

PAPER • OPEN ACCESS

Assessment the Heavy elements in Policemen's Serum using FAAS

To cite this article: Mostafa S. Mohammed *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **928** 072143

View the [article online](#) for updates and enhancements.

You may also like

- [Towards Discovery of Differences of Source Code Through Semantic Difference Checking](#)
Qingdi Han and Wu Gao
- [Research on the causes of regional differences in urban residential land incremental value based on shapley value decomposition framework](#)
Zhenhua Wu, Qingping Yu, Yabei Wang et al.
- [A white light speed trap](#)
Lars Lading



ECS
The
Electrochemical
Society
Advancing solid state &
electrochemical science & technology

DISCOVER
how sustainability
intersects with
electrochemistry & solid
state science research

Assessment the Heavy elements in Policemen's Serum using FAAS

Mostafa S. Mohammed, Nada F. Tawfiq, Laith Abdul Aziz Al-Ani

College of Science, Al-Nahrain University

kiaspectraphysics2009@gmail.com

Abstract: Determination of lead, cadmium and nickel concentrations in serum samples (n=50), collected from policemen at difference checkpoint in Karbala governorate, was carried out by flam atomic absorption spectrometer. The results show, that the Pb, Cd and Ni mean value were (1.016 ± 0.052) ppb, (0.043 ± 0.007) ppb and (0.212 ± 0.015) ppb respectively. The result also show that the mean values of heavy elements in serum samples were higher in policemen group when compared to control group, where the statistically significantly difference ($p < 0.05$), except for Ni were statistically non-significantly difference ($p > 0.05$).

Keyword: Heavy element, atomic absorption spectroscopy, blood, serum.

Introduction:

Heavy elements are any metal element that is extremely high in density and is poisonous or toxic even at low concentration. As well as, it can be define as a collective term which is applied to the group of metals with atomic density greater than 4g/cm^3 or 5 times greater than water[1]. Toxic heavy metals are mainly emitted from various human activities. Automotive traffic is one of the major sources of pollution, such as the use of leaded gasoline. Heavy metals are classified as ten out of 20 trace elements are human body toxic, such as lead (Pb), cadmium (Cd), nickel (Ni)[2]. Heavy elements are classified as prevalent toxic metals which tend to be concentrated in environmental systems and humans [3]. Lead has been demonstrated to be accumulated in bone and in some soft tissues, such as liver, kidney and brain, while Cd is known to damage organs such as the kidneys, liver and lungs, but fumes of Nickel



are respiratory irritants which may cause cancer of the larynx, cancer of the nose and pneumonitis and so increased risk of developing lung cancer[4].

Flame atomic absorption spectroscopy, FAAS, is a well-known quantitative elemental analysis method for a wide range of samples, where it is simple, inexpensive, rapid, and applicable to wide range of samples[5]. The FAAS concepts are that the sample must be transformed to an atomic vapor by a method known as atomization. In this step, the sample is volatilized and decomposed in the gas phase to produce atoms and maybe some ions[6]. Hollow cathode lamp is use as a the line source radiation, it is directional to the flame whose contains the gaseous analyze atoms. Such ground state atoms absorb some of the radiation from the source. The magnitude of this absorption is proportional to the amount of ground-state atoms in the flames and it is represent the sample concentration[7].

Experimental

Fifty samples of policemen were collated from three major checkpoint within Karbala governorate and twenty five samples as a control group were collated form population that living about checkpoints area.

The questionnaire included data on demographic characteristics obtained by means of an interview taking into account exposure to heavy metal sources as a participant age, working period and smoking habited.

Centrifuged was used to separated blood serum from whole blood. FAAS was used for analysis of blood serum samples. The analysis of heavy element was done in market research and consumer protection center labs, Baghdad University, Iraq.

Result and Discussion

The minimum, maximum concentration and mean values of heavy elements in serum samples of both the policemen and control group are summarized in table (1).

Table (1): Descriptive statistics of heavy elements concentrations (ppb) in serum samples of policemen and control group.

Heavy elements	Statistical values	Policemen	Control group
Pb	Minimum	0.508	0.083
	Maximum	1.833	1.033
	Mean± Std. Error	1.016±0.052	0.439±0.045
	P- Value<0.05(0.001)		
Cd	Minimum	0.001	0.003
	Maximum	0.373	0.064
	Mean± Std. Error	0.043±0.007	0.037±0.003
	P- Value>0.05(0.524)		
Ni	Minimum	0.036	0.013
	Maximum	0.474	0.255
	Mean± Std. Error	0.212±0.015	0.142±0.012
	P- Value<0.05(0.004)		

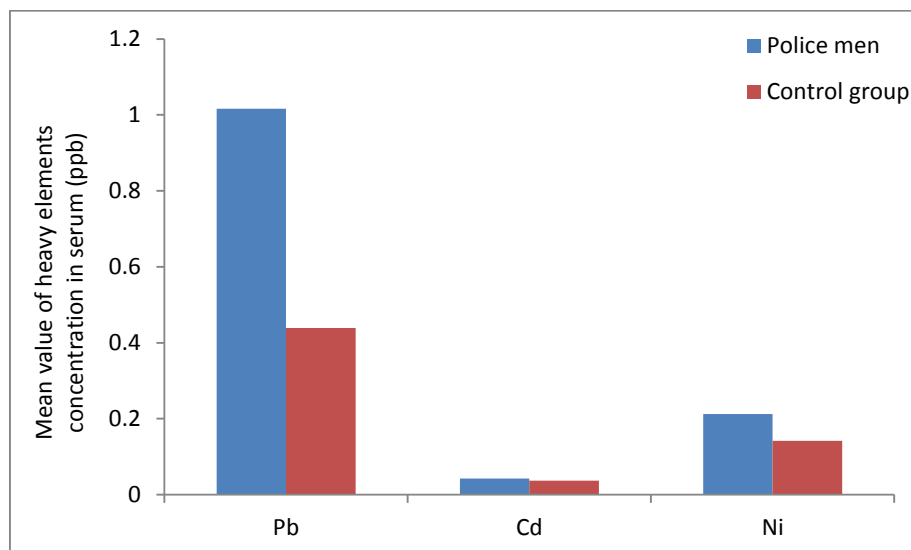


Fig. (1): The relation between heavy elements concentration (ppb) in serum samples of policemen and heavy elements concentration (ppb) in serum sample of control group.

The mean value of heavy elements concentrations were compared with those obtained with the control group. The mean value of Pb and Ni concentrations in serum samples of the policemen is significantly higher than that control group. Independent Sample T-Test confirmed a significant difference concentrations in serum samples among policemen and control groups, ($P < 0.05$). Also, mean value of Cd concentrations in serum samples of the policemen is higher than control group, with independent Sample T-Test confirmed a non-significant difference, ($P > 0.05$). Suggesting that the checkpoints contribute significantly to the heavy elements emissions. Emissions from the cars and waste of machine parts could also increase heavy elements exposure[8]. Previous studies indicated that the main source of environmental lead was from the exhaust of vehicles and main source of environmental, cadmium and nickel was from the brake wear and tire particulates [9].

Figure (1) shows that the concentration of Pb in serum samples is higher than that of Cd and Ni. The concentrations of heavy elements in serum samples of the present study can be arranged in the following sequence (from more available to less available): $Pb > Ni > Cd$. This can be attributed to the fact that the widespread use of Pb in the human activities led to the increase in the proportion of the human exposure to the element. This finding is in agreement with those of other researchers in other countries[10].

Heavy Elements Concentrations in Serum Samples of Policemen as a function Age (30-50)

Table (2) shows the mean value of heavy elements in serum among various age groups of policemen. The age group for policemen was separated into four sub-group as a 1(30-35), 2(36-40) and 3(41-45), and 4(46-50).

Table (2): mean value of heavy elements concentrations (ppb) in serum samples of policemen as a function of age years.

Age (years)	Mean value $\pm$ Std. Error		
	Pb	Cd	Ni
(30-35)	0.759 $\pm$ 0.080	0.034 $\pm$ 0.006	0.270 $\pm$ 0.031
(36-40)	0.773 $\pm$ 0.046	0.038 $\pm$ 0.005	0.180 $\pm$ 0.024
(41-45)	1.079 $\pm$ 0.059	0.073 $\pm$ 0.033	0.219 $\pm$ 0.042
(46-50)	1.434 $\pm$ 0.068	0.037 $\pm$ 0.004	0.184 $\pm$ 0.025

The mean values of lead concentration were observed to be direct proportional to the age groups, where they are increasing with increase the age years, as show in figure (2), which indicates that accumulation of lead level depends on age[11]. The results show significant increase of lead concentration with age (p-value<0.05).

The mean values of Cd was higher at the (41-45) sub-group, while the sub-group (30-35) showed the highest Ni mean value.

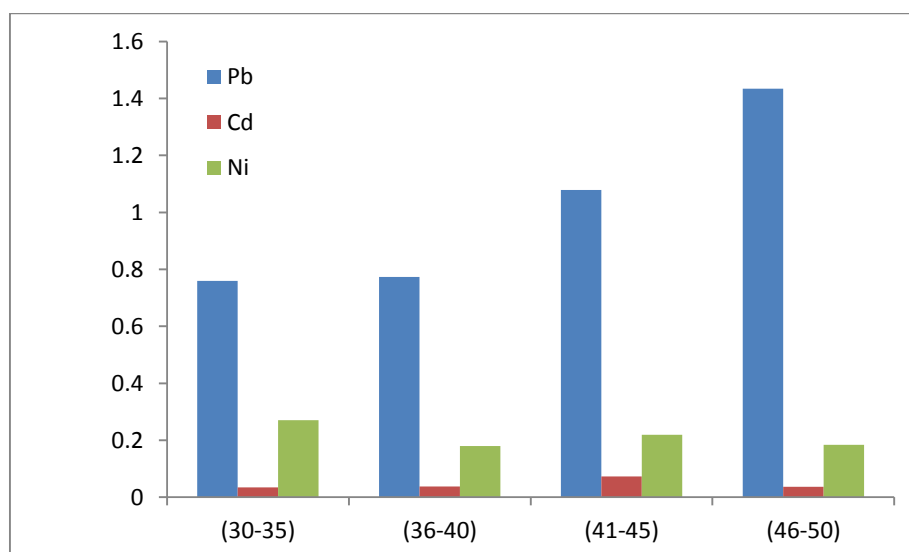


Fig. (2): The relation between mean value of heavy elements concentrations (ppb) in policemen sampes as a function of age.

Heavy elements Concentrations in Serum of Policemen as a function Worker Period (1-30) Years.

To explain these results, policemen were divided into sub-groups according to the working period : (1) 5 – 10 years, (2) 11 – 15 years, (3) 16 – 20 years, (4) 21 – 25 years and (5) 26-30 years.

In order to analyze these results, the mean value of serum concentrations for policemen according to working years was calculated for each sub-group. The results are presented in table (3) and plotted graphically in figure (3).

Table (3): Mean value of heavy element concentrations of policemen samples as a function of working period.

Working period	Mean value $\pm$ Std. Error		
	Pb	Cd	Ni
(1-10)	0.607 $\pm$ 0.033	0.034 $\pm$ 0.004	0.192 $\pm$ 0.033
(11-15)	0.764 $\pm$ 0.038	0.028 $\pm$ 0.006	0.219 $\pm$ 0.028
(16-20)	1.008 $\pm$ 0.031	0.048 $\pm$ 0.005	0.196 $\pm$ 0.030
(21-25)	1.267 $\pm$ 0.026	0.077 $\pm$ 0.037	0.232 $\pm$ 0.041
(26-30)	1.633 $\pm$ 0.049	0.035 $\pm$ 0.007	0.227 $\pm$ 0.051

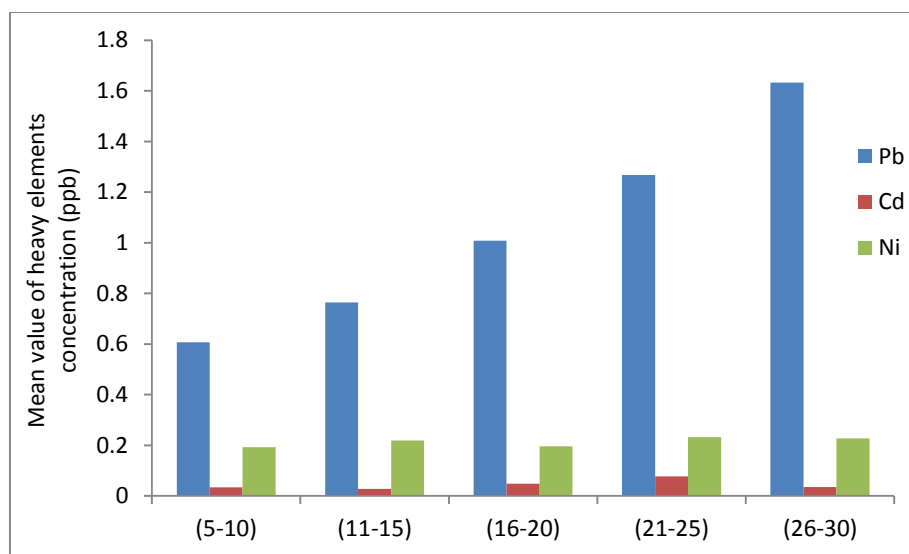


Fig. (3): The relation between mean value of heavy elements concentration (ppb) in policemen samples as a function of working period.

Figure (3) show that the lead mean value in the serum of policemen increase with the increasing of the number of working years. This implied that exposure to leaded benzene and gasoline elevated serum lead level among policemen[12]. In opposite to the increase of lead concentrations in the serum with the working years, we notice that the concentrations of cadmium and nickel variable with the increase working years. The

reasons for these variations in cadmium and nickel concentrations might be due to different contributions by inhalation of dusts as well as other anthropogenic sources such as the metal emissions from different sources such as emissions from cars and particulates (dusts) might increase metal emissions in some areas[13].

Heavy elements Concentrations in Serum of Policemen as a function smoking habited.

Heavy elements concentrations for policemen were compared with smoking habit, policemen group were divided into sub-groups according to the smoking habited: (1) smoking and (2) nonsmoking. In order to analyze these results, the mean value of serum concentrations for smokers and nonsmokers policemen was calculated for each sub-group. The results of mean heavy elements concentration for each subgroup are presented in table (4) and plotted graphically in figure (4).

Table (4): mean value of heavy elements concentrations (ppb) in serum samples of policemen as a function of smoking habited.

Element	Statistical values	Mean value± Std. Error	
		Smoking	Nonsmoking
Pb	Mean± Std. Error	1.029±0.068	0.996±0.082
	P- Value	0.762	
Cd	Mean± Std. Error	0.047±0.011	0.038±0.004
	P- Value	0.522	
Ni	Mean± Std. Error	0.192±0.018	0.242±0.027
	P- Value	0.117	

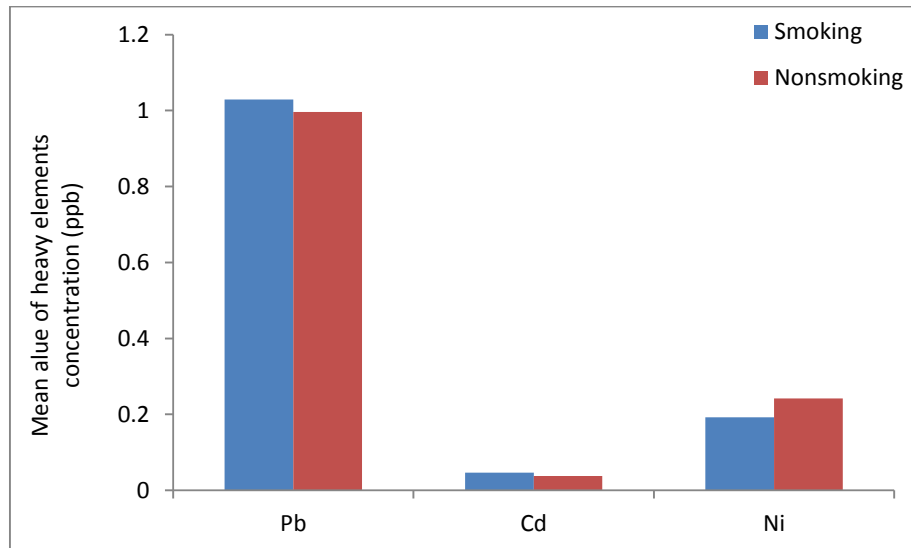


Fig. (4): The relation between mean value (ppb) of heavy elements concentration in serum samples of policemen as a function smoking habited.

Figure (4) shows a relationship was observed between the smoking habit and the accumulation of lead in human body, where it is agreement with previous study[14]. The cadmium concentration in serum sample of smoking policemen was higher than non-smoking policemen. Cadmium inhaled through cigarette smoke is more easily taken up by the body than cadmium in food or water[15]. The concentration of nickel in the smoking policemen was smaller to the non-smoking policemen. However, the mean values of heavy elements concentrations in the serum samples of smoking and non-smoking was statistically non-significantly difference ($p > 0.05$), as show in figure(4.10). The high concentrations of Ni may be attributed to high traffic density which increases the emissions[16]. The highest concentration of Ni content in street dust was found in the streets with heavy traffic density[17]. Ni pollution on a local scale is caused by emissions from vehicle engines[18].

Conclusion

1. The mean values of both Pb and Ni concentrations in the serum samples of policemen was higher than control group and mean value of Cd concentrations in serum samples of the policemen is smaller than control group. As to demographic variables, all lead mean value in serum were positively correlated with age and number of working years, but cadmium and nickel concentrations were fluctuated within given range. For personal behavior, smokers were with non-significantly higher levels of Pb and Cd, and Ni level in control group was non-significantly higher than policemen.

In general, most checkpoints are contaminants at levels that are low enough to be considered a public health concern. However, some policemen has high levels of heavy elements content in policemen serum compared with the value of the control group.

2. The heavy elements concentration in the serum samples increased with increasing number of worker years.
3. The heavy elements concentration in the serum samples increased with increasing age years.
4. The heavy elements concentration in the serum samples increased with increasing smoking.

References

1. Ali, H., E. Khan, and I. Ilahi, Environmental chemistry and ecotoxicology of hazardous heavy metals: environmental persistence, toxicity, and bioaccumulation. *Journal of chemistry*, 2019. 2019.
2. Evrenoglou, L., A. Partsinevelou, and P. Nicolopoulou-Stamati, Correlation between concentrations of heavy metals in children's scalp hair and the environment. A case study from Kifissos River in Attica, Greece. *Global NEST J.*, 2017. 19(4): p. 592-600.
3. Banday, U.Z., S.B. Swaleh, and N. Usmani, Heavy metal toxicity has an immunomodulatory effect on metallothionein and glutathione peroxidase gene

- expression in *Cyprinus carpio* inhabiting a wetland lake and a culture pond. *Chemosphere*, 2020: p. 126311.
4. Paul B. Tchounwou, Clement G. Yedjou, Anita K. Patlolla, and Dwayne J. Sutton, Heavy metal toxicity and the environment, in *Molecular, clinical and environmental toxicology*. 2012, Springer. p. 133-164.
 5. Amália G G Dionísio, Amanda Maria Dantas de Jesus, Renata S. Amais and George L. Donati, Old and new flavors of flame (furnace) atomic absorption spectrometry. *International Journal of Spectroscopy*, 2011.
 6. Tyson, J., J.M. Appleton, and A. Idris, Flow injection calibration methods for atomic absorption spectrometry. *Analytica Chimica Acta*, 1983. 145: p. 159-168.
 7. Bobbins, W.B. and J.A. Caruso, Development of hydride generation methods for atomic spectroscopic analysis. *Analytical Chemistry*, 1979. 51(8): p. 889A-899A.
 8. Loyal, M., Phasing out Lead from Gasoline: World-Wide Experience and Policy Implementations. Environment Department, The World Bank, Washington, 1996.
 9. Awofolu, O., Impact of automobile exhaust on levels of lead in a commercial food from bus terminals. *Journal of Applied Sciences and Environmental Management*, 2004. 8(1): p. 23-27.
 10. Mozghan Moghtaderi, Tahereh Moghtaderi, Saeed Hosseini Teshnizi and Seyed Hesamedin Nabavizadeh, Heavy metal concentration in classroom dust samples and its relationship with childhood asthma: a study from Islamic Republic of Iran. *EMHJ*. 26(5-2020).
 11. Criteria, U.S.E.P.A.E. and A. Office, Air quality criteria for lead. Vol. 4. 1986: US Environmental Protection Agency, Office of Research and Development
 12. Bahrami, A.R., et al., Comparison of benzene exposure in drivers and petrol stations workers by urinary trans, trans-muconic acid in west of Iran. *Industrial health*, 2007. 45(3): p. 396-401.
 13. Wuana, R.A. and F.E. Okieimen, Heavy metals in contaminated soils: a review of sources, chemistry, risks and best available strategies for remediation. *Isrn Ecology*, 2011.
 14. Chelchowska, M., et al., Tobacco smoke exposure during pregnancy increases maternal blood lead levels affecting neonate birth weight. *Biological trace element research*, 2013. 155(2): p. 169-175.
 15. Singh, V.P., Metal toxicity and tolerance in plants and animals. 2005: Sarup & sons.
 16. Soriano, M.C.H., Environmental risk assessment of soil contamination. 2014: BoD–Books on Demand.
 17. Zereini, F. and C.L. Wiseman, Urban airborne particulate matter. *Environ. Sci. Eng.* doi. org/10.1007/978-3-642-12278-1_27, 2010.
 18. Reşitoğlu, İ.A., K. Altinişik, and A. Keskin, The pollutant emissions from diesel-engine vehicles and exhaust aftertreatment systems. *Clean Technologies and Environmental Policy*, 2015. 17(1): p. 15-27.