Original Article

Harmful Outcome of Occupational Exposure to Petrol: Assessment of Liver Function and Blood Parameters among Gas Station Workers in Kermanshah City, Iran

Abstract

Background: Petrol is an integral ingredient in industrial world. According to the US Agency for Toxic Substances and Disease Registry, there are typically more than 150 chemicals in petrol, including small amounts of benzene, toluene, xylene, ethyl benzene, and trace amounts of some contaminants, such as lead. The aim of this study was to measure the possible deleterious effect of long-term exposure to petrol on blood parameters and liver function. **Methods:** This is a case–control study conducted on 160 participants. Among them, 80 participants worked in a gas station for at least 4 years and 80 participants appeared with no history of occupational exposure to petrol. Blood sample was taken at the time of admonition to the tardive office at each station at 10 AM to measure the association of number of total and differential leukocyte and liver functions. **Results:** Based on the results, significant reduction in total leukocyte numbers was found in exposed group compared to unexposed group (1347 ± 4.59, <0.001). However, there was a significant increase in neutrophil (75.9 ± 3.50 in exposed group compared with 58.9 ± 3.15 among unexposed group, $P < 0.001$). However, no significant difference was found in liver enzymes between both groups. **Conclusions:** Long-term exposure to petrol fumes has deleterious effect on white blood cells. A significant reduction in the number of total and differential lymphocyte seems to be attributed to the toxic effect of petrol ingredients.

Keywords: *Blood parameters, exposure, gas stations, liver, occupational*

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Introduction

Petrol is an integral ingredient in industrial world.[1] Petrol is a volatile inflammable petroleum derived from a combination of liquid matrix primarily used for internal combustion of machines.[2] Human exposure to petrol vapor is suggested to affect human health statues through not only inhalation but also ingestion.[3] According to the US Agency for Toxic Substances and Disease Registry, there are typically more than 150 chemicals in petrol, including small amounts of benzene, toluene, xylene, ethyl benzene, and trace amounts of some contaminants, such as lead. The aromatic hydrocarbons such as benzene, toluene, ethylbenzene, and xylene (collectively labeled: BTEX) are simultaneously present in crude oil;[4] while benzene (Group 1) and ethylbenzene (Group 2) have been classified as carcinogens, the main concern for exposures to toluene and xylene is their effects on the central nervous system. Exposure to petrol is known to contribute to neurological, inhalation, and teratogenic disorders.[3,5] Some people are at higher risk of exposure to gasoline vapors including those working in gas station, truck drivers, and refinery workers.[3]

Gas station is identified to play important roles in occupational exposures.[6] In fact, chronic exposure to petroleum due to inhalation of aromatic hydrocarbons seems to be a significant contributing factor to such problems.[7] Kerosene and petrol are distilled from crude petroleum including aliphatic, aromatic, and a variety of other branched, both saturated and unsaturated, hydrocarbons.[4] Occupational disease due to exposure to petrol in gas station workers is known as one of the worldwide health issue and its fatal and nonfatal incidents are rising constantly in both developing and developed countries.[5] Based on the Nancy's report, urinary toluene was found to be a useful biomarker for toluene exposure. In addition to the Tanasorn's results, gasoline workers have high

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chances of cancer risk from daily exposure to benzene and formaldehyde.[8]

Hepato- and nephrotoxicity are the consequences of both human and animal exposure to unleaded petrol.[9] Benzene (C_6H_6), an ingredient of petrol, is identified as a carcinogen which induces cytochrome P_{450}, leading to biological and health problems.[10] Among occupations with high amount of respiratory disorders, gas station comes with the highest rate.[11] C_6H_6 may cause deleterious effect on various vital tissues of the body including bone marrow, which in turn leads to changes in the blood cells.[10] The aim of this study was to measure the possible deleterious effect of long-term exposure to petrol on blood parameters and liver function among workers in gas stations in Kermanshah city.

Methods

This is a case–control study conducted on eighty males working in a gas station for at least 4 years and the eighty participants appeared with no history of occupational exposure to petrol in twenty gas stations in Kermanshah city in Iran. Participants were selected through convenience sampling method.

Selection of study group

All participants took an interview in which the history of occupational exposure was questioned.

Inclusion criteria

All participants were male in the age group of 25–50 years with no history of smoking, acute infection, systemic illness, and family history of malignancy.

Exclusion criteria

Those who reported any of the above-mentioned factors at any stage of the study were excluded.

An interview-administered questionnaire was used to collect information on the history of exposure. At the end of the interview, blood sample was taken at the time of admonition to the tardive office at each station at 10 AM. All blood samples were analyzed by an automated hematological analyzer to measure white blood cells (WBCs) including neutrophils, lymphocytes, monocytes, and leukocytes in the Razi pathology laboratory.

A volume of 4.5 ml of venous blood was collected from the peripheral vein (median cubital vein) and then transferred to an anticoagulant bottle immediately in which 2 ml blood was collected in a plastic tube for liver function tests including aspartate aminotransferase (AST) and alanine aminotransferase (ALT). The sample was kept under room temperature to be transferred to the laboratory. Each sample was centrifuged and kept in the freezer at −70°C to be processed. Finally, the total and differential leukocyte numbers were measured.

Data analysis

Data were analyzed using SPSS version 19 (IBM Corp., Chicago, IL, USA). The main study variables included both qualitative and quantitative measures. To conduct analysis, test of normality was done through Kolmogorov–Smirnov test. Univariate (Chi-square and independent sample *t*-tests) analysis was used to determine unadjusted association of the study variables with exposure to petrol. The study variables include both quantitative (age, total leukocyte count [TLC], neutrophil, leukocyte, lymphocyte, and monocyte**)** and qualitative (AST and ALT) measures.

Results

The demographic characteristic of participants against the statues of history of exposure to petrol is as follows: all participants were male and were of 20–50 years of age. The participants in the exposed group were older (35.01 ± 7.19 years among exposed compared to 34.82 ± 7.19 years among controls, $P = 0.86$) and fairly obese (25.55 ± 13.40 kg/m^2 among exposed group compared with 24.18 ± 1.56 kg/m^2 among unexposed group, $P = 0.36$) [Table 1]. According to the results, petrol workers had predominantly lower rate of TLCs (6200 ± 1324.12 among those with exposed group compared to 7547 ± 365.31 among unexposed group, $P < 0.001$) and differential leukocytes (20.4 ± 5.48 among exposed group compared to 29.94 ± 3.18 among unexposed group, $P < 0.001$). Moreover, the mean of TLC in exposed (6200 ± 1324.12) and unexposed groups (1324.12 ± 365.31) was significantly different ($P < 0.001$).

The mean of leukocytes was significantly different among exposed (20.4 ± 3.50) and control groups (29.94 ± 3.15, $P < 0.001$) [Table 2]. However, no significant difference was found in liver enzymes between both groups [Table 3].

Discussion

This is a cross-sectional study that examined the relationship between physiological factors and being exposed to petrol. In the present study, significant association between neutrophil and eosinophil with being exposed to petrol was found which is in accordance with the study conducted by Hall in both animals and humans, suggesting that the long-term exposure to petrol has a deleterious effect on WBCs.[12] Due to the fact that the primary function of WBC is to defend the body against infectious agents, neutrophils are known to destroy invading agents with phagocytosis and also releasing the antimicrobial compounds from their granules. In addition, eosinophils are mainly antiallergic and important in defense against parasitic infections. Basophils play an important role in repairing both inflammation and tissue because of injury. Lymphocytes are concerned with cellular and humoral immunities. Monocytes are phagocytic and can also act as immune regulatory cells.[12] Results of the present study showed that the mean of WBCs was significantly

Table 1: Mean of age in exposed and unexposed groups

Parameter	Exposed group (*n*=80)	Unexposed group (*n*=80)	
	Mean±SD	Mean±SD	*P*
Age	35.01±7.19	34.82±7.19	0.86
BMI	25.55±13.40	24.18±1.56	0.36

SD=Standard deviation, BMI=Body mass index

Table 2: Mean of differential blood parameter count among exposed and unexposed groups

Parameters	Exposed group (*n*=80)	Unexposed group (*n*=80)	
	Mean±SD	Mean±SD	*P*
Neutrophil	75.9±3.50	58.9±3.15	<0.001
Leukocyte	20.4±5.48	29.94±3.18	<0.001
Lymphocyte	6.35±3.7	3±1.34	<0.001
Monocyte	2.3±0.43	1.8±0.62	<0.001

Independent sample *t*-test. SD=Standard deviation

Table 3: Liver enzymes of the study groups

Parameters	Exposed group (*n*=80)	Unexposed group (*n*=80)	*P*
AST* (U/L)			
>45 U/L	13 (17.6)	11 (16.7)	0.65
≤45 U/L	67 (82.4)	69 (83.3)	
ALT** (U/L)			
>45 U/L	11 (14.8)	9 (14.9)	0.63
≤45 U/L	69 (85.2)	71 (85.1)	

*AST=Aspartate aminotransferase, **ALT=Alanine aminotransferase

different between both groups. However, compared with exposed group, unexposed group had higher rate of TLC. Results of the current study also indicated that compared to individuals with no history of exposure to petroleum, those with such history had higher rate of neutrophils, lymphocytes, and leukocytes. The results of the present study suggested significant difference between all blood parameters in both exposed and unexposed groups, which is fairly in accordance with the study of Abubakar *et al*. and Aleemuddin *et al*. In that study, despite a difference between exposed and unexposed groups in lymphocyte, it is not significant.[13] In addition, TLC was significantly different between exposed and unexposed groups.[14] In the present study, a significant association was found between all blood parameters. Moreover, a significant reduction in the WBCs may be attributed to the cytotoxic compounds present in petrol. What is more, the effect of petrol exposure on the blood parameters was significantly different among both groups. Benzene is suggested to be activated in the bone marrow. Its cytotoxic effects are, therefore, mediated through disturbances in DNA function.[15] These results are highly in accordance with the report published by Aleemuddin *et al*.[14] However, Ita and Udofia reported an increase in WBCs in those being exposed to petrol. The author attributed the results to the high rate of infection in cases due to immunosuppressant effect of toxic petrol products, which in turn leads to an increase in WBC.[16]

In addition, a significant reduction in lymphocyte was found in the differential leukocyte count, which is in accordance with the results of the study conducted by Ita and Udofia. Furthermore, reduction in the rate of lymphocyte in those who exposed to petrol suggests that some constituents in the petrol can suppress the immune system following chronic exposure.[16] Increase in the rate of neutrophil and eosinophil, due to predisposition of the individuals to various infection. However, Singh reported a significant decrease in the number of eosinophils.[17]

Numerous studies are conducted on the number of total and differential WBCs. However, not all the study results are universally consistent. For example, in the current study, an inverse and significant association between the rate of WBC and being exposed to petrol was found, suggesting that the more inclusion of bone marrow, the more decrease in neutrophil and eosinophil measures.

Limitation

It was difficult to access all workers of gas station. As a result, the study samples were not enough to collect the blood for measuring hem factors.

Conclusions

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.

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Conflicts of interest

There are no conflicts of interest.

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