Iraqi Journal of Science, 2026, Vol. xx, No. x, pp: xx
DOI: 10.24996/ijs.2026.67.6.22

ISSN: 0067-2904

Evaluation of the Heavy Metals Concentration Upon Occupational Workers at Several Petrol Filling Stations in Baghdad City, Iraq

Faiza Kadhim Emran
Department of Biology, College of Science, University of Baghdad

Received: 15/3/2025 Accepted: 22/6/2025 Published: xx

Abstract

Several heavy metals emitted from car petrol may accumulate in occupational workers at elevated concentrations, resulting in various impacts on these workers. The current work was designed to assess the blood content of Zn, Cu, and Pb in occupationally exposed workers. Four car filling stations situated within Baghdad city, Iraq, and 40 occupational workers were subjected to this study; in addition, a sample of 20 individuals away from these examined fuel stations was selected to act as a control sample during November 2023. From both occupational workers and control samples, 4 ml of blood from each individual was taken and placed in a gel tube for coagulation. Each blood sample was centrifuged for 40 min at 3000 rpm to separate blood serum. The serum of each sample was placed into glass tubes and kept in a refrigerator at 20º C and then used to assess blood Zn, Cu, and Pb content. Also, the ages of both control and workers samples and the working period of only occupational workers were recorded. The obtained data has shown that the mean of examined blood heavy metals content was significantly lower in the control sample than those detected in occupational workers where control sample had a mean value of Zn of 65.15 ± 11.0, Cu of 101.3 ± 14.57 and Pb of 14.625 ± 2.52 µg/dl while worker sample gave mean value of 98.03 ± 23.07, 123.26 ± 40.96 and 57.68 ±14.33 µg/dl for Zn, Cu, and Pb respectively. Also, this work has found that there were insignificant ($P < 0.05$) effects of age on blood heavy metals whilst a significant effect of working period ($P < 0.001$) on blood heavy metal content of examined workers was recorded. Also, t-test analysis has revealed significant differences ($P < 0.05$) between the mean values of control and occupational workers for all examined blood heavy metals content.

Keywords: fuel stations workers, control blood sample, occupational health, heavy metals.

تقييم تركيز المعادن الثقيلة لدى العاملين في عدد من محطات تعبئة الوقود في مدينة بغداد، العراق

فائزة كاظم عمران
قسم علوم الحياة ، كلية العلوم، جامعة بغداد، بغداد، العراق

الخلاصة

قد تتراكم العديد من المعادن الثقيلة المنبعثة من بنزين السيارات في العمال المهنيين بتركيزات مرتفعة مما قد يؤدي إلى تأثيرات مختلفة على هؤلاء العمال. تم تصميم العمل الحالي لتقييم محتوى دم العمال المعرضين مهنيًا من الزنك والنحاس والرصاص. خضعت أربع محطات تعبئة سيارات تقع داخل مدينة بغداد – العراق لهذه

*Email: faiza.kadhim@sc.uobaghdad.edu.iq

الدراسة بالإضافة إلى 40 عاملًا مهنيًا تم اختيارهم بعيدًا عن محطات الوقود هذه ليكونوا عينة ضابطة خلال شهر نوفمبر 2023. تم أخذ 4 مل من دم كل فرد من العمال المهنيين وعينات الضبط ووضعها في أنبوب هلامي للتخثر. تم طرد كل عينة دم لمدة 40 دقيقة عند 3000 دورة في الدقيقة لفصل مصل الدم. تم وضع مصل كل عينة في أنابيب زجاجية وحفظها في الثلاجة عند درجة حرارة −20 درجة مئوية ثم استخدم لتقييم محتوى الدم من الزنك والنحاس والرصاص. كما تم تسجيل أعمار كل من عينات الضبط والعمال بالإضافة إلى فترة عمل العامل المهني فقط. ظهرت البيانات التي تم الحصول عليها أن متوسط محتوى المعادن الثقيلة في الدم المفحوص كان أقل بشكل ملحوظ في عينة التحكم من تلك المكتشفة لدى العمال المهنيين حيث كان متوسط قيمة الزنك في عينة التحكم 65.15 ± 11.0 والنحاس 101.3 ± 14.57 والرصاص 14.625 ± 2.52 ميكروغرام / ديسيلتر بينما أعطت عينة العامل متوسط قيمة 98.03 ± 23.07 و 123.26 ± 40.96 و 57.68 ± 14.33 ميكروغرام / ديسيلتر للزنك والنحاس والرصاص على التوالي. كما وجد هذا العمل أن هناك تأثيرًا غير مهم (**$P < 0.05$**) للعمر على المعادن الثقيلة في الدم بينما تم تسجيل تأثير مهم (**$P > 0.001$**) لفترة العمل على محتوى المعادن الثقيلة في دم العمال المفحوصين. كما أظهر تحليل اختبار **t** وجود فروق معنوية (**$P > 0.05$**) بين متوسط قيم عينة الدراسة والعاملين في المهنة لجميع مستويات المعادن الثقيلة في الدم المفحوصة.

Introduction

Gasoline and diesel fuels used by different vehicles have received much care worldwide as a source of releasing various heavy metals such as Pb, Cu, Zn, Cd, Cr, Fe, and Ni [1,2,3]. Other intense studies have examined the possible health and environmental impacts of these heavy metals [4,5]. Obviously, Different studies have examined various vehicle petrol filling stations [6,7], whilst further works have focused on the health and environmental effects of such fuel stations [8] in addition to risk awareness [9]. Meanwhile, significant works have thoroughly investigated the probable impacts on exposed petrol station workers caused by volatile organic compounds and several heavy metals [10]. Certain studies have documented various health problems among exposed workers, such as anemia [11], hepatic [12], kidney [13], pulmonary [14], enzyme activity [15], central and peripheral nervous systems in addition to psychological disorders such as depression among exposed workers [16]. Also, much attention has been paid to workers' blood-heavy metal content working in petrol filling stations [17]. The current study was designed to assess blood Zn, Cu, and Pb contents in both control and occupational workers of several fuel-filling stations situated within Baghdad city.

Material and Methods

In November 2023, 40 workers (all men) of various vehicle petrol filling stations were selected within Baghdad city and subjected to this study in addition to 20 individuals away from these stations to act as control. The ages of both samples and the working period of occupational workers were recorded. A 5 ml blood was taken by disposable syringe from each individual of both examined samples, and 4 ml from each blood sample was placed into a gel tube and left to coagulate and centrifuged for ten minutes at 3000 to separate the serum. To assess the blood content of zinc, copper, and lead, the serum was split into two subsamples placed in glass tubes and kept at -20° C for the test.

Concentrated nitric acid HNO_3 supplied by Fluka, Triton x-100 $C_{34}H_{62}O_{11}$ supplied by Mumbai at 10% concentration, ammonium hydrogen phosphate solution $NH_4H_2PO_4$ supplied by Fluka at 20% concentration (solution 1), and heavy metal salts of zinc $Zn(NO_3)$ 22 g, and copper $Cu(NO_3)$ 7.7 g and lead $Pb(NO_3)_2$ 16 g supplied by Merck were used to prepare the stock solutions at a concentration of 10000 ppm (solution 2) for each based on the calculation of the molecular weights of the salts, and the pH was adjusted to 7. 100 ml from two solutions

(1 and 2) were prepared for each studied sample, and then the digestive solution was made by taking 1 ml of concentrated nitric acid and mixed with 300 ml of non-ionic distill water thoroughly in a 500 ml volumetric flask. Each flask received 25 ml from pre-prepared solution 1 and 5 ml from the second prepared solution and stored in the refrigerator at 4 C°. Meanwhile, 900 µl from the digestive solution was added to 100 µl of each blood sample for both examined control and occupational samples and mixed for 5 minutes. The standard solution for each examined heavy metal was prepared at a concentration of 1000 ml/l to calibrate the FAAS device model AA-6300, supplied by Shimadzu Company/ Japan. A digital pH meter (model Hanna-24) equipped with a glass electrode was also used to adjust and calibrate the pH of the used solutions. Blood heavy metal content was recorded in 20 µl of each sample following the previous study [18] using proper cathode lamps of each heavy metal, which were 324.7, 307.59, and 283.30 nm wavelength of Zn, Cu, and Pb, respectively. All obtained readings were used to calculate mean and standard deviation in addition to biometrical analysis such as t-test and correlation analysis.

Results and Discussion

Means ± standard deviation of age and blood heavy metals content in both samples of the control and occupational workers are presented in Table 1. The age mean value of the control sample was 39.7 ± 6.8 years, while the similar mean age value of occupation workers was 40.13±7.98 years.

Table 1: Mean value ± sd of age and heavy metal blood content in control and occupational worker samples.

Examined Sample	Mean ± Standard deviation			
	Age	Zn	Cu	Pb
Control	39.7 ± 6.8	65.15±11.0	101.3±14.57	14.625±2.52
Occupational workers	40.13±7.98	98.03±23.07	123.26±40.96	57.68 ±14.33

For Zn blood content, the mean values were 65.15 ± 11.0 µg/dl and 98.03 ± 23.07 µg/dl for control and occupational workers respectively (Figure 1).

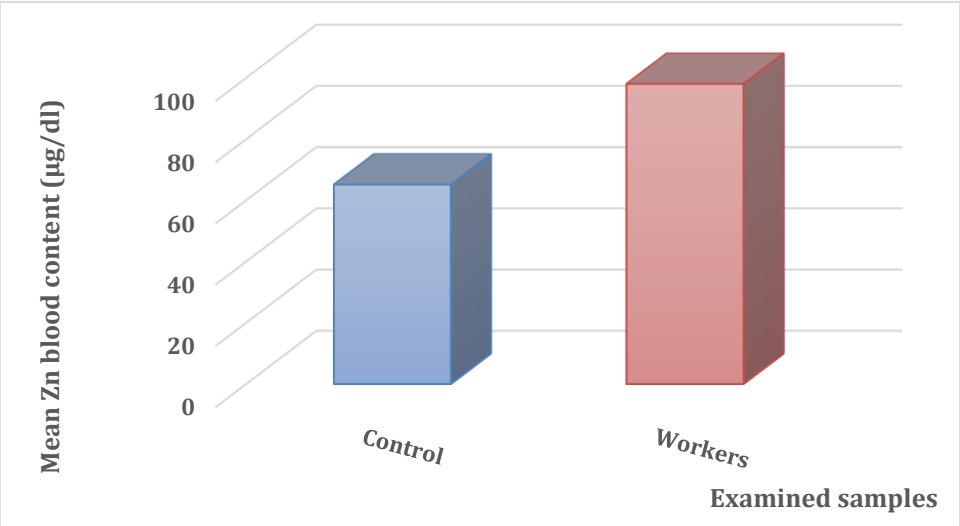

Figure 1: Mean Zn blood content (µg/dl) in examined control and occupational workers.

In the case of Cu blood content, it was found that the control sample gave a lower mean value (101.3 ± 14.57 µg/dl) than that of workers (123.26 ± 40.96 µg/dl), as shown in Figure 2.

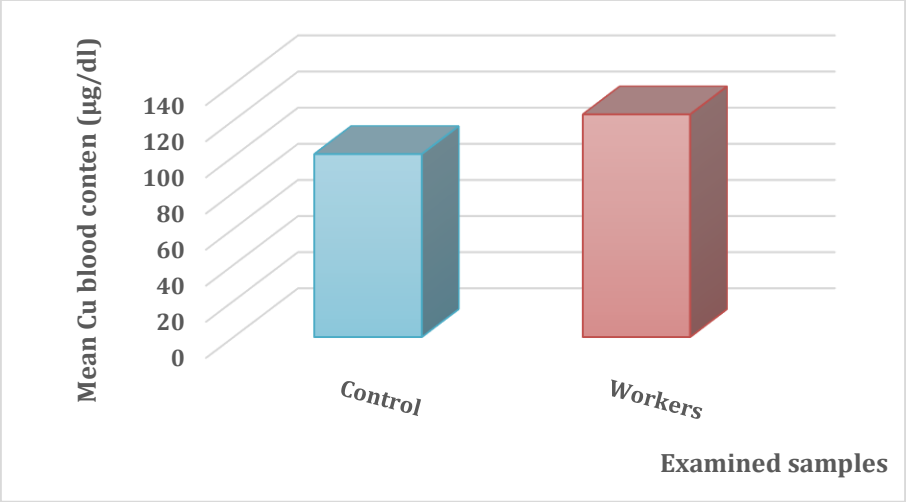

Figure 2: Mean Cu blood content (µg/dl) in examined control and occupational workers.

Regarding Pb blood content, the study has recorded a much lower mean value (14.625 ±2.52 µg/dl) in the control sample than that recorded (57.68 ± 14.33µg/dl) for occupational workers (Figure 3).

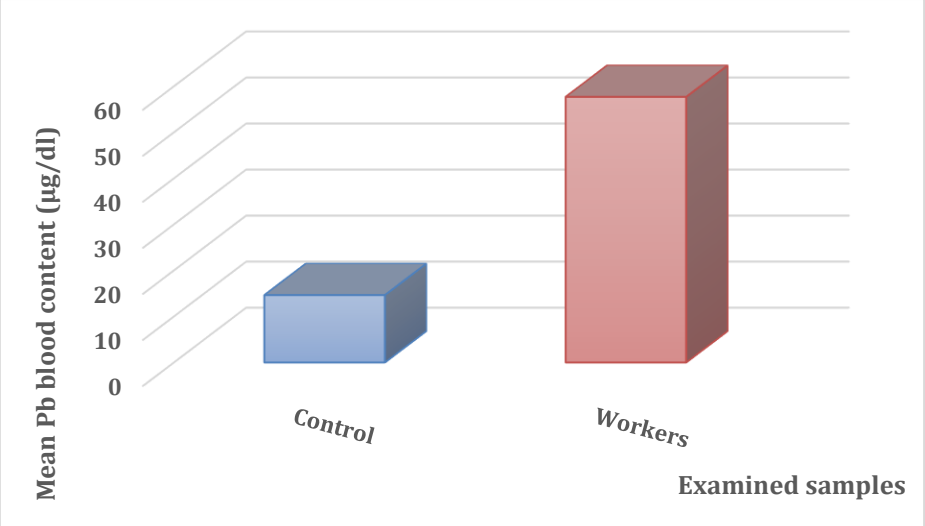

Figure 3: Mean Pb blood content (µg/dl) in examined control and occupational

Student (t) analysis test between mean values of blood heavy metals content in both examined samples was displayed in Table 2.

Table 2: t analysis test between heavy metal blood content in both control and occupational worker samples.

Heavy metal	df	t value	probability
Zinc	58	6.0257	Significant at P≥ 0.01
Copper	58	4.3172	Significant at P≥ 0.05
Lead	58	13.113	Significant at P ≥ 0.05

This biometrical analysis has revealed significant differences ($P \geq 0.050$ between the mean blood contents of both the control and worker of all examined heavy metals, recording values of 6.0257, 4.3172, and 13.113 for Zn, Cu, and Pb, respectively (Table 2).
Meanwhile, correlation analysis between the ages of both control and worker samples was given in Table 3, which also includes the working period and mean blood content of all examined heavy metals.

Table 3: Correlation analysis between the age of examined samples and heavy metal content and between working period and heavy metal content.

Variable	Examined Sample	Heavy Metals	Correlation analysis	
			r value	Probability
Age	Control	Zinc	0.0859	Not significant
		Copper	0.1583	Not significant
		Lead	0.0868	Not significant
	Occupational workers	Zinc	0.0458	Not significant
		Copper	0.0853	Not significant
		Magnesium	0.0463	Not significant
Working period	Occupational workers	Zinc	0.8048	Significant $P \geq 0.05$
		Copper	0.8691	Significant $P \geq 0.05$
		Lead	0.9389	Significant $P \geq 0.05$

It seems very clear that correlation coefficient values (r) between age and mean values of examined blood heavy content of both samples were found not significant ($P < 0.05$), confirming that there was no clear impact of age variable on the mean of these blood heavy metal content. However, the current work has found a clear correlation between the working period and blood heavy metal content, where significant ($P \leq 0.05$) correlation coefficient values were detected to ensure a significant impact of the working period on these examined blood heavy metal content (Table 3).

These results are supported by the results of other studies, where an old study [19] carried out in Basrah, Iraq, found that occupational workers in fuel filling stations had higher blood lead content than those in the control. Another study examined similar fuel filling stations in Khartoum city- Sudan [20] and reported findings of blood lead content being higher in exposed workers than in control. A Similar study examining blood lead and cadmium content in a fuel filling station in Semarang city- Indonesia, has reported that the mean blood content of both Pb and Cd is almost within normal limits, and this may be due to the short working period [21]. Recent work examined Cu, Zn, Fe, and Pb blood serum of fuel filling station workers in Dhi Qar city, southern Iraq [22] and reported higher blood content of these four heavy metals than those of control. Recent work has examined the Zn, Cu, and Fe blood content of occupational workers of ten fuel filling stations in Al-Ramadi city- Iraq, and reported a significant increase ($P \geq 0.05$) in worker mean blood content of these examined heavy metals [17].

Other factors, such as cigarette smoking, may affect blood-heavy metal content in exposed workers [23]. Also, occupational protective equipment may significantly affect the concentrations of blood heavy metal content [24].

It seems that the accumulation of such heavy metal in workers' blood may show several early health indicators, such as depression as reported by early work [16], and other health symptoms such as hair loss, tooth decay, vision impairment, and weight fluctuation [25,26].

Conclusion

From these findings, it is very clear that the blood heavy metals content of occupational workers at petrol filling stations was significantly higher than that of the control sample. These results confirm that workers have been affected by these examined heavy metals released from car petrol. The effect of exposure period and workers' age on the content of heavy metals in the blood is also mentioned.

Conflict of interest

The author declares that there is no conflict of interest

References

[1] S. Wójcik, J. Baszuk, P. Marciniak, W. Wojty´s, M.D. ebniak, T. Cybulski, C. Gronwald, J. Alchimowicz, and J. Masoj, "Influence of the levels of arsenic, cadmium, mercury and lead on overall survival in lung cancer," *Biomolecules* , vol.11, no.11.pp. 1160,2021.

[2] Y. Shi, Y. Zou, Z. Shen, Y. Xiong, W. Zhang, and C. Liu, "Trace elements, PPARs, and metabolic syndrome," *International Journal of Molecular Sciences*, vol.21, no.6,pp.2612, 2020.

[3] S. Singh and N.L. Devi, "Heavy Metal Pollution in Atmosphere from Vehicular Emission. In book: Heavy Metal Toxicity: Environmental Concerns," *Remediation and Opportunities*, pp.183-207, 2023.

[4] M.S. Alam and A. Khan, " The impact study of vehicular pollution on environment," *International Journal for Science and Advance Research in Technology*, vol. 6, no.12, pp. 30-37, 2021.

[5] K. Mäkká, A. Šiser, L.Mariš, and K. Kampová, "Impact of filling stations: Assessing the risks and consequences of the release of hazardous substances," *Applied Sciences*, vol. 14, no.1, 22, pp. 1-18, 2024.

[6] A. Tabinda, S. Abbas, A.Yasar, and R. Rasheed, "Comparative analysis of air quality on petrol filling stations and related health impacts on their workers," *Air Quality Atmosphere & Health*, vol. 12, no. 6, pp. 1317-1322, 2019.

[7] F.D. Fanny and D.H. Ramdhan, "Analysis of occupational safety and health at oil plus filling station installations: Literature Review," *Media Publikasi Kesehatan Indonesia*, vol. 7, no.11, pp. 2592-2599,2024.

[8] M.J. Perie,W.C. Ulakpa, and O.E. Eyankware, "Petroleum filling stations and their impact on the environment in Nigeria". *Journal of Environmental & Earth Science*, vol. 4, no.1, pp. 1-14, 2022.

[9] L. Kuburi, U.Umar, and A.N. Oyedeji, "Risk assessment of petrol filling stations in a Metropolitical City of Kaduna State, Nigeria," *Journal of Strategic Studies & International Affairs,* vol. 27, no.2, pp. 179-184,2023.

[10] N. Atasoy, A.U.Kömüroğlu, A.Kul, and U.M. Yücel, "Heavy Metal Exposure of Workers Working at Petroleum Products Filling Stations and its Effects on Oxidative Stress," *Fresenius environmental bulletin*, vol. 29, no.07, pp.5142-5151,2021.

[11] M. Safaa, S. Marwa, A. Hasan, and I. Janan , "Influence of Benzene Exposure on Hematological Variables in the Workers of the Fuel Filling Station ," *1st International Multi-Disciplinary Conference Theme,* Sustainable Development and Smart Planning, IMDC-SDSP 2020, Cyperspace, 28-30 June 2020 2020, June 28-30, Cyberspace Copyright © 2020 EAI DOI 10.4108/eai.28-6-2020.2298212

[12] M. N. Mahmood, and H. W. Omer, "Study of hematological parameters in petrol stations workers in Samarra city-Iraq," *International Journal of Health Sciences*, vol. 6, no. S1,pp. 1345-1349 ,2022.

[13] H.S.Abou-ELWafa, A.A. Albadry and A.El-Gilany, " Bazeed, Some biochemical and hematological parameters among petrol station attendants: A comparative study," *BioMed Research International.*, vol. 20, no.15, pp. 1-6,2015.

[14] V. Indumathy, M. Gandhimathi, and J.Kishore, "Assessment of pulmonary function test among employees of petrol filling stations,"*Indian Journal of Public Health Research and Development,* vol. 14, no.1, pp. 105-109,2022.

[15] T.GÜrsoy and N.Atasoy, "Heavy metal exposure of workers working at petroleum products filling stations and its effects on reduced GSH enzyme level. In book: Science and Mathematics Science Theory," *Current Research and New Trends,* pp.12-23,2021.

[16] P.Kumar, B.N.Gupta, K.P. Pandya, and S.H. Clerk, "Behavioral studies in petrol pump workers," *International Archives of Occupational and Environmental Health*, vol. 61, no.1-2, pp. 35-38,1988.

[17] A. Q. Alhadithi, and F. Kadhim, "Detecting the Concentration of some trace elements in blood samples of fuel station workers," *International Journal of Drug Delivery Technology*, vol. 13, no.02, pp. 584-590,2023.

[18] I. Kristofer, P. Caitlin, Q.Wang, E. Edwards, E. Yoorae, S.Amisha, D. Whelton and J.Andrew, "Drinking water contamination from the thermal degradation of plastics: Implications for wildfire and structure fire response". *Environmental Science: Water Research & Technology*, vol.7, no.2, pp. 274–284. 2021.

[19] L.A. Al-Rudainy, "Blood lead level among fuel station workers," *Oman Medical Journal*, vol. 25, no.3, pp. 208-211. 2010.

[20] M.Mariño, G. Bartolomé, S. Román, and D. Muñoz, "Influence of physical training on erythrocyte concentrations of iron, phosphorus and magnesium," *Journal of the International Society of Sports Nutrition*, vol.17, no.1, pp.7. 2020.

[21] N. K .Dewi and A.Yuniastuti, "Blood lead and cadmium among fuel station workers in Semarang City", *Journal of Engineering and Applied Sciences,* vol. 12, no.11, pp. 3478 -3480. 2017.

[22] A. Maktoof, S. Zaki, S.Enavah, and Z.Abid Aun, "Measuring the concentration of heavy elements in blood of workers in fuel station in Dhi Qar government, "*Journal of Physics Conference series*, vol.1294, no.6, pp. 1-5,2017,2019.

[23] Z.M. Salih, A. Kamal, M.Tawoos, and T.M. Kamel, "The effect of some physical factors and lead on soil and smoking workers in gas stations in Kirkuk governorate," *Journal on Modern Research Methodologies*, vol. 2, no.6,2023.

[24] S. Cheraghian, H.Hossaini, M.Pirsaheb, and K.Abdi, "Airborne Heavy Metals Penetrating through Face Masks: A Manikin Respiratory Model Study and Associated Health Risks," *Journal of Hazardous Materials Advances*, Available online,2025.

[25] B. Mood, M. Naseri, K. Tahergorabi, Z. Khazdair, and M.R. Sadeghi, "Toxic mechanisms of five heavy metals: Mercury, lead, chromium, cadmium, and arsenic," *Frontiers in Pharmacology*,vol.12, pp.1-19, 2021.

[26] S.A.K. Al-Hiyaly, and. L.L. Alwan, "Impacts of Oil Industrial Process upon Occupationally Exposed Workers at Al-Dora Refinery," *Iraqi Journal of Oil and Gas Research*, vol. 1, no.1, pp.72-81,2021.