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Original article

Lead Concentration in The Blood of Smokers and Non-Smokers Workers in Car Repairing Shops in the City of Sebha, Libya

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ABSTRACT

Aim. *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, Libya.* ***Methods.*** *Blood samples were collected by a laboratory technician, and a questionnaire was prepared to collect specific data for each worker (age, weight, and duration of work). The sample size was (11) smoking workers and (37) non-smoking workers. About 3 replicates were taken for each sample. Lead was estimated using an atomic absorption device. 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.* ***Results****. 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.* ***Conclusion****. 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.*

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INTRODUCTION

Occupational pollution still poses a health threat to humans [1,2], 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 [3,4]. There are two types of lead, which is an inorganic mineral found in paint, dust, and dirt [5]. 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 [6]. 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 [7,8]. Lead is used in more than 900 It also has applications in agriculture [9]. The most important routes of exposure are inhalation, ingestion, and skin contact. Especially for people who are occupationally exposed [10]. 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/m^3 [11]. 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/liter, while in ocean surface water, it ranges between 0.01 and 0.03 µg /liter [12]. 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 [13]. In plants growing on uncontaminated soil, it is at a low concentration and rarely exceeds 1 mg/kg, and as for human blood, exposure to lead, even in low quantities, poses a health risk [14]. the Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) of the Centers 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. 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) [15]. While workers (professionals) (30 µg/dl). While the World Health Organization 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 [16].

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 [17]. 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 [18]. It causes harm to human reproductive organs, and sometimes even levels below 10 µg/dL of lead can be dangerous [19]. and using blood as a biomarker gives an initial assessment of the bioburden present in the body [20]. 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 [21], making it available to tissues as well as for excretion through the kidneys, [22], 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 [23]. However, blood lead levels of 25–60 µg/dl led to neurological and psychological effects [24], 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 [25]. In addition to nephropathy, poor fertility in adults, autism, congenital malformations [26], lung and stomach cancer, and kidney damage Brain and kidneys due to chronic exposure [27]. While acute exposure symptoms appear in the form of headaches, loss of appetite [28], high blood pressure, kidney weakness, and arthritis [29]. In a study conducted previously [30], lead causes higher levels of aminolaevulinic 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.

METHODS

Sampling location and industry description

Blood samples were collected from workers in three residential areas with a large number of workshops in the city of Sebha. These areas are: Mahdia, Abdel Kafi, Hajara. There is a large group of service, craft and industrial workshops in Sebha, including blacksmithing, carpentry, aluminum, glass, iron and copper manufacturing, in addition to car and battery repair. These workshops use smelters, files, welding, and metallurgy, which can result in exposure to heavy metals, especially lead. These workshops use smelters, files, welding, and metallurgy, which can result in exposure to heavy metals, especially lead. In addition, antioxidants, stabilizers, and coloring and polishing agents are commonly used.

Sample collection

Blood samples were collected from workers at a car repair shop. Private data, such as age, number of years worked, weight, and medical history, was recorded for each volunteer. The samples were taken at a rate of 48 with 3 replicates per sample (n = 144). The average age of the volunteers was between 18 and 53. The volunteers' arms were cleaned with distilled water and then with alcoholic ethanol before being left to evaporate. A laboratory technician, specialized in drawing and handling blood samples, drew 4 ml of blood and placed it in dry, sterile Vacutainer tubes for storage. All non-heat glassware used in this study was sterilized by autoclaving at 120°C for 2 hours, as stated by previous studies [31, 32].

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 to compare with the tested samples. The Atomic Absorption Spectrophotometer used was the *nov AA400 type*, located in the Central Scientific Laboratory for Scientific Research and Consultation at Sebha University. The method of atomization under high temperatures was employed. The liquid was burnt and transformed into discrete atoms with varying wavelengths. The concentrations of lead were determined using an absorption lamp, absorption coefficients, and standard wavelengths.

Separation of plasma from blood

The plasma was separated from the blood using a centrifuge at a speed of 42,000 rpm. The resulting plasma was then transferred to special tubes [33]. For chemical digestion, the wet digestion method was employed. Specifically, 1.0 ml of blood serum was taken at a temperature of 25°C and placed in a 25 ml volumetric flask. Next, 10 ml of concentrated nitric acid (70%) was added. The sample was heated gradually on a hot plate at 70°C until it reached boiling point and was reduced to the minimum volume possible. This process took one hour. Then, 2 ml of nitric acid was added, and the solution was further heated at 80°C until a semi-dry solution was obtained. Complete the volume to 25 ml with distilled water, dry as before, and then complete the volume to 25 ml with distilled water. Filter the samples and store the filtrate in tightly covered glass containers [34,35].

Statistical analysis

Using SPSS, we employed the arithmetic mean, standard deviation. T-test, and Levene's test to identify any differences between smoking and non-smoking workers.

RESULTS AND DISCUSSION

The study assessed the blood lead concentration of workers in automobile repair shops, comparing smokers and non-smokers. The concentration was measured in µg. lead/dl. blood using an atomic absorption device. The sample size consisted of 11 smoking workers and 37 non-smoking workers.

Indicating results that the concentration of lead in the blood of both smokers and non-smokers exceeds the permissible limit. The average lead concentration for smokers (n=11) was 20.879 µg/dl, while non-smokers (n=37) recorded an average of 12.887 µg/dl. Additionally, the study found a direct correlation between the concentration of lead in the blood of workshop workers and their smoking habits and years of work. This is in line with the findings of [36] and [37]. The statistical analysis results for estimating lead concentration based on the study variables (weight, age, and years of work).

Table 1. Lead concentration 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.

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

The table (1&2) shows that smokers weighing less than 60 kg have a lead concentration of (19.070±0.00), while those weighing between 60-75 kg have an average of (6.8660±21.0600). This indicates statistically significant differences in lead concentration based on body weight. The average lead concentration for workers with less than 10 years of experience was 18.7140±9.3388. For those with 10-20 years of experience, the average was 20.543±1.5144. Workers with over 20 years of experience had an average

of 24.8233±1.41369. These results suggest that there are no statistically significant differences in lead concentration based on years of work.
Regarding lead concentration, there were no statistically significant differences based on age. The average concentration for workers under 25 years old was 19.0850±10.7409, for workers aged 25-45 it was 20.5260±2.54830, and for workers over 45 it was 25.300±1.5273. A group of workers who do not smoke was studied. The lead concentration was measured in three categories of workers based on their body weight. The first category included workers who weighed less than 60 kg, and their lead concentration was 11.2940±22.6928. The second category included workers who weighed between 60-75 kg, and their lead concentration was 11.7600±2.58270. The third category included workers who weighed more than 75 kg, and their lead concentration was 19.3433±3.56719. These results indicate that there are statistically significant differences in lead concentration based on body weight. The concentration of lead in the blood of workers increases with the number of years worked. Specifically, workers with less than 10 years of experience had an average lead concentration of 11.8400±2.5706, while those with 10-20 years of experience had an average of 17.9100±2.62532, and those with over 20 years of experience had an average of 23.2000±1.59806. These results indicate a correlation between years of work and lead concentration. Specifically, workers under 25 had an average blood lead concentration of 10.6970±2.41003, workers aged 25-45 had an average of 13.4169±3.76750, and workers over 45 had an average of 18.2120±3.8516.

Table 3. 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						

The study evaluated the relationship and difference between the concentration of lead in the blood of smoking and non-smoking workers using one-way ANOVA with a confidence level of 95%, Levene's correlation test, and t-test. The results in table 3 show significant differences ($P < 0.05$), in lead concentration between smokers and non-smokers.
Table 3 presents the lead levels in smokers (20.8791±6.54131) and non-smokers (12.8870±3.94090). The Levene test yielded an (f) value of 3.155 at a significance level of $\alpha = 0.05$. The F test had a corresponding Sig value of 0.082, the T value was 5.024, and the t test had a corresponding Sig value of (0.000). The study [38] confirms statistically significant differences in lead concentration between smokers and non-smokers. It concludes that occupational exposure significantly increases lead concentration in the blood, which further increases with the presence of other sources of exposure, such as smoking. Furthermore, various factors contribute to an increase in blood lead concentration, including duration of employment. This is supported by the majority of studies conducted on this topic. When comparing our results to those of previous studies, we found that they were consistent with [39,40].
The study aimed to compare the concentration of lead in the blood of smokers and non-smokers aged between 15 and 75. The results showed that the average concentration of lead in smokers was 20.0 mg/dL, while non-smokers had an average of 12.9 mg/dL. A study conducted by [41] found that the concentration of lead in the blood of 45 workers in a parking garage was higher than in the blood of 40 non-garage workers in Jimma city, Ethiopia. Among all individuals exposed to lead, 53% had blood lead levels ranging between 12-20 mg/dL, and 47% had levels exceeding 20 mg/dL.The concentration of this focus increases with the number of years worked in the garage. This focus increases with the number of years the garage has been in operation, as previously described [42]. In workers with more years of experience, the concentration in their blood ranges from 11.73 to 36.52 mg/dL. This is consistent with the findings of [43]. In a study conducted by [44] on battery manufacturing workers in Kolhapur and found high levels of lead in their blood. The blood lead levels of workers (53.63 ± 16.98; range 25.8–78 mg/dL) were compared to those of the control group (12.52 ± 4.08; range 2.8 – 22m g/dL). This finding is consistent with a study conducted by [45]. that estimated lead levels in the blood of workers in battery repair shops in the city of Kirkuk, Iraq. It has been discovered that there is a direct correlation between the concentration of lead in the blood and the duration of exposure. The average concentration of lead for workers who had worked for 1-4 years was found to be between 54-72 mg/100 ml, while those who had worked for 5-8 years recorded a concentration of -96. For workers with more than 9 years of experience, the rate reached 149 mg/100 ml, according to a study conducted by [46]. It is important to note that the use of clear, objective language and precise word choice is crucial in scientific writing. The concentration of lead was found to be high among workers in the Al-Safira laboratory in Aleppo-Sawa, as well as in the surrounding population, including children and adults. The lead concentration ranged between 28-55 mg/dL.

CONCLUSION

conclude from this study that workers are exposed to high levels of lead, and these concentrations increase with the increase in the number of years of work, and smoking is considered an important factor in increasing the concentration of lead in the blood of workers. This study recommends: Industrial and service workshop workers should receive training courses and awareness programs about the potential harmful health effects of exposure to lead. workshop workers are required to conduct regular laboratory tests and measure the levels of heavy metals, particularly lead, in their bodies to determine the rate of lead concentration in various parts of the body. workers must wear protective masks to safeguard their respiratory system, thick gloves to minimize contact with lead, and work clothes to protect their body from damage. Smoking, consuming food and drinks are strictly prohibited during work hours to reduce the risk of ingesting lead compounds.

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تركيز الرصاص في دم المدخنين وغير المدخنين العاملين بورش تصليح السيارات بمدينة سبها، ليبيا

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المستخلص

الاهداف: هدفت هذه الدراسة إلى تقدير عنصر الرصاص في مصل الدم للعاملين (المدخنين وغير المدخنين) في محلات تصليح السيارات في مدينة سبها، ليبيا. **طرق الدراسة**: تم جمع عينات الدم من قبل فني المختبر، وتم إعداد استبيان جمع البيانات المحددة لكل عامل (العمر، الوزن، ومدة العمل). بلغ حجم العينة (11) عاملا مدخنا و (37) عاملا غير مدخنين. تم أخذ 3 مكررات لكل عينة. قُدر الرصاص باستخدام جهاز الامتصاص. استخدم تحليل التباين الأحادي (**ANOVA**) بمستوى ثقة 95% (ليفين) واختبار **T** الارتباط والاختلاف بين تركيز الرصاص في دم العمال. المدخنين وغير المدخنين. **النتائج**. توجد فروق معنوية عند مستوى **P<0.05** في تركيز الرصاص بين المدخنين وغير المدخنين. كان متوسط المدخنين (6.54131±20.8791)، وغير المدخنين كان المتوسط (3.94090±12.8870)، وكانت قيمة **(f)** لاختبار ليفين المحسوبة عند مستوى دلالة **(α=0.05)** هي(**.(3.155** ، والقيمة **(Sig)** المقابلة للاختبار. وكانت قيمة**(0.082)** **(F)** ، وقيمة **(T)** **(5.024)**، وقيمة **(sig)** المقابلة لاختبار **(t)** كانت (0.000)، مما يؤكد وجود فروق ذات دلالة إحصائية في تركيز الرصاص بين المدخنين وغير المدخنين. أظهرت نتائج التحليل الإحصائي تقدير تركيز الرصاص تبعاً لمتغيرات الدراسة (الوزن، العمر، سنوات العمل)، كما وجدت فروق ذات دلالة إحصائية في تركيز الرصاص حسب وزن الجسم لدى المدخنين وغير المدخنين، بينما سنوات العمل. أظهرت النتائج عدم وجود فروق معنوية في تركيز الرصاص لدى المدخنين، أما بالنسبة لغير المدخنين فقد وجدت فروق في تركيز الرصاص تبعاً لسنوات العمل. أما بالنسبة للعمر، فلا توجد فروق ذات دلالة إحصائية في تركيز الرصاص لدى العاملين المدخنين. بينما بالنسبة لغير المدخنين توجد فروق ذات دلالة إحصائية. خاتمة. نستنتج من هذه الدراسة أن التعرض المهني يساهم بشكل كبير في زيادة تركيز الرصاص في الدم، ويزداد هذا التركيز مع وجود مصادر التعرض الأخرى مثل التدخين. وتسهم سنوات العمل أيضًا في زيادة العبء البيولوجي. لذلك، بالنسبة للأشخاص المعرضين للرصاص.

الكلمات الدالة. محلات تصليح السيارات، الرصاص، المدخنين، غير المدخنين.