ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF RESEARCH IN PHARMACEUTICAL SCIENCES

Published by JK Welfare & Pharmascope Foundation Journal Home Page: https://ijrps.com

Evaluation of renal and liver function in petrol station workers in Kirkuk city

Dlawer Abdulhammed Ahmad AL-Jaff

College of Pharmacy, University of Kirkuk, Kirkuk-36001, Iraq

Article History:

Received on: 13.11.2018
Revised on: 05.02.2019
Accepted on: 08.02.2019

Keywords:

Petrol,
Liver,
Kidney,
Occupational exposure,
Liver damage

ABSTRACT

A cross-sectional study to evaluate the effects of occupational petrol exposure on the kidney and liver of petrol station workers in Kirkuk city was done. 29 petrol pump workers who were continuously exposed to petrol for at least one year in the Kirkuk city having no medical history and 10 healthy age-matched controls who were never exposed to petrol were enrolled. These serum parameters of both the groups were compared by the Mann-Whitney U test. Since all the parameters studied were normal in the workers exposed to petrol, it can be concluded that petrol did not affect their liver and kidney health. However, higher levels of serum cholesterol, TG, and LDL in the petrol station workers as compared to the controls are suggestive of higher risk of developing liver damage. Larger studies should be conducted to validate the findings of the present study further.

* Corresponding Author

Name: Dlawer Abdulhammed Ahmad AL-Jaff
Phone: 009647706679059
Email: dr.dlawerjaff@gmail.com

ISSN: 0975-7538

DOI: https://doi.org/10.26452/ijrps.v10i2.402

Production and Hosted by

IJRPS | https://ijrps.com
© 2019 | All rights reserved.

INTRODUCTION

Occupational exposure to various harmful chemicals can lead to a plethora of health hazards. Petrol station workers who refuel the vehicles are exposed to petrol fumes on a routine basis (Khisroon *et al.,* 2015). So, these workers are at high risk for these health hazards. These health hazards can range from simple rashes to cancers.

Petrol is composed of numerous particulate and non-particulate compounds. It contains a mixture of volatile and nonvolatile compounds mainly the mixture of aliphatic and aromatic hydrocarbons (aromatic, saturated and unsaturated) and non-hydrocarbons (Nitrogen, Sulphur, Oxygen, Vanadium and Nickel) (Peters *et al.,* 2018).

Petrol fumes mostly contain benzene, toluene, ethyl benzene and xylene (BTEX). So, the petrol station workers are regularly exposed to these toxic fumes (BTEX). The common routes of entry of these toxic fumes into the body are the skin and the respiratory system (Alegretti *et al.,* 2004). Benzene and its derivatives like ethylbenzene are well-documented carcinogens. Benzene belongs to genotoxic group 1 human carcinogen while ethyl benzene belongs to human carcinogen group 2B (International Agency for Research on Cancer IARC (2012). The other harmful effects of benzene, ethylbenzene, and xylene are pancytopenia, aplastic anaemia, myeloid and myelodysplastic leukaemia (Kirkeleit *et al.,* 2008; Smith *et al.,* 2010), respiratory and neurological problems (Tunsaringkarn *et al.,* 2012).

There are several health hazards reported to be induced by short term and long term petro exposure. Respiratory problems related to the lungs are the most common problems reported in the workers exposed to petrol (Brown *et al.,* 2018). Halogenated hydrocarbons are reported to cause hepatitis. Liver cirrhosis has been reported in the workers exposed to petrol (Gunathilaka *et al.,* 2017).

Studies in humans and animals to evaluate the effects of petrol have reported the toxic effects of

petrol exposure on the kidney and the liver (Periago *et al.,* 2005; Adami *et al.,* 2006; Benson *et al.,* 2011). Kidney adenoma (Benson *et al.,* 2011), increased activity of enzymes in the liver, urea, creatinine, and potassium, and decreased chlorine and sodium have been reported in laboratory animals (Uboh *et al.,* 2009). In studies involving drivers, proteinuria, elevated serum activity of liver enzymes (aspartate aminotransferase, alkaline phosphatase, alanine aminotransferase), and total bilirubin and fatty liver changes have been reported. Xylene and toluene, the major components of petrol have been documented to cause damage to the liver and kidney in the form of toxicity. Toluene has been reported to cause kidney damage. Benzene and its derivatives, and xylene have been associated with liver and kidney cancers (Neghab *et al.,* 2015).

Since petrol contains volatile compounds which are readily available in an atmosphere when dispensed in petrol stations, it is readily inhaled by the petrol station workers. Xenobiotics including volatile chemical compound from a petrol can transform to a different metabolite in the body, many of these metabolites may have high reactivity with liver and kidney that are the major metabolising and excreting organs respectively and thereby can cause damage to these tissues (Uhegbu Friday *et al.,* 2015). Regular occupational exposure to petroleum products may have harmful effects on many organs (Okoro *et al.,* 2006). Both liver and kidney may be affected by petrol vapor; these toxic effects are determined biochemically by monitoring some plasma enzymes. Abnormalities in serum aspirate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatases (ALP), usually indicate damage to the liver while abnormalities in blood urea and serum creatinine indicate damage to the kidney (Benson *et al.,* 2011). The present study was conducted to evaluate the liver and renal functions among the petrol station workers in Kirkuk city.

MATERIALS AND METHODS

Study population: This was a cross-sectional study that included 29 petrol station workers who continuously worked not less than one year in Government petrol stations in Kirkuk city and 10 healthy age-matched controls who never worked in petrol stations or petroleum industries. Petrol station workers who had diseases affecting renal and liver function, who were taking medications that affected renal and liver function, smokers, and alcohol consumers were excluded from the study.

Ethical consideration: The principle of the declaration on the right of the subject was employed for this study. The participants were included in this study only after obtaining signed informed consent from them.

Liver and Kidney function tests: Five ml of blood was drawn from a peripheral vein and centrifuged for 5 minutes at 10,000 rpm, and serum was collected. Serum levels of AST, ALT, ALP, TSB, urea, creatinine, cholesterol, TGs, VLDL, LDL, and HDL were assessed by Cobas c111 (Germany).

Statistical analysis: Data was analysed by SPSS version 21. Mann-Whitney U test was used to compare different parameters between the two groups. Frequencies/percentages were calculated for qualitative variables and compared between groups through the Chi-Square test. P value < 0.05 was considered statistically significant.

RESULTS

Study participants

In the present study, 29 petrol pump workers who continuously worked not less than one year in the petrol station and 10 healthy controls who never worked in petrol stations or petroleum industries were enrolled. All the participants were males. There was no significant (p=0.32) difference in the mean age of the petrol station workers (34.22±6.57) years and the controls (36.70±6.33) years. None of the participants had any chronic diseases like diabetes, hypertension, cardiac disease, or any other systemic illness at the time of the study. None of the participants was smokers or consumed alcohol. All the participants were enrolled for the study after signing informed consent forms (Table 1).

Renal and liver function

TSB was significantly (0.004) lower in the petrol station workers (0.48±0.43 mg/dL) as compared to the controls (0.70±0.22 mg/dL). The levels of cholesterol (192.35±36.34 vs. 159.00±24.24 mg/dL, p=0.023), TG (254.61±89.34 vs. 140.00±9.13 mg/dL, p<0.0001), and LDL (96.91±30.91 vs. 73.50±22.86 mg/dL, p=0.030) were significantly higher in the petrol station workers as compared to the controls. There was no significant difference seen in the levels of AST, ALT, ALP, Urea, Creatinine, VLDL, and HDL between the petrol station workers and the controls (Table 2).

Aminotransferase (AST), Alanine aminotransferase (ALT), Alkaline phosphatases (ALP), Total serum bilirubin (TSB), Triglycerides (TG), Very low-density lipoprotein (VLDL), Low-density lipoprotein (LDL), and High-density lipoprotein (HDL). Statistics used: Mann-Whitney U test was used to compare different parameters between two groups. A p-value <0.05 was considered statistically significant.

Table 1: Demographic features of the study participants

	Petrol station workers (n=29)	Controls (n=10)
Age, years (mean±SD)		
Gender	Males (n=29)	Males (n=10)
	Females (n=0)	Females (n=0)
Duration of work in the petrol station	>1 year	0
Any systemic or chronic disease	None	None
Smokers	None	None
Alcohol consumers	None	None

Table 2: Comparison of parameters between petrol pump workers (n=29) and controls (n=10)

Group	AST (Units/L)	ALT (Units/L)	ALP (Units/L)	TSB (mg/dL)	Urea (mg/dL)	Creatinine (mg/dL)
Petrol pump workers (n=29)	22.94±8.22	28.66±15.52	69.61±18.36	0.48±0.43	28.00±7.27	0.80±0.13
Controls (n=10)	22.00±4.83	23.60±11.34	68.00±9.19	0.70±0.22	28.00±6.33	0.68±0.23
P value	0.814	0.544	0.937	0.004	0.844	0.232

Table 2: Comparison of parameters between petrol pump workers (n=29) and controls (n=10) (Contd….)

Group	Cholesterol (mg/dL)	TG (mg/dL)	VLDL (mg/dL)	LDL (mg/dL)	HDL (mg/dL)
Petrol pump Workers (n=29)	192.35±36.34	254.61±89.34	51.00±17.88	96.91±30.91	44.48±10.12
Controls (n=10)	159.00±24.24	140.00±9.13	43.00±12.30	73.50±22.86	43.00±7.15
P value	0.023	0.000	0.189	0.030	0.503

DISCUSSION

The inhalation of petrol fumes poses a potential risk to health in the petrol station workers and the general population. The workers at the petrol stations attend cars regularly and control multiple fuel dispensers, hence are frequently exposed to petrol fumes. Chronic exposure to petrol fumes has been reported to cause haematological disorders like leukocytosis, lymphocytosis, lymphocytopenia, decreased red blood cells count, chronic liver disorders and cirrhosis (Pranjić *et al.,* 2003).

The halogenated hydrocarbons are reported to cause toxicity in the liver tissues. There are many mechanisms proposed to explain the cellular toxicity induced by these hydrocarbons. The important pathways related to toxicity caused by organic compounds especially the hydrocarbons are inflammation, cytochrome P450 dysfunction, mitochondrial dysfunction, and oxidative stress (Malaguarnera *et al.,* 2012). The liver is the most affected organ in the body by these exposures to toxic organic substances because it is the site for the detoxification. Although occupational exposures cause the highest damage to the liver, it remains underdiagnosed due to lack of awareness. The major issue in assessing liver damage is the difficulty in the quantification of occupational exposure of these toxic petrol fumes (Gunathilaka *et al.,* 2017). Since mostly the young population of a country usually is more involved in these jobs, there is an urgent need of spread of awareness and development of prevention and management strategies to reduce these occupational exposures (Gunathilaka *et al.,* 2017).

Benzene is an important component of petrol fumes. Recently it has been reported that petrol station workers had elevated levels of DNA damage, micronucleus, and reduction in leukocyte viability (Salem *et al.,* 2018). All the petrol station workers in this study were males. Similarly, in the present study, all the participants were males. This can be explained by the practice followed in the Arabian countries of engaging male employees in the jobs where night shifts are needed, and intensive hard work is involved (Salem *et al.,* 2018).

Neghab et al. (2015) recently conducted a study to understand the effects of petrol exposure on kidney and liver health. This study reported that petrol exposure was associated with liver and kidney dysfunction. The workers exposed to petrol fumes had lower albumin, serum protein, sodium, and calcium levels as compared to the healthy participants who did not have occupational exposure to petrol fumes. The workers who had occupational exposure to petrol fumes also showed higher se-

rum concentration of urea nitrogen, plasma creatinine, AST, ALT, and direct bilirubin (Neghab *et al.,* 2015). In contrast to these findings, in the present study, we did not observe any significant difference in the levels of AST, ALT, ALP, urea, and creatinine levels between the petrol station workers and the controls that did not have any petrol exposure. The workers and the controls had the mean levels of the liver and kidney enzyme activities and lipid profiles in the normal range. However, these petrol station workers had higher levels of serum cholesterol, TD, and LDL as compared to the non-exposed group (control group), which indicates that the workers are at higher risk of developing liver damage as compared to the controls.

The studies related to the effects of petrol fume exposure have reported mixed results. Akinosun et al20 has reported that there was no significant difference in the levels of AST, ALT total protein, total bilirubin, and albumin between the exposed and control groups (Akinosun *et al.,* 2006). Consistent with these findings in the present study we also did not observe any significant difference in the levels of AST, ALT, ALP, urea, and creatinine levels between the petrol station workers and the controls.

Studies have documented that petrol exposure resulted in kidney and liver dysfunctions (Pranjić *et al.,* 2003; Abdel Aziz *et al.,* 2006) but there is evidence suggesting that there is no effect of petrol exposure on the kidney function (Brautbar *et al.,* 2002). There are studies that report no significant effects on kidney function and liver functions, evident from no change in the levels of AST, ALT, and creatinine (Niaz *et al.,* 2015; NIOSH, 2003). In the present study also, we found no effect of petrol exposure on kidney function.

Studies have reported that dysregulation in the levels of TG and cholesterol is associated with hepatic toxicity (Arguello *et al.,* 2015). In an animal study, it was observed that exposure to motor fumes resulted in increased levels of cholesterol, HDL, LDL, and TG (Aberare *et al.,* 2011). In the present study, we observed significantly higher levels of cholesterol, TG, and LDL in the workers as compared to the controls. So, it can be hypothesized that these workers are at risk of hepatic toxicity.

This inconsistency in the findings related to the liver and kidney function markers in the present study and the normal serums levels of the markers may be explained by the observation that in Iraq, the drivers usually refuel the cars and hence the petrol station workers are less exposed to the petrol fumes. However, this observation cannot be generalized because of the cross-sectional nature of the study and the small sample size. To draw a conclusion, this study should be expanded to a larger cohort of workers and controls. Another limitation is the lack of quantification of the components of the petrol fumes in the participants. So, first the concentration or levels of different components of petrol fumes should be assessed to quantify the petrol exposure, and the participants should be classified on the basis of the levels of these components to compare with the controls. We observed decreased levels of serum total bilirubin in the exposed group as compared to the control group. This finding is in line with other reported studies where it has been reported that the workers who had occupational exposure to petrol fumes had decreased levels of serum total bilirubin (Ansari-Lari *et al.,* 2004).

Increased serum ALT and AST are indicators of acute liver diseases and abnormal levels of protein, albumin, and elevated serum creatinine are the indicators of renal disorders. There are several studies that report the ill effects of petrol exposure on liver and kidney health (Ansari-Lari *et al.,* 2004; Saadat *et al.,* 2005). Although we did not find any significant difference in terms of the levels of the enzyme markers of liver and levels of serum creatinine we observed higher levels of cholesterol, TG, and LDL (markers of liver damage) in the petrol station workers as compared to the controls, since all the parameters studied were in the normal levels in the workers exposed to petrol, it can be concluded that occupational exposure to petrol did not affect the liver and kidney health in the petrol station workers at Kirkuk. However, larger extensive studies should be conducted to evaluate the effect of petrol exposure on the health of the workers.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interest

The Author declares that there is no conflict of interest.

REFERENCES

Abdel Aziz, I.I., Al-Agha, S.Z., Shehwan, O.A. Hematological and biochemical studies for gasoline toxicity among gasoline workers in Gaza Strip. Journal of Al-Aqsa University, vol. 10, no. (S.E), 2006 pp. 41-58.

Aberare, O.L., Okuonghae, P., Mukoro, N., Dirisu, J.O., Osazuwa, F., et al. Triglycerides, total cholesterol, high-density lipoprotein cholesterol and low-density lipoprotein cholesterol in rats exposed to premium motor spirit fumes. North American journal of medicine & science, vol. 3, no. 6, June 2011 pp. 277-80.

Adami, G., Larese, F., Venier, M., Barbieri, P., Lo Coco, F., et al. Penetration of benzene, toluene and xylenes contained in gasoline through human abdominal skin in vitro. Toxicology In Vitro, vol. 20, no. 8, December 2006 pp. 1321-1330.

Akinosun, O.M., Arinola, O.G., Salimonu, L.S. Immunoglobulin classes and liver function tests in Nigerian petrol workers. Indian Journal of Occupational and Environmental Medicine, vol. 10, no. 2, August 2006 pp. 58-61.

Alegretti, A.P., Thiesen, F.V., Maciel, G.P. Analytical method for evaluation of exposure to benzene, toluene, xylene in blood by gas chromatography preceded by solid-phase microextraction. Journal of chromatography. B. Analytical technologies in the biomedical and life sciences, vol. 809, no. 1, September 2004 pp. 183-187.

Ansari-Lari, M., Saadat, M., Hadi, N. Influence of GSTT1 null genotype on the offspring sex ratio of gasoline filling station workers. Journal of Epidemiology and Community Health, vol. 58, no. 5, April 2004 pp. 393-394.

Arguello, G., Balboa, E., Arrese, M., Zanlungo, S. Recent insights on the role of cholesterol in non-alcoholic fatty liver disease. Biochimica et Biophysica Acta, vol. 1852, no. 9, September 2015 pp. 1765-78.

Benson, J.M., Gigliotti, A.P., March, T.H., Barr, E.B., Tibbetts, B.M., et al. Chronic carcinogenicity study of gasoline vapour condensate (GVC) and GVC containing methyl tertiary-butyl ether in F344 rats. Journal of Toxicology and Environmental Health, Part A, vol. 74, no. 10, 2011 pp. 638-657.

Brautbar, N., Williams II, J. Industrial solvents and liver toxicity a review study. International Journal of Hygiene and Environmental Health, vol. 205, no. 6, 2002 pp. 479-91.

Brown, K.W., Armstrong, T.J. Hydrocarbon Inhalation. 2018 Sep 8. Treasure Island (FL): StatPearls Publishing; 2018. Available from http://www.ncbi.nlm.nih.gov/books/NBK470289/ PubMed PMID: 29262161.

Gunathilaka, M.L., Niriella, M.A., Luke, N.V., Piyarathna, C.L., Siriwardena, R.C., De Silva, A.P., de Silva, H.J. Possible gasoline-induced chronic liver injury due to occupational malpractice in a motor mechanic: a case report. Journal of Medical Case Reports, vol. 11, no. 1, July, 2017 pp. 179.

Khisroon, M., Gul, A., Khan, A., Ali, N., Zaidi, F., et al. Comet assay based DNA evaluation of fuel filling stations and automobile workshops workers from Khyber Pakhtunkhwa province, Pakistan. Journal of Occupational Medicine and Toxicology.

Kirkeleit, J., Riise, T., Bråtveit, M., Moen, B.E. Increased risk of acute myelogenous leukaemia and multiple myeloma in a historical cohort of upstream petroleum workers exposed to crude oil. Cancer Causes Control, vol. 19, no. 1, February 2008 pp. 13-23.

Malaguarnera, G., Cataudella, E., Giordano, M., Nunnari, G., Chisari, G., Malaguarnera, M. Toxic hepatitis in occupational exposure to solvents. World Journal of Gastroenterology, vol. 18, no. 22, June 2012 pp. 2756-2766.

Neghab, M., Hosseinzadeh, K., Hassanzadeh, J. Early Liver and Kidney Dysfunction Associated with Occupational Exposure to Sub-Threshold Limit Value Levels of Benzene, Toluene, and Xylenes in Unleaded Petrol. Safety and Health at Work, vol. 6, no. 4, December 2015 pp. 312-6.

Niaz, K., Bahadar, H., Maqbool, F., Abdollahi, M. A review of environmental and occupational exposure to xylene and its health concerns. EXCLI Journal, vol. 14, November 2015 pp. 1167-1186.

NIOSH (National Institute for Occupational Safety and Health). Manual of analytical methods (NMAM) In Hydrocarbons, Aromatic: Method 1501. 4th ed., 3. Cincinnati (OH): National Institute for Occupational Safety and Health, 2003 pp. 4-7.

Okoro, A.M., Ani, E.J., Ibu, J.O., Akpogomeh, B.A. Effect of petroleum products inhalation on some haematological indices of fuel attendants in Calabar metropolis, Nigeria. Nigerian Journal of Physiological Sciences, vol. 21, no. 1-2, December 2006 pp. 71-5.

Periago, J.F., Prado, C. Evolution of occupational exposure to environmental levels of aromatic hydrocarbons in service stations. Annals of occupational hygiene, vol. 49, no. 3, April 2005 pp. 233-240.

Peters, C.E., Parent, M.É., Harris, S.A., Bogaert, L., Latifovic, L., et al. Canadian Cancer Registries Epidemiology Group. Occupational Exposure to Diesel and Gasoline Engine Exhausts and the Risk of Kidney Cancer in Canadian Men. Annals of Work Exposure and Health, vol. 62, no. 8, October 2018 pp. 978-989.

Pranjić, N., Mujagić, H., Pavlović, S. Inhalation of gasoline and damage to health in workers at gas stations. Medical Archives, vol. 57, no. 1, 2003 pp. 17-20.

Saadat, M., Ansari-Lari, M. Alterations of liver function test indices of filling station workers with respect of genetic polymorphisms of GSTM1 and

GSTT1. Cancer Letters, vol. 227, no. 2, September 2005 pp. 163-167.

Salem, E., El-Garawani, I., Allam, H., El-Aal, B.A., Hegazy, M. Genotoxic effects of occupational exposure to benzene in gasoline station workers. Industrial Health, vol. 56, no. 2, April 2018 pp. 132-140.

Smith, M.T. Advances in understanding benzene health effects and susceptibility. Annual Review of Public Health, vol. 31, 2010 pp. 133-148.

Tunsaringkarn, T., Siriwong, W., Rungsiyothin, A., Nopparatbundit, S. Occupational exposure of gasoline station workers to BTEX compounds in Bangkok, Thailand. International Journal of Occupational Medicine and Environmental Health, vol. 3, no. 3, July 2012 pp. 117-125.

Uboh, F.E., Ebong, P.E., Umoh, I.B. Comparative Hepatoprotective Effect of Vitamins A and E Against Gasoline Vapor Toxicity in Male and Female Rats. Gastroenterology Research, vol. 2, no. 5, October 2009 pp. 295-302.

Uhegbu Friday, O., Chinedu, I., Nkeiruka, I. Glory Effect of Exposure of Male Albino Rats to Kerosene, Diesel and Petrol on Kidney Function. International Research Journal of Environmental Sciences, vol. 4, no. 11, November 2015 pp. 12-18.