National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Biochemical assessment of the hepatic functions of the petrol pump workers of Jaipur city

Rahul[1], Nivedita Gupta[2], Sangeeta Vyas[3], Manisha Sankhla[3], Poonam Punjabi[3]

[1]Department of Medical, Health and Family Welfare, Government of Rajasthan, India, [2]Department of Biochemistry, S.M.S Medical College and Associated Hospitals, Jaipur, Rajasthan, India, [3]Department of Physiology, S.M.S Medical College, Jaipur, Rajasthan, India

Correspondenceto: Rahul, E-mail: drrahul5@yahoo.com

Received: May 05, 2017; **Accepted:** May 22, 2017

ABSTRACT

Background: In recent years, occupational health hazards have grown as one of the major public health issues worldwide. In this context, petrol pump workers were studied who by virtue of their occupation is continuously exposed to the various chemical substances and volatile organic compounds liberated in the form of gasoline vapors in their breathing zone. **Aims and Objectives:** To explore the effects of gasoline vapors on some biochemical parameters (the liver enzymes) among the petrol pump filling attendants working at various petrol pumps of Jaipur city. **Materials and Methods:** This study was conducted with 80 subjects (40 petrol pump workers working for more than three years at various petrol pumps of Jaipur city as study group and 40 matched male adults working as peons and ward boys in the different departments of the institute were considered as the control group). Liver enzymes were assessed using fully automated analyzer (Beckman Coulter AU680) available at the Central Biochemistry Laboratory in S.M.S Hospital Jaipur. Mean±standard deviation values for each parameter were determined for both the study and control groups and compared using an unpaired *t*–test, and $P < 0.05$ was considered significant. **Results:** Liver enzymes: serum glutamic pyruvic transaminase and serum glutamic oxaloacetic transaminase were found significantly higher among the petrol filling attendants in comparison to the control group, except serum alkaline phosphatase which was although higher in petrol filling attendants but statistically insignificant between the two groups. **Conclusions:** This study observed that the petrol pump workers are at greater risk of developing biochemical alterations in the hepatic enzymes with time. However, further longitudinal studies with larger sample size and regular follow-ups are required to get better insights into the results.

KEY WORDS: Gasoline Derivatives; Occupational Exposures; Petrol Pump Workers; Liver Enzymes

INTRODUCTION

An "occupational disease" is any disease contracted primarily as a result of an exposure to risk factors arising from work activity.[1] From the Indian perspectives, the major occupational diseases of concern have been silicosis, musculoskeletal injuries, coal workers' pneumoconiosis, asbestosis, byssinosis, pesticide poisoning, and noise-induced hearing loss for which various agencies such as the National Institute of Occupational Health, Industrial Toxicology Research Centre, and Central Labor Institute are strategically working to reduce the morbidities related to these diseases.[2]

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2017.7.0516622052017	

However, rapid urbanization and economic development in the past few years have further intensified the problems and complexities of occupational health-related issues.[2] There has been a significant rise in urban population of 62 million in 1951-286 million in 2001 and 377 million in 2011.[3] This phenomenal growth in urban population in India has led to an exponential rise in the vehicular traffic density leading to a

mushrooming of petrol filling stations to cater the increasing needs of the society.

At these petrol pumps, as there is no provision of self-service, the fuel filling attendants are employed for fueling of vehicles.[4] Apart from filling tasks, these fuel dispensers are also engaged in works like unloading of fuel and daily checking of fuel levels in the storage tanks.[5] In addition, these filling attendants are exposed to the emissions liberated from the tailpipes of the vehicles as many motorists usually do not turn down their vehicles while getting refueled thus, making these attendants substantially exposed to various gasoline derivatives.[6]

Gasoline is a complex combination of aliphatic and aromatic hydrocarbons of which Benzene, Toluene, ethylbenzene, xylene (BTEX) are some of its vital constituents and considered among the most hazardous compounds for the human health.[7,8]

According to occupational safety and health administration guidelines, the permissible exposure limits for BTEX is 1 ppm (3.19 mg/m^3), 200 ppm (750 mg/m^3), 100 ppm (435 mg/m^3), 100 ppm (435 mg/m^3), respectively, as a time-weighted average over an 8 h work shift.[9]

The European Union and the Expert Panel on Air Quality Standards, U.K, have announced that the mean annual standards of ambient air for benzene to be 5 μg/m^3 and 16.25 μg/m^3, respectively.[10] In India, the central pollution control board has established 5 μg/m^3 as the annual average ambient air quality standard concentration for benzene.[11]

However, studies conducted by Majumdar et al. in Kolkata,[12] Sehgal et al. in Delhi,[13] Singla et al. in Agra,[14] recognized high concentrations of benzene, toluene and xylene at the filling stations far exceeding than those laid down by the Indian national ambient air quality standards. Furthermore, many overseas studies such as Correa et al. in Rio de Janeiro[15] and Esmaelnejad et al. in Shahreza[16] observed high levels of BTEX at the filling stations.

Many harmful effects have been reported after exposure to the different chemical constituents present in gasoline. Breathing small amount of gasoline vapors are known to cause nose and throat irritation, headaches, dizziness, nausea, vomiting, confusion, and breathing difficulties.[17] At high concentrations, well defined and marked systemic pulmonary inflammatory responses have been observed in healthy human volunteers.[18]

Various epidemiological and experimental studies have also demonstrated that the hydrocarbons present in petroleum fumes adversely affect the physiological processes causing different forms of carcinogenic, neurotoxic, immunotoxic, genotoxic, and mutagenic manifestations.[19]

In India, the petrol filling attendants work continuously for 8-12 h a day without using any protective devices and maintaining personal hygiene.[4] In addition, many of these workers come from extreme rural areas and do not stretch back to their homes for months, but prefer to stay in their workplace. Besides this, they lack the basic information along with their work-related hazards and about the safety measures to be taken while handling such noxious chemical substances.

Hence, this study was conducted to explore the effects of gasoline vapors on some biochemical parameters (the liver enzymes) among the petrol pump filling attendants working at various petrol pumps of Jaipur city.

MATERIAL AND METHODS

This study was conducted in the Upgraded Department of Physiology, SMS Medical College, Jaipur, as a part of the Postgraduate Dissertation from September 2014 to December 2015 in association with the Central Biochemistry Laboratory, S.M.S Hospital, Jaipur. Before commencement of the study, the ethical approval was obtained from the Institutional Ethical Committee.

Two groups were formed in this study. Each group constituted 40 nonsmoker, nonalcoholic males in the age group of 20-40 years. The study group included the fuel filling attendants working at least 8 h/day for more than 3 years at various petrol pumps in Jaipur city. The control group was formed by the peons and ward boys working in the different departments of the institute not occupationally exposed to the petroleum fumes.

A written informed consent was obtained after explaining the procedure to the volunteers in the study. Each subject was then interviewed with a detailed questionnaire regarding their occupation, income and personal habits. A brief physical, anthropometric (height, weight, body mass index [BMI]), and clinical examination were carried out and recorded in pre-structured proforma. The subjects of both the groups without any history of acute or chronic illness, any type of known allergic conditions, history of any major surgery (Cardiac, pulmonary, abdominal), and drug history were included in the study.

Around 4 ml blood sample was drawn by venipuncture from a peripheral vein of the arm under aseptic precautions using standard protocols and was transferred in the plain tube for separation of serum and its utilization for estimation of liver enzymes.

Each plain tube containing the blood sample was labeled with a registration number issued for each subject by the computerized registration counter of the S.M.S hospital and was delivered within 2 h of the sample collection to the

Central Biochemistry Laboratory of the S.M.S Hospital for analysis using the Fully Automated biochemistry Analyzer Beckman Coulter AU680.

All the tests were carried out during the morning OPD hours between 8:30 am and 10:00 am to avoid possible diurnal variations. The volunteers in the study were instructed for overnight fasting and to avoid beverages such as tea, coffee, and other stimulants before reporting at the department for the tests.

Statistical Analysis

Each parameter of liver enzymes of each subject was expressed as mean ± standard deviation; statistical analysis was performed using unpaired Student's *t*-test and $P < 0.05$ was considered significant.

RESULTS

No statistically significant differences ($P > 0.05$) were observed in the means of age, height, weight, and BMI between study and control groups as depicted in Table 1. The mean exposure years to gasoline in the study group (Petrol pump workers) were observed to be 9.78 ± 3.29.

Table 2 depicts that all studied parameters of liver function tests were increased in the study group than the control group. This difference was statistically significant ($P < 0.05$) in all parameters of liver function tests except in serum alkaline phosphatase S. ALP.

Table 1: Distribution of study population, according to age and anthropometric parameters

Variables	Mean±SD		*P* value	Significance
	Petrol pump workers (*n*=40)	Control group (*n*=40)		
Age (years)	30.70±3.04	29.90±2.72	0.21	NS
Height (cm)	167.55±3.12	168.18±2.78	0.34	NS
Weight (kg)	61.70±3.95	63.25±4.89	0.12	NS
BMI (kg/m^2)	21.97±1.07	22.34±1.25	0.15	NS

NS: Not significant (*P*>0.05), SD: Standard deviation, BMI: Body mass index

DISCUSSION

In this study, the liver function tests were evaluated since the liver is considered as one of the primary organs of detoxification and various experimental and animal studies have also shown that the organic solvents used in petrol chemical industries affect the hepatic functions adversely.[20,21]

Among the battery of liver function tests, the liver enzymes: Serum glutamic pyruvic transaminase (SGPT), serum glutamic oxaloacetic transaminase (SGOT), and serum alkaline phosphatase (S. ALP) were measured and compared between the petrol pump workers and the control group.

SGPT and SGOT are enzymes present predominantly in the hepatocytes and spill into the bloodstream whenever the liver cells are damaged, so these enzymes are seen as sensitive biomarkers of liver cell injury.[20] S. ALP is another enzyme which apart from its diverse sources like bones and placenta, is also concentrated in the cells lining the biliary ducts of the liver and are being often associated with its elevated plasma levels in cases of biliary obstruction and diseases of the biliary tract.[20]

In this study, although the mean values of SGPT, SGOT, SALP were observed within their respective reference ranges, still these enzymes were found significantly higher among the petrol filling attendants in comparison to the control group, except SALP which was although higher in petrol filling attendants but statistically insignificant between the two groups. Moreover, 25% of the fuel filling attendants working for more than 10 years at various petrol filling stations were found to have elevated levels of SGPT suggesting that the petrol filling attendants are at greater risk of developing hepatocellular injury with time.

Similar findings were reported in the surveys conducted by Saadat and Ansari-Lari (2005),[22] Neghab et al. (2015).[23] In 1998, Michailova et al. also found a substantial increase in the serum activities of SGPT and SGOT in oil industry workers.[24]

The findings of this study were also, in accordance with the research work conducted by Mahmood (2012), which observed higher serum transaminases activity in the

Table 2: Comparison of liver function tests parameters in petrol pump workers and control

Liver function tests parameters	Mean±SD		*P* value	Significance
	Petrol pump workers (*n*=40)	Control group (*n*=40)		
SALP (IU/L)	82.05±20.0	75.26±19.70	0.13	NS
SGOT (U/L)	31.09±13.49	23.38±5.37	0.001	S
SGPT (U/L)	36.94±17.75	24.79±11.95	0.006	S

NS: Not significant (*P*>0.05), S: Significant (*P*≤0.05), SD: Standard deviation, S. ALP: Serum alkaline phosphatase, SGOT: Serum glutamic oxaloacetic transaminase, SGPT: Serum glutamic pyruvic transaminase

fuel-filling workers of Sulaimani City compared to the controls though these values were still within the normal accepted range for clinical diagnosis of hepatic injury.[19]

Earlier, Nwanjo and Ojiako (2007) too, found a significant increase in the activities of serum aspartate and alanine aminotransferases and alkaline phosphatase in petrol station attendants with long-term exposure (6-10 years) to petrol vapors in comparison to the control group.[25]

However, the observations regarding the liver functions in the present study were in contrast to the findings of Akinosun et al. (2006) which did not reveal any difference in the levels of liver enzymes in both petrol filling attendants and the controls except for significantly lower levels of Alkaline Phosphatase.[20]

Such differences in the findings of various research works, including this study are quite possible, might be due to the variations in the duration and concentrations to which the fuel filling attendants are exposed, methodology adopted, differences in handling of the potential confounding factors such as age, sex, BMI, personal habits (smoking and alcohol intake), and use or neglect of personal protective devices in the workplace.[23]

The possible metabolic mechanisms for the underlying alterations in the liver enzymes as proposed by the various investigators worldwide are that following inhalation, benzene and the other hydrocarbons present in gasoline are readily absorbed from the lungs and get metabolized in the liver by CYP450 2E1 oxidative pathways which contribute to the production of free radicals and quinine metabolites such as phenol, hydroquinone, benzoquinone; 1,2,4 benzenetriol.[26] These free radicals and toxic metabolites cause lipid peroxidation and damage of hepatic cell membrane, causing the release of liver enzymes in the circulation.[26,27]

As this study was limited to a small sample size, so it would be premature to generalize the results of this study to the entire population of petrol pump workers; however, it cannot be also denied that the outcomes of such occupations become apparent after a number of years. Thus, it is imperative to recognize the possible dangers early and take important measures before they result into permanent morbidities.[28]

Hence, to prevent such occupational hazards, health education and training programs should be carried out for the workers, supervisors and owners. Furthermore, regular health checkups and use of the personal protective measures at the filling stations are needed to be employed by the employer for the protection and healthy well-being of these workers.[29]

In western countries, rubber hood over the delivery pump and self-service at the fuel filling stations have been utilized to limit the exposure of attendants to gasoline fumes.[29] Moreover, various technical and legal processes that restrict the emission of gasoline vapors during storage and transit operations has been implemented by the European Union, which have led to a noteworthy reduction in the benzene levels in the breathing air of gas station workers.[5] However, such standardizations in India are required to be built up and followed strictly.

Furthermore, the research on the concept of bio-diesel, which is still in its infancy, should be explored, as it may serve as a boon to cope with the adverse effects of the noxious chemical constituents of gasoline vapors in the near future.[30]

CONCLUSIONS

This preliminary study observed that the petrol pump workers are at greater risk of developing biochemical alterations in the hepatic enzymes with time; however, studies with larger sample size and regular follow-ups on various health aspects including the liver functions among these workers are required to get a better insight into the results.

ACKNOWLEDGMENTS

This study was a part of Postgraduate M.D. dissertation of the first author Dr. Rahul under the supervision of Prof. (Dr.) Sangeeta Vyas, with substantial contributions of the co-authors. The Authors would like to thank Dr. Kusum Lata Gaur, Professor, Department of Community Medicine, S.M.S Medical College, Jaipur, for her valuable support and timely guidance to carry out this research work.

REFERENCES

1. WHO. Occupational and Work Related Diseases. Available from: http://www.who.int/occupational_health/activities/occupational_work_diseases/en. [Last accessed on 2015 Dec 08].
2. Saiyed HN, Tiwari RR. Occupational health research in India. Ind Health. 2004;42(2):141-8.
3. Bhagat RB. A turn around in India's urbanization. Asia Pac Popul J. 2012;27(2):23-39.
4. Kesavachandran C, Rastogi SK, Anand M, Mathur N, Dhawan A. Lung function abnormalities among petrol-pump workers of Lucknow, North India. Curr Sci. 2006;90(9):1177-8.
5. Periago JF, Prado C. Evolution of occupational exposure to environmental levels of aromatic hydrocarbons in service stations. Ann Occup Hyg. 2005;49(3):233-40.
6. Aleemuddin M, Babu MG, Manjunath ML, Quadri SS. Effects of chronic inhalation of petroleum products on hematological parameters. Int J Curr Res Acad Rev. 2015;3(4):196-201.
7. Lagorio S, Forastiere F, Iavarone I, Rapiti E, Vanacore N, Perucci CA, et al. Mortality of filling station attendants. Scand J Work Environ Health. 1994;20(5):331-8.
8. Rezazadeh Azari M, Naghavi Konjin Z, Zayeri F, Salehpour S,

Seyedi MD. Occupational exposure of petroleum depot workers to BTEX compounds. Int J Occup Environ Med. 2012;3(1):39-44.
9. NIOSH. NIOSH Pocket Guide to Chemical Hazards, Report No. 2005-149, DHHS (NIOSH) Publication; 2007. Available from: http://www.cdc.gov/niosh/docs/2005-149/pdfs/2005-149.pdf. [Last assessed on 2015 Dec 08].
10. Edokpolo B, Yu QJ, Connell D. Health risk assessment of ambient air concentrations of benzene, toluene and xylene (BTX) in service station environments. Int J Environ Res Public Health. 2014;11(6):6354-74.
11. National Ambient Air Quality Status; 2009. Central Pollution Control Board. New-Delhi: Ministry of Environment and Forests, Government of India. Available from: http://www.cpcb.nic.in/upload/Publications/Publication_514_airqualitystatus2009.pdf. [Last assessed on 2015 Dec 08].
12. Majumdar D, Dutta C, Mukherjee AK, Sen S. Source apportionment of VOCs at the petrol pumps in Kolkata, India; exposure of workers and assessment of associated health risk. Transp Res D Transp Environ. 2008;13(8):524-30.
13. Sehgal M, Suresh R, Sharma VP, Gautam SK. Variations in air quality at filling stations, Delhi, India. Int J Environ Stud. 2011;68(6):845-9.
14. Singla V, Pachauri T, Satsangi A, Kumari KM, Lakhani A. Comparison of BTX profiles and their mutagenicity assessment at two sites of Agra, India. ScientificWorldJournal. 2012;2012:272853.
15. Correa SM, Arbilla G, Marques MR, Oliveira KM. The impact of BTEX emissions from gas stations into the atmosphere. Atmos Pollut Res. 2012;3(2):163-9.
16. Esmaelnejad F, Hajizadeh Y, Pourzamani H, Amin MM. Monitoring of benzene, toluene, ethyl benzene, and xylene isomers emission from Shahreza gas stations in 2013. Int J Environ Health Eng. 2015;4(1):1-7.
17. Pranjic N, Mujagic H, Nurkic M, Karamehic J, Pavlovic S. Assessment of health effects in workers at gasoline station. Bosn J Basic Med Sci. 2002;2(1-2):35-45.
18. Salvi S, Blomberg A, Rudell B, Kelly F, Sandström T, Holgate ST, et al. Acute inflammatory responses in the airways and peripheral blood after short-term exposure to diesel exhaust in healthy human volunteers. Am J Respir Crit Care Med. 1999;159(3):702-9.
19. Mahmood NM. Relationship between exposure to petrol products and the trace metal status, liver toxicity and hematological markers in gasoline filling workers in Sulaimani city. J Environ Occup Sci. 2012;1(1):6-11.
20. Akinosun OM, Arinola OG, Salimonu LS. Immunoglobulin classes and liver function tests in Nigerian petrol attendants. Indian J Occup Environ Med. 2006;10(2):58-61.
21. Uboh FE, Ebong PE, Akpan HD, Usoh IF. Hepatoprotective effect of vitamins C and E against gasoline vapor-induced liver injury in male rats. Turk J Biol. 2012;36:217-23.
22. 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 Lett. 2005;227(2):163-7.
23. 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. Saf Health Work. 2015;6(4):312-6.
24. Michailova A, Kuneva T, Popov T. A comparative assessment of liver function in workers in the petroleum industry. Int Arch Occup Environ Health. 1998;71 Suppl: S46-9.
25. Nwanjo HU, Ojiako OA. Investigation of the potential health hazards of petrol station attendants in Owerri Nigeria. J Appl Sci Environ Manage. 2007;11(2):197-200.
26. Bahadar H, Mostafalou S, Abdollahi M. Current understandings and perspectives on non-cancer health effects of benzene: A global concern. Toxicol Appl Pharmacol. 2014;276(2):83-94.
27. Uboh FE, Ebong PE, Umoh IB. Comparative hepatoprotective effect of vitamins A and E against gasoline vapor toxicity in male and female rats. Gastroenterology Res. 2009;2(5):295-302.
28. Benjamin OA. Fundamental Principles of Occupational Health and Safety. 2nd ed. Geneva: International Labor Organization; 2008. p. 65.
29. Udonwa NE, Uko EK, Ikpeme BM, Ibanga IA, Okon BO. Exposure of petrol station attendants and auto mechanics to premium motor sprit fumes in Calabar, Nigeria. J Environ Public Health. 2009;2009:281876.
30. Annamalai K. The status of biodiesel as an alternative fuel for diesel engine-an overview. J Sustain Energy Environ. 2011;2(2):71-5.

How to cite this article: Rahul, Gupta N, Vyas S, Sankhla M, Punjabi P. Biochemical assessment of the hepatic functions of the petrol pump workers of Jaipur city. Natl J Physiol Pharm Pharmacol 2017;7(10):1099-1103.

Source of Support: Nil, **Conflict of Interest:** None declared.