

THE EFFECT OF EXPOSURE TO PETROLEUM PRODUCTS ON SOME RENAL FUNCTION PARAMETERS OF MOTOR MECHANICS IN PORT HARCOURT METROPOLIS OF NIGERIA

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ABSTRACT

The effect of petroleum products on some renal function parameters was assessed in motor mechanics in Port Harcourt, Nigeria using urinalysis, urea and creatinine estimations. Traces of protein in urine were found in the exposed population, which increased as the duration of exposure increased. Mean urea and creatinine levels showed a significant difference ($p < 0.05$) between the exposed and non exposed subjects. Specific gravity levels of test subjects were low compared to normal. Tukey test analysis shows a significant difference in urea level between groups of the exposed population but those of creatinine and specific gravity had no inter group difference. A direct relationship therefore was observed between the levels of urea, creatinine, specific gravity, urinary protein and the duration of exposure to these products

Keywords: Petroleum product, creatinine, urea, specific gravity, protein.

INTRODUCTION

Exposure to petroleum and its products constitute major health hazards in the eastern Nigeria (Oluwole *et al*; 1996). The most commonly used products are petrol, super petrol, kerosene, bitumen, lubricating oil, gasoline, asphalt, tars, benzene, toluene, etc and they constitute health hazards such 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).

A study carried out on refinery workers revealed that gasoline is a major cause of renal cancer (Poole *et al*; 1993). Another preliminary survey of petrol station attendants and motor vehicle repairers in Oyo State revealed minor abnormalities such as abnormal erythrocyte sedimentation rate (ESR) abnormal sperm counts, dermatitis etc. (Olusi, 1981). Their significance as public health hazards is enhanced by the fact that many of them possess carcinogenic, mutagenic and teratogenic properties and experimental results also show that Nigerian petrol, like that of other countries is potentially mutagenic and carcinogenic in rats (Olusi, 1981) and by extrapolation, possibly humans

Despite the toxicity and health hazards exhibited by petroleum products, it still remains the major fuel substance used daily by various classes of

people who are exposed to them mainly through skin contact, inhalation and ingestion. The main objective of this study was to determine whether exposure to petroleum products such as petrol and engine oil have any effect on the levels of some renal function parameters of motor mechanics in Port Harcourt metropolis, in Nigeria.

MATERIALS AND METHODS

Blood samples were collected from fifty (50) motor mechanics frequently exposed to petrol and gasoline either by inhalation, or skin contact, by venepuncture.

This involved location of the major vein on the arm and tying of a tourniquet just above the elbow to stabilize the vein as well as making it conspicuous: the site of collection was properly swabbed with cotton wool soaked in methylated spirit. Venous stasis was avoided by plugging and withdrawing the needle gently. The mechanics were randomly selected from various mechanic workshops within Port Harcourt metropolis. The blood samples were immediately put into heparinized bottles and centrifuged at 3,000 rpm for 10 minutes using MSE minor centrifuge within one hour of collection. The separated plasma were transferred into clean bijoux bottles and stored at 4°C for 14 days before assaying for creatinine and urea concentrations.

The motor mechanics were taught how to collect early morning (mid stream) urine which were

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Table 1: The mean (\pm SD) plasma creatinine and urea concentrations, specific gravity and protein level and the duration of exposure (years) in motor mechanics and nonmotor mechanics.

Population	Mean \pm SD plasma creatinine (μ mol/L)	Mean \pm SD plasma urea mmol/l	Mean \pm SD Urine spec. Gravity	Mean \pm SD urinary protein conc. g/l
* Non-Exposed	74.4 \pm 7.22	2.8 \pm 0.86	1.017 \pm 0.008	Nil
Exposed				
Duration of Exposure				
1-5 years*	78.1 \pm 23.58	3.0 \pm 0.75	1.016 \pm 0.007	Nil
6-10 years	80.6 \pm 15.45	3.2 \pm 0.91	1.075 \pm 0.009	Trace
11-15 years	82.5 \pm 22.64	3.5 \pm 0.53	1.019 \pm 0.009	Trace
16-20 years	89.4 \pm 18.98	3.6 \pm 0.48	1.018 \pm 0.007	Trace
21-25 years	107.5 \pm 31.82	4.2 \pm 0.99	1.020 \pm 0.007	Trace
26-30 years	105.0 \pm 18.03	4.2 \pm 0.93	1.028 \pm 0.003	Trace
31-35 years*	117.7 \pm 27.54	4.8 \pm 1.44	1.028 \pm 0.003	Trace

* Creatinine, specific gravity and urea concentrations in the non exposed population were not considered according to the various age groups in which those of the exposed population were because these parameters normally do not vary in concentration according to age in adults.

* Comparison of these groups using the Tukey honesty test showed significance at $p < 0.05$, for urea concentration. The creatinine concentration and specific gravity even though showed significance on ANOVA was not significant for Tukey honesty test.

submitted in sterilized stericon universal containers in the morning of the day the blood samples were collected from them.

Blood and urine samples were also collected from fifty (50) apparently healthy subjects who were not engaged in activities that predisposed them to serious contact with petrol and engine oil. These were used as control.

Information relating to duration of exposure, age of individuals, frequency of exposure and mode of contact were obtained using a questionnaire shown in figure 1.

Determination of urea:

The assay method used to measure plasma urea level in this study was based on the colorimetric method reported by Cheesbrough (1987) which involves the diacetyl monoxime urea method. The urea acid reagent and the diacetyl monoxime reagents were prepared as stated for the method. The urea color reagent was obtained by mixing diacetyl monoxime. The test involved the reaction of urea with diacetyl monoxime at high temperature in an acid medium in the presence of cadmium ions and thiosemi carbazide. The absorbance of the red color produced was measured in a Gallenkamp colorimeter at 530nm wavelength. The diacetyl monoxime urea method was calibrated from a stock urea standard, 125mmol/l from which working standards of concentrations 2.5, 5, 10, 15, 20 mmol/l were obtained. The approximate urea reference (normal) range for adults is 3.3-7.7mmol/l.

Determination of creatinine

The creatinine level in the plasma was determined using the alkaline picrate (Jaffe's Method) reported by Tietz, 1982. The creatinine reagents and standard were prepared as stated for the method. The method involved the precipitation of proteins when acid and sodium tungstate were added to plasma. The supernatant which contained creatinine reacted with yellow alkaline picrate to give an orange color which was read colorimetrically at 520nm wavelength. A working creatinine standard of 1mg/100ml (90.91 μ mol/l) was used for the assay. The reference (normal) range of creatinine for the method was 60-120 μ mol/l.

Determination of urinary protein and urine specific gravity:

A urinalysis was performed using the AMES multiple reagent strips on the urine samples collected from the participated subjects. The AMES multiple reagent strip (Borhinger) contains test areas which respond to the concentration of analytes in the urine. In the case of protein, the test area was impregnated with the indicator tetra-bromophenol blue which detected mainly albumin. In the presence of protein, there was a change in the color of the indicator from light yellow to green-blue depending on the amount of protein present. A color matching any block greater than 'Trace' indicated significant proteinuria. The reagent test area for protein has a sensitivity range of 0.15 -0.30g/l albumin.

The test strip area for specific gravity contain

Figure 1: Questionnaire

RIVERS STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY, DEPARTMENT OF MEDICAL LABORATORY SCIENCES, PORT HARCOURT.

Dear Sir/Madam,

The purpose of this exercise is to elicit information that will enable the researcher study the effects of petroleum products on kidney function of auto mechanics in Port Harcourt metropolis. It is my pleasure to request you to be one of the subjects for this research. Your cooperation is highly solicited.

The data collected will be strictly used for this study only and will be treated confidentially.

Thank you.

Yours sincerely,

INSTRUCTION:

Please study carefully & fill appropriately.

1. Age Sex: M F
2. Occupation _____
3. Duration of work (years) 1-5 6-10 14-15 16-20 21-25 26-30 31-35
4. How often do you come in contact with petroleum products?

 Everyday, Once a week Once a month
5. In what ways are frequently exposed to the products?

 Inhalation Skin contact Orally Specify any other

certain pretreated poly-electrolytes, the pka of which change depending on the ionic concentration of the urine. The indicator bromothymol blue was used to detect the change. Colour range from blue – green to yellow green i.e (specific gravity of 1.005-1.030).

The procedure involves a visual reading technique. All reagent areas on the strip were immersed into the urine specimen and removed immediately. The strip edge was run against the rim of the containers to remove excess urine. The strip was then held horizontally and test areas were compared with color chart on the label. The test was read within 60 seconds.

Statistical calculations of mean, standard deviation, analysis of variation and Tukey honesty test were used to analyze the data. Data were considered significant at $p < 0.5$.

RESULTS

Results were obtained from one hundred subjects viz; fifty motor mechanics and fifty apparently healthy subjects (those apparently not exposed to petroleum products). The analysis was done on the results obtained from both motor mechanics and normal subjects. The age bracket in the study was between 15 to 53 years and the duration of exposure was between 1 to 33 years. The subjects were all males.

The mean levels and standard deviations of the urine specific gravity, plasma creatinine and urea and protein presence in the exposed (motor mechanics) and non-exposed (non motor mechanics) and the duration of exposure to the products are shown in the table 1.

The table shows that proteinuria began to appear in subjects after about five years of exposure.

Table 2(a): Summary of analysis of variance for creatinine level

Source of Variation	SS	DF	MS	F	P Value
Total	41614	99			
Groups	8336.83	7	1190.976	3.29	P<0.05
Error	332177.17	92	361.708		

Table 2(b): Summary of analysis of various for urea level

Source of Variation	SS	DF	MS	F	P Value
Total	82.7176	99		5.15	
Groups	23.28495	7	3.11264		P<0.05
Error	59.43265	92	361.708		

Table 2(c): Summary of analysis of variance for specific gravity

Source of Variation	SS	DF	MS	F	P Value
Total	6.6×10^{-3}	99			
Groups	8.0×10^{-4}	7	1.14×10^{-1}	18.1	P<0.05
Error	5.8×10^{-3}	92	6.30×10^{-5}		

The non-exposed subjects did not indicate proteinuria. Progressive increase in the concentrations of urea and creatinine as the years of exposure to the product increase was also observed. The specific gravity also increased from 1.016 ± 0.007 for those exposed between 1 to 5 years to 1.028 ± 0.003 for those exposed between 31 to 35 years, an increase of 1.18 percent.

Analysis of variance of the effect of exposure to petroleum products on the creatinine and urea concentrations and specific gravity in the exposed and unexposed population are shown in table 2. Exposure to petroleum products exerted a significant effect on mean creatinine and urea concentrations and specific gravity. Tukey honesty test analysis showed that there was no significant difference in the means of creatinine concentration and specific gravity at the different levels of exposure. However, the mean urea concentration for individuals exposed between 1 – 5 years (group 1) is significantly different from those exposed from 16 – 20 years (group 4) and 31 – 35 years (group 7) at $p<0.05$.

DISCUSSION

A review of the toxicology of oil field pollutants in cattle revealed that cattle that ingested water polluted with petrol had organs such as kidney, liver, brain and lungs poisoned (Coppock *et al*, 1995). A striking observation made in the study is the presence of trace protein whose intensity

increased as the years of exposure increases in all subjects exposed to the products for >5 years. The mean creatinine concentration increased from $74.40 \pm 7.22 \mu\text{mol/L}$ in the normal population to from 78.10 to $23.58 \mu\text{mol/L}$ for those exposed from 1 to 5 years to $117.70 \pm 27.54 \mu\text{mol/L}$ for those exposed from 31 – 35 years. A further observation in the finding is that there was a progressive increases in the levels of creatinine and urea in the exposed subjects as their years of exposure in the occupation increase. The urea level increased from $2.8 \pm 0.86 \mu\text{mol/L}$ in the non exposed population to from $3.0 \pm 0.75 \mu\text{mol/L}$ for those exposed from 1-5 years to $4.8 \pm 1.44 \mu\text{mol/L}$ for those exposed for 31-35 years. These findings are in agreement with a related work done by Vyskocil *et al*, 1991 who also stated that besides being carcinogenic or mutagenic, petroleum products have been shown to cause nephrotoxicity leading to urinary excretion of proteins and enzymes such as lactate dehydrogenase and N-acetyl- β -glucosaminidase.

The occurrence of these effects, however, depend on the level and concentration of exposure (Benjamin *et al*, 1985). Urea and creatinine are good indicators of the normal functioning kidney and increase in these substances in plasma is indicative of kidney dysfunction, although several factors such as excessive protein intake or catabolism, shock, dehydration, gastrointestinal hemorrhage, infection, diabetes etc, could contribute to this (Anderson, 1985). The specific gravity of urine is

also a good indicator of the concentrating power of the kidney and reduction in specific gravity suggests a loss of integrity of the kidney. The present study indicates that exposure to petroleum products has effect on the levels of creatinine, and urea. Even though there was a significant difference between the specific gravity in the exposed and non-exposed subjects, it does not suggest impairment of the kidney concentrating ability.

Duricic and Duricic (1991) discovered degenerative changes in renal and hepatic function after exposing rats to light and heavy petrol. The observed increase in the levels of these parameters in this study might be possibly due to toxic effect of these products on the kidney since Olusi (1981) has reported a latency period before onset of effects to be from 10-25 years depending on frequency, time, mode and concentration of exposure. Our results therefore suggest that with considerable exposure to the products over a long period of time, petroleum products could cause nephrotoxicity in motor mechanics occupationally exposed to them.

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