ORIGINAL ARTICLE

NATIONAL JOURNAL NJMR MEDICAL RESEARCH

RETRACTED: Assessment of Hepato-Renal Biomarkers in Petrol Pump Attendants: Impact of Protective Gear Usage

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Keywords:
Renal disease,
hepatic impairment,
petrochemical product,
occupational exposure,
volatile substance

Date of Acceptance:
26-10-2023

DOI:
10.55489/njmr.13042023982

ABSTRACT

⚠ ***This article has been retracted. This article has been retracted by the editor and the publisher due to unattributed authorship. The content is no longer valid for citation or scholarly use. The full retraction notice to be published on 1st July, 2025.***

Background: Petrol Pump attendants (PPA) in India wear a variety of safety gear, including as overalls, masks, and gloves. It is still entirely unknown if they can effectively protect vulnerable organs like the liver and kidney. The study's objective is to examine the hepato-renal axis' biochemical characteristics in PPA employees who wore protective gear while on duty and those who did not.

Methods: The research population was divided into three Groups. Group A consisted of 15 adults male PPAs who had consistently implemented protective measures when administering petroleum products. 32 PPA who did not wear protective gear made up Group B. A total of twenty-eight male adults who had not been exposed to petroleum products made up Group C, the control Group. For PPA selected for the research, a minimum of five years of exposure was required. Through the administration of a questionnaire, data on worker safety was gathered about the usage of self-protective gear as a standard safety procedure for personal protection. To evaluate biochemical indicators of hepato-renal functioning, serum was used. Both the Student's t test and the analysis of variance were used to find statistical differences. It was deemed significant at p 0.05.

Results: ALP, AST, ALT, creatinine, urea, albumin, and total protein activities or levels in both Group A and Group B were substantially different from control (Group C), suggesting liver impairment.

Conclusion: Data from this study indicate that none of the three protective gear options employed by PPA in Group B significantly decreased exposure.

INTRODUCTION

Long-term proximity to a service station, where a fuel attendant works, is a significant source of exposure to hazardous chemicals [1], and this is true everywhere in the world, though it might be more prevalent in countries where there are no regulations against workplace exposure to toxic substances. According to 1997 research done in Italy, where ambient benzene levels were assessed using both active and passive stationary and portable samplers in 26 gas stations. Although it appears that seasonal fluctuations altered the degree of environmental pollution as levels were much lower in winter and higher in summer, Brugnone et al. [2] observed that there was a noteworthy amount of benzene in the environment.

In addition to measuring the levels of benzene in the atmosphere, Brugnone and colleagues 2 assessed the blood benzene levels of the gas station employees at the

conclusion of their shift and the following morning before work started. These gas station employees had considerably raised mean blood levels of benzene at the conclusion of their shift (the levels though were significantly lower in winter and higher in summer). Even while the increases were smaller than those discovered at the conclusion of the work shift, they were still considerably higher than the mean blood benzene levels of control participants the following morning. This suggests that benzene exposure is a type of occupational danger for the population under study.

While there are many underdeveloped countries where the level of hazardous exposure documented by Brugnone et al. [2] is still prevalent, many wealthy countries now have more or better safety measures in place against toxic exposure than there were in 1997. Polycyclic aromatic hydrocarbons (PAHs) were found in significant quantities in surface soils from Calabar metropolis petroleum handling facilities (such as kerosene tanks, generating plants, gas stations, and mechanic workshops), according to Nganje et al (Nigeria) [3]. Additionally, Kamal et al. [4] reported on an increase in PAH exposure at Pakistani auto mechanic workstations as recently as 2015. The mean concentration of benzene, ethylbenzene, toluene, and xylene (BTEX) was somewhat greater in petrol stations than on the side of the road in Thailand. All of these data lend credence to the idea that exposure to petroleum product components is a regular occupational danger for gas station workers, and that wearing protective gear may reduce the amount of exposure. The study's objective is to look at the effects of certain protective gear on hepatic and renal damage markers found in PPA serum.

METHODS

The research was divided into three groups, the first of which, Group A, comprised of fifteen adult male gasoline station attendants (PPAs) who regularly employed protective gear (gloves, overalls, and face masks) while performing their duties of distributing petroleum products. 32 male adults in the second Group (Group B), who did not wear protective gear, made up Group B. 28 male adults served as the control group (Group C). The study's participants were all between the ages of twenty-one and twenty-nine. Participants in the research were stationed in the Ibadan city and its surrounds and had a minimum of 5 years of exposure. Which fueling station would be included in the research was chosen using a random sample procedure. The participants at all stations that would be included in the research were also identified using the same method, with the exception of the PPA in the first set, or Group A.

Each subject's informed permission was acquired once the study's objective and anticipated results had been made explicit. The thirty male adults who appeared to be in good health and who were chosen as the control group from the general population confirmed that they had not engaged in any occupation associated with exposure to gasoline or diesel, including work as auto mechanics, attendants at gas stations, drivers of commercial vehicles, motorcycle riders, or any other occupation (common in the environment) capable of causing exposure to petroleum products. Lifestyle decisions that might affect hepato-renal indices, the existence of hepato-renal illnesses, and un-aged PPA, female PPA, and male PPA with exposure periods of less than five years were among the exclusion criteria. Male PPAs who satisfied the inclusion criteria but worked part-time jobs that involved gasoline and may lead to further exposure were not included in the research. As part of a typical safety process for personal protection, the use of self-protective equipment such overalls, gloves, masks, etc. was observed and gathered through an applied questionnaire to determine the level of worker safety. The length of exposure at the current or previous jobs (related to fuel exposure) was also determined.

All samples were collected at the conclusion of an eight-hour workday. Each individual had 5 mL of blood drawn from the ante-cubital vein and put into anticoagulant-free tubes right away. Each blood sample underwent a 2500 g centrifugation step to extract serum, which was then promptly frozen at -200C until needed for the investigation of renal and hepatic parameters. Everything was done in conformity with the updated Helsinki Declaration. The serum of gasoline filling station employees and control individuals were assessed for total bilirubin, total protein, and albumin using the Jendrassik-Groff [5], Biuret [6], and standard Bromocrescol green methods, respectively. The Jaffé reaction was used to measure the amount of creatinine, whereas the diacetyl monoxime technique was used to measure the level of urea. Additionally evaluated were the serum activities of liver enzymes as well as the uric acid level. Alkaline phosphatase, aspartate aminotransferase, alanine aminotransferase, and -glutamyl transferase (ALT, AST, ALP & -GT) were the enzymes. AST and ALT activity were calculated using the Bergmeyer et al. [7] technique. However, the technique used for alkaline phosphatase (ALP) was developed by Mc Comb and Bowers [8]. These estimates were made using Hitachi® 902 automated machines from Roche Diagnostic in Germany.

To determine the mean and SD, the data were statistically analysed using SPSS version 15. (standard deviation). The magnitude of the significant difference between Group A and Group C, Group B and Group C, and Group A and Group B was determined using the Student's t-test. Analysis of variance was used to assess the outcomes of all three Groups. It was deemed significant at P 0.05.

RESULTS

Table 1 below lists the outcomes of the estimated biochemical indicators. When Groups A and C were compared, -glutamyl transferase activities, globulin and total bilirubin concentrations were not significantly different

(p>0.05), but creatinine, urea, ALP, AST, and ALT were significantly higher (p0.05) and total protein, albumin, and uric acid were significantly lower (p0.05) in Group A attendants compared to control. ALP, AST, ALT, creatinine, urea, uric acid, and globulin were significantly higher (p0.05) in Group B attendants than in Group C (control), whereas total protein and albumin were lower (p0.05) when Group B and Group C were compared. On the other hand, -glutamyl transferase was not significantly different (p>0.05) when Group B and Group C were compared. Only the amounts of total bilirubin, globulin, and uric acid significantly differed between Groups A and B, according to the comparison. ANOVA was used to compare Groups A, B, and C against each other, and all parameters except glutamyl transferase revealed significant differences.

The gasoline station personnel in Group B all admitted that not all safety precautions had been taken simultaneously. Face mask and gloves, which are among the three safety precautions (along with overall and gloves), were never used at any point by any of the attendees in Group B, whereas five attendees stated that overall was only ever used on very rare occasions in the five years prior to the study period, such as during the cold harmattan session. 35 of the Group B attendants did not believe that using a face mask would help them to restrict their exposure to gasoline. On the other hand, every PPA in Group A reported that protective equipment was consistently used while in a gas station area.

Table 1: Fuel station employees' serum levels or activity of hepatic and renal damage indicators compared to control participants

Parameter	Group A (n=15)	Group B (n=32)	Group C (n=28)	P- value
Gamma-glutamyl transferase (IU/L)	47.27±5.37	46.83±6.95	45±6.39	0.842
Alkaline phosphatase (IU/L)	67.76±5.75*	71.18±8.59#	57±5.39	0.038
Total protein (g/L)	78.74±8.64*	79.65±6.28#	83.94±3.94	0.014
Albumin (g/L)	31.46±9.01*	28.93±2.88#	36.39±4.43	0.029
§Globulin (g/L)	43.96±5.48	47.68±3.84#	43.71±7.88	0.361
§Total bilirubin (µmol\L)	12.83±0.91	17.48±1.88#	12.46±1.87	0.011
Alanine aminotransferase (IU/L)	36.66±4.52*	37.16±4.41#	28.49±2.77	0.008
Aspartate aminotransferase (IU/L)	37.91±4.48*	37.91±5.23#	31.6±7.63	0.022
Uric acid (mmol\L)	157.87±23.98*§	188.81±20.84#	171.07±16.17	0.027
Creatinine (µmol\L)	28.75±3.10*	29.52±4.82#	23.16±3.18	0.005
Urea (mg/dL)	26.26±3.24*	28.26±2.69#	19.86±3.19	0.009

Abbreviations: Group A- petrol filling station attendants that did not use protective gears; Group B- petrol filling station attendants that rarely used protective gears; Group C- control. Results are expressed as mean ± standard deviation. *P ≤ 0.05 is significant when Group A and Group C were compared. **#** P ≤ 0.05 is significant when Group B and Group C were compared. **§** P ≤ 0.05 is significant when Group A and Group B were compared. P ≤ 0.05 is significant when the three Groups were considered.

DISCUSSION

Benzene, toluene, ethylbenzene, and xylene (BTEX) are volatile organic chemicals and benzene and ethylbenzene are well-known carcinogens, according to ACGIH [9] and US EPA [10]. In both Group A and Group B of PPA, the current investigation has shown that gasoline exposure produces hepato- and nephrotoxic consequences. The haematological system, the central neurological system, and the reproductive system are also affected by benzene, according to ATSDR [11] and a few other studies from the past. Ethylbenzene and xylene can have respiratory and neurological consequences, whereas toluene affects the reproductive and central nervous systems [12–14].

The study by Tunsaringkarn et al. [15] appears to be different, though, as the non-carcinogenic risk of exposure to BTEX compounds was lower than the reference hazard level for both gas stations and the side of the road. This would indicate that there were no negative health effects to the bone marrow, as well as both haematological and neurological parameters. Toluene is more quickly absorbed, soluble in the blood with a half-life of 15-20 hours, and while it has a chronic impact on various organs, including the liver, lungs, kidneys, and heart, it cannot be blamed for the toxic effects on the hepatonephrons shown in the current test subjects (PPA) [13,16]. Toluene and benzene's synergistic effects, as described by Kitwattanavong et al. [17], cannot be completely ruled out as the cause of the gasoline station attendants' much elevated levels of markers for the liver and kidney.

Workers at gas stations are directly exposed to BTEX chemicals not only through the nasal and oral routes but also through the cutaneous route in many areas of the world, as it has also been found in Thailand by Tunsaringkarn et al. [15]. However, the respiratory system is the primary exposure pathway. The issue is made worse by the selling of these flammable materials in containers, a procedure that is commonly acknowledged to be followed by splashing of these products not only on people but also in the surroundings of gasoline filling stations. Without a doubt, splashing will increase the visibility and potential exposure sources of both cutaneous and oral routes. The liver is typically the organ that is most vulnerable to chemical injury; by promptly and

thoroughly removing chemicals, it significantly reduces the amount of medication that enters the general circulation. The liver is exposed to the highest quantities of possible toxins because it is the first organ to be exposed to a medication or chemical following absorption through the gastrointestinal tract or peritoneal space.

More significantly, the principal organ for the biotransformation of numerous substances inside the body might also be connected to the high sensitivity of the hepatic cells to chemical assault. The metabolic transformation process is well recognised for changing the chemical in such a way that it loses its biological activity inside the body, gets more polar, and becomes water soluble, all of which always make these substances easier to expel from the body. As a result, the liver functions as a detoxification organ because it not only inhibits the biological action of hazardous chemicals but also decreases their blood levels, avoiding the buildup of an agent to dangerous levels in the body. Being the primary organ that metabolises chemicals, hazardous reactive compounds or short-lived intermediates that are generated throughout the biotransformation process will have a serious influence on hepatic cells. Unfortunately, there are drawbacks that may come from these significant responsibilities.

The integrity of the many cell types that make up the liver is impacted by chemical agents in various ways. The majority of the hepatic lobule is made up of the hepatocytes, also known as parenchymal cells, which account for around one-third of all the cells in the human liver. These cells are more severely and negatively impacted by hepato-toxic substances as a result of their huge numbers and significant xenobiotic metabolising activity. Although they are abundant and a different cell type from hepatocytes, endothelial cells border the sinusoid and make up the majority of the liver's remaining cells. Additionally, fixed macrophages, sometimes referred to as Kupffer cells, are present in the hepatic microvasculature. They phagocytize germs and foreign particles in the blood, and they may serve as the foundation of the immunological response associated with hepatotoxicity. Studies have shown that these cells play a significant role in inflammatory reactions in the liver and are also capable of producing reactive oxygen species and cytokines. Between parenchymal and endothelial cells in the liver are fat-storing cells known as parasinusoidal cells or stellate cells. Unlike parenchymal cells, however, these cells' roles in chemically caused liver damage are less well understood. The large increases in the activities of aspartate and alanine aminotransferase, and alkaline phosphatase in both Groups A and B imply hepatocytes membrane injury with potential cholestasis, even if histology reports are not available to validate the involvement of each cell type. The significantly higher level of globulin in Group B is an indication of an inflammatory response, especially since albumin was also decreased. Low levels of albumin (in both Group A and B) compared to control suggest that the toxic effects of gasoline exposure altered the liver's ability to synthesise. The lack of a substantial variation in Group B's globulin level suggests that they were resistant to infection.

Additionally highly elevated were all renal indicators, indicating renal injury. Although not all hepatotoxic substances are also nephrotoxic, when a substance's toxicity is mediated by free radical action and the enzymes responsible for producing reactive oxygen species are sufficiently expressed in both the liver and kidney, hepato-nephrotoxic effects may be the result of exposure to a toxic substance. Furthermore, the involvement of both hepatic and renal cells in this group of test subjects may not be unexpected given that the gasoline, diesel, and kerosene to which they are exposed is composed of a number of distinct compounds.

Since the liver has a considerable capacity for regeneration, it is possible that many hepatic indicators may return to normal levels. Therefore, additional research is required to determine whether these harmful effects are reversible by examining hepato-renal markers in people who work at filling stations on a permanent basis (current attendants) and comparing them to people who have stopped working there (former fuel filling station attendants). It is without a doubt advantageous to find various strategies to lower exposure levels to the components of gasoline, which is the most volatile and widely available petroleum product. This should logically be the first step in preventing this occupational danger.

The fact that several of the hepato-renal function indicators of Groups B and A were substantially different from Group C (control) when examined separately suggests that the three preventive measures (overall, glove, and face mask) did not prevent hepatic and renal damage. This implies that contact with petroleum compounds may not be entirely prevented by wearing overalls, a face mask, and gloves. Additionally, the very volatile nature of gasoline, the petroleum substance that is most often delivered in many filling stations, may overcome the protective benefits of these gears, increasing contact.

CONCLUSION

The same levels or activity of several hepatic and renal function indicators in Group A and Group B patients imply that these precautions had no appreciable protective effect against hepato-renal impairment. This suggests that these typical protective gears are insufficient to prevent organ injury. For these attendants, alternative protective strategies have to be developed.

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