Estimating the Concentration of Lead in the Blood of Smokers and Non-Smokers Working in Car Repair Shops in the City of Sebha – Libya

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Abstract *- This study aimed to estimate the element of lead in the blood serum of workers (smokers and non-smokers) in car repair shops in the city of Sebha, in southern Libya. Blood samples were collected by a laboratory technician specialized in blood collection, and a questionnaire was prepared to collect specific data for each worker (age, weight, duration of work). The sample size was (11) smoking workers and (37) non-smoking workers. (3) replicates were taken for each sample. Lead was estimated using an atomic absorption device. The results of a one-way ANOVA with a confidence level of 95% (Levene's) and a t-test showed the correlation and difference between the concentration of lead in the workers' blood. Smokers and non-smokers. There were significant differences at the level of $P < 0.05$ for lead concentration between smokers and non-smokers. The smokers had an average of (20.8791±6.54131), and the non-smokers had an average of (12.8870±3.94090), and the value (f) of the Levene test calculated at a significance level (α=0.05) was (3.155), and the value (Sig) corresponding to the test The (F) value was (0.082), the (T) value was (5.024), and the (sig) value corresponding to the (t) test was (0.000), which confirms the presence of statistically significant differences in lead concentration between smokers and non-smokers. The results of the statistical analysis showed To estimate lead concentration according to study variables (weight, age, years of work), there were significant differences in lead concentration according to body weight for smokers and non-smokers, while years of work. The results showed that there were no significant differences in lead concentration for smokers, while for non-smokers there were differences in Lead concentration according to years of work. While age, there are no significant differences in lead concentration for smoking workers. While for non-smokers there are significant differences. We conclude from this study that occupational exposure contributes significantly to increasing the concentration of lead in the blood, and this concentration increases with the presence of other sources of exposure, such as smoking. Years of work also contribute to the biological burden. So, for people exposed to lead.*

Keywords: *car repair shops, lead, smokers, non-smokers.*

I. Introduction:

Occupational pollution still poses a health threat to humans (Khan et al., 2010, Ali, et al., (2022), especially lead pollution due to its multiple sources, ease of transmission, frequent use, and health effects, which make it an environmental and occupational toxic substance, Khuder. et al., (2007) & Rodrigues, et al.,(2008). There are two types of lead, which is an inorganic mineral found in paint, dust, and dirt. Ogbodo, et al., (2019), The second type is organic lead. This type is absorbed through the skin, which makes it dangerous and causes more health problems in the central nervous system than inorganic lead. Duruibe et al., (2007).There are two sources of lead: the first is natural, such as volcanoes, weathering of parent rocks, and fires. The second is industrial or professional Fatok & Ayoade, (1996). Lead is used in more than 900 Ahmed, et al., (2008). It also has applications in agriculture, Ezejiofor., (2014). The most important routes of exposure are inhalation, ingestion, and skin contact , Ahmed, et al., (2020). Especially for people who are occupationally exposed. (US EPA., (2007). International organizations and bodies concerned with biological monitoring of pollutants and their impact on human health, such as the National Institute for Human Safety and Health (NIOSH), the US Environmental Protection Agency (EPA), and the World Health Organization (WHO), have estimated the permissible limits of lead in ecosystem components and components. Biological as follows: between 0.05 and 0.1 µg/m3. (Nduka, et al. 2019). indicated that air pollution contributes to increasing the concentration of lead in human blood through inhalation of polluted air, as 1 µg/m3 of lead in the air increases its concentration in the blood of children (1.9 µg/dL) and adults. (1.6 µg /dL). In natural waters, it ranges between 0.1 and 10 µg/litre, while in ocean surface water, it ranges between 0.01 and 0.03 µg /litre, Al Oudat et al., (2007). It is agreed that the concentration of lead in drinking water should not exceed 0.01-0.05 mg/L. While the concentration of lead in natural soil ranges between 10 and 40 mg/kg, in the deep soil layers it is less than the surface soil layer. Mico et al., (2006), Khan, et al., (2010). In plants growing on uncontaminated soil, it is at a low concentration and rarely exceeds 1 mg/kg, Al Oudat et al., (2007), and as for human blood, exposure to lead, even in low quantities, poses a health risk, Raisska et al., (2007), so the Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) of the Centres for Disease Control and Prevention (CDC). The permissible limit changed from 60 µg/dL in the 1960 to 30 µg/dL in the 1970. Until it reached 25 µg/dL in the 1980, Adela, et al., (2012) With the increase in technological and industrial development in all areas of life, there was an increase in lead levels in the components of the ecosystem that surrounds and in which humans live, which made it necessary to lower the danger threshold in the 1990. (5 µg/dl) for children in the age group between 1 and 5 years and adults (10 µg/dl). Al Oudat et al., (2007). While workers (professionals) (30 µg/dl). Schutz et al., (2005). While the World Health Organisation indicated that lead causes negative health effects even at low concentrations, the presence of lead in the blood at a concentration of 10 µg/dl causes health risks, and it has set a permissible limit that should not be exceeded. (5.4 µg/dl), and that the weekly intake of an adult does not exceed 0.05 mg/kg body weight, Al Oudat et al., (2007).The Agency for Research on Cancer (ARC) and the Agency for Toxic Substances and Disease Registry (ATSDR) indicated that lead is classified among the most toxic metals and is linked to various types of cancer. Approximately 50% of inhaled inorganic lead can be absorbed into the lungs. Vaglenov et al., (2001) Adults absorb 10–15% of lead from food, while children absorb approximately 50 percent through the digestive system. Lead in the blood binds to red blood cells and is slowly eliminated. It accumulates in the skeleton when lead levels in the blood are greater than 40 µg/dl. Schütz et al., (2005). It causes harm to human reproductive organs, and sometimes even levels below 10 µg/dL of lead can be dangerous. Gil F et al., (2011) and using blood as a biomarker gives an initial assessment of the bioburden present in the body. Ali, & Hagani., 2005). but it cannot show the amount of lead stored in the body. Like bones. This is due to the difference in the half-life of lead, where the half-life in the blood is about 30 days and in the skeleton is about 30 years. However, blood plays an important role in distributing lead throughout the body Ahmad et al., (2018), making it available to tissues as well as for excretion through the kidneys, Othman et al., (2009)& Dongre, et al., (2011). his reinforces the importance of using blood as a vital indicator to detect body burden in the short term. This is useful in the early clinical diagnosis of diseases. While bones reflect the body's long-term burden, This makes lead acute and chronically toxic. The Occupational Safety and Health Administration (OSHA) has warned that a concentration of 10 µg/dL or higher is cause for concern Pala et al., (2009). However, blood lead levels of 25–60 µg/dl lead to neurological and psychological effects, Vaglenov et al., (2001), difficulty concentrating, in addition to slowing of motor nerve conduction and headaches, and anaemia appears at a level higher than 50 µg/dl. When it reaches 100 µg/dl due to encephalopathy and poor behavioural, cognitive, and motor development in children, Chirila & Draghici., (2011), in addition to nephropathy, poor fertility in adults, autism, congenital malformations, Ahmed et al., (2005), lung and stomach cancer, and kidney damage Brain and kidneys due to chronic exposure Afridi et al., (2011), Ljaz., et al (2016). While acute exposure symptoms appear in the form of headaches, loss of appetite, Ahmed et al., (2020), high blood pressure, kidney weakness, and arthritis, Bawaskar & Bawaskar (2020). Saliu., et al (2015) In a study conducted by Shah, et al.,(2012) , (2008), lead causes higher levels of aminolevulinic acid in the urine of those exposed (16 µg/dl) compared to those who are not exposed (7 µg/dl). An assessment of heavy metals has been conducted in almost all developed and developing countries, but what has been published in Libya regarding the assessment of cancerous and non-cancerous health risks is considered very rare, especially with regard to workshop workers. It is expected that heavy metals, especially lead, are a cause of the increase in cancer, especially in recent decades. Therefore, this study aims to estimate the concentration of lead in blood samples and evaluate the effects of occupational skin pollution on smoking and non-smoking workers.

II. Materials and methods

A. **Sampling location and description of the industry**: The city of Sebha is considered the third-largest Libyan city in area. Its area is about 365,150 hectares, and it has a large population mass estimated at 116,016 people. It is located within the desert area, in the northern part of the Murzuq Basin, and is about 420 metres above sea level , The capital, Tripoli, is about 800 meters away. There are many service, craft, and industrial workshops in Sebha, such as blacksmithing, carpentry, polishing, aluminium, glass, iron, and copper manufacturing workshops, and car and battery repair workshops. All of these workshops use smelters, files, welding, and metals. They also contain lead. In addition to the use of plasticizers, antioxidants, stabilisers, primers, colouring materials, and polishing, Therefore, exposure to heavy metals is common, especially lead. Three residential areas with a large number of workshops were chosen to collect blood samples from workers: Mahdia, Abdel Kafi, and Hajara.

B. **Sample collection:** Blood samples were collected from car repair shop workers, and some private data was recorded for each volunteer, such as age, number of years of work, weight, and medical history. At a rate of 48, there were 3 replicates per sample (n = 144), and the average age was 18–53, as shown in Table 1. The person's arm was cleaned well with distilled water and then with alcoholic ethanol, and left to evaporate. 4 ml of blood was drawn, by a laboratory technician specialized in drawing and handling the blood sample, and placed in dry, sterile tubes for storing blood samples (Vacutainer). Ahmed, et al., (2020) All non-heat glassware used in this study was autoclave sterilised at 120°C for 2 hours, Al Oudat et al., (2007)

C. **Preparation of standard solutions:** Standard solutions were prepared at concentrations of 0.1, 0.3, 0.5, and 0.7 µg/ml. The lead concentration was measured at a wavelength of 228 nm, using acetylene air, so that we could compare with the tested samples. Using the method of atomization under high temperatures inside the Atomic Absorption Spectrophotometer, type nov AA400, located in the Central Scientific Laboratory for Scientific Research and Consultation at Sebha University. The liquid was burned and converted into finite atoms with different wavelengths, and using an absorption lamp for the element lead, the concentrations were determined with absorption coefficients and standard wavelengths.

D. **Separation of plasma from blood:** The plasma was separated from the blood using a centrifuge at a speed of 42,000 rpm, and the plasma was placed in special tubes Ogbodo, et al.,(2019). Chemical digestion: The wet digestion method was used, taking (1.0) ml of blood serum at a temperature of 25°C and placing the plasma in a volumetric flask (25 ml). (10 ml) of concentrated nitric acid (70%) was added. It was placed on the hot plate and heated slowly at a temperature of 70 °C until boiling until it reached the smallest possible volume. It took an hour. It was added. 2 ml of nitric acid and continued heating at a temperature of 80 °C until a semi-dry solution was obtained. Then, complete the volume to (25 ml) with distilled water, then dry again as before, and complete the volume to (25 ml) with distilled water, then The samples were filtered, and the filtrate was stored in tightly covered glass containers. Ahmad et al., 2005 & Adela, et al., 2012).

III.Statistical analysis:

Using SPSS using the arithmetic mean, standard deviation, T-test, and Levene's test to find differences between the two groups of smoking and non-smoking workers

IV.Results and discussion:

The blood lead concentration of smokers and non-smokers working in automobile repair shops was assessed in µg .lead/dl. blood. Using an atomic absorption device, the sample size was (11) smoking workers and (37) non-smoking workers.

Table 1: Average lead conc in the blood of auto repair shop workers in µg/dl for smoking workers, and data for each worker (age, weight, duration of work).

No sample	Age person	Duration of working years	person weight/kg	Lead concn/µg/dl. (n=3)
F1	25y	7	59	19.06
F2	40y	20	67	23.7
F3	50y	30	62	26.4
F4	23y	1	67	9.9
F5	30y	12	7477	20.2
F6	52y	30	61	24.6
F7	43y	15	64	22.2
F8	23y	1	61	13.1
F9	30y	5	64	17.2
J1	22y	8	61	34.1
J2	31y	12	65	19.2

Table 2: Average conc of lead in the blood of workers in auto repair shops in µg/dl for non-smoking workers, and data for each worker (age, weight, duration of work)

No sample	Age person	Duration of working years	person weight/kg	Lead conc/µg/dl. (n=3
A1	35y	17	75	20.2
A2	50y	15	75	18.3
A3	22y	2	59	11.5
A4	44y	27	77	22.0

A5	24y	7	62	14.6
A6	20y	15	57	15.1
A7	18y	3	55	10.5
A8	53y	5	80	15.1
A9	40y	3	70	12.1
B1	45y	7	73	18.4
B2	51y	30	79	24.3
B3	22y	2	60	10.5
B4	35y	5	67	11.4
B5	40y	8	69	13.1
B6	32y	4	66	11.3
B7	28y	6	66	12.2
B8	39y	1	70	9.06
B9	20y	4	63	11.6
C1	19y	2	59	9.6
C2	20y	1	60.5	8.7
C3	18y	2	58	9.6
C4	30y	5	63	11.9
C5	45y	8	68	14.2
C6	20y	2	61	10.1
C7	33y	6	66	13.4
C8	40y	9	81	15.3
C9	18y	1	66	8.06
D1	21y	3	68	9.2
D2	19y	2	58	9.4
D3	46y	11	82	13.2
D4	22y	4	60	12.1
D5	18y	1	58	8.0
D6	25y	3	67	11.1
D7	30y	6	70	12.3
D8	42y	8	70	18.1
D9	21y	3	59	10.4
E1	19y	1	58.5	9.6

The results showed shown in Table (1) and Table (2) that the concentration of lead in the blood of smokers and non-smokers is higher than the permissible limit. The average lead concentration for smokers in a sample size of (11) workers was (20.879 µg/dl), while a sample of non-smokers of (37) workers recorded an average of (12.887 µg/dl). The results also showed that the concentration of lead in the blood of workshop workers is directly related to smoking and years of work. This is consistent with the study of Caciari., et al 2013; Khan., et al 2010; Fathi., et al 2022. The results of the statistical analysis to estimate lead concentration according to the study variables weight, age, years of work) showed the following.

Table 3. Lead conc according to study variables (weight, age, years of work), mean ± SD. (µg/dL) in the blood of smoking and non-smoking workers in car repair shops in the city of sebha.

Workshop workers who smoke(N=11)					Non-smoking workshop workers			
Variable		**N**	**Mean**	**Sd**	**Variable**	**N**	**Mean**	**Sd**
e weight	Less than 60	1	19.0700	0.00	Less than 60	5	11.2940	2.26928
	60-75	10	21.0600	6.86608	60-75	17	11.7600	2.58270
					More than 75	6	19.3433	3.56719
years of work	Less than 10 years	5	18.7140	9.33884	Less than 10 years	23	11.8400	2.57060
	10-20	3	20.5433	1.51447	10-20	3	17.9100	2.62532
	More than 20	3	24.8233	1.41369	More than 20	2	23.2000	1.59806
Age	Less than 25	4	19.0850	10.74093	Less than 25	10	10.6970	2.41003
	25-45	5	20.5260	2.54830	25-45	13	13.4169	3.76750
	More than 45	2	25.3500	1.52735	More than 45	5	18.2120	3.85165

Table 4. One-way analysis of variance (ANOVA) showing the variation of lead in the blood of smoking and non-smoking workers according to study variables (weight, age, years of work

Workshop workers who smoke(N=11)							Non-smoking workshop workers					
Variables	**Source of variance**	**Sum of squares**	**Ddl**	**Mean squares**	**" F**	**Sig**	**Sum of squares**	**Ddl**	**Mean squares**	**" F**	**Sig**	**Significance level**
	Inter-groups	3.600	1	3.600			279.569	2	139.784			
Weight(kg)	Intragroups	424.287	9	47.143	0.076	0.789	190.948	25	7.638	18.301		
	Total	427.887	10				470.517	27				
	Inter-groups	70.447	2	35.224			308.803	2	154.402		0.000	
Years of work	Intragroups	357,440 357.440	8	44.680	0.788	0.487	161.714	25	6.469	23.870		0.05
	Total	427.887	10				470.517	27				
	Inter-groupes	53.476	2	26.738			188.572	2	94.286	8.360		
Age	Intragroupes	374.411	8	46.801	0.571	586	281.944	25	11.278		0.002	
	Total	427.887	10				470.517	27				

Group of smoking workers: We note from table (3)(4) that the lead concentration for the category of smokers whose body weight is less than 60 kg is(19.070±0.00), while for workers whose body weight is between (60-75) kg, the average is(6.8660±21.0600),which confirms the presence of statistically significant differences in lead concentration according to body weight. While the lead concentration according to years of work less than 10 years recorded an average of 18.7140±9.3388), while those whose years of work ranged from (10-20) years had an average of (20.543±1.5144), while workers whose years of work reached more than 20 years had an average of (24.8233). ±1.41369), This confirms that there are no statistically significant differences in lead concentration according to years of work. As for the lead concentration in relation to the age of workers who are less than 25 years old (19.0850±10.7409).While the average concentration for workers whose ages are between (25-45) is (20.5260±2.54830), while for workers whose ages are older than (45) the average is (25.300±1.5273), which confirms that there are no statistically significant differences in lead concentration according to age. Group of non-smoking workers. We note that the lead concentration for the category of non-smoking workers whose body weight is less than (60 kg) reached (11.2940±22.6928). While those whose body weight is between (60-75 kg) average (11.7600±2.58270), while those whose body weight is greater than (75) (19.3433± 3.56719),which confirms the presence of statistically significant differences in lead concentration according to body weight. While the concentration of lead in the blood of workers whose working years are less than 10 years(11.8400± 2.5706),while those whose working years range from (10 – 20), verage(17.9100±2.62532),while workers with more than 20 years of work average (23.2000±1.59806), which confirms the existence of differences in lead concentration according to years of work. The average concentration of lead in the blood of workers who are less than 25 years old was recorded (10.6970±2.41003), while the average of workers whose ages are 25-45 was recorded (13.4169±3.76750). As for the average of workers whose ages are older than 45, (18.2120±3.8516), which confirms the existence of statistically significant differences in lead concentration according to age.

Table 5. One-way analysis of variance (ANOVA) and Levene's test, T-test showing lead item variance. In the blood of car repair workers, both smokers and non-smokers

Smoking status	**N**	**Mean**	**Sd**	**Levene's test**		**Test the difference**		**ddl**	**Significance level**
				Sig.	**F**	**T**	**Sig.**		
Smoker	11	20.8791	6.54131	0.082	3.155	5.024	0.000	12,235	0.05
Non-smoker	37	12.8870	3,94090						

Lead concentration in the blood of smokers and non-smokers

One-way ANOVA with a confidence level of 95%, Levene's correlation test and t-test were used to evaluate the relationship and difference between the concentration of lead in the blood of smoking and non-smoking workers. Our results in Table 6 indicate that there are significant differences at the ($P < 0.05$) level for lead concentration between smokers and non-smokers. The results of the table (5), showed the lead level in smokers with an average of (20.8791±6.54131), and in non-smokers with an average of (12.8870±3.94090), and the (f) value for the Levene test)) calculated at the significance level (α =(0.05) reached (3.155), Also, the (Sig) value corresponding to the (F) test was (0.082), the (T) value was (5.024), and the (Sig) value corresponding to the (t) test was (0.000), which confirms the presence of statistically significant differences in lead concentration. between smokers and non-smokers, We conclude from this study that occupational exposure contributes significantly to increasing the concentration of lead in the blood, and this concentration increases with the presence of other sources of exposure, such as smoking. In addition, there are factors that contribute to increasing the concentration of lead in the blood, such as years of work. This is confirmed by most studies conducted on this subject. When we compared the results we obtained with the results of previous studies, it was found that they were consistent with the study, Al-Ghabban, (2018), Yalemsew., et al(2022) where the results of the study conducted to compare the concentration of lead in the blood of smokers and non-smokers whose ages ranged between (15-75) showed that the concentration I smokers average (20.0 mg/dL), while non-smokers average (12.9 mgs/dL). It is consistent with a study conducted by Adel, et al., (2012), Hawad., et al (2009). In Jimma city, Ethiopia. It was found that the concentration of lead in the blood of 45 workers working in the parking garage was higher than its concentration in the blood of 40 people who did not work in the garage. 53% of them had blood lead levels among all individuals exposed to lead, ranging between 12 - 20 mg/dL, and 47% were more than 20 mgs/dL. This focus increases with the increase in years of work in the garage. Its concentration in the blood of workers with more years of work ranges from 11.73 to 36.52 mg/dL. It is consistent with the study of Bhagwat, et al (2008), Emirco., et al 2008. conducted on battery manufacturing workers in Kolhapur, and the results showed high blood lead levels .in workers (53.63 ± 16.98; range 25.8–78 mg/dL) compared to Control group (12.52 ± 4.08; range 2.8 – 22m g/dL). It is consistent with a study conducted by Othman et al. (2003) to estimate lead in the blood of workers in battery repair shops in the city of Kirkuk, Iraq. It was found that there is a direct relationship between the concentration of lead in the blood and the number of years of exposure, as the average concentration of lead for workers whose number of years of work ranged from 1-4 years was between 54-72 mg/100 ml, while those from 5-8 years recorded a concentration between -96. 124 mcg/100 ml, While for workers whose number of years of work was more than 9 years, the rate reached 149 mg/100 ml It is consistent with a study conducted by Al- Al-Oudat et al. (2007) in the Al-Safira laboratory in Aleppo - Sawa. It was found that the concentration of lead was high among workers working in the laboratory, and also among The population surrounding the laboratory, whether children or adults, lead concentration ranged between 28-55 mg/dL

V. Recommendations

Industrial and service workshop workers must receive training courses and awareness programs about the potential harmful health effects of exposure to lead and how to take safety measures while working inside workshops.

Obliging workshop workers to conduct laboratory tests on a regular basis, and to measure the levels of heavy metals, especially lead, in their bodies to determine the rate of lead concentration in various parts of the body, in order to establish strict systems, instructions and guidelines for occupational health and safety to protect workers. These measures must include monitoring the level of lead in the air in The workplace and blood lead levels are examined, in addition to implementing pre-employment medical examinations and periodic medical examinations for workers.

- Requiring workshop workers to use protective masks to protect the respiratory system, to wear thick gloves to reduce their contact with lead when working, and to wear work clothes to protect the worker’s body from damage.
- Refrain from smoking and consuming all kinds of food and drinks during the period of work in these workshops in order to reduce the chance of swallowing lead compounds.
- Conducting genetic studies to determine the effect of occupational lead exposure on genetic material genes.
- Conducting histological studies to determine the effect of exposure to occupational lead on various systems and organs of the body.

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