International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 17s, 2025
https://theaspd.com/index.php

Environmental Impact Of Fuel Station Pollutants On Some Blood Gases And Biochemical Variables

Areej. A. Alrawy[1], Mahmoud. I.Mohammed[2]
[1,2]Department of biology, College of Science, University of Mosul, Mosul, Iraq
Areej.23scp17@student.uomosul.edu.iq[1] , mahjsbio74@uomosul.edu.iq[2]

Abstract
The current study investigated the impact of pollutants emitted from fuel filling stations on the health of workers in this field in the city of Mosul. Blood samples were collected and blood gas tests were conducted, including oxygen, carbon dioxide, carboxyhemoglobin, lactic acid, and bicarbonate concentrations, in addition to measuring blood pH. These samples were divided into general workers and compared with healthy individuals not exposed to these pollutants. They were also divided into workers working 18 hours (first group) and workers working 8 hours (second group). These samples were also compared with the same healthy individuals not exposed to these pollutants (control group). The results of this study showed that the levels and concentrations of these blood gases studied showed significant variations compared to their levels and concentrations in the control group. It showed a significant increase in the percentage of carboxyhemoglobin (COHb). The results also showed a significant increase in the Molecular weight of a gas CO2 (pCO2). While the results showed a significant increase in the concentration of lactic acid in the blood of workers in these stations compared to the control group. While it showed a significant decrease in the Molecular weight of a gas O2(pO2)in the blood of fuel station workers compared to the control group.
***Key word**: pollutants, stations, workers, blood, fuel filling stations.*

INTRODUCTION

Environmental pollution is a global problem because it affects various types of life and causes numerous negative consequences for human health and well-being. It also has negative effects on the environment and the lives of organisms in general. All living organisms, large and small, depend on the Earth's components, such as water and air, and their pollution exposes these organisms to danger. Environmental pollutants also affect urban areas more than they affect rural areas [8, 28, 2].Such issue of the current time as environmental pollution is getting more acute every day, such that the system loses its ability to decompose, recycle, or convert them into substances that do not cause any harm [3], pollution is not the issue of the single nation but rather global issue and that is what whole world community is grappling with. The rising pollution has degraded the environment and also rendered it imbalanced and negative impacts of the same are getting manifested in various forms as well. The greatest risk that pollution poses is against human lives. Due to these trends even presented by WHO, in approximately half of cities of the world the content of carbon monoxide has been reached in such amount which is dangerous in the health aspect, whereas lead has reached the level of danger to health in one-third of cities of the world [1].Environment pollution is a wide range problem and is likely to affect the health of human populations in an exceptional manner [16].This issue lies in its historical background as its development appears the most after the industrial revolution, As a result of the exponential expansion of factories and industrial operations, pollution reached unprecedented heights during the Industrial Revolution of the 18th and 19th centuries [26].

Gasoline stations are major contributors of pollution to the air especially volatile organic compounds (VOCs) such as benzene, toluene, ethyl benzene and xylene, the BTEX in the gasoline present in the air of the gas stations happens because of high gasoline evaporation. Consequently, knowing the concentration of these compounds in the gas stations in busy and crowded cities is one of the significant concerns of the environmental health, which is twice important due to its adverse health impact [4].

Benzenes, toluene and xylene (BTX) and its alkyl derivatives they are classified as dangerous compounds and their harmful action to human health is well known, they are poisonous to the human health due to their being toxic or mutagenic or carcinogenic [10]. The sustained exposure to the pollutants associated with fuel may harm liver or kidney performance, which is revealed through the changes in such important biochemical indicators as alanine aminotransferase (ALT), aspartate aminotransferase (AST), serum albumin, or creatinine [12] . Fuel station workplaces are featured by long-term exposure to a mixture of air pollutants that is a combination of carbon monoxide (CO), carbon dioxide (CO 2), volatile organic compounds (VOCs), and particulate matter. These pollutants are residues of evaporation, burning, and car exhaust, and they are very dangerous to respiratory, cardiovascular, and metabolic health [18].

In this study, the effects of prolonged exposure to fuel station pollutants on blood gases and a few sample biochemical markers in Mosul fuel station workers are measured and compared according to work experience and unexposed workers to evaluate the deviation in physiological parameters that may be related to exposure at the workplace.

MATERIALS AND METHODS

Blood Sample Collection

Eighty venous blood samples were collected from individuals working at fuel stations located on both the right and left sides of Mosul during the period from October 2024 to December 2024. Their ages ranged from 19 to 46 years in Mosul and were divided into:

1. Exposed
2. Not Exposed

These samples were compared with (30) blood samples from healthy, non-smoking individuals of the same age, representing the control group. The information collected from these individuals is shown in the questionnaire in Appendix (1). Blood samples totaling 5ml were drawn from smokers, with hemolysis samples excluded to avoid false positives. The blood was divided into three parts. In the first part, 1 ml of blood was placed in a tube. The tube was washed with liquid heparin to test dissolved gases in the blood (pCO_2, pO_2, etc.). This was done using an ABL800 FLEX radiometer, made in the USA, located at Al-Jumhuri General Hospital in Mosul, as shown in Figure (1).

Figure (1): Dissolved Gases Tester

The second part of the blood was 2 ml of venous blood placed in plastic anticoagulant tubes containing ethylene diamine tetra acetic acid (EDTA). Blood component tests included packed cell volume (PCV), platelet count, and red blood cell count (RBC). Hemoglobin (Hb) concentration was determined, and samples were analyzed using an Auto Hematology Analyzer from Rayto, a Chinese company.

The remaining blood was placed in tightly sealed, dry, anticoagulant-free tubes called Jell tubes. The tubes were placed at room temperature for 20 minutes. Then, a centri-fuge was used at 9000 x g for 15 minutes to obtain serum. The serum was divided into portions and placed in dry, sterile Eppendorf tubes. The samples were stored in a deep freezer at -20°C until the required biochemical tests were performed in this study.

Statistical analysis

Statistical analysis of the results was performed. Data were col-lected, reviewed, recorded, and entered into IBM SPSS statistical software, version 26. After ensuring that the quantitative data followed a parametric distribution, we presented means, standard deviations, and ranges. Duncan's multiple-range test re-vealed significant differences between parameters, which were indicated by different letters at a probability level of $P \leq 0.05$.

RESULTS AND DISCUSSION

The Effect of Some Gaseous Pollutants on the Blood of Fuel Station Workers

Carboxyhemoglobin (COHb) Ratio

The results of the current study, shown in Figure (2), showed increase in the percentage of carboxyhemoglobin (COHb). The highest rate in the blood of fuel station workers was (2.92) compared to the control group.

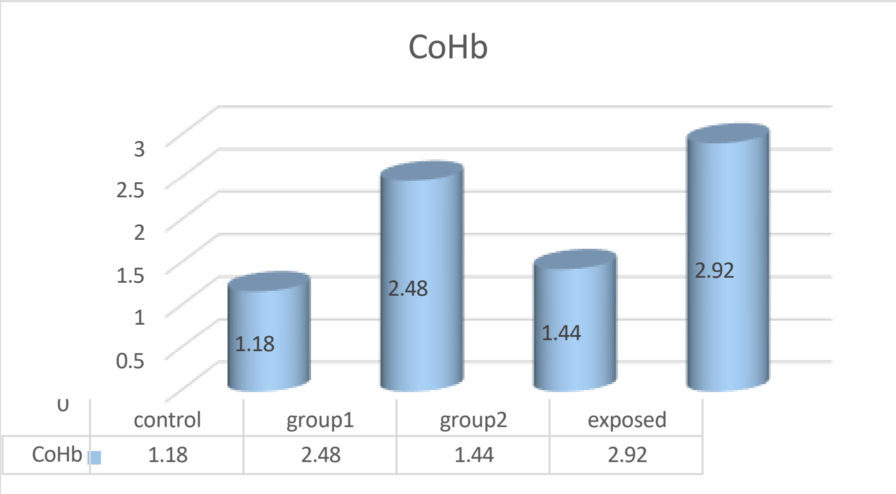

Fig (2) carboxyhemoglobin levels in each group

Molecular weight of a gas CO_2 (pCO_2)

The results in Figure (**3**) showed a significant increase in pCO_2 levels at a probability level of ($P \leq 0.05$). The highest level of this gas in the blood of exposed individuals and workers at these stations was (59.78) compared to the control group.

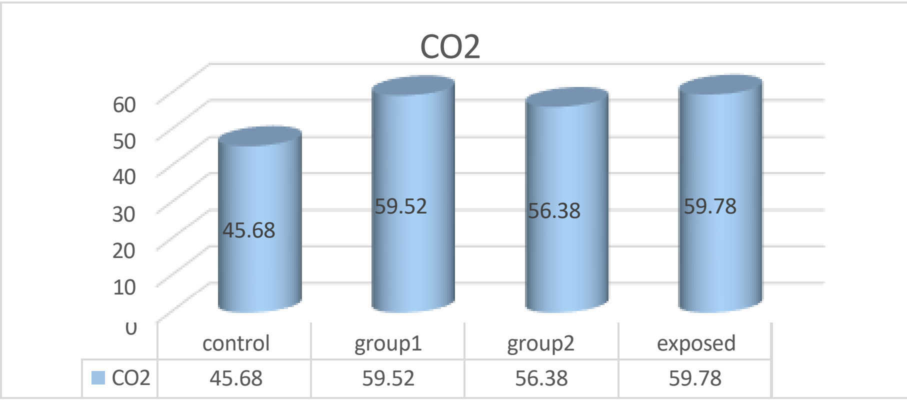

Fig (**3**) PCO2 levels

Concentration of Lactic Acid

The results in Figure (**4**) showed a significant increase in the concentration of lactic acid in the blood of workers at these stations compared to the control group.

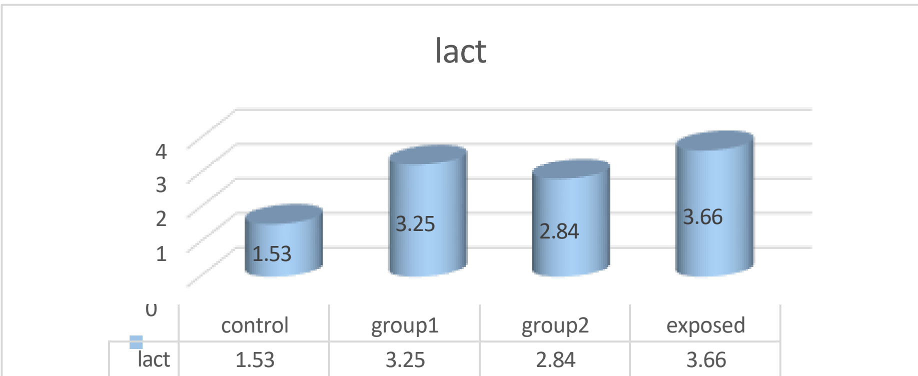

Fig (**4**) Lactic Acid level in each group

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 17s, 2025
https://theaspd.com/index.php

Molecular weight of a gas O_2 (pO_2)

The results in Figure (**5**) showed a significant decrease in the percentage of pO2 in the blood of fuel station workers compared to the control group.

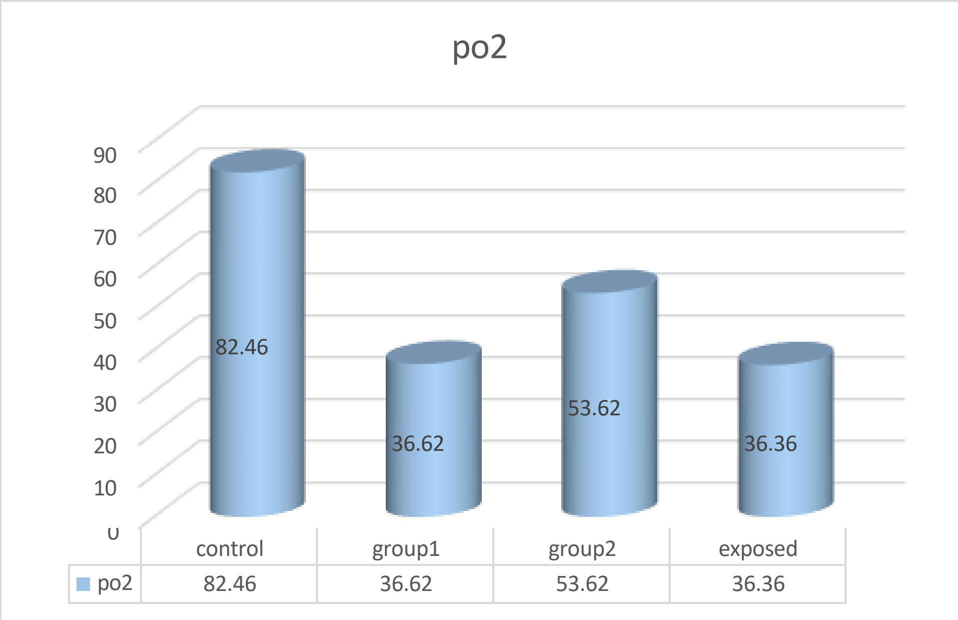

Fig (**5**) the relationship between groups and PO_2

Value of pH

The results in Table (**6**) showed that pH values showed a non-significant decrease in the blood of workers working at these stations compared to the control group.

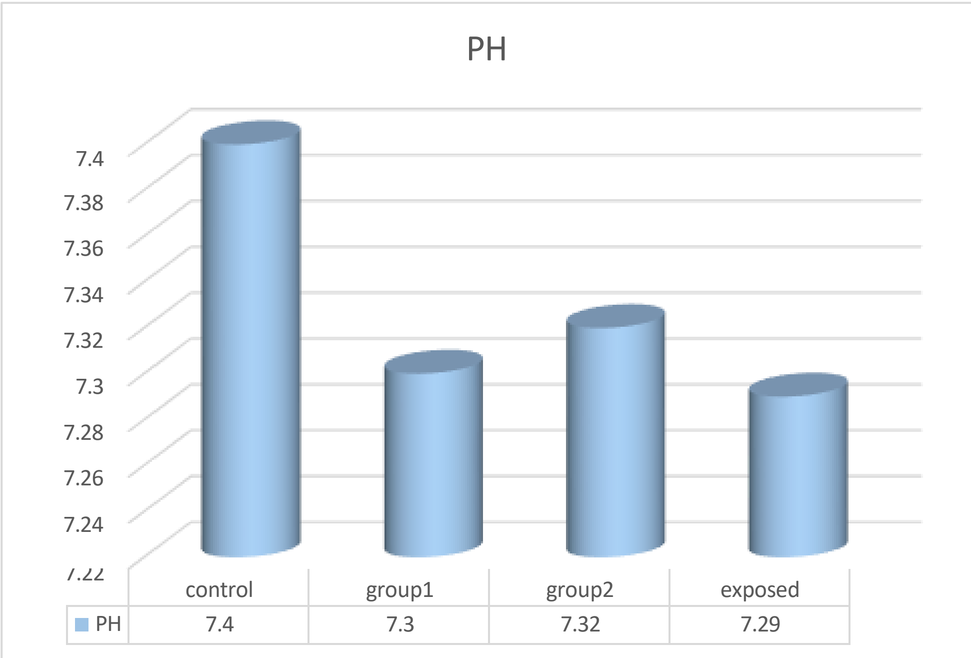

Fig (**6**) PH levels

Concentration of Bicarbonate Ion

The results in Table (7) indicated a significant decrease in the concentration of bicarbonate ions in the blood of these workers compared to the control group.

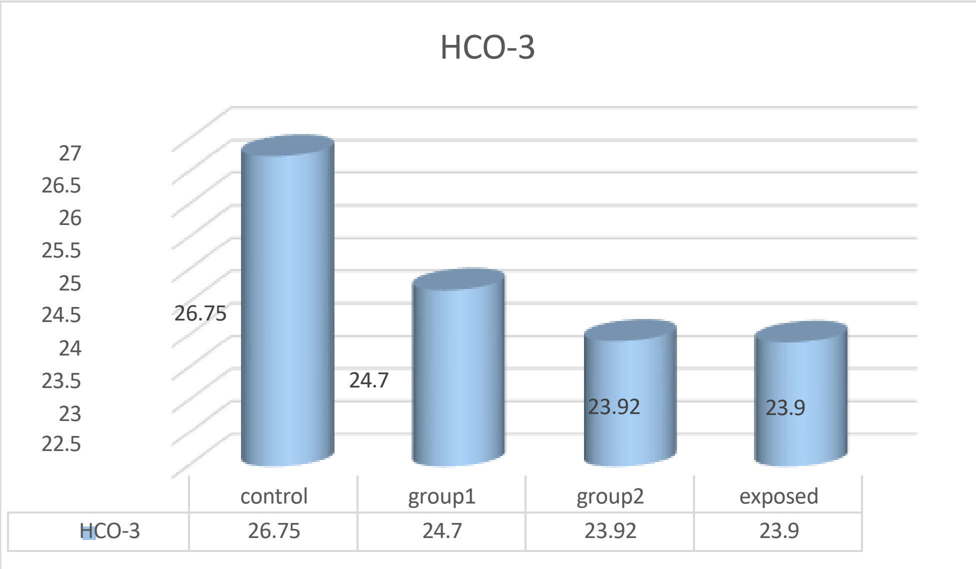

Fig (7) HCO-3 level

Carbonic Anhydrase Activity (CA)

The results in Figure (8) show a significant increase in the activity of the carbonic anhydrase enzyme in the total blood serum of the workers.

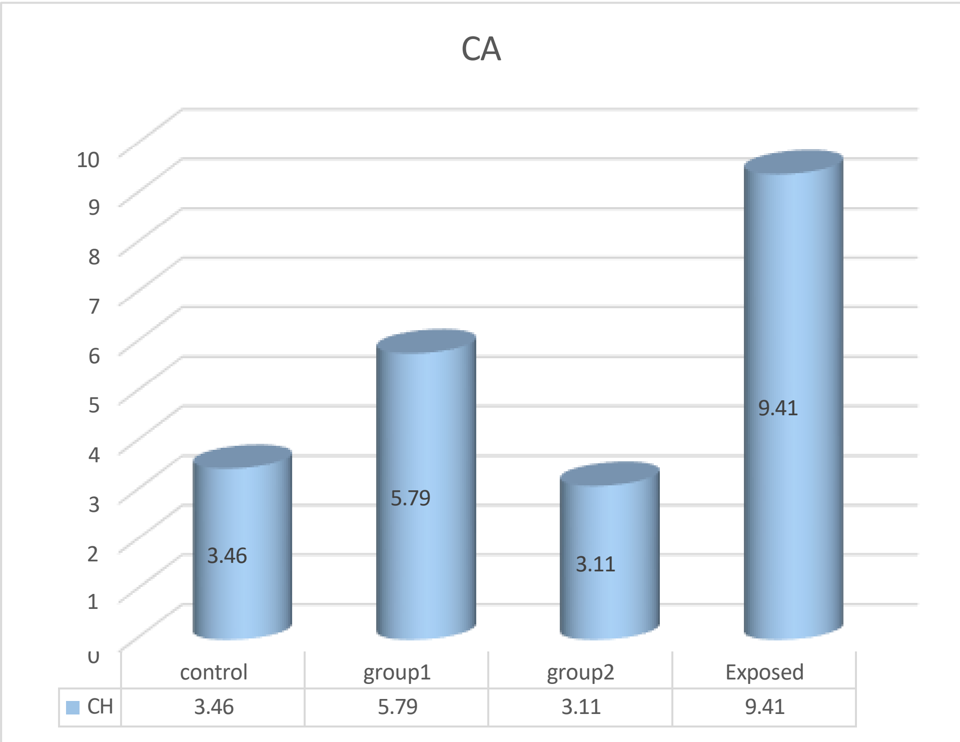

Fig (8) The relationship between groups and CA Activity

Acetyl cholinesterase (AchE) Activity

The results in Figure (9) showed a significant increase in the activity of this enzyme in the total blood serum of workers at fuel stations in Mosul compared to the control group.

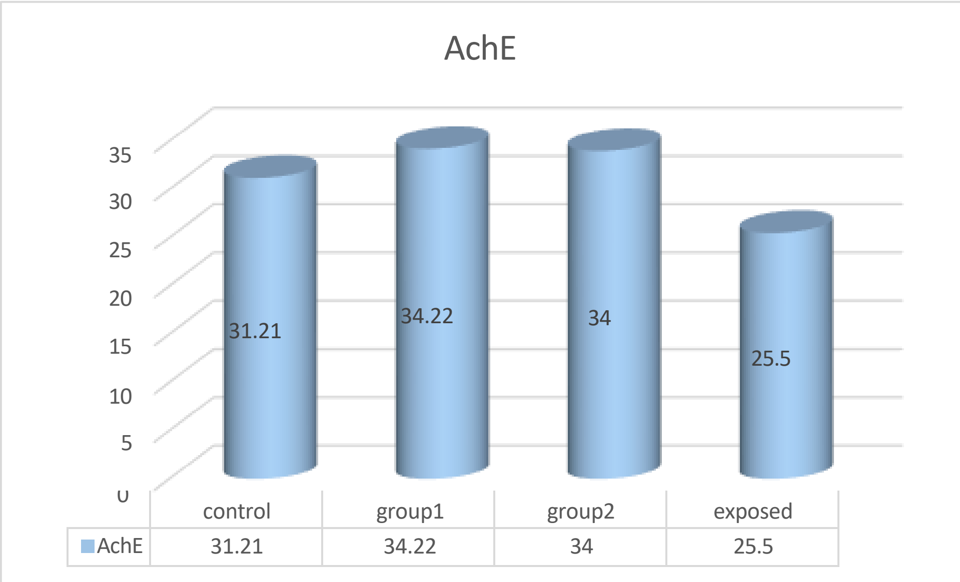

Fig (9) AchE Activity in each group

DISCUSSION

Fuel workers are found to have comparatively high levels of carboxyhemoglobin in their body which denotes large amounts of exposure to carbon monoxide (CO), even though it was not much of an increase, even the slight increase is enough to bring harm, There are several factors that affect the level of COHb such as exposure duration, working time and level of occupation and mechanics are of a very high risk and this align with what [6] found by in their study on the effect of COHb levels. The results showed the highest rate in the blood of those who worked 18 hours, (2.48), and the lowest rate, (1.44), in the blood of workers who worked 8 hours, respectively, compared to the control group. The results of this study are consistent with another study, which showed the impact of exposure to pollutants emitted from these stations on health and its contribution to cardiovascular and pulmonary diseases. It also showed an increase in both carboxyhemoglobin and carbon monoxide levels [25]. The reason for the high COHb in the blood of these people is that inhaling gases and vapors from the operation of fuel stations increases the concentration of hemoglobin in the blood, as this leads to a decrease in the percentage of oxygenated blood and an increase in the percentage of carbon monoxide combined with the blood. The inhaled air of those not exposed to the effects of the gases emitted from these stations contains 80% oxygen, 19% nitrogen, and less than 1% carbon monoxide and dioxide and water vapor. However, in the blood of workers and people who work in contact with such polluted places, the inhaled air from the smoke contains a large percentage of carbon monoxide, a toxic gas that combines with blood hemoglobin more quickly than oxygen, leaving room for hemoglobin in red blood cells to carry oxygen. This is the reason for the high percentage of COHb [9]. The results of the current study are consistent with other studies, which showed an increase in carboxyhemoglobin (COHb) levels and its harmful effects on the body due to the combination of hemoglobin with carbon monoxide [14].

Regarding pCO_2 figure3 shows a significant increase in pCO_2 levels at a probability level of ($P \leq 0.05$). The highest level of this gas in the blood of exposed individuals and workers at these stations was (59.78) compared to the control group. The highest level was (59.52) in the blood of individuals with 18-hour work hours, and the lowest level was (56.38) in the blood of workers with 8-hour work hours, respectively, compared to the control group. This increase in pCO_2 levels may be due to the emission and inhalation of various gases, as carbon dioxide is one of the main waste products of such polluted workplaces [23]. In addition, there are gases and vapors in the blood of workers resulting from the various processes at fuel stations, which lead to increased levels of gases, including CO_2. The most common atmospheric pollutants are CO_2, SO_2, CO_2, and NO_2, which are among the largest sources of air pollution [19].

The results in Figure (4) showed a significant increase in the concentration of lactic acid in the blood of workers at these stations compared to the control group. The highest level in the blood of these workers was (3.66), while the results showed the highest level in the blood of those who worked 18 hours, and the lowest level in workers who worked 8 hours, at (2.84) compared to the control group. Studies have shown that when oxygen concentrations are very low, it cannot quickly reach the mitochondria to oxidize the coenzyme nicotinamide adenine dinucleotide (the reduced form) NADH produced by the glycolysis pathway. In this case, the muscle enzyme lactate dehydrogenase (LDH) performs its functional role, which is the formation of lactic acid. However, in the absence of oxygen, anaerobic glycolysis, or lactate fermentation, occurs. However, in the presence of oxygen, lactic acid is not formed, and the pyruvic acid continues to be oxidized in the citric acid cycle to carbon dioxide and water [11, 20].The results of the current study are consistent with previous studies, indicating that increased lactic acid leads to extensive damage to various organs in the body [21,5].

The results in Figure (5) showed a significant decrease in the percentage of pO2 in the blood of fuel station workers compared to the control group. The highest significant decrease in pO2 in the blood of workers directly exposed to the pollutants emitted from these stations was (36.36) compared to the control group. The highest decrease in the number of working hours was (36.62) in the blood of those who worked 18 hours, and the lowest rate was (53.62) in the blood of workers who worked 8 hours, compared to the control group. The results of this study were consistent with many studies, which indicated a decrease in the percentage of oxygen in the blood of those exposed to the effects of any of these pollutants compared to people not exposed to any type of pollution [24]. The reason for the decrease in oxygen is attributed to the speed of the combination of hemoglobin with carbon monoxide, forming carboxyhemoglobin COHb, and thus it will affect the process of transporting oxygen in the blood [25].

The results in figure (6) showed that pH values showed a non-significant decrease in the blood of workers working at these stations compared to the control group. The highest non-significant decrease in the blood of these workers was (7.29) compared to the control group. The average decrease in the blood of workers working for 18 hours was (7.32) compared to the control group. The results of this study are consistent with another study that indicated the pH effect of direct contact with these pollutants on tissues found on the inner surface of the respiratory system and on other body systems via the circulatory system [22].

The results in figure (7) indicated a significant decrease in the concentration of bicarbonate ions in the blood of these workers compared to the control group. The highest significant decrease rate was 23.92. The highest decrease rate was in the blood of those who worked 18 hours at these stations, and the lowest rate was in the blood of workers who worked 8 hours at these stations, at 23.90, respectively, compared to the control group. The results of this study are consistent with other studies, which indicated a decrease in the concentration of bicarbonate ions in the blood of workers working in such areas with various pollutants, including the study by [13, 7].

The results in Figure (8) show a significant increase in the activity of the carbonic anhydrase enzyme in the total blood serum of the workers, reaching (9.41) compared to the control group. Regarding the duration of working hours, the highest activity of the carbonic anhydrase enzyme was (5.79) in the serum of the first group (18) working hours, and the lowest activity of this enzyme in the serum of the second group, reaching (3.11) in the serum of the second group compared to the control group. This enzyme is found in the lining of the pulmonary blood vessels, as well as in the epithelial tissues of the alveoli. The respiratory system is the only system in the body that comes into contact with the air in the environment. The function of this system is gas exchange during respiration. Humans breathe atmospheric air, which is usually laden with environmental pollutants in various forms, whether vapors, gases, dust, or smoke. The most common way to be exposed to these air pollutants is through the lungs, because lung tissue does not provide a protective barrier against exposure to pollutants. The delicate lung tissue allows many pollutants and oxygen to pass into the blood. These pollutants, which pass through the surface of lung tissue, cause damage and interfere with its vital role in oxygen supply, in addition to causing general damage [28]. Excessive inhalation and exposure to these polluting gases leads to oxidative stress, which of course leads to increased production of free oxygen radicals, which affect the outer membranes of tissues, thus causing damage to lung cells and changing their ability to selectively permeate, and releasing large amounts of the CA enzyme outside the cell and then into the blood serum [17].

The results in Figure (9) showed a significant increase in the activity of this enzyme in the total blood serum of workers at fuel stations in Mosul compared to the control group. The highest activity in the total blood serum of workers was (35.50). Regarding the number of working hours, the first group (18) working hours showed an increase in the activity of this enzyme (34.22), compared to the second group (8 working hours), which showed a lower activity increase (34), compared to the control group. The mechanism of action of these gaseous pollutants emitted from fuel stations in terms of their impact on the nervous system is through inhibiting the activity of the enzyme acetylcholine esterase, which always breaks down acetylcholine and converts it into acetic acid and choline. Acetylcholine is a chemical transmitter for a number of nerve fibers and is secreted at the nerve endings, where these pollutants combine with the enzyme to form a phosphorylated enzyme that cannot break down acetylcho-line [20]. The study suggests that the increase in acetylcholinesterase (AchE) activity is a result of oxidative stress caused by exposure to air pollutants emitted from fuel stations. This stress affects neural cells and is believed to stimulate the gene expression of AchE as a protective mechanism to prevent overstimulation by acetylcholine. Research indicates that elevated AchE activity is primarily due to exposure to volatile organic compounds (VOCs) such as benzene and toluene, which impact the nervous system and elicit neurotoxic responses. These responses may trigger an adaptive increase in AchE activity as a compensatory mechanism [15].

CONCLUSION

The study results indicate that chronic exposure to pollutants emitted from fuel stations affects the physiological balance of blood gases in workers. A significant increase observed in the concentrations of both carbon dioxide (PCO2) and lactic acid in the blood, indicating disturbances in cellular ventilation. The results also showed a significant decrease in oxygen concentration (pO_2), reflecting impaired gas exchange efficiency and oxygen deficiency. Carboxyhemoglobin (COHb) levels showed a non-significant increase, but this elevation increased with longer working hours, indicating a gradual accumulation of carbon monoxide (CO) in the blood. Similarly, pH values and bicarbonate ion concentration (HCO3-) showed a non-significant decrease in the blood of workers at these stations compared to the control group. Accordingly, these results emphasize the need to take preventive measures for workers in such environments, especially those working for long hours.

REFERENCES

1. Ahmed, S. (2024). Environmental Pollution and Global Issue (With special regard to air pollution). Procedure International Journal of Science and Technology, 1(3), 1–13. https://doi.org/10.62796/pijst.2024v1i301
2. Al-Annaz, R. M., Abdul-Fattah, J. H., & Al-Kattan, M. M. (2012). Effect of Salvia Powder on Blood and Histological Picture of Liver and Heart Muscle in Male Albino Mice. Rafidain journal of science, 23(2A).
3. Al-Kattan, M. M., Bashi, Z. I., & Katheem, A. A. (2018). The Effect of Flaxseeds on some Physiological and Biochemical Characters in Liver Tissue of Quail Birds. Rafidain journal of science, 27(1A).
4. Allahabady, A., Yousefi, Z., Ali Mohammadpour Tahamtan, R., & Payandeh Sharif, Z. (2022). Measurement of BTEX (benzene, toluene, ethylbenzene and xylene) concentration at gas stations. Environmental Health Engineering and Management, 9(1), 23–31. https://doi.org/10.34172/EHEM.2022.04
5. Al-Qattan, M. M., & Al-Shalash, H. T. (2024). The Effect of Intermittent Fasting in some Physiological and Biochemical Aspects of New Zealand Rabbits. Rafidain journal of science, 33(2 E).
6. Annisa, P. R., Budiyono, B., & Sulistiyani, S. (2021). Risk Factors of Workers' COHb Levels in Automotive Workshops. International Journal of English Literature and Social Sciences, 6(3), 088–092. https://doi.org/10.22161/ijels.63.12
7. Csekő, K., Hargitai, D., Draskoczi, L., Keri, A., Jaikumpun, P., Keremi, B., and Zsembery, A. (2022). Safety of chronic hypertonic bicarbonate inhalation in a cigarette smoke-induced airway irritation guinea pig model. BMC Pulmonary Medicine, 22(1), 131.
8. Environmental Protection Agency (EPA) - Industrial Emissions Report, 2023.
9. Febriyanto, T., Baruara, G., and Ardhiana, R. (2022). Description of blood Hemoglobin Levels in VAPE users in the hex ohm Community Bengkulu city in 2021. Proceeding B-ICON, 1(1), 363-366.
10. Garg, A., & Gupta, N. (2020). BTEX Emissions, Seasonal Variability and its Associated Health Risks on Human Health in Outdoor Air of Delhi. IOP Conference Series: Earth and Environmental Science, 489(1), 012021. https://doi.org/10.1088/1755-1315/489/1/012021
11. Han, D. H., Wong, M., Peraza, N., Vogel, E. A., Cahn, R., Mason, T. B., and Leventhal, A. M. (2023). Dose–response effects of two nicotine salt formulations on electronic cigarette appeal and sensory attributes. Tobacco Control.
12. Iyanda, A. A., & Anetor, J. I. (2018). Biomarkers of hepato-renal damage of fuel filling station attendants using or abstaining from use of protective gears. Annals of Clinical Chemistry and Laboratory Medicine, 3(1), 15–21. https://doi.org/10.3126/acclm.v3i1.17176
13. Kadiyala, V., Lee, L. S., Banks, P. A., Suleiman, S., Paulo, J. A., Wang, W., and Conwell, D. L. (2013). Cigarette smoking impairs pancreatic duct cell bicarbonate secretion. JOP: Journal of the Pancreas, 14(1), 31.
14. Kahar, F., Wikandari, R. J., Irnawati, I., and Penmaley, M. S. (2022). The Effect of Cigarette Smoking Duration on Hemoglobin Level Measured with Cyanmethemoglobin Method. Indonesian Journal of Medical Laboratory Science and Technology, 4(2), 157-167.
15. Khan, A., Kanwal, H., Bibi, S., Mushtaq, S., Khan, A., Khan, Y. H., & Mallhi, T. H. (2021). Volatile Organic Compounds and Neurological Disorders: From Exposure to Preventive Interventions. In M. S. H. Akash & K. Rehman (Eds.), Environmental Contaminants and Neurological Disorders (pp. 201–230). Springer International Publishing. https://doi.org/10.1007/978-3-030-66376-6_10
16. Kumar, D. (2020). THE EFFECTS OF ENVIRONMENT POLLUTION IN THE PERSPECTIVE OF AIR POLLUTION, WATER AND LAND/SOIL WASTE POLLUTION. Globus An International Journal of Management & IT, 11(2), 6. https://doi.org/10.46360/globus.mgt.120201002
17. Lakey, P. S., Berkemeier, T., Tong, H., Arangio, A. M., Lucas, K., Pöschl, U., & Shiraiwa, M. (2016). Chemical exposure-response relationship between air pollutants and reactive oxygen species in the human respiratory tract. Scientific reports, 6(1), 1-6.
18. Lehtomäki, H., Rao, S., & Hänninen, O. (2023). Phasing out fossil fuels would save millions of lives worldwide. BMJ, p2774. https://doi.org/10.1136/bmj.p2774
19. Mallah, M. A., Soomro, T., Ali, M., Noreen, S., Khatoon, N., Kafle, A., and Zhang, Q. (2023). Cigarette smoking and air pollution exposure and their effects on cardiovascular diseases. Frontiers in public health, 11, 967047.
20. Nazıroğlu, M. (2012). Molecular role of catalase on oxidative stress-induced Ca2+ signaling and TRP cation channel activation in nervous system. Journal of Receptors and Signal Transduction, 32(3), 134-141.
21. Pappas, R. S., Gray, N., Halstead, M., and Watson, C. H. (2024). Lactic Acid Salts of Nicotine Potentiate the Transfer of Toxic Metals into Electronic Cigarette Aerosols. Toxics, 12(1), 65.
22. Shao, X. M., and Friedman, T. C. (2020). Pod-mod vs. conventional e-cigarettes: nicotine chemistry, pH, and health effects. Journal of Applied Physiology, 128(4), 1056-1058.
23. Stern, N. H. (2007). The economics of climate change: the Stern review. cambridge University press.
24. Thirión-Romero, I., Pérez-Padilla, R., Zabert, G., and Barrientos-Gutiérrez, I. (2019). Respiratory impact of electronic cigarettes and "low-risk" tobacco. Revista de investigación clínica, 71(1), 17-27.
25. Vámos, O., Kulcsár, N., Mikecs, B., Kaán, R., Abafalvi, L., Dinya, E., and Kispélyi, B. (2024). Acute effects of traditional and electronic cigarettes on palatal blood flow in smokers: A cross-over pilot study. Journal of Oral Biology and Craniofacial Research, 14(2), 152-157.
26. Winter, J. (2024). A Historical Perspective Review of the Environmental Pollution. Science Insights, 44(2), 1253–1261. https://doi.org/10.15354/si.24.re916
27. World Health Organization (2024) - Air Quality in Cities
28. Zhu, X., Du, C., Gao, B., and He, B. (2023). Strategies to improve the mass transfer in the CO2 capture process using immobilized carbonic anhydrase. Journal of Environmental Management, 332, 117370.