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Short Article

Organic Solvents and Health Hazards associated with Exposure to Petrol Fumes

Abdimuhammad Abdi

Lecturer, Department of Chemistry, Education Faculty, Badakhsan University, Afghanistan

***Corresponding author:**
Abdimuhammad Abdi

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Abstracts: Chemical hazards which emanate mainly from contact and inhalation of fuel are recognized to have profound impact on human health. Fast urbanization trends have resulted in a tremendous rise in the number of transportation vehicles, thereby, resulting in the increased need of petrol. Long-term exposure to petrol fumes has deleterious effects on body. The rapidly multiplying number of automobiles in most cities is causing a corresponding increase in air pollution, which is a cause of grave concern. Also, the failure to use personal protective equipment poses a great risk for the petrol-filling workers.

Keywords: Organic solvents, chemical hazard, petrol, fuel pumps, BTEX.

OVERVIEW

Organic solvents comprise a large group of compounds with a variety of chemical structures, and include alcohols, ketones, ethers, glycols, aldehydes, aliphatic and aromatic saturated and non-saturated hydrocarbons, halogenated hydrocarbons, carbon disulfide, among others. Organic solvents may be absorbed via inhalation, ingestion, and transdermal routes of exposure. During occupational exposure, inhalation of solvent vapor is generally the most important route. Dermal absorption is important when liquid solvents come into direct contact with the skin, although this route is often overlooked. The ingestion of solvents in clinically significant amounts occurs very infrequently in the occupational setting. Higher solvent volatility, with generation of significant airborne concentrations of vapor, large surfaces from which evaporation may take place, lack of appropriate enclosure and/or exhaust ventilation systems, and relatively high temperature of the work environment may all contribute to increased uptake by inhalation.

Organic solvents may be absorbed by workers either through the respiratory tract or the skin. Uptake is influenced by level and duration of exposure, workload, and the specific physicochemical features of each solvent, as well as by work practices and the use of protective equipment. The kinetics of metabolism and excretion are highly variable among compounds. Individual host variation (e.g., genetic polymorphism in enzyme expression) can also influence rates of solvent metabolism and clearance. Metabolites can be measured in blood, urine, or exhaled breath, and these may serve as an index of absorption.

Fast urbanization trends have resulted in a tremendous rise in the number of transportation vehicles, thereby, resulting in the increased need of petrol. This increase in demand of petrol has led to a steady rise in the number of petrol pumps in the world. Petrol pump workers work 10 hours/day and six days/week at most of the pumps. The high level of environmental pollution and exposure to petrol and diesel vapors can have an impact on the lung function of petrol pump workers. Several studies have reported that these categories of workers are exposed to several

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hazards in their workplaces, which could be physical, chemical or ergonomic (Mutua and Fedeha, 2012; Afolabi *et al.*, 2011; Cezar-Vaz *et al.,* 2012).

Chemical hazards which emanate mainly from contact and inhalation of fuel are recognized to have profound impact on petrol attendants. These workers are exposed to both the hydrocarbon in fuel and the fumes from the exhaust of vehicles.8 The pollutants from fuel include benzene, toluene, ethylbenzene and xylenes (BTEX) which can lead to several health conditions such as neurological diseases and cancers. It can also cause teratogenicity. Many diseases affecting the immune, endocrine, cardiovascular, respiratory and reproductive systems have also been attributed to benzene which is considered the most hazardous pollutant in gasoline due to its genotoxic and carcinogenic effects (Rekhadevi *et al.,* 2010; 2011; Chaun *et al.,* 2014; Bahadar *et al.,* 2014; Ekpenyong *et al.,* 2013; El-Mahdy *et al.,* 2015). Long term exposure of petrol attendants to petrol vapour have been reported to cause hepatotoxicity, nephrotoxicity and cardiotoxicity (Nwanjo and Ojiako, 2007; Wiwanitkit, 2007). A link has been observed between long term exposure to benzene and higher prevalence of hypertension. Benzene in petrol is harmful to the bone marrow and can decrease the number of red blood cells leading to anaemia (Sahb, 2011). Studies have recorded a significantly lower packed cell volume among petrol attendants compared to the general population (Udonwa *et al.,* 2009; Abou-Elwafa *et al.,* 2015; Ajugwo *et al.,* 2014). Neglect of ventilation in the work place or failure to use personal protective equipment when using petrol containing solvents like benzene will increase the incidence of toxic effects of benzene in humans, which includes haematotoxicity, immunotoxicity, neurotoxicity and carcinogenicity (Akshoy, 1989). Acute poisoning can lead to death with higher exposure associated with inflammation of respiratory tract and haemorrhage in the lungs. Various occupational solvents like benzene and atmospheric polluted air are absorbed into the human body either through the respiratory tract or via epidermal contact. These may cause primary respiratory symptoms and impaired pulmonary and dermatological functions (Kaung and Weihui, 2005).

Petrol is a volatile inflammable petroleum derived from a combination of liquid matrix primarily used for internal combustion of machines (Hussain *et al.,* 2013). Human exposure to petrol vapor is suggested to affect human health statues through not only inhalation but also ingestion. Exposure to petrol is known to contribute to neurological, inhalation, and teratogenic disorders. Some people are at higher risk of exposure to gasoline vapors including those working in gas station, truck drivers, and refinery workers (Tunsaringkarn *et al.,* 2012; Moolla *et al.,* 2015). Kerosene and petrol are distilled from crude petroleum including aliphatic, aromatic, and a variety of other branched, both saturated and unsaturated, hydrocarbons (Hopf *et al.,* 2012).

Petrol is a mixture of volatile hydrocarbons, while diesel fuel is a distillate of petroleum which contains paraffins, alkenes and aromatics. Both petrol and diesel undergo combustion in automobile engines and give rise to combustion-derived nanoparticles (CDNPs). Diesel exhaust particles are the most common CDNPs in the urban environmental air. These particles are highly respirable and have a large surface area where organic materials can be adsorbed easily. The particles which are generated from diesel exhaust are sub-micronic by virtue of their greater surface area-to-mass ratio- and can carry a larger fraction of toxic hydrocarbons and metals on their surface. They can remain airborne for longer time periods and can be deposited in greater numbers and deeper into the lungs than the large-sized particles. Benzene occurs naturally in crude oil and is a constituent of petrol. It is a major monocyclic aromatic hydrocarbon which is largely used as a solvent in automobiles and solvent gasoline. In India, the percentage of benzene in automobile engines is about 3%. Petrol-pump workers who are exposed to the petrol fumes exhibit a number of clinical signs and symptoms which may be due to benzene toxicity. Improvement in the engine design, soot filters and fuel modification may provide the best approach to control the exposure to these fumes.

Long-term exposure to petrol fumes has deleterious effects on WBCs. A significant reduction in the number of total and differential lymphocytes seems to be attributed to the toxic effect of petrol ingredients on bone marrow (Zamanian *et al.,* 2018). Gasoline contains more than 150 chemicals including benzene, toluene, xylene, and phenolic compounds such as volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs). Many of the substances in gasoline and its fumes are released into the environment and create health risk to people. These chemicals react with the vital tissue macromolecules regulating the cellular functions leading to long lasting health disorders (ATSDR, 1995).

The haematopoietic system, as the cells recycle continually, is highly sensitive to most of the air pollutants, which are reaching the blood very fast without being biotransformed. The solvents and air pollutants may interfere in the process of red blood cells proliferation.these changes are reflected in the synthesis of heme and the life expectancy of RBCs. Toxic material from air leads to significant damage to red blood cells causing aplastic anemia (Sadicova, 1990). This would lead to increase erythropoises as compensation. In the endocrine system the thyroid glands are important targets of the solvents and air pollutants especially like Lead (Moore *et al.,* 1986). The hormones of the hypothalamic-hypophysial axis are controlled by diverse factors, and constitute the target of toxic substances present in the solvents and air pollutants like heavy Lead (Lopez, 2000). So it is reasonable to suppose that workers exposed to benzene and lead may have altered the values of TSH and presumably thyroid hormones.

Most of the petrol filling stations were situated near to the heavy traffic; the workers were more prone to exposure to CO. The ambient air concentration of CO was maximum during the peak working hours, the workers were exposed to more amount of CO along with other air pollutant and solvents. Previous studie showed that exposure to solvents like benzene decreases the RBC count and Hb level causing anemia among workers exposed to >10ppm. Exposure to CO is causing tissue hypoxia and a stimulation of RBC formation. The CO emitted mainly by internal combustion engines of motor vehicles readily enters the blood through the respiratory system and binds over 200 times more firmly to Hb than oxygen, forming carboxy haemoglobin and seriously interfering with blood's oxygen transport capability, which ultimately leads to hypoxic hypoxia. Tissue hypoxia is the most potent stimulus for the erythropoises so it leads to the stimulation of erythropoietin - a factor which stimulates the erythropoiesis- which ultimately leads to the production of more number of RBC and Hb in the circulating blood.

Petrol filling station number had also increased as a result of increased number of automobiles on the road. Staff working here is exposed not only to air pollutant but also to organic and inorganic component present in petrol. Petrol is a complex mixture consisting mainly of hydrocarbons with a range of 3-11 carbon atoms. There is a wide range of volatile aromatic hydrocarbons present in the atmosphere of service stations as a result of emission of vapors during dispensing, loading, unloading, and transportation of petrol. The major VAHs are benzene, toluene, and xylene (BTX), often referred to as the BTX compounds

Air pollution from vehicles is an inescapable part of the urban life throughout the world. A long-term exposure to the air pollutants leads to deleterious effects on the respiratory functions. Air pollutants and chemicals like benzene, lead and carbon monoxide can cause adverse health effects by interacting with molecules which are crucial for the biochemical or physiological processes of the human body. The rapidly multiplying number of automobiles in most cities is causing a corresponding increase in air pollution, which is a cause of grave concern. Also, the failure to use personal protective equipment poses a great risk for the petrol-filling workers.

REFERENCES

1. Abou-ElWafa, H. S., Albadry, A. A., El-Gilany, A. H., & Bazeed, F. B. (2015). Some biochemical and hematological parameters among petrol station attendants: a comparative study. *BioMed research international*, *2015*.
2. Afolabi, O. T. (2011). Assessment of safety practices in filling stations in Ile-Ife, South Western Nigeria. *Journal of Community Medicine and primary Health care*, *23*(1-2), 9-15.
3. Ajugwo, A. O., Adias, T. C., Aghatise, K., Fadairo, J. K., & Nyenke, C. U. (2014). Reduced haematological indices in auto-mechanics and fuel attendants in Elele Nigeria. *Am J Med Biol Res*, *2*(1), 1-4.
4. Aksoy, M. (1989). Hematotoxicity and carcinogenicity of benzene. *Environmental health perspectives*, *82*, 193-197.
5. ATSDR. (1995). Toxicological profile for Gasoline. U.S. department of health and human services, *Public Health Service,*
6. Bahadar, H., Mostafalou, S., & Abdollahi, M. (2014). Current understandings and perspectives on non-cancer health effects of benzene: a global concern. *Toxicology and applied pharmacology*, *276*(2), 83-94.
7. Cezar-Vaz, M. R., Rocha, L. P., Bonow, C. A., Da Silva, M. R. S., Vaz, J. C., & Cardoso, L. S. (2012). Risk perception and occupational accidents: a study of gas station workers in Southern Brazil. *International journal of environmental research and public health*, *9*(7), 2362-2377.
8. Chauhan, S. K., Saini, N., & Yadav, V. B. (2014). Recent trends of volatile organic compounds in ambient air and its health impacts: A review. *Int. J. Technol. Res. Eng*, *1*(8), 667-678.
9. Ekpenyong, C. E., Davies, K., & Daniel, N. (2013). Effects of gasoline inhalation on menstrual characteristics and the hormonal profile of female petrol pump workers. *Journal of Environmental Protection*, *4*(08), 65-73.
10. El Mahdy, N. M., Radwan, N. M., Kharoub, H. S., & El-Halawany, F. (2015). Chromosomal abnormalities among petrol station workers occupationally exposed to benzene. *Current Journal of Applied Science and Technology*, 502-513.
11. Hopf, N. B., Kirkeleit, J., Bråtveit, M., Succop, P., Talaska, G., & Moen, B. E. (2012). Evaluation of exposure biomarkers in offshore workers exposed to low benzene and toluene concentrations. *International archives of occupational and environmental health*, *85*(3), 261-271.
12. Kaung, S., & Weihui, L. (2015). Clinical analysis of 43 cases of chronic benzene poisoning, *Chemico-Biological Interactions*. 153-154.
13. Lopez, C. M. (2000). Thyroid hormone changes in males exposed to lead in the buenos aires area (Argenti *Pharmcol. Res 42* (6), 599-602.
14. Mahmood, N. M. A., Sharef, D. M. S., & Hussain, S. A. (2013). Plasma proteins profile and renal function relative to exposure time of gasoline

filling station workers in Sulaimani City. *Int J Pharm Pharm Sci*, *5*(4), 334-338.
15. Moolla, R., Curtis, C. J., & Knight, J. (2015). Occupational exposure of diesel station workers to BTEX compounds at a bus depot. *International journal of environmental research and public health*, *12*(4), 4101-4115.
16. Moore, M. R., McIntosh, M. J., & Bushnell, I. W. R. (1986). The neurotoxicology of head. Neurotoxicology, 7, 541-556.
17. Mutua, J., & Fedha, I.M. (2012). Safety and health assessment in Kenyan petrol stations: case study of Thika-Nairobi highway stations: Proceedings of the 2012 Mechanical engineering conference on sustainable Research and Innovation, Nairobi, 3-4th May 2012; 4, 211-213.
18. Nwanjo, H. U., & Ojiako, O. A. (2007). Investigation of the potential health hazards of petrol station attendants in Owerri Nigeria. *Journal of Applied Sciences and Environmental Management*, *11*(2).197-200.
19. Rekhadevi, P. V., Mahboob, M., Rahman, M. F., & Grover, P. (2011). Determination of genetic damage and urinary metabolites in fuel filling station attendants. *Environmental and molecular mutagenesis*, *52*(4), 310-318.
20. Rekhadevi, P. V., Rahman, M. F., Mahboob, M., & Grover, P. (2010). Genotoxicity in filling station attendants exposed to petroleum hydrocarbons. *Annals of Occupational Hygiene*, *54*(8), 944-954.
21. Sadikova, S. S., Buglanov, A. A., Tadzhieva, Z. A., & Gafurov, F. Z. (1990). Indicators of iron metabolism and cellular immunity in healthy children and in those with iron deficiency anemia in relation to ecological conditions. *Pediatriia*, (8), 41-44.
22. Sahb, A. A. (2011). Hematological assessment of gasoline exposure among petrol filling workers in Baghdad. *Journal of the Faculty of Medicine*, *53*(4), 396-400.
23. Tunsaringkarn, T., Siriwong, W., Rungsiyothin, A., & Nopparatbundit, S. (2012). Occupational exposure of gasoline station workers to BTEX compounds in Bangkok, Thailand. *Int J Occup Environ Med (The IJOEM)*, *3*(3 July).
24. Udonwa, N. E., Uko, E. K., Ikpeme, B. M., Ibanga, I. A., & Okon, B. O. (2009). Exposure of petrol station attendants and auto mechanics to premium motor sprit fumes in Calabar, Nigeria. *Journal of Environmental and Public Health*, 1-5.
25. Wiwanitkit, V. (2007). Benzene exposure and hypertension: an observation. *Cardiovascular journal of Africa*, *18*(4), 264-265.
26. Zamanian, Z., Sedaghat, Z., & Mehrifar, Y. (2018). Harmful outcome of occupational exposure to petrol: Assessment of liver function and blood parameters among gas station workers in Kermanshah city, Iran. *International journal of preventive medicine*, *9*, 100.