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Research Article

PLASMA PROTEINS PROFILE AND RENAL FUNCTION RELATIVE TO EXPOSURE TIME OF GASOLINE FILLING STATION WORKERS INSULAIMANI CITY

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ABSTRACT

Objective: The present study investigates the changes in plasma proteins profile and renal function (serum levels of urea and creatinine)

Methods:The study include screening plasma protein profile and renal function in 74 male petrol-filling workers and compares them with corresponding values in 27 sex- and age-matched controls using spectrophotometry and electrophoresis method respectively.

Results: Plasma albumin was significantly elevated and gamma-globulin was significantly decreased in workers. Meanwhile, serum urea and creatinine levels were significantly elevated. No correlation with exposure time was reported.

Conclusion: Gasoline-filling workers do not show marked changes in most of plasma proteins, they demonstrate a decrease in gamma globulin levels and biochemical evidence of impaired renal function, which were not positively correlated with the duration of exposure.

Keywords: Gasoline filling, Workers, Exposure, Plasma proteins

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, O2, 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 smallamounts of gasoline vapors can lead to nose and throatirritation, headaches, dizziness, nausea, vomiting, confusionand breathing difficulties. Some effects of skin contactwith gasoline include rashes, redness, and swelling.Allergic reactions (hypersensitivity) have been reported but these are rare occurrences [7,8].Occupational diseases in gasoline-filling workers have been recognized formany years, and affect workers in different ways, suchdiseases are still problems in all parts of the world.Thenumbers of such work-related diseases in developingcountries are much higher in reality than the numbersthat are reported.The numbers of cases and types ofoccupational diseases are increasing in bothdeveloping and industrialized countries [9].Hazards in the gasoline-filling stationscan be found in avariety of forms, including chemical, physical,biological, psychological, and non-application ofergonomic principles, etc. Because of the multitude ofhazards in such workplaces and the overall lack ofattention given to health and safety by manyemployers, work-related accidents and diseasescontinue to be serious problems in all parts of theworld [10].Although many types of petrol derivatives have delivered daily in Sulaimani petrol stations, gasoline and kerosene automobile fuels are the major derivatives of great concern regarding daily exposure. The present study was designed to evaluate the effects of long-term exposure to petroleum products on the plasma proteins profile and kidney function, with respect to the duration of exposure in gasoline-filling workers within Sulaimani city area.

METHODS

Before the commencement of the study, ethical approval was obtained from University of Sulaimani Ethical Review Committee.This study was carried out on 74male adult subjects, with age range between 25 to 60 years (42.0±8.8 years), who work in gasoline-filling stations and exposed to different fuel derivatives for not less than 5 years (22.2±5.6 years), and gave informed consent to participate in the study. Questionnaires were distributed and accurately filled; candidates who met the criteria for participation in this study were enrolled in the study. Several fuel stations located in Sulaimani region were used as sites for this study. Twenty-seven healthy subjects, matched with age with workers, with no access to such type of occupational exposure were included as controls. Venous blood (10 ml) was taken from a peripheral vein on the arm of each subject and immediately transferred into 2 tubes, 3 ml in a tube containing potassium EDTA anticoagulant and 7ml in a plain tube for preparing serum. The samples obtained were analyzed for the plasma proteins profile using electrophoresis technique (Adelab Scientific, Australia) [11]. The separated serum was utilized for estimation of serum urea and creatinine levels using autoanalyzer based method (Kenza 120, Biolabo, France) [12].

Statistical analysis

Values are expressed as the mean ± SD. Two-tailed unpaired Student's *t*-test was used to compare means. $P<0.05$ was considered statistically significant. Analyses were processed using GraphPad Prism software for Windows (version 5.0, GraphPad Software, Inc., San Diego, CA).

RESULTS

As shown in figure 1, total plasma protein levels are not significantly changed ($P>0.05$) in gasoline-filling workers compared to non-exposed subjects, while plasma albumin levels are significantly elevated in workers compared to controls (10.3%, $P<0.05$). Meanwhile, figure 2 shows that both alpha-1 and Alpha-2 globulin levels are not significantly changed in gasoline-filling workers compared to non-expose controls. Moreover, although beta-globulin levels are not-significantly altered, gamma-globulin levels are significantly decreased in gasoline-filling workers compared with non-exposed subjects (35.1%, $P<0.05$)(Figure 3). Correlation

between the changes in plasma levels of albumin and gamma-globulin with the daily exposure (hr/day) and total exposure time (years) revealed no significant correlation as shown by small r values and high P values (>0.05) (Figure 4). In figures 5 and 6, serum levels of urea and creatinine were shown to be significantly elevated in gasoline-filling workers (78.4% and 20.3%, respectively) compared to non-exposed subjects, though these values are still within the highest accepted normal ranges. Moreover, the changes in serum levels of urea and creatinine reported in the present study failed to show significant levels of correlation with daily or total exposure duration when analyzed with Persons' correlation test (Figure 7).

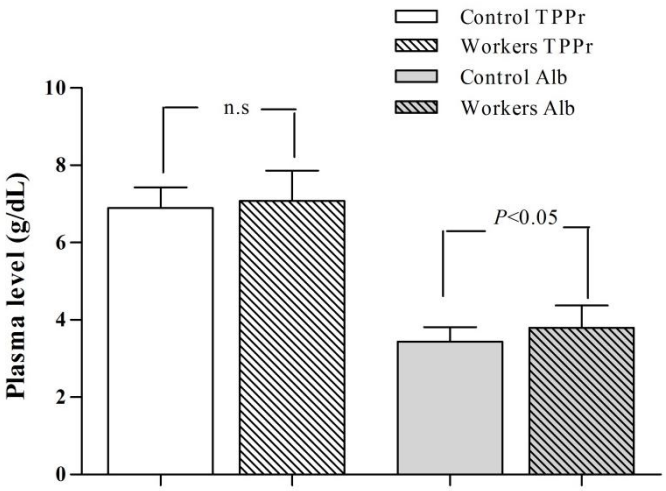

Fig. 1: Total plasma protein and albumin levels in gasoline-filling workers compared with non-exposed subjects;n.s= non-significant (*P*<0.05).

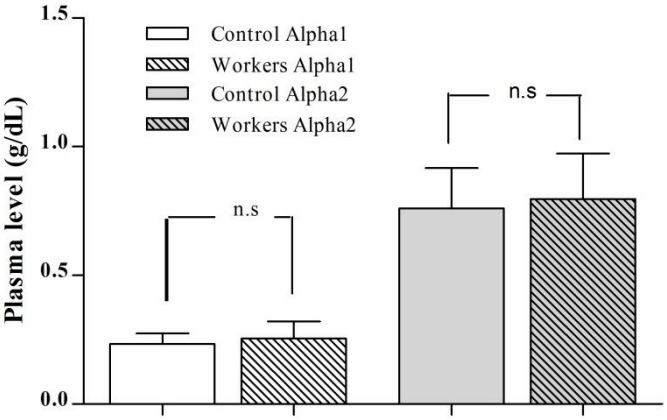

Fig. 2: Plasma levels of Alpha 1- and Alpha-2 globulin in gasoline-filling workers compared with non-exposed subjects;n.s= non-significant (*P*<0.05).

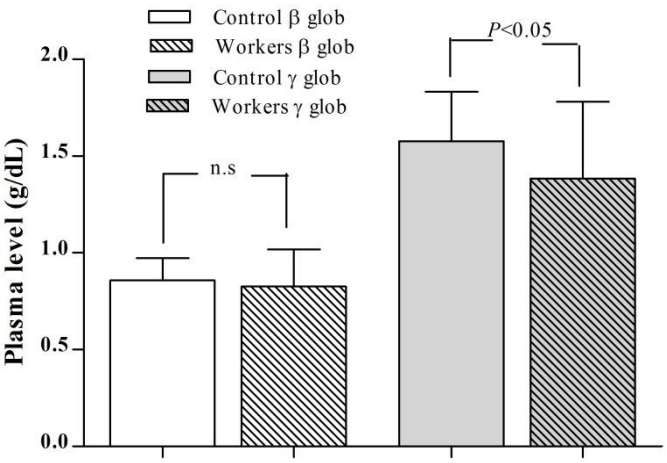

Fig. 3: Plasma levels of beta- and gamma-globulins in gasoline-filling workers compared with non-exposed subjects;n.s= non-significant (*P*<0.05).

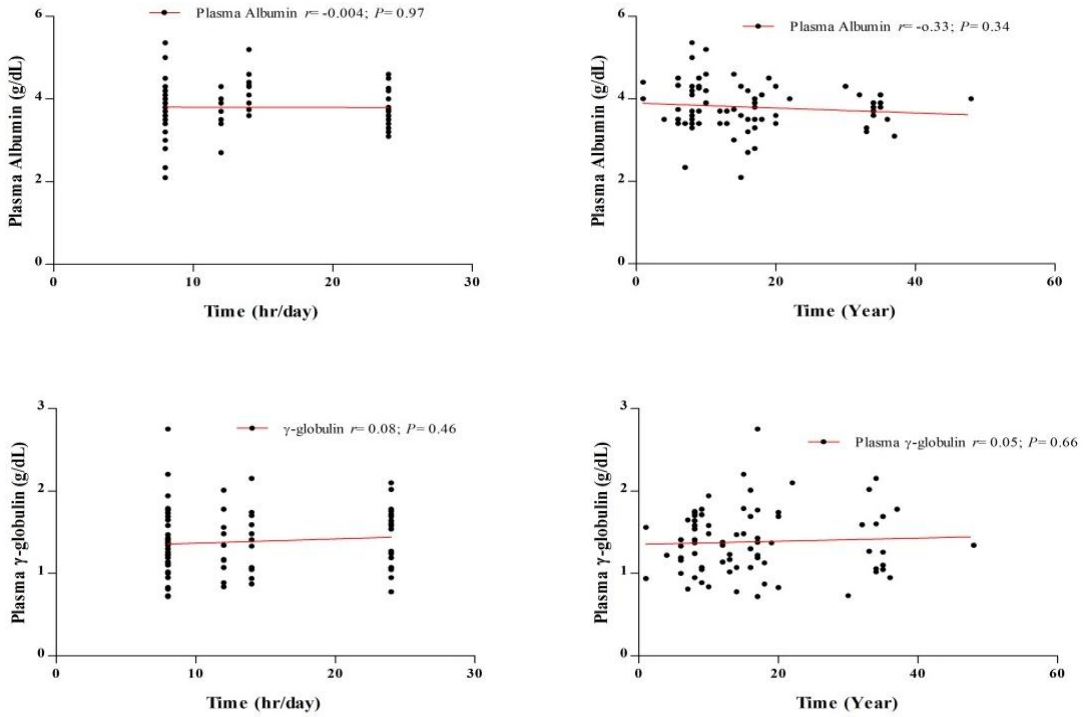

Fig. 4: Person correlation between plasma albumin and gamma-globulin levels with the time of occupational exposure in gasoline-filing workers.

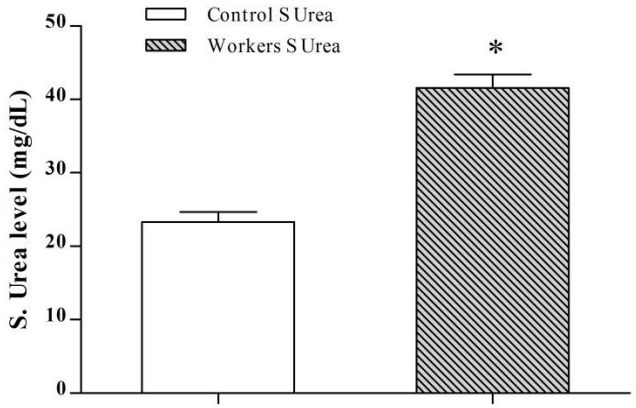

Fig. 5: Serum urea levels in gasoline-filling workers compared with non-exposed subjects; * significantly different compared to non-exposed subjects (*P*<0.05).

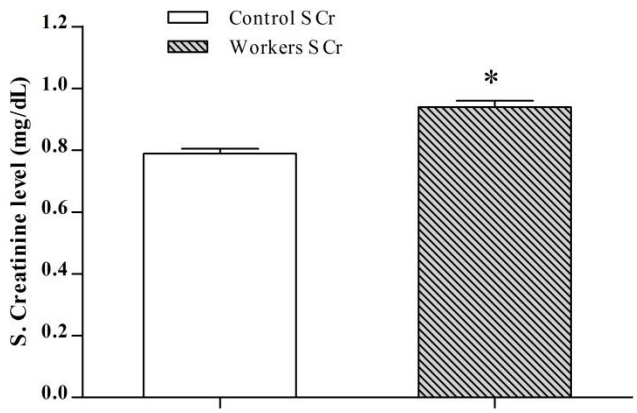

Fig. 6: Serum creatinine levels in gasoline-filling workers compared with non-exposed subjects; * significantly different compared to non-exposed subjects (*P*<0.05).

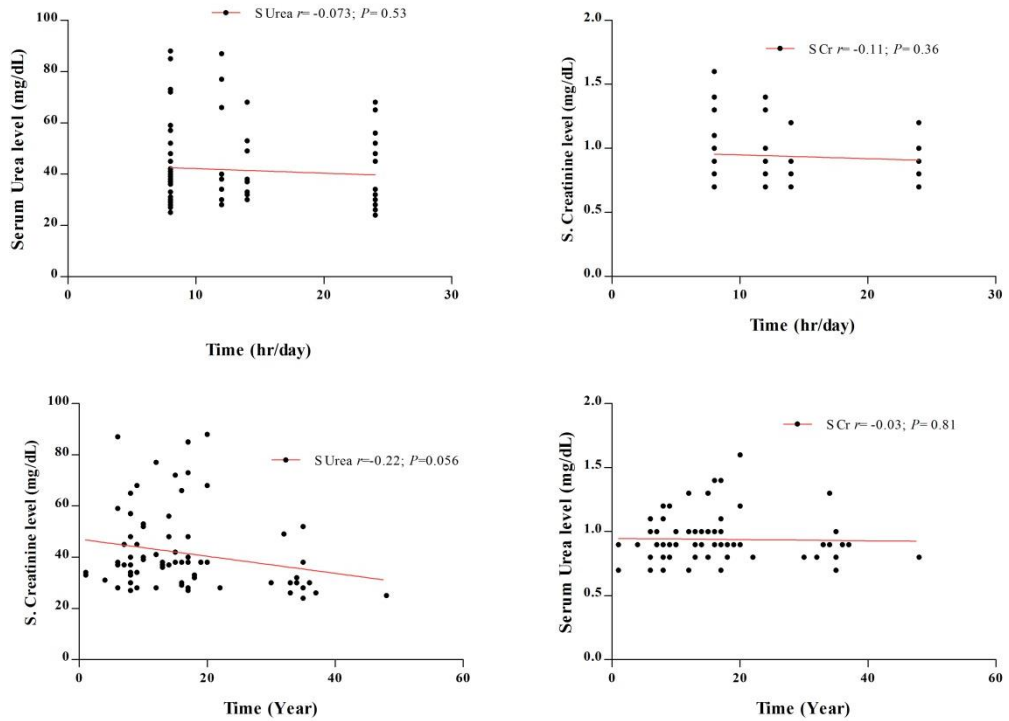

Fig. 7: Person correlation between serum levels of urea and creatinine with the time of occupational exposure in gasoline-filing workers.

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 and plasma proteins profile 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 [13,14].The present study assessed the effect of long-term exposure to gasoline fumes that is constantly inhaled by the workers on kidney function and on the plasma proteins profile as an aspect of general humoral immunity. Although the results indicated non-significant changes in most of the plasma proteins, gamma globulin levels are significantly decreased, which may be considered as an indication for immunotoxicity. This finding was not in tune with that reported by Akinosun*et al*., who reported an increase in IgMlevels which may be attributed to inflammatory reactions [15]. However, within the Sulaimani city area, exposure to gasoline fumes produced remarkable impairment in liver function, which may be a causative factor for the reported changes in certain liver-originated plasma proteins [16].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 [17,18], 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 [19], this effect has not been confirmed in man [20]. Both human and experimental studies suggest that many chemicals can affectthe kidney [21]. Of these chemicals, the role of organic solvents inchronic kidney diseases, particularly chronic glomerulonephritis,has long been debated [22]. In the present study, serum levels of urea and creatinine (markers of renal function) were significantly elevated in gasoline-filling workers; however, although they are 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 [23,24].Stengel *et al*., based on a casecontrol study, did not favor an effect of solvent exposure inglomerulonephritis incidence, but rather suggested a role in theprogression to ESRD [25]. 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 andmembranousglomerulonephritis [26].

Gasoline, however, include many chemicals and additives where anyone could be the cause for such deterioration in renal functions. Accordingly,the identification ofspecific solvents and exposed job categories at risk would improveintervention to prevent or delay mild renal impairment progression to end-stage renal disease in the occupational setting. In the present study, the correlation between duration of exposure and the reported changes in gamma globulin level and renal function was weak and non-significant; this might be attributed to involvement of other factors, including the constituents of the gasoline, other than the time that influence these changes. In a previous study carried out in 1995, the environmental levels of gasoline constituentswere measured in the breathing zone of service station attendants during different periods. The results obtained showed that both variables could significantly increase the environmental levels of gasoline vapors and, subsequently, the risk of occupationally exposed workers [27]. Since then, technical specifications for gasolineshave been changed and technical solutions have been designed to reduce the occupational risk.In conclusions, although gasoline-filling workers exposed to gasoline fumesdo not show marked changes in most of plasma protein, they demonstrate a decrease in gamma globulin levels and biochemical evidence of impaired renal function, which were not positively correlated with the duration of exposure.

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