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NEPHROTOXICITY IN PETROL PUMP ATTENDANTS OF DEHRADUN REGION

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ABSTRACT

The present study was conducted to evaluate the nephrotoxic effects of petroleum fumes on male petrol attendants. Investigations had been carried out on hundred (100) adult petrol attendants from different filling stations in Dehradun region of Uttrakhand. All the subjects involved in this study were between the ages of 27-40 years. The subjects were grouped according to the duration of time they had worked in the filling station. Kidney function tests were also evaluated using serum creatinine, BUN and urea level. The petrol attendants show significant ($P<0.05$) increase in creatinine, BUN and urea level with increase in years of exposure. The study suggests that long term inhalation of petrol fumes is associated with adverse effect on the kidney function.

KEYWORDS: Kidney: Petroleum fume: Petroleum attendants.

INTRODUCTION

Petrol (or gasoline) is a volatile and inflammable petroleum-derived liquid mixture primarily used for internal combustion of machines. It consists of hydrocarbons (aromatic, saturated and unsaturated) and non-hydrocarbons (N, S, O_2, vanadium and nickel)[1,2]. Certain peoples have a greater risk of exposure to gasoline vapors; these include filling-station workers, service station attendants, drivers of gasoline trucks and refinery workers[3]. The volatile nature of petrol products makes them readily available in the atmosphere any time it is dispensed, especially at petrol filling stations and depots. People are exposed to gasoline fumes during fuelling and refuelling at gas stations, but the filling station workers are more at risk by virtue of their occupational exposure[4]. Atmospheric concentration of gasoline vapor (approximately 2000 ppm) is not safe when inhaled even for a brief period of time (seconds). During fuelling of vehicles, the concentration of gasoline vapor in the air is between 20 and 200 ppm[5,6]. Many of the harmful effects seen after exposure to gasoline are due to the individual chemicals in the gasoline mixture, such as benzene, lead and oxygenates. Breathing small amounts of gasoline vapors can lead to nose and throat irritation, headaches, dizziness, nausea, vomiting, confusion and breathing difficulties. Some effects of skin contact with gasoline include rashes, redness, and swelling. Allergic reactions (hypersensitivity) have been reported but these are rare occurrence[7,8]. Occupational diseases in gasoline-filling workers have been recognized for many years, and affect workers in different ways, such diseases are still problems in all parts of the world. The numbers of such work-related diseases in developing countries are much higher in reality than the numbers that are reported. The numbers of cases and types of occupational diseases are increasing in both developing and industrialized countries[9]. Hazards in the gasoline-filling stations can be found in a variety of forms, including chemical, physical, biological, psychological, and non-application of ergonomic principles, etc. Because of the multitude of hazards in such workplaces and the overall lack of attention given to health and safety by many employers, work-related accidents and diseases continue to be serious problems in all parts of the world[10] Exposure to petroleum and its products therefore constitute health hazards. Some of such hazards include nervous system damage, blood disorders (including anaemia, leukemia), renal damage, hepatic dysfunction and intoxication leading to serious psychotic problems, anaesthetic effects, dermatitis etc.[11]. Like other known xenobiotics, the chemical pollutants from gasoline vapours may be metabolically transformed into various metabolites in the body[12]. Some of these metabolites may be very reactive, interacting in various ways with the metabolizing, transporting and excreting tissues to elicit toxic effects[13]. The interaction of these metabolites with the renal tissues may cause cellular injury, hence, damage to the tissues. Once the renal tissues are damaged, the overall functionality of the kidneys may be compromised.

The present study was designed to evaluate the effects of long-term exposure to petroleum products on the kidney function, with respect to the duration of exposure in gasoline-filling workers within Dehradun city area.

MATERIALS AND METHODS

A total of hundred (100) human volunteers were selected from different filling stations of Dehradun (UK) pre-exposed to petrol fumes in the course of their duties. After explaining the purpose and procedure of the research to all the subjects, their informed consent was obtained according to WHO standards. The parameters of gasoline filling station workers (petrol pump workers) were divided into three groups according to the years of exposure. These groups were 01-05 years, 06- 10 years and 11-15 years of exposure.

Study Location

The filling stations were chosen from the different location in Dehradun using random sampling method. The filling stations used for this study were chosen base on the frequent availability of petroleum products and duration of period the subjects have been working in the filling station. The area where these filling stations are sited is a non-industrialized area of Dehradun because the release of hydrocarbon into the atmosphere might affect the outcome of the study.

Ethical Issues

The approval to undertake this research work was obtained from Management Board of the filling stations used to undertake the study. Written consents of willingness to participate in the study as subject were obtained from 100 participants listed for the study. All listed subject were staff of petrol station who have worked for a particular period of time within the range of the study. All ethical issues involving the identity, compensation and management of the subjects followed the approved guidelines.

Collection and Preparation of Samples

Blood samples were collected from the volunteers by venipuncture using a sterile needle and syringe. Each specimen was put in a labeled anticoagulant sample bottle before transferring it into a centrifuge tube. The blood samples were then centrifuged at 2500g for 5 minutes using a Wisperfuge (model 684) centrifuge to obtain the plasma samples used for the kidney function tests.

Determination of Biochemical Parameters Mod. Jaffe's kinetic method was used for serum creatinine estimation and urea and BUN was estimated by enzymatic UV kinetic initial rate method using *Urease* and *GLDH*.

Statistical Analysis

The data obtained were expressed as mean ± SEM.The statistical analysis was carried out by one way analysis of variance (ANOVA). A $P<0.05$ was considered significant using Statistical Package for Social Sciences (SPSS version 18).

RESULTS

Total 100 subjects were taken for the study. All were males. Their age ranges from 27-40 years with a mean age of 32.36±7.18 years. Out of which 45 were found to be alcoholic, 32 were found to be smokers as well as alcoholic, 10 were found to be tobacco chewers and alcoholics, 05 were diabetic All were excluded from the study.

Table-1

S.No.	Type of Subjects	Number
1.	Total	100
2.	Male	100
3.	Female	00
4.	Alcoholics	45
5.	Tobacco chewers+ Alcoholics	10
6.	Smokers+ Alcoholics	41
7.	Diabetics	05
8.	Non-alcoholic, non-smokers and are not having any disease	50

Only 50 gasoline filling workers were non-alcoholic, non-smokers and are not having any disease were analyzed for kidney function tests.The gasoline filling station workers (petrol pump workers) were divided into three groups according to the years of exposure. It was found that 12, 31 and 07, gasoline fillers were working from the past 01-05 years, 06- 10 years and 11-15 years respectively.

Table-2

Period of exposure	No. of petrol pump workers
1-5	12
6-10	31
11-15	07
Total	50

The result were summarized on two tables given below:

Table-2

PARAMETERS	**DURATION (YEARS)**		
	01-05	**06-10**	**11-15**
Weight(Kg)	61.8±8.4	63.4±10.8	60.8±9.0
Height(Inches)	5.4±0.34	5.6±0.36	5.5±0.2
B.M.I(kg/m sq)	23.2±2.9	21.8±2.9	22.3±2.6
Blood Pressure [Systolic (mm Hg)]	117.7±6.4	121.7±6.0	123.28±5.4
Blood Pressure [Diastolic (mm Hg)]	81.1±5.6	80.7±4.3	81.2±5.0

The three study groups were similar in terms of age, sex and BMI, which are important parameters that may affect kidney function test status. The table 2 represents the anthropometric data. The comparison was taken such that variation due to age and BMI can be neglected. Significant rise in systolic blood pressure was observed with increase in years of exposure, however insignificant change was found in diastolic blood pressure with increase in duration of service with petrol pump.

Table 3

PARAMETERS	**DURATION (YEARS)**		
	01-05	**06-10**	**11-15**
Urea (mg/dl)	47.08±7.82	56.9±6.8	58.85±4.82
BUN(mg/dl)	22±3.65	26.3±3.2	27.5±2.25
Creatinine(mg/dl)	0.91±0.16	1.21±0.24	1.4±0.16

The mean urea level of petrol pump attendants increases significantly with increase in years of exposure The mean urea level of group with 1-5 years of exposure was 47.0±7.8 mg/dl which is above than normal. On the other hand in case of groups with 06- 10 years and 11-15 years of exposure with gasoline fumes, urea levels was 56.9±6.88 mg/dl and 58.85±4.82 mg/dl respectively. The variation in BUN exhibit same trend.

The petrol fumes exposed subjects show significant rise in serum creatinine level, in the subjects with 1- 5 years of exposure serum creatinine level was found to be 0.91±0.16 mg/dl, where as in subjects exposed between 06- 10 years and 11-15 with petrol fumes, serum creatinine level was 1.21±0.241 mg/dl and 1.4±0.169 mg/dl respectively.

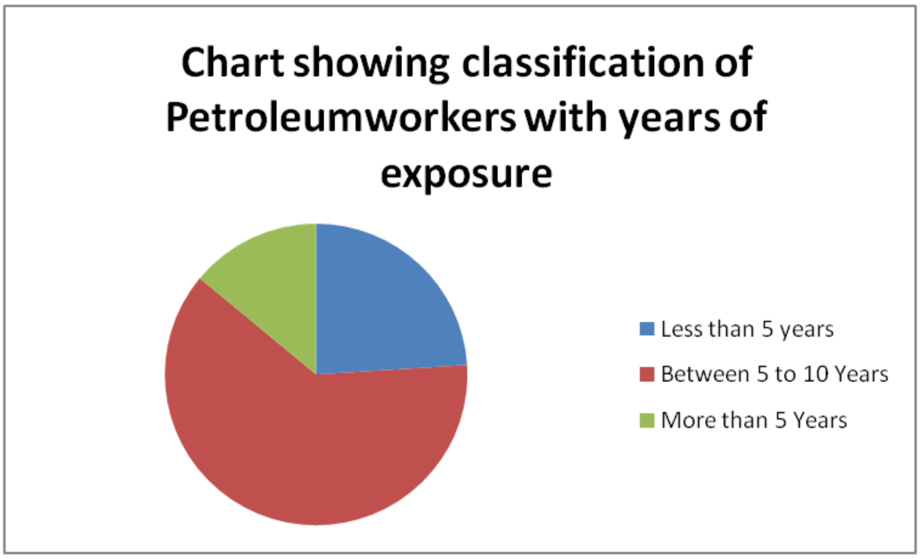


Chart showing variation of serum urea concentration in petroleum workers with years of exposure years of exposure

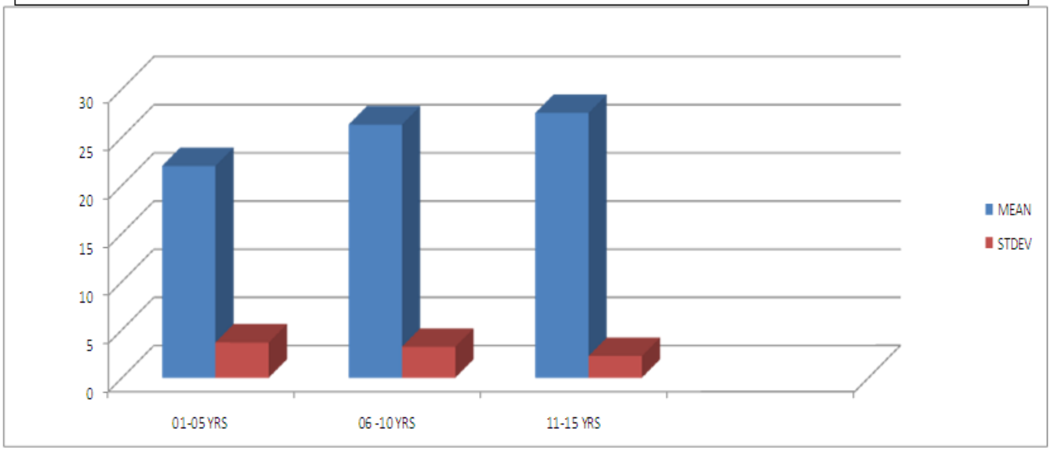
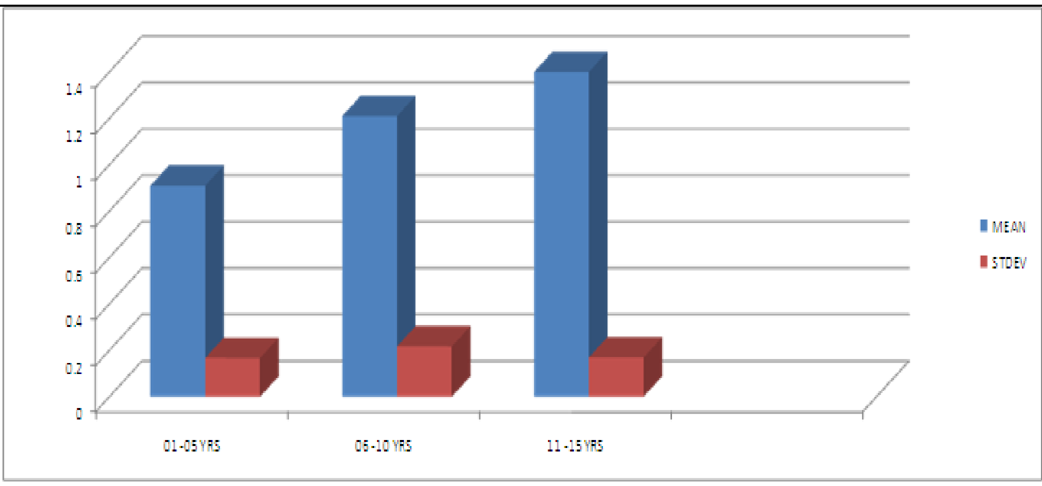


Chart showing variation of serum creatinine concentration in petroleum workers with years of exposure years of exposure



DISCUSSION

Toxicological data obtained in laboratory animals (including carcinogenic, teratogenic, and mutagenic activities) and epidemiological results from human studies in relation to gasoline exposure provide a broad picture of the current aspects of the essential toxicological properties of gasoline. Knowledge of the intrinsic toxic properties of gasoline and its constituents is undoubtedly important, but to identify the potential toxicity, i.e., the damage that can occur in man and his environment under normal conditions of use, is even more important. Recognition that occupational and environmental agents can impair the functions of the kidney has led to progress in further researches. Studies on experimental animals and humans have shown that many experimental chemicals suppress the immune response, leading to increased incidence of influenza and common cold[14,15]. The present study assessed the effect of long-term exposure to gasoline fumes that is constantly inhaled by the workers on kidney function .Fuel products are mixtures of aliphatic and aromatic hydrocarbons mostly related to gasoline, most of them are toxic to many organ systems including the kidney[16,17], which may be attributed to an increase in liberating toxic metabolites including reactive oxygen species. While experiments with rats indicate that exposure by inhalation to the aromatic hydrocarbons toluene, styrene, and xylene was nephrotoxic[18], this effect has not been confirmed in man[19]. Both human and experimental studies suggest that many chemicals can affect the kidney[20]. Of these chemicals, the role of organic solvents in chronic kidney diseases, particularly chronic glomerulonephritis,has long been debated[21]. In the present study, serum levels of urea, BUN and creatinine (markers of renal function) were found to significantly elevate with increase in years of exposure;Urea was above the normal level in all the three groups.Creatinine level was within the highest accepted values, they may represent a greater tendency toward progression to renal disease. In this regard, some previous studies have shown that exposure to petrol derivatives may have detrimental effects on kidney functions[22,23]. Stengel *et al.*, based on a case control study, did not favor an effect of solvent exposure inglomerulonephritis incidence, but rather suggested a role in theprogression to ESRD[24]. Using an appropriate cohort study design, Jacob et al., showed that long-term exposure to gasoline fumes was associated withfaster progression to end-stage renal disease in patients with IgA and membranous glomerulonephritis[25]. Gasoline, however, include many chemicals and additives where anyone could be the cause for such deterioration in renal functions. Accordingly, the identification of specific solvents and exposed job categories at risk would improve intervention to prevent or delay mild renal impairment progression to end-stage renal disease in the occupational setting. In conclusion, our findings show that long time exposure to petrol fumes could have adverse effects on the liver and kidney. Therefore, there is the need to modify the mode of operation of the petrol station attendants so as to safeguard their health and this can be achieved by adopting the use of nose and mouth masks, although this cannot completely stop the exposure to the petrol fumes but can reduce it to some certain level.

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