **Score**	**Attitude** **Percent**
It is important to use PPE during paint contact	4.57	91.4%
It is important to wash hands before touching any part ofthe body.	4.60	92%
The mask and hand washing are protective tools to decrease lead exposure?	3.53	70.6%
Some workers have difficulty in wearing personal protective devices.	2.70	54%
Eat, drink, and smoke in the workplace will increase risk of lead poisoning.	3.31	66.2%
Eliminate of lead in paint helps to reduce lead exposure.	3.42	68.4%
Taking clothes to the home can helptransmit lead to family.	3.41	68.2%
Avoiding sleep in the workplace can decrease lead exposure.	3.34	66.8%
Supervisor should provide workers with advice about hazards.	4.22	84.4%
Over all attitude	**33.1**	**73.6%**

Table (6) shows the workers overall mean of positive attitude (73.6%) about lead poisoning.

Table (7) Relationship between workers level of knowledge and attitude		**Attitude**
Level of knowledge	Pearson Correlation	0.344**
	P-value	0.000
	N	122

Table (7) shows correlation between workers' knowledge and attitude
Statistical significant (P value = 0.000).

Table (8):Relationship between socio-demographic data and workers' attitude level about lead poisoning (n=122)			
Socio-demographic data	**chi-square value**	*df*	**P-value**
Age	7.283	4	0.122
Sex	8.710	2	0.013[*]
Marital status	12.110	4	0.016[*]
Level of education	13.364	6	0.038[*]
Years of experience	2.364	2	0.307

Table (8)associated of workers' demographic data with their level of attitude
ShowedStatistical significant P value,

IV.   Discussion

Hundred and twenty two workers participated in this descriptive crossectionalstudy.According to the workers' socio-demographic data 79.5% of the participant's age range between 18 and 35 years. Males weredominating by (86.9%). More than 50% of the workers were single.Also 50% were university graduate and only one third had secondary education. The majority of the workers' experience range between one to five years(Table 1).

The result of this study denotes that 60% of workershaven't got any information from any source about lead poisoning while only 27% of them acquire their knowledge in the work place. This was considered serious to anyone be providedbyprior knowledge in such a risky place (Table 2).

The results in (Table 3) revealed that 32% of the participants unaware about what is lead health hazards related to their job. These results suits the resultsmentioned in a study4** (OKI, *2018)* stated that lead exposure is estimated to account for 0.6% of the world's health problemsoccurred in low and middle-income countries.In (Table3)64.7% of the workers in this study wereunaware that lead is a toxic element, and can cause respiratory

infection. This ignorance about information of lead hazards needs actual interference.The results of (Table 3.1) revealedmost of the workers had no idea where to report if they encountered health problem.+-

A study was done by 11*(Namungu et al, 202)* in Kenya to assess levels of exposure to lead knowledge, and occupational safety among workers in the workplace. They found that the majority of respondents worked long hours each day, increasing their exposure to lead hazards and consequently raising their risk of acquiring related issues. This study results (Table 3.2) was similar to the previous study mentioned above that workers knowledge about occupational hazards and safety measures utilization werelacking awareness regarding the complications that might occur by exposure to lead material. We presume this needs attention from the authority of the companies. This study results agreed with a study done by12*(Prasetyo and Dwiyanti, 2021)* which stated that lead can more easily interrelate with and poison paint workers through inhalation, ingestion, and skin irritation.

With regard to the prevention of the lead poisoning as a hazard for health safety we observed that in (Table 3.3) the results reflect that most of the workers following the infection control precautions, except they reported that none of the workers had periodic test for lead poisoning. However, it is necessary to have a general understanding of performing protective measures to reduce the potential for harm and adverse health effects. Adherence to safety practice guidelines is the key for reducing the risk of injury and illness among workers. This finding is consistent with a study findings by13*(Rasheed ,2019)* done in Nigeria which revealed that (87.7 %) of worker lacked knowledge about lead poisoning.

The overall mean of the workers knowledge about occupational hazards and safety(Table 3.4) attained all the aspects of the mean analysis were poor. And the overall mean below 50%. This might needs crucial intervention. This poor level of knowledge among workers might be due to the fact that the supervisors did not provide them with accurate information about Lead poisoning. Therefore, poor knowledge could affect the workers awareness about the risk associated with hazards and the misuse of PPE in workplace.

The results of this study indicated that majority of workers had no idea about lead-content paints and the hazards associated with their job.Decisions on management are frequently made based on the lead levels in venous blood, which is the definite biomarker of exposure and risk 14*(Brightman, 2017)*.It is possible that paint companiesignore the workerso that not to demand routine examinations, comprehensive medical insurance and reimbursement which will impose a significant cost on companies due to increased health care costs. Lack of information could have a negative influence on health of workers. Understanding of lead hazards will help in achieving positive behavioral change among workers and influence reaction to various hazards threats at the workplace and this will improve the rate of utilization of PPE. Therefore, an effort to encourage the development of national legislation to control the manufacturing to produce paints free of lead is crucial. Thisstudy resultswere in agreement with theprevious study of8*(Awodele et al,2014)* in Nigeria, which revealed that (72.5%) of the level of awareness is high. The percentage of utilization of PPDs is currently 82.8% which are high. This current results not indicated that the workers are aware about the hazards associated with the utilization of lead, the workers only follow the instructions of supervisors, which was considered a bad indicator if there is any lack of directionsindeed.Association between workers socio – demographic data and their knowledge about lead poisoning reflect positive P Value (P= 0.000*) (Table 4).

Also workers response to their attitude in (Table 5), we encountered that therewas knowledge deficit about lead poisoning among some worker,even though the majority of workers had positive attitude in this regard, 47.5% but some of them address that the personal protective equipment tools are important. Forty nine point five of workers do not realize that eating, smoking and drinking in the work area can increase lead poisoning spread.

The overallmean of attitude results showed (73.6%) in (Table6).Thisresults disagree with the a study done*by 15(AzamiM et al. et al,2018)in* Iran which found that (43.1%) of theresults reflect negative attitude including misuse of PPDs.

Statistically significant was observed in the relationship between workers' knowledge and attitudein (Table 7) (P-value 0.000).

With regard to the association between workers sociodemographic data and their attitude in (Table 8) there was statistical significance difference in all aspects except the years of experience (P value < 0.05).

V.   Conclusion

Based on the study findings, the workers' knowledge in the paint companies about lead exposure and health-related effect was poor; inadequate knowledge about occupational safety hazards was observed. Attitude of worker about lead poisoning was positive. There is positive association between workers knowledge and attitude, and their knowledge and demographic data about lead poisoning.

Study LIMITATIONS

Limitations are remarkable in the present study. The data of this study were obtained in only three paint factories by a small sample size. Hence, the results of the study cannot be generalizable throughout all paint factories. Moreover, data about using personal protective devices (PPDs) were only based on opinions of the worker and no observation was carried out during work.

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1. Study concept and design or acquisition, analysis, or interpretation of data byZaed and Saeeda. 2. Drafting the article or revising it critically for important intellectual content by Kalthoum and Nafisa. 3. Agreement to be Accountable for Accuracy and Integrity of all aspects of the work by Saeeda and Kalthoum.4. Final Revision and approval of the version to be published byKalthoum.

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CONFLICT OF INTEREST:

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Should Vancouver style

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