

Research Article

Evaluation of the Effects of Petrochemical on Liver Enzymes of Fuel Attendants in Oluyole Area, Ibadan, Nigeria

Usiobeigbe OS¹ , Obohewemu KO² , Omolumen LE¹ , Idehen IC³ , Udoaka A⁴ , Akindele IA⁵ , Asibor E⁶ ,
Oriaifo BA⁷ , Ikyaagba RO⁸ , Omoviye OE⁹ , Echekwube ME⁶ , Lagundoye SB¹⁰ , Bello GO¹¹ , Kehinde A¹² ,
Aliche PC¹³ , Edo EO¹⁴ , Fawole MF¹⁵ 

¹Department of Chemical Pathology, Faculty of Medical Laboratory Science, Ambrose Alli University, Ekpoma, Edo State, Nigeria

²Department of Health, Wellbeing and Social Care, Global Banking School/Oxford Brookes University, Birmingham, United Kingdom

³Department of Medical Laboratory Science, School of Allied Health Sciences, Kampala International University, Western Campus, Ishaka, Uganda

⁴Department of Medical Laboratory Science, Federal Medical Centre, Ebute-Metta, Lagos State, Nigeria

⁵Department of Medical Microbiology, Lead City University, Ibadan, Oyo State, Nigeria

⁶Department of Histopathology and Cytopathology, Faculty of Medical Laboratory Science, Ambrose Alli University, Ekpoma, Edo State, Nigeria

⁷Department of Healthcare Organizations Management, Faculty of Health Science, Cyprus International University, 99258 Nicosia, North Cyprus

⁸Raigmore Hospital, Inverness, Scotland, United Kingdom

⁹Fellow - Business Development, Sub Sahara Africa. Direct Export Sales Organisation, EMEA. Siemens Healthineers AG, Germany

¹⁰Department of Medical Laboratory Science, Federal Medical Centre, Owo, Ondo State, Nigeria

¹¹Department of Nursing, Babcock University Ilisan Remo, Ogun State, Nigeria

¹²Faculty of Medical Laboratory Science, Achievers University, Owo, Ondo State, Nigeria

¹³Department of Nursing Sciences, Clifford University, Owerri, Abia State, Nigeria

¹⁴National Ear Care Centre, Kaduna, Kaduna State, Nigeria

¹⁵Department of Medical Laboratory Science, Lead City University, Ibadan, Oyo State, Nigeria

*Correspondence author: Iyevhobu Kenneth Oshiohayamhe, Department of Medical Microbiology, Faculty of Medical Laboratory Science, Ambrose Alli University, Ekpoma, Edo State, Nigeria and St Kenny Research Consult, Ekpoma, Edo State, Nigeria; Email: kennylamai@yahoo.com

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Abstract

Probability of adverse health to individuals along the distribution chain, especially fuel attendants. Petrochemical industries, including fuel stations, provide an exposure scenario that increases the vulnerability of front-line staff to gasoline-related ill-health as there are typically more than 150 chemicals in petrol, including small amounts of benzene, toluene, xylene, ethyl benzene, hydrocarbons, cyanides, phenols, heavy metals, toluene and trace amounts of some contaminants, such as lead which are detrimental to the health of an individual. About 5mls of venous blood Samples were collected from 200 persons in Oluyole area, Ibadan. They were each given a questionnaire and an informed consent form to complete. Since 100 of them worked as fuel attendants at different filling stations, they were included in the case group. Among other things, their primary direct exposure sources were inhalation and skin contact. Since they don't trade gasoline or work in the oil sector, the other 100 people were the control group. The requirements for inclusion included not having a history of chronic illnesses, such as hepatitis, diabetes, renal failure or blood problems, as well as not using any particular medications, smoking or drinking alcohol. The following parameters were measured after the samples were spun and separated: total protein, plasma albumin, globulin, aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT) and Alkaline Phosphatase (ALP). The blood was drawn for the laboratory tests in the morning. P<0.01 was seen for high ALT, AST and ALP, which were 86.3%, 111.4% and 88.5%, respectively. Additionally, there was a 37.2%, 37.8% and 36.4% (P<0.01) drop in Total Protein, Albumin and Globulin levels relative to the controls. This study demonstrated that subjects exposed to petrochemicals may experience liver alterations. However, petrochemicals including benzene and other compounds such as acetaldehyde, formaldehyde which are components in the petrochemicals can lead to numerous toxic health effects associated with functional aberration of vital organs in the body such as the liver with a

significant increase in the ALT, AST, ALP and a decrease in Total protein, Albumin and Globulin.

Keywords: Petrochemicals; Benzene; Fuel Attendants; Petroleum and Liver Diseases

Introduction

Fuel especially diesel, gasoline (petrol) and kerosene are used globally including Nigeria. We consume it every day for internal combustion of engines in devices/equipment such as vehicles, generators, which are useful in day-to-day activities or operations, domestically, industrially and for transportation. Hence, making it an important commodity for our everyday survival [1]. The fact that we use Vehicles/motorcycles for transportation daily, generators as a source of electrical power and cooking utensils like stove in households for cooking, ensures that consumption of petroleum products is a necessity. As important as these petroleum products can be, inherent in these products are petrochemicals which are dangerous to human health especially on consistent inhalation [1]. Although many of the same chemical compounds can also be created from other fossil fuels like coal and natural gas or from renewable sources like corn, sugar cane and other types of biomasses, James classified petrochemicals as chemical products derived from crude oil (petroleum) [2,3]. Typically, the production of petrochemical intermediates involves the chemical conversion of raw petrochemicals into more complex derivative products. There are several methods for producing petrochemical derivative products: straight from primary petrochemicals; through intermediate products that are still solely composed of carbon and hydrogen; or through intermediates that add nitrogen, oxygen or chlorine to the final derivative [4]. They are completed goods in some circumstances. In others, achieving the intended composition requires additional stages [2].

Despite the advantages of petroleum products, powerful chemicals enclosed in it are always detrimental to the health of an individual who are continually exposed; these chemicals are called petrochemicals as defined above [1,4]. There might be subsequent exposure to these petrochemicals as they are always in use and one of the principal victims are the fuel attendants who are occupationally exposed to it through oil spills of gasoline, diesel and other petrochemical products, which are largely released by the tankers as well as fuel attendants (who are workers that dispenses premium motor spirits and other petrochemical products commonly sold at filling stations), vessels of crude oil, wells, pipelines and accidental oil spills [1,3,4]. Equally, petroleum can be accidentally released to the environment by operations like piping, leakage, dispensing activities like selling to the motorist, vehicle owners, etc. [5].

The liver as a vital organ has a wide range of functions in the body; it is responsible for maintenance of metabolic processes such as plasma protein synthesis, glycogen storage, detoxification of exogenous and endogenous substances such as xenobiotics, drugs and most metabolites. If these important functions of the liver are impaired, diverse homeostatic mechanisms will be affected with severe consequences [6]. Liver diseases such as cirrhosis, jaundice, tumors, metabolic and degenerative lesions [4, 6], liver cell necrosis and other hepatic disease have become common not only in Western world but also in developing countries including the Asia-Pacific area without knowing a possible cure and this has been attributed to exposure to certain chemicals like petrochemicals, viral infection, chronic alcohol intake as well as the imbalance between reactive oxygen species production and antioxidant protective mechanism [3,4,7]. Chronic liver disease is one of the major health issues throughout the world irrespective of age, sex, region or race and often end in cirrhosis and are characterized by fibrosis and architectural distortion of the liver with the formation of degenerative nodules with varied clinical manifestations and complications. Chronic liver disease is one of the major health issues which occur throughout the world irrespective of age, sex, region or race [4]. Liver diseases have been ranked the fifth most common cause of death and the second leading cause of mortality amongst all digestive diseases with approximately 2 million deaths per year worldwide [8].

Numerous chemicals included in petroleum products have the potential to negatively impact human health when inhaled, swallowed unintentionally, come into touch with the skin or through other exposure routes [3,9]. Even though petroleum is useful, its compounds can pollute the air, soil and drinking water when they are exposed to the atmosphere. This can lead to harm to the body's organs, including the liver [3]. Following several exposures, these chemicals have an adverse effect on human health by accumulating toxic byproducts into cells, tissues or organs, which can lead to cancer, asthma, skin irritation, allergic dermatitis, ulcers, liver, kidney, brain and nerve damage, among other health issues [9,10]. Exposure to petrochemicals on a regular and heavy basis [4] may raise the risk of liver function impairment. Therefore, increased liver function test results may suggest liver disease as a result of petrochemical exposure [3,11]. When petroleum hydrocarbons and other comparable carbon-containing chemicals are oxidized in cells, particularly in mammalian liver and kidney cells, they are transformed into free

radicals or activated metabolites [10-13]. These activated metabolites cause lipid peroxidation products when they react with certain cellular constituents, namely membrane lipids, which may result in membrane alterations [12]. Additionally, they may interact with enzymes to produce protein oxidation and/or breakage in DNA strands that result in inactivation. Their metabolites can attach to proteins and nucleic acids, which enables them to produce these subsequent actions [14-16].

Human exposure to petrol vapor is suggested to affect human health statuses through not only inhalation but also ingestion which contribute to neurological, inhalation and teratogenic disorders [3,9]. Chronic exposure to petroleum due to inhalation of aromatic hydrocarbons seems to be a significant contributing factor to such problems [17]. Also, gasoline workers have high chances of cancer risk from daily exposure to benzene and formaldehyde [3,18]. Exposure to volatile fuel has effect on the haemopoietic system as benzene in petrol is harmful to the bone marrow and can decrease the number of red blood cells leading to anaemia [3,19]. Studies have recorded a significantly lower Packed Cell Volume (PCV) among petrol attendants compared to the general population [19].

Aimed at determining the relative prevalence of chronic liver diseases in Nigeria, this shows that up to 46% of global diseases and 59% of the mortality is due to chronic liver diseases and almost 35 million people in the world die of chronic diseases with liver disease rate steadily increasing over the years [4,10,20]. In Nigeria, (35 million) 2-20% of the population, are infected with hepatitis B and C virus with a prevalence rate of 4.3%-23.3% and 0.5-15% been reported respectively from different part of the country depending on the geographical location. From records the gap that existed in previous authors is that research hasn't been conducted yet in my local government of choice which is Oluyole Area, Ibadan, Oyo state, hence the need to investigate the effect of petrochemicals in the liver of fuel attendants.

To the best of the author's knowledge, no published research have examined the liver function test profiles of gasoline (petrol) station employees in the Oluyole district of Ibadan, despite the fact that multiple studies have indicated the risk of occupational exposure to gasoline on liver function profiles. Thus, the purpose of this study is to quantify or evaluate the potential harm that gasoline exposure may cause to the liver function of those who work at gas stations in Oluyole Area, Ibadan. Put another way, my research was required because of a gap left by earlier authors and because it had not yet been done in my preferred local government, Oluyole Area, Ibadan, Oyo state.

Material and Methods

Design of Research

The purpose of this community-based, cross-sectional analytical study is to determine how gasoline attendants in Oluyole, Ibadan, Oyo state, Nigeria, are affected by petrochemicals in their livers.

Study Population

Fuel attendants in Ibadan, Oyo State, who were sampled throughout the Oluyole area, are among the target demographic. An estimated 200 copies of the survey questionnaire are intended to be returned by respondents. However, an extra 10 copies (5%) were added to allow for questionnaire loss or non-compliance, resulting in a total of 210 questionnaires being created for sampling.

Techniques for Sampling

A list of characteristics crucial for eligibility in the target group was included in the sampling. Both inclusion and exclusion sampling criteria were part of the sampling criteria. Oluyole was chosen as a typical target region since it has a lot of filling stations and fuel attendants are easily accessible there.

Determining the Sample Size

The following formula is used to calculate the study's sample size:

Using Cochran's 1977 formulae:
$$n = \frac{Z^2 \times P(1-P)}{d^2}$$

where n is the required sample size, Z is the critical value at 5% level of significance which is 1.96, P is prevalence of Liver diseases in the general population of Nigeria which is 4.3-23.3% [21], therefore $P = \frac{4.3+23.3}{2} = 13.8$ and d is the margin of error set at 0.05.

$$\begin{aligned}
 n &= \frac{(1.96)^2 \times 0.138 (1-0.138)}{(0.05)^2} \\
 &= \frac{3.842 \times 0.138 (0.862)}{0.0025} \\
 &= \frac{3.842 \times 0.1190}{0.0025} \\
 &= \frac{0.4572}{0.0025} \\
 &= 182.9
 \end{aligned}$$

Factoring in non-response and attrition rate (r) of 10% i.e 0.1 then we have $1-r = 0.9$

Final sample size is thus

$$= 182.9 / 0.9 = 203.2$$

The aforementioned computation indicates that 200 samples will be the total sample size for this investigation. One hundred of these were used as the case group. They were gas station personnel from the different gas stations we visited in the neighborhood. Among other things, skin contact, ingestion by mistake and inhalation were their primary direct exposure routes. The 100 participants in the control group did not trade gasoline or have jobs related to the oil business. The requirements for inclusion included not having a history of chronic illnesses, such as diabetes, hepatitis, renal failure or blood problems, as well as not using any particular medications, smoking or drinking alcohol. People between the ages of 15 and 40 provided the samples for this study.

Ethical Approval

The Lead City University in Ibadan Ethics Committee provided the ethical approval. Before any data or samples were collected, the participants were informed of the study's goal and their agreement was obtained both orally and in writing.

Description of Research Instrument

This case-control study involved the use of both qualitative and quantitative research techniques. For the qualitative research, a questionnaire was distributed to all the participants and was filled with proper guidance. For the quantitative research, instrument like reagents, spectrophotometer, centrifuge, weighing balance and sample bottles was used.

Validity and Reliability of Research Instrument

For the qualitative research, the validity and reliability of the questionnaire was taken into consideration, taking guidance from the language and clinical subject expertise. The questionnaire was written at a sixth-grade level of reading. For the quantitative research, the instrument (spectrophotometer) that was used has been calibrated by the manufacturer. Also, a pilot study was carried out to validate this experiment.

Study Variables

Through a physical evaluation, demographic information such as gender, age, location, length of employment (year) and working hours (hours per day) will be gathered.

Methods of Data Gathering

In the Oluyole neighborhood of Ibadan, Nigeria, a case-control study was carried out. The researchers visited each of the Local Government Area's chosen communities that will take part in the study. The data from the study populations were gathered using a deliberate sampling technique. Before any data is collected, an ethical approval form must be completed and duly signed by each participant.

Analyses of Samples

The following parameters were measured after the samples were spun and separated: total protein, plasma albumin, globulin, Aspartate Amino Transferase (AST), Alanine Amino Transferase (ALT) and Alkaline Phosphatase (ALP). Five milliliters of venous blood were drawn for the laboratory tests in the mornings. In comparison to other bodily tissues, the liver has a higher

concentration of ALT than the kidney, heart or muscle.

Alanineaminotransferase (ALT): The transamination reaction is solely catalyzed by ALT in the cytoplasm [22]. It makes sense for any kind of liver cell damage to raise ALT levels.

Method: Colorimetric Method

Principle: α -oxoglutarate reacts with L-alanine in the presence of ALT to form L-glutamate and pyruvate via the amino group transfer. The pyruvate thus formed is coupled with 2, 4-dinitrophenylhydrazine to produce a colored complex. ALT is measured by monitoring the concentration of pyruvate hydrazone formed with 2,4-dinitrophenylhydrazine.

Sample: Heparinized Plasma.

Reference range: Normal serum ALT is 10-40 U/ L [22].

Aspartateaminotransferase (AST): Transamination reaction catalyzed by AST. There are two unique isoenzyme forms of AST: the cytoplasmic and mitochondrial versions, which differ genetically. AST is concentrated in the heart more than it is in the liver, skeletal muscle or kidney, among other bodily tissues. Increased mitochondrial AST is observed in chronic liver illnesses such as liver tissue degeneration and necrosis, as well as in severe tissue necrosis following myocardial infarction. While the majority of AST activity in the bloodstream of healthy individuals comes from the cytosolic isoenzyme, the mitochondrial isoenzyme accounts for about 80% of the AST activity of the liver. However, in order to diagnose alcoholic hepatitis and liver cell necrotic type conditions, the ratio of mitochondrial AST to total AST activity is crucial.

Method: Colorimetric method

Principle: α -oxoglutarate reacts with L-aspartate in the presence of AST to form L-glutamate and Oxaloacetate via the amino group transfer. The oxaloacetate thus formed is coupled with 2, 4-dinitrophenylhydrazine to produce a colored complex in which the absorbance in alkaline solution is then measured at 505 nm [23]. AST is measured by monitoring the concentration of oxaloacetate hydrazone formed with 2, 4-dinitrophenylhydrazine.

Sample: Heparinized plasma

Reference range: Normal serum AST is 10 to 40U/L [24].

Alkaline Phosphatase (ALP): ALP can be found in the placenta, kidney, bone, liver and mucosal epithelia of the small intestine. It carries out the intestine's lipid transportation and the bone's calcification process. The serum ALP activity is mainly from the liver with 50% contributed by bone.

Method: Colorimetric Method

Principle: Alkaline Phosphatase acts upon the p-Nitrophenylphosphate (substrate) and p-nitrophenol is liberated as a yellow colour which is measured directly. The addition of an alkaline reagent stops enzyme activity at the end of the timed incubation period and increase in absorbance, due to the p-nitrophenol released is determined at 405nm [25].

Sample: Heparinized plasma

Reference range: Normal Plasma ALP is 9 to 35U/L [25].

Total Plasma Protein: Abnormal increase in plasma protein may occur in chronic liver disease, Dehydration, Nephrotic syndrome and Multiple myeloma, while decrease in plasma proteins may occur in Water overload, Severe haemorrhage, Increase in protein breakdown and Insufficient protein intake.

Method: Colorimetric Method

Principle: Cupric ions, in an alkaline medium, interact with protein peptide bonds to form a blue-violet coloured complex. The intensity of the colour formed is directly proportional to the amount of proteins present in the sample [26].

Sample: Heparinized plasma

Reference range: 6.0-8.3g/dL or 60-83g/L [27].

Albumin: A protein that is produced exclusively by the liver, albumin is easily and affordably measured. It is the primary component of total protein (globulins make up the majority of the other constituents). Chronic liver disease, including cirrhosis, causes a decrease in albumin levels, as does nephrotic syndrome, which causes albumin to be lost through the urine.

Method: Bromocresol green (BCG) method.

Principle: In an acidic environment, serum albumin preferentially interacts with bromocresol green to create a green-colored complex. The absorbance is directly proportional to the amount of albumin present in the sample and is measured at 640 nm

(red filter) [28].

Sample: Heparinized plasma.

Reference range: 3.4 to 5.4 g/dL [28].

Globulin

Globulin= Total Protein-Albumin

Reference range: 2.0-3.9g/dL [29].

Data/Statistical Analysis

The acquired data was analyzed with version 16 of the Statistical Package for the Social Sciences (SPSS) after being placed into a spreadsheet. For the study parameters, the odds ratio was computed. Pearson's correlation coefficient was used to evaluate the correlation. The confidence interval was set at 95% and the p-value at 0.05.

Results

The impact of petrochemicals on fuel attendants' livers in Oluyole area, Ibadan, Oyo state; results are shown as mean $\pm$ SEM, n=100. The liver parameters of fuel attendants differed significantly from non-fuel attendants in terms of concentration (Table 1). The impact of petrochemicals on fuel attendants' livers showed the lowest and maximum concentrations of liver parameters for both fuel and non-fuel attendants (Table 2). ALT in gasoline attendants has a p-value of less than 0.01 when compared to the control group (SEM=39.02 $\pm$ 6.379). When compared to the control group (non-fuel attendants), the ALT of the fuel attendants increased dramatically by 86.3% (Fig. 1). AST in gasoline attendants has a P value of less than 0.01 when compared to the control group (SEM=39.18 $\pm$ 5.799). When compared to the control group (non-fuel attendants), the AST of the fuel attendants increased dramatically by 111.4% (Fig. 2). When comparing the fuel attendants' total protein to that of the control group (SEM=5.4 $\pm$ 1.101), the P value is less than 0.01. When compared to the control group (non-fuel attendants), the total protein of the fuel attendants was significantly lower by 37.2% (Fig. 3). P value of Albumin in fuel attendants is <0.01 when compared with the control group (SEM=3.238 $\pm$ 0.7177). The fuel attendants Albumin was significantly decreased by 37.8% when compared with the control (non-Fuel attendants) (Fig. 4). P-value of Globulin in fuel attendants is <0.01 when compared with the control group (SEM=2.162 $\pm$ 0.5108). The fuel attendants Globulin was significantly decreased by 36.4% when compared with the control (non-Fuel attendants) (Fig. 5). P-value of ALP in fuel attendants is <0.01 when compared with the control group (SEM=32.33 $\pm$ 5.691). The fuel attendants ALP was significantly increased by 88.5% when compared with the control (non-Fuel attendants) (Fig. 6).

	Category	Mean	Std. D	SEM	T	Df.	Prob.
ALT 10- 40U/L	Non-Fuel Attendants'	22.62	7.606	.761	-16.521	198	.000
	Fuel Attendants	39.02	6.379	.638			
AST 10- 40U/L	Non-Fuel attendants	17.58	5.934	.593	-26.034	198	.000
	Fuel Attendants	39.18	5.799	.580			
Total Protein 6-8g/dL	Non-Fuel attendants	7.25	.989	.099	12.503	198	.000
	Fuel Attendants	5.40	1.101	.110			
Albumin 3.4- 5.4g/dL	Non-Fuel attendants	4.288	.5647	.0565	11.498	198	.000
	Fuel Attendants	3.238	.7177	.0718			
Globulin 2.0-3.9g/dL	Non-Fuel attendants'	2.972	.5316	.0532	10.986	198	.000
	Fuel Attendants	2.162	.5108	.0511			
ALP 9-35IU/L	Non-Fuel Attendants	18.26	4.865	.487	-18.793	198	.000
	Fuel Attendants	32.33	5.691	.569			

Key: Std. Error Mean - SEM

Table 1: ANOVA table of Liver enzymes, total protein, globulin, albumin and ALP in non-fuel attendants and fuel attendants in the study.

		N	Minimum	Maximum	Mean	Std. Deviation
Non-Fuel Attendant	ALT1040UL	100	10	40	22.62	7.606
Fuel Attendant		100	25	50	39.02	6.379
Non-Fuel Attendant	AST1040UL	100	8	32	17.58	5.934
Fuel Attendant		100	26	51	39.18	5.799
Non-Fuel Attendant	Total protein68gdl	100	6	9	7.25	.989
Fuel Attendant		100	4	7	5.40	1.101
Non-Fuel Attendant	Albumin3454gdl	100	3.5	5.4	4.288	.5647
Fuel Attendant		100	2.4	4.5	3.238	.7177
Non-Fuel Attendant	Globulin	100	2.0	4.0	2.972	.5316
Fuel Attendant		100	1.0	3.1	2.162	.5108
Non-Fuel Attendant	ALP935IUL	100	10	32	18.26	4.865
Fuel Attendant		100	20	41	32.33	5.691

Table 2: Mean and standard deviation of ALT, AST, total protein, globulin, albumin and ALP in non-fuel attendants and fuel attendants in the study.

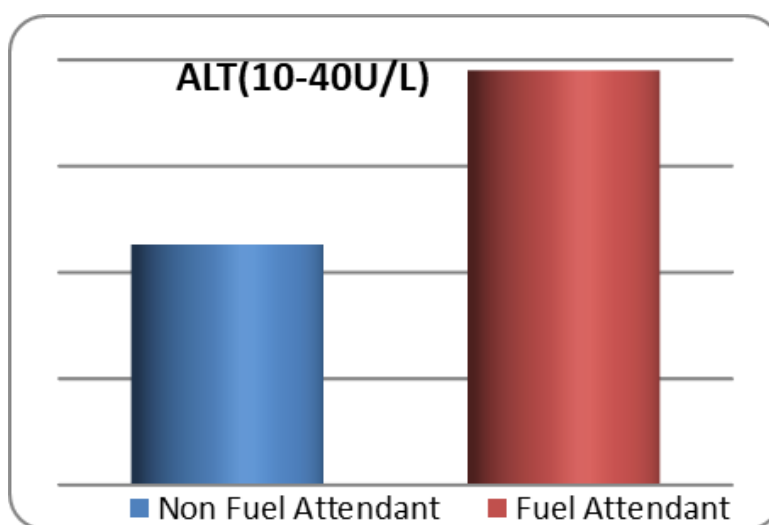


Figure 1: Graph of ALT in Non-fuel attendants and fuel attendants.

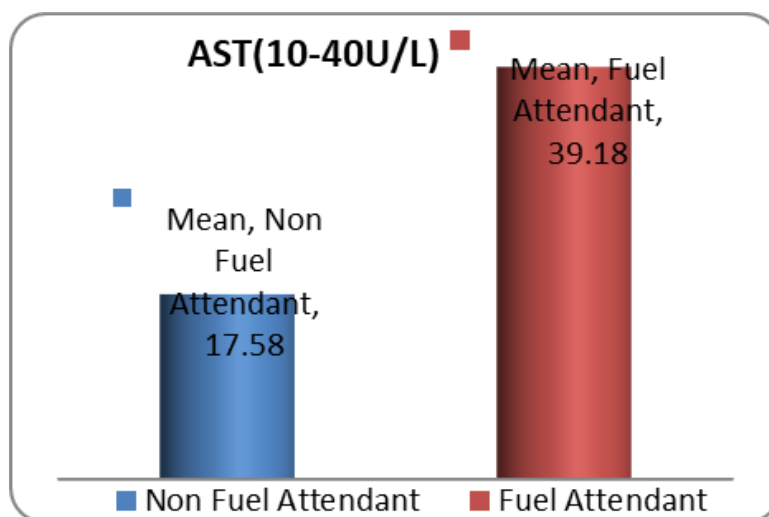


Figure 2: Graph of AST in Non-fuel attendants and fuel attendants.

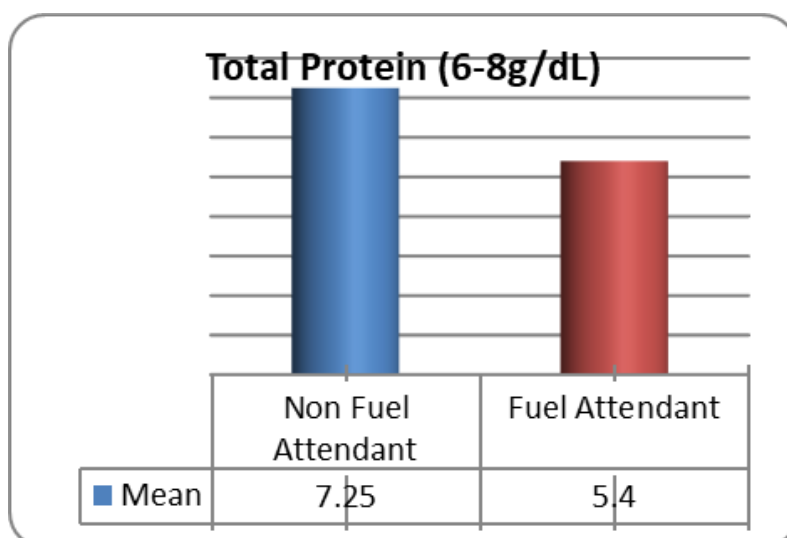


Figure 3: Graph of Total Protein in Non-fuel attendants and fuel attendants.

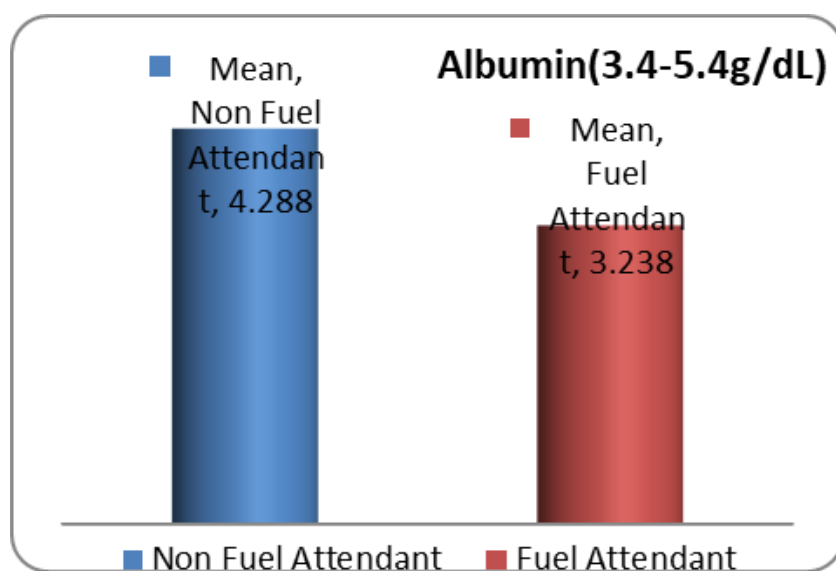


Figure 4: Graph of Albumin in Non-fuel attendants and fuel attendants.

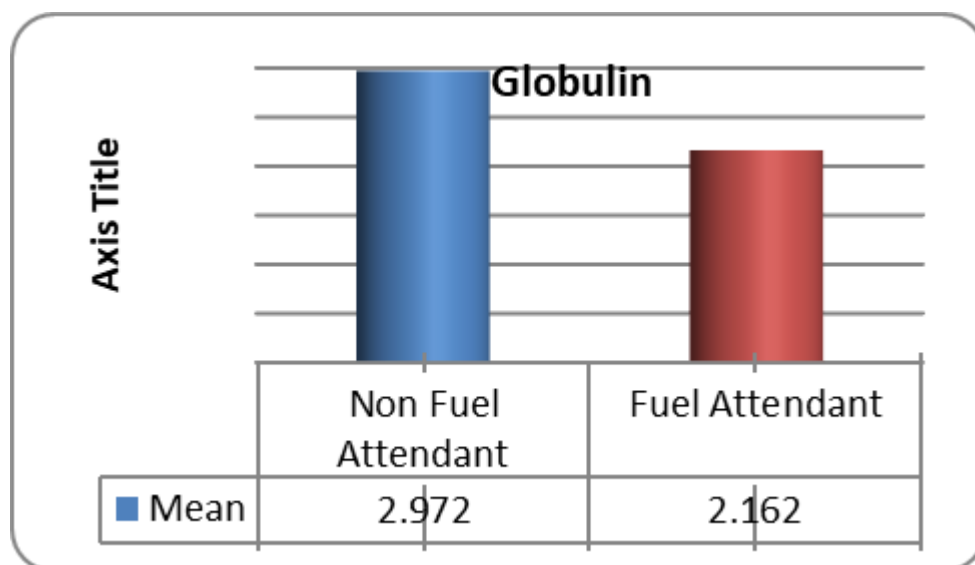


Figure 5: Graph of Globulin in Non-fuel attendants and fuel attendants.

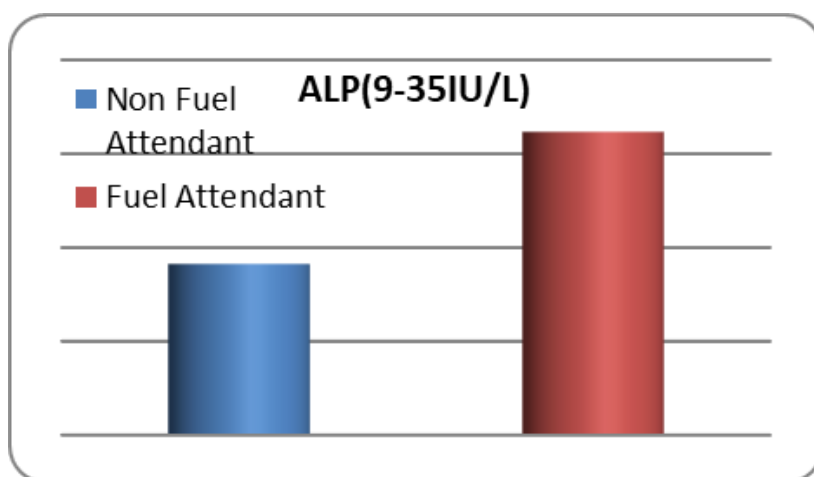


Figure 6: Graph of ALP in Non-fuel attendants and fuel attendants.

Discussion

This study was conducted in the Oluyole neighborhood of Ibadan, Oyo state, to look at the impact of petrochemicals on the livers of gasoline attendants. The results of this investigation showed that petrochemicals had a major impact on the exposed group's liver. Petrochemicals are toxic substances that fall into the category of biochemical substances. These include styrenes, carbonyl compounds, such as formaldehyde and acetaldehyde and Volatile Organic Compounds (VOCs), which are most commonly found as BTEX (Benzene, Ethylbenzene, Toluene and Xylenes). Each of these components has specific toxic properties that can negatively affect liver function [30]. This supports the results of Egbuonu and Nkwazema, who established that petrochemicals pose a health risk to humans [4,31]. The greatest significant health risk associated with the petroleum industry is thought to be VOCs. A portion of the solvent vapors in the workplace can enter the lungs through inhaled air, travel through the pulmonary alveoli and then reach the circulatory system, where they can negatively affect several organs, including the liver [3]. The liver is thought to be the primary organ for detoxifying volatile organic compounds and research has shown that liver injury increases the amount of liver enzymes [15]. Furthermore, the relationship between prolonged exposure to organic solvents such as petrochemicals and liver injury in industrial workers (fuel attendants) has been verified by this investigation and other epidemiological studies [3,4,32].

From the ongoing, this study showed that workers exposed to petrochemicals had significantly elevated ALT, AST, ALP by 86.3%, 111.4% and 88.5% respectively all at $P < 0.01$. Also, there was a decrease in the Total Protein, Albumin, globulin levels compared to the controls by 37.2%, 37.8% and 36.4% ($P < 0.01$) respectively. The raised serum levels of ALT, AST, ALP and decreased Total Protein, Albumin and Globulin could be due to liver injury caused by compounds in the petrochemicals leading to the release of these enzymes from the hepatocytes in response to stimuli of hepatocellular damage or cell death. Responsible for this are the components of the petrochemical such as VOCs (Benzene, ethylbenzene, toluene and xylene) [15,33]. Another deleterious component of the petrochemicals causing this damage is acetylaldehyde as well as formaldehyde, a notable chemical used for fixing tissue in the mortuary [4,10]. The Petro-chemical industry such as the fuel stations are not only a major source of employment in Africa including Nigeria but also provide significant exposure to stressors through exposure to Benzene and its counterparts [3,34]. When fuel is dispensed, employees at gas stations are exposed to a variety of hydrocarbons as well as the fumes from passing cars [3,19]. Petroleum compounds have cytotoxic effects on the majority of human and animal bodily organs, including the kidney and liver [13,35]. Long-term exposure to benzene may result in hepatotoxicity and the degree of benzene poisoning varies depending on the exposure's source, duration and duration as well as the victim's age and underlying medical conditions [3,10,36]. Cytochrome P450 (CYP) 2E1 in the liver converts this benzene, a byproduct of petrochemicals, to benzene oxide. Through oxidation, dehydrogenation or conjugation with sulfate or glucuronic acid, these metabolites go through additional metabolism [4]. The damage to the liver may result from an excess of these harmful substances [10,37]. Additionally, when benzene and its reactive metabolites are activated, Reactive Oxygen Species (ROS) are continuously produced. ROS cause lipid peroxidation, damage DNA and RNA, alter genetic makeup and change how vital enzymes and proteins function (such as the liver) [12,15]. Those who are occupationally exposed to benzene (a petrochemical component) have significantly higher levels of ROS and oxidized lipid than those who are not. Oxidative stress is the mechanism by which other volatile organic compounds damage DNA. Consequently, the liver's antioxidant capacity is diminished, potentially leading to hepatocyte apoptosis. This

possible mechanism may be connected to the incidence of liver dysfunction in individuals exposed to formaldehyde, acetaldehyde and benzene/other organic chemicals [38].

Another petrochemical is styrene [4]. It is broken down by the liver producing the hazardous and possibly cancer-causing metabolite styrene oxide. One of styrene's primary metabolites, styrene 7,8-oxide (SO), is known to lower Glutathione (GSH) levels. Increased lipid structural destruction in the liver has been linked to low GSH levels [10]. It is possible for styrene and its metabolite, SO, to cause malfunctions in the mitochondria. Additionally, SO stimulated the apoptotic response *in-vitro* and significantly increased caspase-3 activity. Given the vital role the liver plays in the metabolism of fats and carbohydrates, liver failure and changes in the lipid profile of the blood of fuel workers may be linked to the incidence of apoptosis and mitochondrial malfunction. Liver dysfunction and styrene levels in the workplace are closely related [10]. The levels of hepatic enzymes and ambient styrene are correlated in a constant and linear manner. Hepatic enzymes' conversion of styrene is linked to some of its hepatotoxic effects [10,15].

Conclusion

This study showed that exposure to petrochemicals has the potential to cause hepatic changes in the exposed subjects. However, petrochemicals including benzene and other compounds such as acetaldehyde, formaldehyde which are components in the petrochemicals can lead to numerous toxic health effects associated with functional aberration of vital organs in the body such as the liver with a significant increase in the ALT, AST, ALP and a decrease in Total protein, Albumin and Globulin. National legislation is the surest way to provide for safety and health protection of workers against occupational hazards. Corporate organizations can however limit exposure of their workers to hazardous chemicals exposure when they establish and implement Occupational, social and health Policy Statements and Standard of operation guidelines/codes of practice for protection of personnel against exposure.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Consent to Participate

Informed consent was obtained from each participant prior to specimen collection.

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Data Availability

Data is available for the journal. Informed consents were not necessary for this paper.

Author's Contribution

The entire study procedure was conducted with the involvement of all writers.

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