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EFFECT OF CHRONIC GASOLINE INHALATION ON THE HAEMATOLOGICAL PARAMETERS AND PEAK EXPIRATORY FLOW RATE AMONG PETROL PUMP WORKERS OF METROPOLITAN CITY

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ABSTRACT

Background: Explosive growth of the automotive industry concomitant with globalization, urbanization, and accelerated economic development has contributed to work-related ill-health and injuries due to exposure to petroleum fumes. Oxidative stress, chromosomal aberrations, DNA damage, disruption of cell cycle are some of its adverse effects resulting in considerable morbidity.In view of its health effects this study was undertaken to determine its impact on human physiological parameters in asymptomatic gas station workers.

Method: A test group of 50 asymptomatic petrol pump workers and a control group of 50 male hospital staff workers not living in the vicinity of any petrol pump were investigated for haematological parameters and PEFR after fulfilling requisite inclusion and exclusion criteria and results studied.

Results: Petrol pump workers had statistically significant lower mean haemoglobin content, red and white blood cell counts and PEFR as compared to control group.

Conclusion: Thus, this study suggests that early screening, diagnosis, intervention and referral along with application of safety measures to reduce exposure to gasoline vapours is essential.

INTRODUCTION:

According to the International Labour Organization, at least 2 million of the estimated 2.7 billion workers die every year from work-related ill-health and injuries, about 160 million people suffer from work-related diseases (WRDs). Additionally, about 4% of the world's GDP (1.25 trillion dollars) is lost because of work-related health problems. Of these, those caused by exposure to chemical agents (organic solvents) has become a major concern, one of which is exposure to gasoline vapours as a result of explosive growth of the automotive industry concomitant with globalization, urbanization, and accelerated economic development.

Among those highly exposed to petroleum fumes are workers working in gasoline stations who spend a full work-day exposed to gasoline vapours from different sources, like losses from underground tanks, displacement vapour, losses from filler pipes during refueling, fuel spillage, and evaporative and exhaust pipe emissions from motor vehicles. During refueling the vapour-saturated air is expelled through the filling channel around the nozzle, and into the breathing zone of the service attendant filling the tank.

Petrol or Gasoline is a volatile liquid which consists of aliphatic and aromatic hydrocarbons and additives. Toxicological studies indicate that its volatile BTEX compounds (benzene, toluene, ethylbenzene, and xylene) are most toxic to humans as they are gradually released into the air and may exist as vapour and a water-soluble fraction. Of these Benzene (C_6H_6) a clear, colourless, non-corrosive, highly inflammable liquid and is designated as the most important and toxic chemical. It is also an intrinsic component of tobacco smoke and tobacco smokers have higher body burden of benzene than non – smokers. It causes oxidative stress, chromosomal aberrations, DNA damage, disruption of cell cycle and programmed cell death. It is a well known carcinogen and its exposure is associated with adverse effects on hepatic, renal, lung and central nervous systems and risk of haematologic abnormalities like aplastic anaemia, leukaemia, lymphoma, and pancytopenia. The seriousness of poisoning depends on route, amount and length of exposure. Acute exposure to petrol vapours at low doses causes irritation to the eyes, respiratory tract and skin. Exposure to higher concentration of vapour may produce CNS effects such as staggered gait, slurred speech and confusion. Very high concentration may result in rapid unconsciousness and death due to respiratory failure.

Pulmonary sequelae following inhalation of petrol vapour or secondary to pulmonary elimination of volatile hydrocarbons (following ingestion or dermal absorption) include symptoms like chronic cough, breathlessness, wheezing, persistent atelectasis and petechial haemorrhage. This may be associated with concomitant 'Hydrocarbon hepatitis' secondary to vascular endothelial damage, possibly due to hydrocarbons induced degeneration of fatty tissue. With occupational exposure to BTEX it is found that exposure to benzene from petrol vapour caused haematotoxicity among petrol pump workers. In view of the above health effects this study was undertaken to determine its impact on human physiological parameters in asymptomatic gas station workers

Method:

After approval of the institutional ethics committee, the study was carried out at Lokmanya Tilak Municipal Medical College & General Hospital, a tertiary care medical institute of Municipal Corporation Mumbai, after obtaining informed and signed consent from 100 young healthy male adult voluntary participants, in the age group of 20- 40 years. The sample size of 100 was divided into two groups of 50 each. One, a test group consisting of 50 petrol pump workers and the other control group of 50 male hospital staff workers not living in the vicinity of any petrol pump. Those who fulfilled the following inclusion and exclusion criteria were selected.

Inclusion criteria for test group:

- Normal healthy young male adults
- Age group 20 years to 40 years.
- Working for not less than 5 years at petrol pump.
- Co-operative and capable of understanding the procedure.

Inclusion criteria for control group:

- Normal healthy young male adults

- Age group 20 years to 40 years.
- Not residing or working near petrol pumps.
- Co-operative and capable of understanding the procedure.

Exclusion criteria:
- Subjects suffering from any major past and present illness
- Alcoholics and smokers

Detailed history regarding any major illness in the past and present illness was taken. General examination including pulse, respiratory rate & blood pressure was done. The chest was examined for any deformity. Systemic examination was carried out to rule out any major diseases.

Materials Used:
- Digital blood pressure monitor (Omron Sphygmomanometer)
- Wright's Peak Flow Meter
- Automated Haematology Analyzer (Sysmex machine).

Method:
Blood was collected for haematological tests between 9 am to 12 pm after light breakfast. About 2.5 mL venous blood from the antecubital vein of each participant was taken with the help of a 10-mL disposable plastic syringe and immediately transferred to a sterile vacutainer, containing potassium–EDTA anticoagulant. All samples were analyzed in the most immediate time. All blood samples were analyzed for haemoglobin content, RBC & WBC count by the department of Pathology using fully automated haematology analyzer (Sysmex). Following blood collection, on the same day, peak expiratory flow rate was recorded after each comfortably seated subject was explained and demonstrated and made to practice the breathing maneuvers. The test was performed three times and the best reading was considered for analysis. Data was analyzed using SPSS software ver.20, and unpaired 't' test was applied and to obtain the results.

Results:

Table 1: Demographic variables

	Petrol pump workers (n = 50) (MEAN ± SD)	Control group (n = 50) (MEAN ± SD)	p Value
AGE	30.84 ± 4.99	33.12 ± 4.16	0.16
BMI	23.51 ± 2.56	24.08 ± 2.27	0.24

p> 0.05 – statistically not-significant, p < 0.05 – statistically significant*, p< 0.01 – statistically highly significant**

There are no significant differences between the means of both the groups, p value for both age and BMI > 0.05. Age and BMI in both the groups were comparable.

Table 2: Comparison of Hbgm% in Study group

Parameter	Group I (MEAN ± SD)	Group II (MEAN ± SD)	p Value
Hbgm%	12.25 ± 1.43	15.09 ± 0.90	< 0.01**

p> 0.05 – statistically not significant, p < 0.05 – statistically significant*, p< 0.01 – statistically highly significant**

Mean value of Hbgm% in group II is higher in comparison to that of group I and the difference is statistically highly significant.

Table 3: Comparison of RBC Count (cells in millions/mm^3) in Study group

Parameter	Group I (MEAN ± SD)	Group II (MEAN ± SD)	p Value
RBC Count (cells in millions/mm^3)	4.38± 0.66	5.26± 0.46	< 0.01**

p> 0.05 – statistically not significant, p < 0.05 – statistically significant*, p< 0.01 – statistically highly significant**

Table 3 shows, the mean value of RBC count in group II is higher than that of group I and the difference is statistically highly significant.

Table 4: Comparison of WBC (cells in thousands/mm3) count in Study group

Parameter	Group I (MEAN±SD)	Group II (MEAN±SD)	p VALUE
WBC Count (cells in housands/mm^3)	5.24± 0.73	7.59± 1.14	< 0.01**

p> 0.05 – statistically not significant, p < 0.05 – statistically significant*, p< 0.01 – statistically highly significant**

Table 4 shows, the mean value of WBC count in group II is higher than that of group I and the difference is statistically highly significant.

Table 5 : Comparison of PEFR (L / min) in Study group

Parameter	Group I (MEAN±SD)	Group II (MEAN±SD)	p VALUE
PEFR (L / min)	453.40± 59.13	567.60± 31.53	< 0.01**

p> 0.05 – statistically not significant, p < 0.05 – statistically significant*, p< 0.01 – statistically highly significant**

Table 5 shows, the mean value of PEFR in group II is higher than that of group I and the difference is statistically highly significant.

DISCUSSION:
In India, rather than self-service, petrol pumps are manned by attendants, who as a result are continuously exposed to gasoline vapours. This study was designed to evaluate the effect of chronic gasoline inhalation on haematological parameters and peak expiratory flow rate among asymptomatic the petrol pump workers.

Haematological parameters:
For clinical assessment of benzene toxicity the principal screening tool is a complete blood count[25]. Petrol pump workers had statistically significant lower mean haemoglobin content, red blood cell and white blood cell counts as compared to control group as shown in Table 2, 3 and 4 respectively . Similarly, A. M. Okoro et al.[20], Lavanya M, et al. [18] found lower haemoglobin concentration, Ali A. A. Sahb[3], M. Lavanya et al.[18], Madhura Yogesh Bedekar et al.[19] found lower RBC count and Madhura Yogesh Bedekar et al. found lower total leucocyte count of petrol pump workers as compared to control in their respective studies.

Prosper Opute et al.[21] in their study found that reduction in red blood cell count was associated with excessive haemolysis and inhibition of haematopoesis due to reduced production of erythropoietin from the kidney [16]. Decrease in white blood cell count was attributed to the toxic effect of the ingredients of petrol on progenitor cells of WBC in the bone marrow [7]. A study conducted by S. O. Ita and U.A. Udofia in rats, observed an increase rather than a decrease, in WBC count in petrol group and suggested the possibility of increased infection in this group due to immunosuppressant effect of toxic petrol products which in turn probably lead to an increase in WBC count .[15] The findings of various studies differ regarding the total WBC count and probably depend on the extent of bone marrow involvement.

These effects could be due to benzene and xylene, as reported by d'Azevedo et al.[11].Benzene is reported to be activated in the bone arrow and cytotoxic effects are mediated through disturbances in DNA function which causes pancytopenia and could lead to bone marrow aplasia[20].These changes could lead to impaired migration of phagocytic cells,

compromised effect on humoral immune responses causing lowered resistance to viruses, bacteria and foreign bodies.[2]LikeBenzene, Lead[14] reportedly causes cytotoxic effects on bone marrow, mediated through abnormal DNA function. Xylene another toxic component of gasoline has been found to cause leucopenia[11].

Peak expiratory flow rate:

In the present study the mean value of PEFR is reduced in petrol pump workers as compared with control group as shows in Table-5 and graph 4 and the difference is statistically significant ($p < 0.05$).

This finding is in compliance with the previous studies conducted by Sharma et al.[3], Choudhari et al.[10] and Aprajita et al.[5]which also demonstrated a significant decline in PEFR.

The respiratory tract is highly vulnerable and most commonly affected system to gasoline toxicity; the hydrocarbons of gasoline are readily absorbed by the lungs due to its high accessibility and excellent absorption surface[13,24].

Adverse effects of petrol vapor on the lung functions may occur through several ways. Azeezet al.[6] explained that petroleum hydrocarbons cause an increase in lung tissue malondialdehyde (MDA), an indicator of lipid peroxidation. They also, decrease the glutathione content and the activities of superoxide dismutase that serve as a primary line of defense in destroying the free radicals.This triggers oxidative stress leading to loss of cellular and tissue integrity.

Another possible mechanism underlying impaired lung functions is that, exposure to petroleum hydrocarbons impairs type II pneumocytes resulting in a decreased production of surfactant and consequently alveolar collapse, ventilation-perfusion mismatch, and hypoxemia. This ultimately leads to hemorrhagic alveolitis, interstitial inflammation, intra-alveolar hemorrhage and edema, bronchial necrosis and vascular necrosis causing defective lung parenchyma[8]. Since, consequences of such occupational hazards may not become evident for many years, it is important to identify the potential dangers early and adopt necessary measures before they result into permanent morbidities.

CONCLUSION:

This study along with others different studies suggests, exposure to petrol and its products is harmful to health. Long term exposure to petrol and its derivatives at petrol filling stations must be reduced as far as possible. As prevention is always better than cure, following safety practices to minimize such exposure is essential. Thus, there is increasing need to develop a discreet plan of action towards early identification and reduction in occurrence of health risk factors in petrol pump workers. Hence, health education and training programs for safe handling of the petrochemical substances for workers, supervisors and the owners[22]and mandatory use of the personal protective equipment like safety wears, respirators, gloves, shoes at the filling stations are needed to be instituted by the employer for the protection of their workers[1].Furthermore, periodic evaluation of health status of petrol pump workers should be an obligatory procedure. Systemic dysfunction should be identified, prevented and treated through early screening, diagnosis, intervention and referral. In many developed countries, establishment of vapor recovery systems at gasoline filling stations and use of alternative energy sources like bio-fuels should be explored for wellbeing of these petrol filling workers.[4,12]

Limitations of present study:

1. The sample size was small and subjects from only city were included so results obtained in the present study cannot be extrapolated to the entire population.
2. Other haematological parameters like differential leukocyte count which are also affected by gasoline could also have been studied along with other parameters.
3. Pulmonary function test including FVC, FEV1,FEV3, FEF25-75% , which are factors associated with respiratory functions were not evaluated in this study.

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