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Assessment of Certain Biochemical Parameters among Petrol Station Workers in Sana'a City, Yemen

Ali Alhaj^{1,*}, Abdulhabib R. Alqubaty¹, Mogahid Nassar², Farouk Al-qadasi³¹ Department of Biochemistry, Faculty of Medicine and Health Sciences, University of Sciences and Technology, Sana'a, Yemen² Department of Pathology, Faculty of Medicine and Health Sciences, University of Sciences and Technology, Sana'a, Yemen³ Health and Nutrition Program, Yemen Family Care Association, Sana'a, Yemen**ABSTRACT****Objective:** To assess hepatic and renal functions among petrol station workers in Sana'a city, Yemen.**Methods:** A comparative, cross-sectional study was conducted in Sana'a city, in the period from November 2017 to April 2018. It included 109 petrol station workers exposed to petrol for at least six hours daily over a period of six months or more and 109 apparently healthy office clerks from the University of Science and Technology as non-exposed individuals. Data were collected using a pre-designed questionnaire through face-to-face interview. Then, blood samples were collected from petrol station workers and office clerks and tested for albumin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), urea and creatinine in the Laboratory Department of the University of Science and Technology Hospital. Data were analyzed using SPSS, version 23.0.**Results:** The mean concentration of serum albumin among petrol station workers was significantly lower than that of office clerks. In contrast, the mean level of serum ALP was significantly higher among the petrol station workers than the office clerks. On the other hand, there were no statistically significant differences in the mean levels of serum ALT and AST between the two groups. Although the mean concentrations of creatinine and urea were higher among office clerks than petrol station workers, the difference was only significantly higher for creatinine among office clerks.**Conclusions:** Although no specific biochemical abnormalities exist in the hepatic and renal functions of petrol station workers in Sana'a city, these parameters may show evident effects with prolonged exposure to petrol components. Further longitudinal studies with larger sample sizes, longer durations of exposure and regular follow-up are recommended to assess the impact of long-term exposure to petrol on hepatic and renal functions.**Keywords:** Liver function, Kidney function, Petrol station, Yemen* **Corresponding author:** A. Alhaj (alhajj20@yahoo.com)

1. Introduction

Petrol is a complex combination of aliphatic and aromatic hydrocarbons, such as benzene, toluene, ethylbenzene and xylene, which are considered among the most hazardous compounds for the human health (1, 2). Petrol fumes are widespread in the environment, and the common sources of contact or exposure are petrochemical industries (refineries, oil fields and filling stations) and homes (3). Several harmful effects of exposure to petrol are due to the individual chemicals, such as benzene, lead and oxygenates, in its mixture. Inhalation of small amounts of petrol vapors can lead to nose and throat irritation, headache, dizziness, nausea, vomiting, confusion and breathing difficulties (4). Lead poisoning is a serious threat to human health, particularly to workers with daily exposure. This occupational condition may cause serious complications to some organs such as kidneys, brain, reproductive organs and liver (5, 6).

Oxidation of petroleum hydrocarbons and other related carbon-containing compounds in the cells, particularly of the liver and kidney, converts them into free radicals or activated metabolites (7). Furthermore, lead induces overproduction of reactive oxygen species, which can result in peroxidation damage to hepatocyte membranes. Damage to hepatic cells leads to the release of transaminases and increases their levels in the serum (8).

The tissues of blood, liver and kidneys are the major ones affected by petrol compounds, where anemia, liver cancer and renal failure related to the exposure to its components have been reported (9, 10). Exposure to petrol components is increasing in some of the Middle East countries such as Iran, Pakistan, Afghanistan and Iraq, where people collect and trade petrol as an unregulated job. They are directly exposed to its components through inhalation, skin contamination and accidental ingestion when sucking on a pipe to remove petrol from vehicle fuel

tanks (11). Yemen is not different from these countries regarding these practices. To the best of our knowledge, no published studies have investigated the hepatic and renal functions of petrol station workers in Sana'a city, Yemen. Therefore, the present study aimed to assess liver and renal functions by assessing the biochemical parameters of albumin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), urea and creatinine among petrol stations workers in Sana'a city in comparison to healthy office clerks.

2. Methods

2.1. Study design, setting and populations

This was a comparative, cross-sectional study conducted in Sana'a city in the period from November 2017 to April 2018. The study included 109 petrol station workers exposed to petrol for at least six hours daily over a period of six months or more, whose owners agreed to their participation in the study. On the other hand, 109 apparently healthy office clerks not occupationally exposed to petrol were recruited from the University of Science and Technology as office clerks. Both groups were ensured not to have any history of hepatic or renal diseases before or during their job as well as not to have a history of taking medications affecting liver and kidney function tests.

2.2. Data collection

Data on the age, duration of work in years and length of work per day were collected from both groups by a pre-designed questionnaire through face-to-face interview.

2.3. Sample collection and biochemical measurements

A 5-ml blood sample was withdrawn from each participant through venipuncture. Immediately after blood collection, the blood was centrifuged to separate the serum. Serum was then stored at



-20°C until analysis. Serum levels of albumin, ALT, AST, ALP, urea and creatinine were measured in the Biochemistry Laboratory of the University of Science and Technology Hospital using cobas c 311 analyzer (Roche Diagnostics, Mannheim, Germany).

2.4. Statistical analysis

Data were analyzed using IBM SPSS Statistics for Windows®, version 23.0 (IBM Corp., Armonk, NY, USA). Quantitative variables were expressed as mean ± standard deviation, where independent *t*-test was used to compare between the means of parameters among petrol station workers and office clerks. Differences were considered statistically significant at *P* values < 0.05.

3. Results

3.1. Comparison between the characteristics of petrol station workers and office clerks

Table (1) shows that the mean age of petrol station workers was 26.8 ± 8.0 years (range: 18–60) and was significantly lower (*P* < 0.001) than the age of office clerks (5.5 ± 5.7 years; range: 19–48). The mean duration of work for petrol station workers was lower (5.5 ± 5.7 years) than that for office clerks (6.4 ± 3.6 years), but the difference was not statistically significant (*P* = 0.147). On the other hand, the mean length of work per day was significantly higher (*P* < 0.001) among petrol station workers (11.8 ± 3.4 hours) than that for office clerks (7.7 ± 1.6 hours).

Table 1. Comparison between petrol station workers and office clerks in Sana'a city according to certain characteristics*

Variable	Petrol station workers (mean ± SD)	Office clerks (mean ± SD)	<i>P</i> -value
Age	26.8 ± 8.0	30.4 ± 5.5	<0.001
Duration of work (years)	5.5 ± 5.7	6.4 ± 3.6	0.147
work per day (hours)	11.8 ± 3.4	7.7 ± 1.6	<0.001

* Each group included 109 participants; SD, standard deviation

3.2. Comparison between petrol station workers and office clerks with respect to the findings of hepatic and renal function tests

Regarding the findings of liver function tests, Table (2) shows a significantly lower mean level of serum albumin (4.3 ± 0.7 vs. 5.0 ± 0.5; *P* < 0.001) but significantly higher mean level of ALP (91.3 ± 34.1 U/L vs. 85.3 ± 23.2 U/L; *P* = 0.027) among petrol station workers compared to their counterparts. However, there were no statistically significant differences between the two groups with respect to the mean levels of serum ALT and AST.

Regarding the findings of renal function tests, the mean levels of creatinine (1.1 ± 0.2 vs. 0.8 ± 0.2) and urea (32.8 ± 6.6 vs. 27.8 ± 7.3) were higher in office clerks than petrol station workers; however, only the difference in the mean levels of creatinine was statistically significant (*P* = 0.038) (Table 2).

Table 2. Comparison between petrol station workers and office clerks in Sana'a city with respect to the findings of hepatic and renal function tests*

Biochemical parameter	Petrol station workers (mean ± SD)	Office clerks (mean ± SD)	<i>P</i> -value
Albumin (g\dl)	4.3 ± 0.7	5.0 ± 0.5	<0.001
ALP (U\L)	91.3 ± 34.1	85.3 ± 23.2	0.027
ALT (U\L)	18.0 ± 9.1	24.7 ± 12.3	0.195
AST (U\L)	20.5 ± 10.3	24.1 ± 6.6	1.000
Creatinine (mg\dl)	0.8 ± 0.2	1.1 ± 0.2	0.038
Urea (mg\dl)	27.8 ± 7.3	32.8 ± 6.6	0.130

* Each group included 109 participants; SD, standard deviation.

4. Discussion

Up to the best of our knowledge, this is the first study to assess hepatic and renal functions among petrol station workers in Sana'a city. In the present study, the significantly lower mean serum albumin among petrol station workers compared to the office clerks is in line with the published literature, where significantly decreased albumin levels in exposed people com-



pared to the controls have been reported elsewhere (12–15). This finding is also in line with that observed among Egyptian petrol station attendants, where the mean levels of serum albumin and total protein were non-significantly lower than those of their counterparts (16).

Experimentally, lead acetate was found to have a significant reduction in total soluble proteins and albumin but not on plasma globulins (17). Moreover, early liver dysfunction was found to be associated with occupational exposure to sub-threshold limit levels of benzene, toluene and xylenes in unleaded petrol (12). It has been suggested that the toxic effects of petrol exposure alter the synthetic ability of the liver (14). In the present study, leaded petrol is still in use, posing those working in petrol stations to the risk of exposure to lead toxicity. In contrast, in Sulaimani city of Kurdistan, plasma albumin levels were found to be significantly elevated in gasoline-filling station workers compared to the controls (18). On the other hand, albumin levels were found to be unchanged among workers exposed to lead in the United Arab Emirates and Nigeria compared to unexposed controls (19, 20).

In the present study, the mean ALP activity was found to be significantly higher in petrol station workers compared to the controls. This finding is in accordance with that among Iranian unregulated gasoline traders (21). In addition, it is in agreement with the findings among petrol station attendants in Nigeria and volatile substance abusing street children in Turkey (22, 23). On the other hand, Gupta et al. (24) found that ALP activity was non-significantly higher in petrol filling attendants. The increase in ALP activity generally originates from the hepatobiliary system. Therefore, toxic effects of lead on the liver could result in disturbances of the transport functions of the hepatocytes or the biliary tree and can cause elevation of ALP activity (25). In contrast, the finding of the present study is inconsistent with the significantly lower

ALP activity among those occupationally exposed to lead in a mechanic village in Nnewi, Nigeria (20), which was attributed to the decrease in the zinc level in exposed artisans. In addition, it disagrees with a finding by Saadat and Ansari-Lari (26), who reported non-significant differences in the mean ALP activity among male gasoline workers in Shiraz - Iran compared to matched controls.

In the present study, ALT and AST were higher among office clerks than petrol station workers, but the increase remained in the normal range and with no statistically significant difference between the two groups. Similar findings were reported among petrol station attendants exposed to fuel vapor for 1-5 years in Owerri, Nigeria (22). However, a significant increase in the activities of ALT and AST was found among such attendants with long-term exposure (6-10 years) to petrol vapors in comparison to the controls. In line with this finding, non-significant AST differences were found among Egyptian petrol station attendants compared to their corresponding controls (16). In contrast, higher serum transaminase activities were observed among fuel-filling workers of Sulaimani city compared to the controls, though these values were within the normal range for clinical diagnosis of hepatic injury (27). Furthermore, significantly higher liver enzymes among petrol filling attendees in comparison to controls have been reported in several studies (12, 14, 15, 24, 26).

In the present study, the mean length of exposure to petrol was 5.5 years, which may have a lower effect on hepatic function in comparison to longer periods of exposure. In this respect, it was found that petrol pump workers in Jaipur city in the state of Rajasthan, India working for more than 10 years at various petrol-filling stations had elevated levels of AST, suggesting that petrol-filling attendants are at greater risk of developing hepatocellular injury over time (24). The increase in the duration of service and ex-



posure to fumes in petrol stations among Nigerian attendants in Ibadan was found to increase the levels of AST, ALT, ALP and total bilirubin (28).

Although the mean levels of urea and creatinine were higher among office clerks compared to petrol station workers in the present study, the difference was statistically significant for creatinine but not urea between the two groups. The higher level of urea in office clerks in the present study may signify higher dietary intake of proteins. This finding is consistent with that among Iranian unregulated gasoline traders (21). In Egypt, non-significantly higher serum urea and creatinine levels were found among petrol station attendants compared to the controls in Mansoura (16). In another context, serum levels of urea and creatinine were shown to be significantly higher among petrol-filling workers in Sulaimani city of Kurdistan, petrol attendants exposed to petrol fumes in Ibadan city of Nigeria and petrol station attendants in Basrah governorate of Iraq compared to their corresponding controls (18, 28, 29).

The duration of exposure to petrol appears to affect kidney function tests. In this respect, significantly higher mean levels of urea and creatinine were found among Nigerian petrol station attendants and motor mechanics exposed to fuel vapors over longer periods of exposure compared to their corresponding controls (22, 30). Such elevated levels can be attributed to renal damage or toxicity (14, 22). Because kidneys have a considerable reserve capacity (20), clinical manifestations of renal impairment do not become evident until more than 50% of the nephrons have been destroyed (31). These observations may suggest that both urea and creatinine are not sufficiently sensitive to detect renal impairment due to lead poisoning.

5. Conclusions

No specific laboratory abnormalities in liver and renal functions are evident among petrol station workers in Sana'a. However, these may become manifest with prolonged exposure to petrol components. Further longitudinal studies with larger sample sizes, longer duration of exposure and regular follow-up on various health aspects are recommended to assess the impact of long-term exposure to petrol on liver and kidney functions among petrol station workers in the country.

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Authors' contributions

AA designed the study and drafted the manuscript. ARA helped in sample collection. MN helped in laboratory work. All authors read and approved the final draft of the manuscript submitted to the journal.

Competing interests

The authors declare that they have no competing interests associated with this article.

Ethical approval

The protocol of the study was ethically approved by the Research Ethics Committee of the Faculty of Medicine and Health Sciences, University of Science and Technology, Sana'a. Permission was also obtained from the Ministry of Oil and Minerals and from petrol station owners. Written informed consent to voluntarily participate was obtained from all subjects after explaining the purpose of the study. The confidentiality of the data was also assured.

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