

ARTICLE / INVESTIGACIÓN

Evaluation of Heavy Metal Pollution in the Blood Serum of Industrial Workers, Mosul, Iraq

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DOI. 10.21931/RB/2022.07.02.4

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Abstract: The study was conducted in the two main industrial areas in Mosul, northern Iraq, where the study included measuring the number of heavy metals (cadmium, aluminum, mercury, chromium) in the blood of workers in those areas. For 20 workers, in contrast, blood samples were drawn from Mosul University employees. They were considered as a control group for being far from industrial activity and for 20 employees. An atomic absorption device was used to analyze blood samples after diluting. In addition, workers were divided into groups according to (age, smoking status, and period of occupational exposure). The results revealed statistically significant differences when comparing the samples of workers to the control group, while the results did not show significant differences between groups of workers.

Key words: Pollution, Blood Serum, Industrial Area.

Introduction

Heavy elements are characterized by their toxic behavior when they exceed the permissible limit¹, in addition to the fact that their effect on humans does not appear directly but after a period of time, and this is what gives them a cumulative character in the organs of the human body, causing many carcinogenic and mutagenic diseases and chronic infections such as lead, cadmium^{2,3}.

These elements are released from two natural sources, represented by natural disasters, and the other source is human, represented by multiple human activities, primarily industrial, which results from the release of these elements into the environment, causing an imbalance in the ecological balance^{4,5}. These chemical elements have been linked to several health issues faced by the human. For example, in a person with liver disease, the continued exposure to these elements raises the harm to this organ⁶. The effect of the heavy metals is to interfere with the conformation of the protein in the body and with enzymes functions⁷.

The element mercury is characterized by its high toxicity, especially when inhaled, as it causes scratches and ulcers in the respiratory tract and is mainly produced from industrial processes^{8,9}.

Cadmium is highly toxic and directly affects humans through smoking, as it enters as a central component of cigarettes and products by industrial plant emissions and contaminated food and water^{10,11}. Cd has a half-life period of 15-30 years and accumulates in the liver as the primary target tissue¹².

Studies have shown that Cd damage to cells is caused mainly by reactive oxygen species (ROS) production¹³, resulting in single-strand damage and destruction of nucleic acid¹⁰. This toxic trace metal can cause liver or renal cell apoptosis in a low dose of exposure¹⁴.

Aluminum is one of the most abundant elements on the earth's surface, especially in the soil. Because of its high

importance, researchers pay great attention to it, especially considering that humans are mainly exposed to Al through drinking water, household goods, cosmetics, and drugs^{15,16}.

Then, the (Al) ability to cross the blood-brain barrier features its tropism for the central nervous system^{17,18}. The Al exposure is one of the predisposing factors for changes in nervous tissue, promoting the degeneration of motor neurons, affecting learning, inducing excitotoxicity^{19,20}, modulating cell biochemistry and tissue integrity, and may drive behavioral dysfunctions^{21,22}.

Researchers such as (23) They confirmed in their study about the measurement of heavy metals in human blood for those in the industrial areas, corresponding to the measurement of heavy metals in the blood of Mosul University employees as a control group, where the results showed that there are significant impairment and an apparent accumulation in the blood of industrial workers of heavy elements.

(24) also indicated in their study about measuring the concentrations of heavy metals (Pb, Co, Hg) in blood Serum that a highly significant increase of $P < 0.001$ in the serum of the industrial areas compared with the control group.

Materials and methods

Study Area

The two main industrial areas of the city of Mosul are the manufacture of the Wadi Okab on the right side (the western part) and the Karama on the left side (the eastern part) (Figure 1).

Study Design

The blood samples were taken from (20) industrial agents randomly in addition to taking blood samples from

Citation: Fathi Al-Obaidi R, Nazar Fadhel M, Rabeea Znad S. Evaluation of Heavy Metal Pollution in the Blood Serum of Industrial Workers, Mosul, Iraq. *Revis Bionatura* 2022;7(2) 4. <http://dx.doi.org/10.21931/RB/2022.07.02.4>

Received: 14 November 2021 / **Accepted:** 20 February 2022 / **Published:** 15 May 2022

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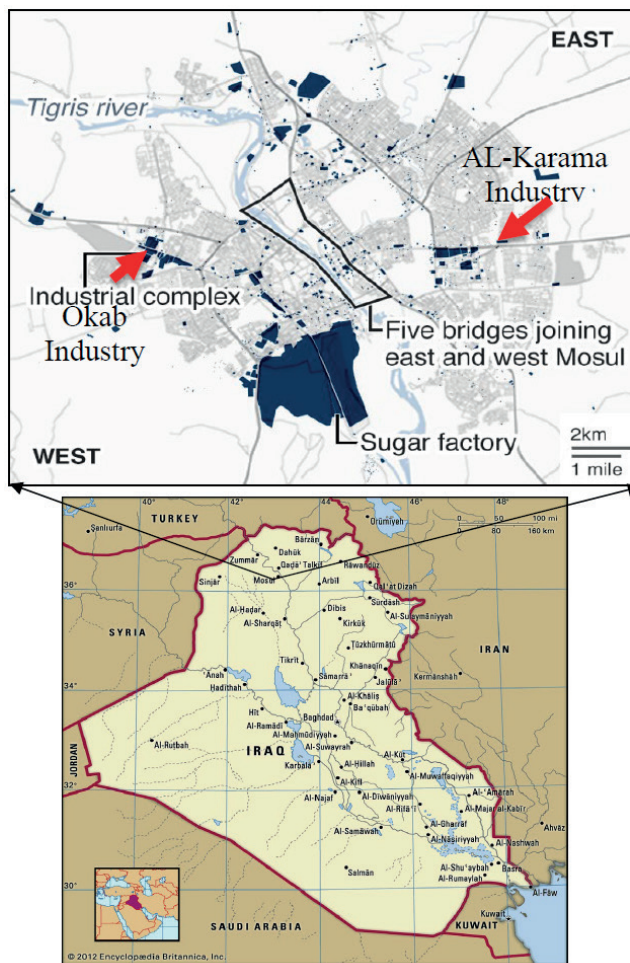


Figure 1. Location of Study Area.

(20) people as a control group working at Mosul University without a history of industrial activity. The control group is not different from the group of workers in terms of gender and age groups.

Blood samples

Samples were collected on 14-10-2019 from 10 a.m. to 4 p.m. samples were taken from 20 workers in (plastic recycling plant, mechanics, car thighs). 20 samples were taken from those working at Mosul University as a control group. 5 ml of the blood of industrial workers was taken and delivered to the laboratory for examinations by means of an automatic absorption device after separating it and isolating the serum from it.

Statistical analysis

The data was processed using the statistical program spss.

Results

The results showed significant differences for heavy metals (Al, Cr, Cd, Hg) elements. There is an apparent increase in the mix of elements measured in the industrial workers' serum from the control group (Table 1).

The group of industrial workers has been classified according to (age groups, smokers and non-smokers, occupational exposure period). Age groups (1-29) years and (30-57) showed the results to lack significant moral differences. (Table 2).

For the smokers and non-smokers category of the industrial workers' group, the results showed no significant differences between the two categories for the measured elements (table 3).

Regarding the occupational exposure period category

Elements	Grouping	N	Mean ± SD (ppm)	p- Value
Al	Workers	20	1.4050 ± 0.66872	p<0.001
	Control	20	0.7095 ± 0.71500	
Cr	Workers	20	0.9890 ± 0.49871	p<0.001
	Control	20	0.5545 ± 0.50351	
Cd	Workers	20	0.5590 ± 0.69120	p<0.001
	Control	20	0.3835 ± 0.20709	
Hg	Workers	20	2.1800 ± 0.90082	p<0.001
	Control	20	2.7400 ± 0.98131	

Significant P<0.05

P> 0.05 No significant

Table 1. Heavy metals concentrations in industrial workers and control group.

Elements	Age grouping	N	Mean ± SD (ppm)	p- Value
Al	(1-15)	10	0.6500 ± 0.46542	p>0.05
	(16-35)	10	1.3000 ± 0.40662	
Cr	(1-15)	10	0.6430 ± 0.32406	p>0.05
	(16-35)	10	1.100 ± 0.29264	
Cd	(1-15)	10	0.7910 ± 0.24854	p>0.05
	(16-35)	10	1.4400 ± 0.39710	
Hg	(1-15)	10	2.3300 ± 0.38646	p>0.05
	(16-35)	10	2.2000 ± 0.52689	

Significant P<0.05

P> 0.05 No significant

Table 2. Determination of heavy metals between two ageing group of workers.

(1-19) and (20-39) years for the industrial group and all measured elements, the results showed that there were no significant differences. (Table 4).

Discussion

Because of the severe and cumulative toxicity of heavy metals, they pose a tremendous and real threat to all living organisms, including humans, as many diseases and epidemics occur to them and accumulate inside human organs for extended periods according to the occupational exposure of people, which results in cancers that infect and damage organs^{25,26}.

Conclusions

Industrial workers face an imminent danger of death due to the high concentrations of heavy metals to which they are exposed, and this requires rapid and urgent intervention from all health and environmental sides to protect them.

Funding

Self-funding.

Conflicts of Interest

There is no conflict.

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Elements	Smoking	N	Mean ± SD (ppm)	p- Value
Al	Smokers	10	0.7800 ± 0.59889	P> 0.05
	Non -Smokers	10	1.6100 ± 0.67667	
Cr	Smokers	10	0.5500 ± 0.42725	P> 0.05
	Non -Smokers	10	1.5600 ± 0.43166	
Cd	Smokers	10	0.1360 ± 0.18202	P> 0.05
	Non -Smokers	10	0.6370 ± 0.43603	
Hg	Smokers	10	1.4500 ± 0.26726	P> 0.05
	Non -Smokers	10	1.9050 ± 0.52113	

Significant P<0.05

P> 0.05 No significant

Table 3. Determination of heavy metals between smokers & non-smokers of workers.

Elements	Period of Working (year)	N	Mean ± SD (ppm)	p- Value
Al	(1-15)	10	0.6800 ± 0.49889	P> 0.05
	(16-35)	10	1.2500 ± 0.42281	
Cr	(1-15)	10	1.0200 ± 0.32725	P> 0.05
	(16-35)	10	1.4500 ± 0.25355	
Cd	(1-15)	10	1.600 ± 0.39602	P> 0.05
	(16-35)	10	1.5000 ± 0.13594	
Hg	(1-15)	10	1.1500 ± 0.36575	P> 0.05
	(16-35)	10	1.3500 ± 0.24334	

Significant P<0.05

P> 0.05 No significant

Table 4. Determination of heavy metals between workers depending on the work period.

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