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Full Length Research Article

Hepatotoxic and Nephrotoxic Effects of Petroleum Fumes on Petrol Attendants in Ibadan, Nigeria

[*1]A.L. Ogunneye, [2]D.A. Omoboyowa, [3]A.L. Sonibare, [3]A.J. Adebusuyi and [3]T.P. Faniran
[1&3]Department of Chemical Sciences, Tai Solarin University of Education, Ijebu - Ode, Ogun State, Nigeria.
[2]Department of Science Laboratory Technology, Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State. Nigeria.
[*Corresponding author: Email ogunneyeal@tasued.edu.ng; ☎+2347036591442]

ABSTRACT: The present study was conducted to evaluate the hepatotoxic and nephrotoxic effects of petroleum fumes on male and female petrol attendants. Investigations had been carried out on thirty (30) adult petrol attendants from different filling stations in Ibadan metropolis of Nigeria with ten (10) healthy adults as control. All the subjects involved in this study were between the ages of 27-35 years. The subjects were grouped according to the duration of time they had worked in the filling station. Serum aspartate amino transferase (AST), alanine amino transferase (ALT), alkaline phosphatase (ALP) activities and total bilirubin concentration were determined to evaluate hepatotoxicity. Kidney function tests were also evaluated using serum creatinine, total protein and urea level. Electrolytes (potassium, chloride and sodium ions) leakages into the serum were also evaluated. The results reveal that serum AST, ALT, ALP activities and total bilirubin concentration in the petrol attendants were significantly ($P<0.05$) higher compared with the control. The petrol attendants that have spent 27-36 months in the petrol station show significant ($P<0.05$) increase in AST, ALT, ALP activities and total bilirubin concentration compared with other petrol attendants that have spent lesser duration in the filling station. The kidney function test reveals that petrol attendants show significant ($P<0.05$) increase in creatinine, total protein and urea level compared with the control. Petrol attendanst show significant ($P<0.05$) increase in serum potassium, chloride and sodium ion concentrations compared with the control group. The study suggests that long term inhalation of petrol fumes is associated with adverse effect on the kidney and liver function.
Keywords: Liver; Kidney: Petroleum fume: Petroleum attendants; Electrolytes

INTRODUCTION

Petrol is a complex mixture of aliphatic and aromatic hydrocarbons derived from blending fractions of crude oil with brand-specific additives. The actual composition of petrol l varies according to the source of crude oil, the manufacturing process and between batches (Chilcott, 2007). Petrol fumes are ubiquitous in our environment and the common sources of contact or exposure are petrochemical industries (refineries, oil fields, filling stations) and homes (Patrick-Iwuanyanwu *et al.,* 2011). Moreover, the day-to-day use of petrol outside the industrial settings is likely to have the same effect on the user as kerosene and other petroleum products. However, the most affected are those who are occupationally and domestically exposed to petroleum products (Smith *et al*., 1993; Carballo *et al*., 1994; Rothman *et al*., 1996; Patrick-Iwuanyanwu *et al.,* 2011).

Kidney is a paired organ whose functions include removing waste products from the blood and regulating the amount of fluid in the body. The basic units of the kidneys are microscopically thin structures called nephrons, which filter the blood and cause wastes to be removed in the form of urine. Together with the bladder, two ureters, and the single urethra, the kidneys make up the body's urinary system (Ogbekhuemen, 2009). The liver is the processing center of the major metabolic activities in vertebrates (Garrelt and Grisham. 1999) and should always be considered in terms of absorption of foreign materials such as foods, drugs etc. to ascertain its high functional status. Most chemical manifestation of liver dysfunction stems from cell damage and impairment of the normal liver capacities. For example, viral hepatitis causes damage and death of hepatocytes. In this case, manifestations may include, increased bleeding (due to decreased synthesis of clotting factors, jaundice (yellow pigmentation due to decreased clearance of bilirubin) and increased levels of circulating hepatocytes enzymes (released from dead liver cells (Garrelt and Grisham, 1999; Sule *et al*., 2012).

Petroleum hydrocarbons and other related carbon-containing compounds are converted into free radicals or activated metabolites during their oxidation in the cells (Nwanjo and Ojiako, 2007), especially mammalian liver and kidney cells. It is these activated metabolites that react with some cellular components such as membrane lipids to produce lipid peroxidation products (Onwurah, 1999) which may lead to membrane change. They may also react with enzymes and cause inactivation through protein oxidation (Stadtman, 1990) and/ or DNA strand breaks (Birnbiom *et al*, 1985; Nwanjo and Ojiako, 2007). Exposure to petroleum and its products therefore constitute health hazards. These manifest as nervous system damage, blood disorders (including anaemia, leukaemia), renal damage, hepatic dysfunction and intoxication leading to serious psychotic problems, anaesthetic effects, dermatitis etc. (Aryanpur, 1979; Nwanjo and Ojiako, 2007). The study was undertaken to investigate the effects of petrol fumes on petrol station attendents in Ibadan metropolis of Oyo state, Nigeria.

MATERIALS AND METHODS

A total of thirty (30) human volunteers from five different filling stations in Ibadan metropolis of Nigeria pre-exposed to petrol fumes in the course of their duties. Another ten (10) apparently healthy subjects who were not engaged in activities that predisposed them to serious contact with petrol fumes were recruited as controls for this study. After explaining the purpose and procedure of the research to all the subjects, their informed consent was obtained according to WHO standards.

Study Location

The filling stations were chosen from the same location in Ibadan metropolis 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 Ibadan 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 40 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 liver and kidney function tests.

Determination of Biochemical Parameters

. The method of Reitman and Frankel (1957) was adopted for the ALT and AST assays. ALP was estimated using the method of King and King (1954) as described by Cheesbrough (2000). Total bilirubin was determined using the methods of Malloy and Evelyn, (1937) as modified by Tietz, (1996). Serum sodium and potassium ions were estimated using reagent titrimetric method described by Maruna and Trinder, (1958) . Chloride ions were determined by the method of Schales and Schales (1941).

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

Table 1 shows the activity of plasma aspartate and alanine amino transferases (AST and ALT), alkaline phosphatase (ALP) and total bilirubin level of petrol attendants in Ibadan metropolis with varying duration of service in the filling station. The plasma ALT, ALP and total bilirubin level of attendants in 16-26 months and 27-36 months period of exposure to the petrol fumes showed significant ($P<0.05$) increase compared with control subjects. The AST, ALT, ALP and total bilirubin level of subjects with 27 – 36 months period of service was significantly ($P<0.05$) higher compared with subjects within 5-15 and 16 – 26 months period of service respectively. Increase in the duration of service in the petroleum station which is equivalent to the period of exposure of individual participant to petrol fumes increases the level of liver function parameters (AST, ALT, ALP and total bilirubin) of the subjects.

Figure 1 shows the mean value of plasma creatinine, total protein and urea of petrol attendants in Ibadan metropolis with varying duration of service in the petrol station. The attendants at varying duration of service have significantly (P<0.05) increased plasma creatinine and urea levels compared with the control. The subjects with 5-15 months duration of service in the filling station show significantly (P<0.05) lower in plasma total protein compared with the control subjects while the subjects with 16-26 months and 27-36 months of service in the filling station show significantly (P<0.05) higher in total protein concentration compared with the control subjects. The plasma creatinine, total protein and urea level of subjects with 27 – 36 months period of service are significantly (P<0.05) higher compared with the plasma creatinine, total protein and urea level of 5-15 and 16 – 26 months duration of service. Increase in the duration of exposure to the petrol fumes significantly (P<0.05) increases the plasma creatinine, total protein and urea of the subjects.

Table 1: Effects of Petroleum Fumes on the Liver Function Parameters of Study Subjects

Parameters	Control	5-15 months	16-26 months	27-36 months
Aspartate aminotransferase (U/l)	9.52 ± 0.19	9.90 ± 0.10	10.30 ± 0.12	12.02 ± 0.54*
Alanine aminotransferase (U/l)	9.40 ± 0.25	9.50 ± 0.16	10.78 ± 0.27*	12.10 ± 0.16*
Alkaline phosphatase (U/l)	80.00 ± 3.70	81.80± 3.10	92.89 ± 3.79*	115.00 ± 4.75*
Total bilirubin (mg/dl)	0.68 ± 0.04	0.72 ± 0.35	1.23 ± 0.95*	1.39 ± 0.16*

Values are means ± Standard error of mean (n = 30); *Indicates significant difference P ≤ 0.05

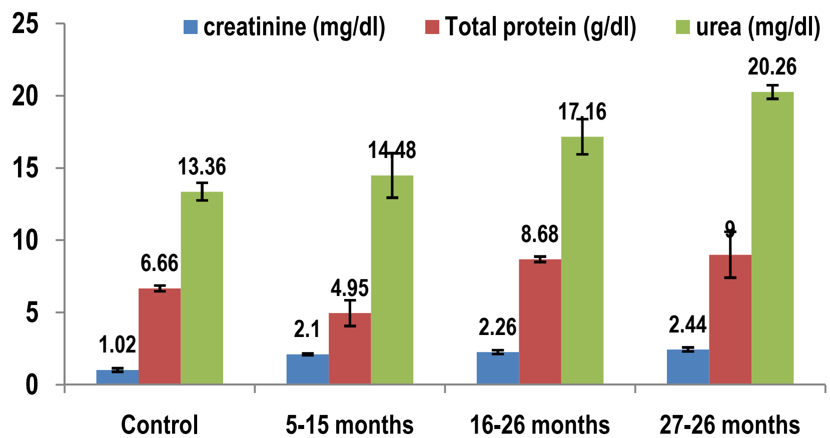

Figure 1: Effects of Petroleum Fumes on the Plasma Creatinine, Total Protein and Urea Levels of Study Subjects

Figure 2 shows the effect of petrol fumes on some selected plasma electrolytes of petrol attendants with the duration of service in the filling station. The subjects with the duration of service 5-15 months and 16-26 months show non-significant (P>0.05) increase in plasma potassium ion concentration compared with the control subjects while the subjects with service duration of 27-36 months showed significant (P<0.05) increase in plasma potassium ion concentration compared with the control. The petrol fumes exposed subjects show significant (P<0.05) increase in chloride and sodium ions concentrations compared with the control subjects. The subjects with 27-36 months of exposure show significant (P<0.05) increase in potassium ion, chloride ion and sodium ion concentration compared with the subjects with 5-15 months and 16-26 months of service in the filling station.

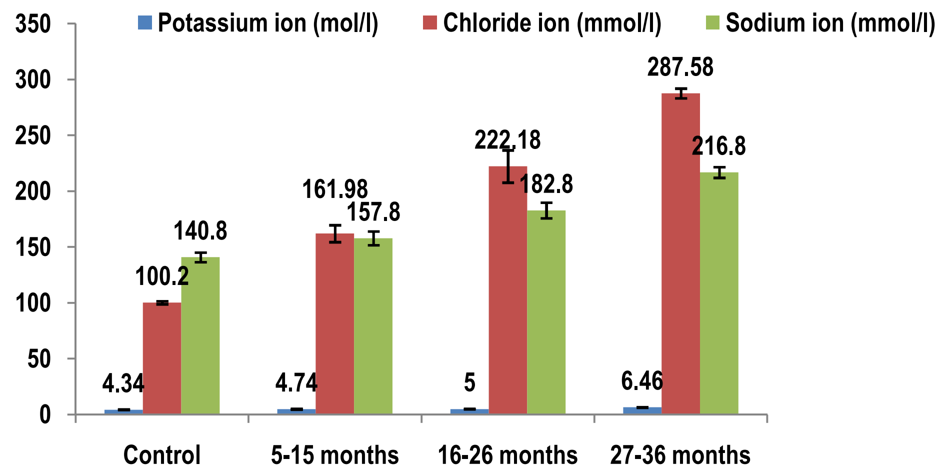

Figure 2: Effects of Petroleum Fumes on the Selected Plasma Electrolytes Level of the Study Subjects

CONCLUSION

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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