Ain Shams Journal of Forensic Medicine and Clinical Toxicology
July 2021, 37: 57-66

Assessment of hematological parameters, liver and kidney functions among fuel station workers in Sohag governorate, Egypt

Marwa A. Hasb Elnabi[1], Soheir A. Mohamed1[1], Hasnaa A. Abo-El Wafa[2], Hosam H. Khalaf[1], Walaa A. Allam[1]

[1] Forensic Medicine & Clinical Toxicology Department, Faculty of Medicine, Sohag University Sohag, Egypt.
[2] Clinical and Chemical Pathology department, Faculty of Medicine, Sohag University, Sohag, Egypt.

Abstract

Introduction: In fuel stations, gasoline induces a wide range of toxicological effects on body tissues and biochemical changes, which pose grave health risks to humanity. **Aim**: This study aims to assess the effects of gasoline on hematological parameters, liver and kidney functions among sample of fuel station workers in Sohag governorate, Egypt. **Methods**: A cross-sectional case control study was done on 100 males working in fuel stations and 50 males didn't work in fuel stations in Sohag governorate, in the duration of one year from first of April 2019 to end of March 2020. Each participant was interviewed with a detailed questionnaire and CBC, liver and kidney function tests were done. Results: The study revealed statistically high significant differences between the studied and the control groups as regards RBCs count and the levels of ALT, AST, total protein and urea. There was a statistically significant effect of smoking on RBCs count, WBCs count, AST level, creatinine and urea level of the studied group. There was statistically significant positive correlation between parameters of CBC, liver and kidney function tests and ages of the workers of fuel station and there was only positive correlation between ALT level and the duration of work. **Conclusion**: this study concluded that exposure to gasoline associated with significant decrease of RBCs count and total protein level and significant increase of ALT, AST and urea levels among workers in fuel stations and these effects increase with advancing in age and most of them get worse with increased duration of work at fuel stations and with smoking. Recommendations: Our study recommends improving working conditions and using natural gas for cars as an alternative to gasoline.

Key words Gasoline, fuel station, liver and kidney, assessment, CBC

Introduction

Gasoline is a volatile and inflammable liquid mixture derived from petroleum that is mainly used for internal machine combustion. It is commonly used as a fuel for vehicles, synthetic solvents, pesticides and cleaners. It comprises many organic compounds, aromatic and inorganic. Any of its products are particularly human carcinogenic (Momoh and Oshin, 2015 & Eltom and Hamd, 2017). Gasoline is a complex mixture of aliphatic and aromatic hydrocarbons, some of which are key components of benzene, toluene, ethylbenzene, xylene, and are considered among the most harmful compounds for human health (Rahul et al., 2017).

Awide range of harmful health conditions, inclu ding respiratory disorders, liver diseases, kidney diseases, hematotoxicity and cancer are associated with gasoline (Bin-Mefrij and Alwakeel, 2017). High gasoline exposure is usually found to cause hematotoxicity, such as anaemia, thrombocytopenia, leukopenia and lymphoma. But the consequences of low levels exposure appear to be obscure. In addition, the possible effects in hemopoietic components may lead later in life to harmful effects in various parts of the body (Al Jothery and Al-hassnwi, 2017). Studies have shown that in gasoline-exposed individuals, bilirubin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), blood urea, and serum creatinine were significantly increased relative to unexposed individuals. While total protein, albumin, sodium and calcium serum concentrations have been significantly reduced (Lippmann et al., 2011& Eltom and Hamd, 2017). Fuel stations are known sources for occupational gasoline exposures. Labor disease caused by gasoline exposure is recognized as a global health concern and the fatal or non-fatal incident in both developing and developed countries is continuously increasing in gas station workers (Zamanian et al., 2018).

Aim of the Work

This work aims to assess the effects of gasoline on hematological parameters, the liver and the kidney function among fuel station workers in Sohag governorate, Egypt.

Methodology

A cross-sectional case control study was done on 100 males working in fuel stations (study group) and 50 males didn't work in fuel stations (control group) in Sohag governorate, in the duration of one year from

April 2019 to March 2020. The study has been approved by Ethical Committee of Faculty of Medicine Sohag University. An informed written consent was obtained from each case under study with maintained confidentiality.

Patients' Selection Criteria:

The study included 100 workers chosen randomly from fuel stations in Sohag governorate work at least for 6 months in fuel stations and 50 males of the same age group working in different jobs in Sohag governorate and not exposed to gasoline. All groups were males in the age group of 20-50 years.

Exclusion Criteria:

Known cases of liver, renal, blood disease or anemia. Each case under study was interviewed with a detailed questionnaire to collect information regarding their

I. Sociodemographic data:

- Age
- Residence

II. History including

- Duration of the work in the fuel station.
- Smoking

III. Collection of samples:

5 ml of venous blood was collected by a single prick from studied and control groups under complete sterile conditions, from peripheral vein without tying any tourniquet at the end of the interview.

Blood samples were sent to the laboratory for analysis of complete blood count (CBC), Liver (serum alanine transaminase, serum aspartate transaminase, serum albumin, total protein and bilirubin) and kidney functions (urea and creatinine levels) of studied and control groups.

Statistical Analysis:

The obtained results were revised, coded and organized for statistical analysis by SPSS version 15 software.

Mean and standard deviation was done for numerical data. Frequency and percentage were obtained for non-numerical data. Comparison between studied and control groups was tested by using Chi-square test for qualitative data, and by using Independent t-test for quantitative data. ANOVA test was used to determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups. Correlation analysis (using Pearson's method) was used to assess the strength of association between two quantitative variables. P-value less than 0.05 was considered statistically significant.

Results

There were a total of 150 persons (100 patients in study group and 50 patients in control group). All groups were males in the age group of 20-50 years. The studied group was fuel station workers aged between 20 and 50 years old (mean: 34.8 ± 9.5 years). The control group was working in different jobs, aged between 20 and 47 years old (mean: 32.2 ± 7.2 years) (table, 1).

As regard residence distribution, 52% of studied group came from rural areas, while 52% of control group came from urban areas (table, 2).

As shown in table (3), the mean duration of work for the studied group was 4.95±2.35 years with range of 8 months to 25 years and the duration of the work in fuel station for 60% of the studied group was less than 5 years, 31% worked for 5-10 years and 9% worked for more than 10 years.

As regard smoking, 63% of studied group were smokers and 60% of control group were smokers (table, 4).

Regarding comparison of the parameters of CBC, liver and kidney function tests, table (5) shows that the mean value of red blood cells count for the studied group was (4.50 ± 0.72) as compared to the control group (4.86 ± 0.39). There was highly significant difference between studied and control groups as regards RBCs count (P- value = 0.001). The studied group had significantly higher serum ALT level compared to the control group (26.65 ± 12.52 IU/L versus 18.80 ± 8.06 IU/L, P- value < 0.001). Studied group also had a significantly higher serum AST level (26.52 ± 9.72 IU/L versus 20.84 ± 8.07 IU/L, P- value <0.001). There was statistically significant decrease in total protein level in the studied group when compared to control group (7.22 ± 0.68 gm/dl versus 7.62 ± 0.46 gm/dl, P- value < 0.001). Studied group also had a significantly higher urea concentration (32.96 ± 9.85 mg/dL versus 25.40 ± 11.14 mg/dL, P- value < 0.001). There were no statistically significant differences in the hemoglobin level, WBCs count, the platelet count, serum concentrations of albumin level, total bilirubin level, direct bilirubin level and creatinine level.

As shown in table (6), there was statistically significant difference between smoker and nonsmoker worked in fuel stations as regard RBCs count, WBCs count, AST level, creatinine level and urea level. There was a significant effect of smoking on RBCs count and WBCs count (decreased count in smoker cases compared to nonsmoker). Also, there was a significant effect of smoking on AST level, creatinine level and urea level (increased level in smoker cases compared to nonsmoker).

There were statistically significant differences in the mean serum concentrations of the platelet count, ALT, AST, albumin, total protein and urea levels among studied group in relation to duration of work in fuel stations. On the other hand, there were no significant differences in the mean serum concentrations of RBCs count, the hemoglobin level, WBCs count, total bilirubin level, direct bilirubin level and creatinine level in relation to duration of work in fuel stations (Table, 7).

As shown in table (8), there was significant positive correlation between the RBCs count, the hemoglobin level, WBCs count, the platelet count, ALT level, AST level, serum albumin level, total protein level, total bilirubin level, direct bilirubin level and creatinine level and urea level and ages in years of the workers of fuel station and there was only positive correlation between ALT level and the duration of work in fuel stations in years.

Table (1): Independent t-test statistical analysis of age in both studied and control groups

Age (Years)	Groups		t-Test	
	Studied group (N:100)	Control group (N:50)	t	P-value
Range	20-50	20 - 47		
Mean ±SD	34.830 ± 9.584	32.200 ± 7.290	1.708	0.090

P is considered statistically significant if ≤ 0.05, SD: Standard deviation

Table (2): Chi-square statistical analysis of residence in both studied and control groups.

Residence	Groups						Chi-square	
	Studied group (N:100)		Control group (N:50)		Total			
	N	%	N	%	N	%	X^2	P-value
Urban	48	48.00	26	52.00	74	49.33	0.213	0.644
Rural	52	52.00	24	48.00	76	50.67		

P is considered statistically significant if ≤ 0.05.

Table (3): Duration of work in fuel station in years among the studied group.

Duration of work in fuel station	N	%
<5 Years	60	60.00
5-10 Years	31	31.00
>10 Years	9	9.00
Total	100	100.00
Range	0.67 – 25 (Years)	
Mean ±SD	4.950 ± 2.352 (Years)	

Table (4): Chi-square statistical analysis of smoking in both studied and control groups. .

Smoking	Groups						Chi-square	
	Studied group (N:100)		Control group group (N:50)		Total			
	N	%	N	%	N	%	X^2	P-value
Non-Smoker	37	37.00	20	40.00	57	38.00	0.127	0.721
Smoker	63	63.00	30	60.00	93	62.00		

P is considered statistically significant if ≤ 0.05.

Table (5): Independent t-test statistical analysis to compare the parameters of CBC, liver and kidney function tests among all groups (studied versus control).

		Groups		t-Test	
		Studied group	**Control group**	**t**	**P-value**
Red blood cells RBCs (10^9/µl)	Range	3 - 5.6	4.1 - 5.6	-3.299	0.001
	Mean ±SD	4.502 ± 0.723	4.864 ± 0.393		
Hemoglobin Hb (gm/dL)	Range	10 - 16	10.5 - 15.2	-1.066	0.288
	Mean ±SD	13.003 ± 1.639	13.280 ± 1.174		
White blood cells WBCs (10^9/µl)	Range	3 - 11.5	4.5 - 8	0.303	0.762
	Mean ±SD	5.836 ± 2.114	5.740 ± 1.057		
Platelets PLT(10^9/µl)	Range	140-400	165-301	-1.459	0.147
	Mean ±SD	230.730 ± 57.840	244.120 ± 41.544		
Alanine Aminotransferase ALT (IU/L)	Range	6 - 56	6 - 35	4.030	<0.001
	Mean ±SD	26.650 ± 12.527	18.800 ± 8.061		
Aspartate Aminotransferase AST(IU/L)	Range	14 - 52	5 - 37	3.560	<0.001
	Mean ±SD	26.520 ± 9.724	20.840 ± 8.075		
Serum albumin (gm/dl)	Range	2.8 - 4.4	3.2 - 4.2	-1.651	0.101
	Mean ±SD	3.595 ± 0.437	3.708 ± 0.294		
Total protein (gm/dl)	Range	6 - 8.3	6.5 - 8.2	-3.714	<0.001
	Mean ±SD	7.227 ± 0.681	7.624 ± 0.461		
Total bilirubin (mg/dl)	Range	0.21 - 1.6	0.4 - 1.2	0.724	0.470
	Mean ±SD	0.844 ± 0.358	0.804 ± 0.209		
Direct bilirubin (mg/dl)	Range	0.1 –0.44	0.1 - 0.4	0.597	0.551
	Mean ±SD	0.226 ± 0.097	0.216 ± 0.093		
Creatinine (mg/dl)	Range	0.5 - 2	0.5 - 1.5	1.490	0.138
	Mean ±SD	0.966 ± 0.335	0.884 ± 0.279		
Urea (mg/dl)	Range	17 - 60	12 - 46	4.237	<0.001
	Mean ±SD	32.960 ± 9.856	25.400 ± 11.147		

P is considered statistically significant if ≤ 0.05.

Table (6): Independent t-test statistical analysis of the parameters of CBC, liver and kidney function tests in relation to smoking of the studied group.

Studied group	Smoking						t-Test	
	Non-Smoker			Smoker				
	Mean	±	SD	Mean	±	SD	t	P-value
RBCs (10^9/µl)	4.712	±	0.496	4.379	±	0.806	2.268	0.026
Hb (gm/dL)	13.189	±	1.199	12.894	±	1.850	0.870	0.387
WBCs (10^9/µl)	6.500	±	2.372	5.447	±	1.857	2.468	0.015
PLT (10^9/µl)	238.378	±	51.954	226.238	±	60.986	1.014	0.313
ALT (IU/L)	24.351	±	10.073	28.000	±	13.662	-1.413	0.161
AST (IU/L)	22.757	±	7.232	28.730	±	10.354	-3.091	0.003
Serum albumin(gm/dl)	3.562	±	0.320	3.614	±	0.494	-0.575	0.567
Total protein(gm/dl)	7.373	±	0.647	7.141	±	0.691	1.656	0.101
Total bilirubin(mg/dl)	0.792	±	0.321	0.874	±	0.377	-1.104	0.272
Direct bilirubin(mg/dl)	0.219	±	0.087	0.230	±	0.103	-0.508	0.613
Creatinine(mg/dl)	0.877	±	0.323	1.018	±	0.334	-2.061	0.042
Urea (mg/dl)	30.081	±	8.325	34.651	±	10.346	-2.286	0.024

P is considered statistically significant if ≤ 0.05, SD: Standard deviation

Table (7): ANOVA- test statistical analysis of duration of work in fuel station in relation to CBC, liver and kidney function tests of the studied group.

Studied group	Duration of work in fuel station			ANOVA	
	<5 Years	5-10 Years	>10 Years		
	Mean±SD	Mean±SD	Mean±SD	F	P-value
RBCs (10^9/µl)	4.501±0.645	4.468±0.831	4.626±0.886	0.162	0.850
Hb (gm/dL)	13.100±1.603	12.765±1.677	13.178±1.847	0.479	0.621
WBCs (10^9/µl)	5.962±1.937	5.288±1.934	6.889±3.327	2.325	0.103
PLT (10^9/µl)	242.967±61.086	209.613±44.166	221.889±60.221	3.706	0.028
ALT (IU/L)	23.483±10.100	30.194±13.358	35.556±17.529	5.978	0.004
AST (IU/L)	24.567±9.123	30.032±10.287	27.444±9.057	3.434	0.036
Serum albumin(gm/dl)	3.668±0.384	3.419±0.442	3.711±0.601	3.888	0.024
Total protein(gm/dl)	7.347±0.631	6.929±0.639	7.456±0.873	4.727	0.011
Total bilirubin(mg/dl)	0.797±0.310	0.892±0.438	0.991±0.328	1.572	0.213
Direct bilirubin(mg/dl)	0.215±0.093	0.233±0.105	0.272±0.091	1.481	0.233
Creatinine(mg/dl)	0.909±0.322	1.058±0.350	1.028±0.326	2.254	0.110
Urea(mg/dl)	30.983±10.262	36.710±7.647	33.222±11.065	3.637	0.030

P is considered statistically significant if ≤ 0.05, SD: Standard deviation

Table (8): Pearson correlations of CBC, liver and kidney function test parameters in relation to ages (years) and duration of work in fuel stations (years)of the studied group.

Studied group	Correlations			
	Age (years)		Duration of work in fuel station (years)	
	r	P-value	r	P-value
RBCs (10^9/µl)	-0.432	<0.001	0.124	0.220
Hb (gm/dL)	-0.495	<0.001	0.079	0.433
WBCs (10^9/µl)	-0.236	0.018	0.153	0.129
PLT (10^9/µl)	-0.427	<0.001	-0.042	0.681
ALT (IU/L)	0.565	<0.001	0.266	0.008
AST (IU/L)	0.503	<0.001	0.058	0.568
Serum albumin (gm/dl)	-0.482	<0.001	0.039	0.700
Total protein (gm/dl)	-0.510	<0.001	0.087	0.389
Total bilirubin (mg/dl)	0.645	<0.001	0.158	0.117
Direct bilirubin (mg/dl)	0.499	<0.001	0.136	0.178
Creatinine (mg/dl)	0.674	<0.001	0.072	0.478
Urea (mg/dl)	0.472	<0.001	0.022	0.825

P is considered statistically significant if ≤ 0.05, r: correlation coefficient

Discussion

A wide variety of adverse effects; either acute or chronic and may be fatal could occur after gasoline exposure. Gasoline has the ability to cause hematotoxicity, hepatotoxicity and nephrotoxicity. The aim of this study was to assess the effects of gasoline on haematological parameters, the liver and the kidney functions in Sohag governorate, Egypt. Unintentional ingestion and inhalation, and dermal exposure or oral ingestion in a suicide attempts are all examples of gasoline exposure routes ***(Hesterberg et al., 2011).*** In the present work, each case under study was interviewed with a detailed questionnaire and CBC, Liver and kidney function tests were done. In the present work, all groups were males in the age group of 20-50 years. The mean value of the age of the studied group was (34.83 ± 9.58). The mean value of the age of control group was (32.20 ± 7.29) and there was no significant statistical difference as regard the age. Similarly, ***Eltom and Hamd (2017)*** mentioned that the population included in the study was with age range from 16-55 years and this was in agreement with ***Rahul et al., (2017)*** who stated that there was no significant statistical difference as regard the age. The reverse was reported by ***Ekpenyong and Inyang (2017)*** who reported that there was significant statistical difference between exposed and unexposed group as regards age. In the current study, the mean duration of work for the studied group was 4.95 ± 2.35 years with range of 8 months to 25 years. The present results were reinforced by the results of ***Bin-Mefrij and Alwakeel (2017)*** where the mean duration of work for the studied group was 5.7 years, with range of 1 to 15 years. Also ***Eltom and Hamd (2017)*** who studied liver enzymes among Sudanese gasoline station workers found that, the range of duration of work for the studied group was 1 to 17 years. In the current study, 63 cases of the studied group (63%) were smoker while, 30 cases (60%) of the control group were smoker. There was no statistical significant difference between the studied group and the control group as regard smoking. These results go in a harmony with those of ***Al Jothery and Al-hassnwi (2017)*** who reported that 62.5% of cases were smokers. In the present study, it was found that the mean value of red blood cells count for the study group was (4.50 ± 0.72) as compared to the control group (4.86 ± 0.39). There was highly significant difference between the studied group and the control group as regards RBCs count. This percentage was nearly similar to the percentage found by ***Ekpenyong and Inyang (2017)***, were the mean value of red blood cells count for cases was 4.2 million cells/mcL. On the other hand, ***Al Jothery and Al-hassnwi (2017)*** reported that the mean value of red blood cells count for cases was 5.9 million cells/mcL, with statistical insignificant relationship between cases group and control group RBCs count and ***Getu et al., (2020)*** reported that the mean RBC count was significantly higher in petrol filling workers as compared with the control group. One possible reason for this difference is that the exposure to benzene may not have been reached to the point that can trigger significant disturbances in different types of blood cells ***(Al Jothery and Al-hassnwi, 2017)***. In the present work, the mean value of hemoglobin level for the studied group was (13.00 ± 1.63) with no statistical significant difference between the studied group and the control group (P- value = 0.288). The present results were in accordance with ***Ekpenyong and Inyang (2017)*** who reported that the mean value of hemoglobin level for the studied group was 13 gm/dl for cases and there was statistical insignificant relationship between the exposed and unexposed male groups. Also ***Bin-Mefrij and Alwakeel (2017)*** found that, the mean value of hemoglobin level for the studied group was 16 gm/dl and there was statistical insignificant relationship between the studied group and the control group as regard hemoglobin level. On contrary, ***Getu et al., (2020)*** reported that the mean Hb level was significantly higher in petrol filling workers as compared with the control group. In the present study, the mean value of white blood cells count for the studied group was (5.83 ± 2.11), and there was no statistical significant difference between the study group and the control group as (P- value = 0.762). These results were in agreement with results observed by ***Al Jothery and Al-hassnwi (2017)***, where there was insignificant relationship between the studied group and the control group. On contrary, ***Zamanian et al. (2018)*** stated that there was statistical highly significant difference between the studied group and the control group as regard to WBCs count. The cytotoxic compounds contained in gasoline can cause a significant reduction in the number of WBCs. The high incidence of infection due to the immunosuppressive effect of gasoline may be another theory of the high number of WBCs in cases ***(Zamanian et al., 2018)***. In the present study, it was found that the mean value of the platelet count for the studied group was (230.73 ± 57.84) with no statistical significant difference between the studied group and the control group. These results were in accordance with ***Bin-Mefrij and Alwakeel (2017)*** who stated that, there was insignificant relationship between the studied group and the control group as regard platelet count. Also in a study done by ***Al Jothery and Al-hassnwi (2017)*** there was insignificant relationship between the studied group and the control group as P value > 0.05. Toxicity to the bone marrow (BM) is mediated by water-soluble gasoline metabolism products like phenols, hydroquinone, and catechol. Covalently and irreversibly, gasoline and its intermediate metabolites bind to BM DNA, inhibit DNA synthesis, and add DNA strand breaks. As a "mitotic poison" and as a mutagen, gasoline works. Acutely, BM precursor cells are preferentially harmed over more basic progenitors by the more advanced, constantly cycling. The stem cell compartment can be more affected by intermittent exposure than by constant exposure. Gasoline can also damage the BM stroma ***(Lezama et al., 2001)***. Benzene is suggested to be activated in the bone marrow. Its cytotoxic effects are, therefore, mediated through disturbances in DNA function ***(Okoro et al., 2006).*** In the present study, it was found that the mean value of ALT level for the studied group was (26.65 ± 12.52) and there was highly significant increase in ALT level in the studied group compared to the control group. The present results were reinforced by the results of ***Abdelrahman et al. (2016)***, where the mean value of ALT level for the studied group was 22.3 IU/L and there was statistically significant difference between the studied group and the control group. Also in another studies done by ***Ukaejiofo, (2006)*** and ***Rahul et al. (2017)***, there was statistically significant difference between the studied group and the control group as regard ALT level. In the current study, the mean value of AST level for the studied group was (26.52 ± 9.72) and there was highly statistical significant difference between the studied group and the control group. The present results go in a harmony with the results of ***Eltom and Hamd (2017)***, where the mean value of AST level for the studied group was 30.3 IU/L and there was statistically highly significant difference between the studied group and the control group as regard AST level. Also ***Ukaejiofo, (2006)*** and ***Rahul et al. (2017)*** found statistical highly significant difference between the studied group and the control group as regard AST level. The findings of this study were also, in accordance with the research work conducted by ***Mahmood, (2012)***, who observed higher serum transaminases activity in the fuel-filling workers of Sulaimani City compared to the controls though these values were still within the normal accepted range for clinical diagnosis of hepatic injury. In the present study, it was found that the mean value of serum albumin level for the studied group was (3.59 ± 0.43) and no statistical significant difference between the studied group and control group was detected. On the other hand, ***Abdelrahman et al. (2016)*** found that, the mean value of serum albumin level for the studied group was 4.1 gm/dl and there was statistical significant difference between studied group and the control group. In the present work, the mean value of total protein level for the studied group was (7.22 ± 0.68). There was highly statistical significant difference. On contrary, ***Abdelrahman et al. (2016)*** found that there was statistical insignificant difference between studied group and the control group as regard total protein level in their study. In the present study, it was found that the mean value of total bilirubin level for the studied group was (0.84 ± 0.35) and the mean value of direct bilirubin level for the studied group was (0.22 ± 0.09), no statistical significant difference between the studied group and the control group was found. The possible metabolic mechanisms for the underlying alterations in the liver enzymes as proposed by the various investigators worldwide are that following inhalation, benzene and the other hydrocarbons present in gasoline are readily absorbed from the lungs and get metabolized in the liver by CYP450 2E1 oxidative pathways which contribute to the production of free radicals and quinine metabolites such as phenol, hydroquinone, benzoquinone; 1,2,4 benzenetriol ***(Bahadar et al., 2014).*** These free radicals and toxic metabolites cause lipid peroxidation and damage of hepatic cell membrane, causing the release of liver enzymes in the circulation ***(Uboh et al., 2009).*** After gasoline undergoes phase 1 metabolism, hepatotoxicity occurs, thereby causing the formation of free radicals. Subsequently these free radicals attach hepatic macromolecules, eventually resulting in lipid peroxidation. This metabolite forms a covalent bond with the liver macromollecules, causing lipid peroxidation ***(Abdelrahman et al., 2016).*** In the present study, the mean value of creatinine level for the studied group was (0.96 ± 0.33). There was no statistical significant difference as regard creatinine level. On the other hand, ***Bin-Mefrij and Alwakeel (2017)***, in their study, reported that there was statistical significant difference between the studied group and the control group as regard creatinine level. Also in a study done by ***Awadalla et al. (2017)***, the authors found that there was statistical significant difference as regard to creatinine level. At variance with the results of studies, other studies failed to demonstrate a significant association between exposure to some gasoline compounds (toluene, xylene and styrene) and renal function impairment. This could probably be due to the confounding effects of several covariates including methodology issues (e.g., variation in study design, genetic susceptibility, age, duration of exposure, sex differences, composition and concentration of exposed hydrocarbons) **(*Ekpenyong and Inyang, 2017)***. In the current study, there was highly statistical significant difference between the studied and the control group as regard the urea level and the mean value of urea level of the studied group is significantly elevated ($P < 0.001$). The present results go in a harmony with ***Awadalla et al. (2017)*** and ***Ekpenyong and Inyang (2017)*** in their studies, where there was statistical significant difference between the exposed group and unexposed groups as regard urea level. This elevation in urea levels may be as a result of the fall in glomerular filtration rate as a result of exposure to petroleum products and also this urea elevation may be attributable to the damage of the nephrons structural integrity **(*Awadalla et al. 2017)***. Some studies have reported significant association between exposure to gasoline and changes in serum electrolyte, urea and Creatinine levels. Whereas, others have found non-significant effect between exposure and serum levels of these substances, these nephrotoxic effects of gasoline constituents a controversial scientific issue ***(Refat et al., 2008)***. Induction of oxidative stress, immune system dysfunction, and inflammation have been implicated in the pathogenesis of gasoline-induced renal function impairment ***(Azeez et al., 2013; Ekpenyong and Nsuhoridem, 2017)***. Petroleum hydrocarbons and other related carbon containing compound are converted into free radicals or activated metabolites during their oxidation in cell especially mammalian liver and kidney cells. These activated metabolites react with some cellular component such as membrane lipid to produce peroxidation products which lead to membrane changes. They may react with enzyme and cause in activation through protein oxidation and or DNA breakage of the strands ***(Abdelrahman et al., 2016)***. Following exposure, gasoline is bio-transformed into reactive metabolites which can directly impair renal function by binding covalently to renal macromolecules and leading to altered structure and biochemical function including impaired activities of some enzymes involved in homeostatic mechanisms ***(Ekpenyong, 2017).*** Aside from the direct nephrotoxic effects of gasoline compounds, other biochemical indices, such as hematological, hormone, and lipid sub-fraction, have been identified to affect kidney function indirectly and vice versa. Excess circulating haem caused by solvent-induced rhabdomyolysis or red blood cell haemolysis, for example, has been linked to acute tubular necrosis and renal failure ***(Voss et al., 2003).*** Given the significant role of the kidney in red blood cell production, it is plausible that this function of the kidney was impaired along with other renal function and in particular, impairment in synthesis and release of Erythropoietin that controls erythropoiesis ***(Ekpenyong and Inyang, 2017***). In the current study, there was statistical significant difference between smoker and non-smoker works in fuel stations as regard RBCs count, WBCs count, AST level, creatinine level and urea level, while ***Al Jothery and Al-hassnwi (2017)*** reported that there was a significant effect of smoking on the hemoglobin level and platelet count and attributed these changes to the synergistic effect of smoking with benzene exposure. Scientific research indicated that the benzene appears as an intrinsic ingredient of cigarette and hence the smokers tend to have more benzene in their bodies compered to non-smokers people ***(D'andrea and Reddy 2014).*** Also, it has been shown that the cigarette smoking has hundreds of chemical molecules (benzene included) that induce the oxidative stress among different tissues ***(Rao et al., 2016).*** According to the current study, The mean serum concentrations of ALT, AST and urea levels were significantly higher among workers who were exposed to gasoline for more than 5 years and the mean value of platelet count, albumin level and total protein level were significantly lower among workers who were exposed to gasoline for more than 5 years. Similarly, ***Nwanjo and Ojiako (2007)***, found a significant increase in the activities of serum aspartate and alanine aminotransferases in petrol station attendants with long-term exposure (6-10 years) to petrol vapors in comparison to the control group. While ***Bin-Mefrij and Alwakeel (2017)*** reported that the mean serum concentrations of urea and creatinine were significantly higher among workers who were exposed to gasoline and fuel fumes for more than 5 years and there were no significant differences in the mean serum concentrations of ALT and AST between group working less than 5 years and those working more than 5 years. In the present study, there was significant positive correlation between the RBCs count, the hemoglobin level, WBCs count, the platelet count, ALT level, AST level, serum albumin level, total protein level, total bilirubin level, direct bilirubin level and creatinine level and urea level and ages in years of the workers of fuel station. The present results reinforced by the results of ***Eltom and Hamd (2017)***, where there was positive correlation between serum ALT and AST levels and age of workers in years at gasoline stations in Khartoum state. Also in that study, there was only positive correlation between ALT and the duration of work in fuel stations in years. The present results go in a harmony with ***Abdelrahman et al. (2016)*** and ***Eltom and Hamd (2017)***, where there was positive correlation between serum ALT activity (IU/L) and duration of work (years) in gasoline stations. Also, ***Al Jothery and Al-hassnwi (2017)*** found that there was negative correlation between duration of work in benzene stations and RBCs count, the hemoglobin level, WBCs count and the platelet count. On the other hand, ***Getu et al., (2020)*** stated that duration of petrol exposure showed a significant positive correlation with RBC count and ***Awadalla et al. (2017)*** found that, there was a significant positive correlation between the urea levels and the duration of exposure in (years). The absence of such correlations could be explained by the idea that the workers with different exposure periods are still having an effective compensatory system to cope with possible changes that might be found during the exposed levels and thus ending up with good hemostasis ***(Al Jothery and Al-hassnwi, 2017).*** Such differences in the findings of various research works are quite possible, might be due to the variations in the duration and concentrations to which the fuel filling attendants are exposed, methodology adopted, differences in handling of the potential confounding factors such as age, sex, BMI, personal habits (smoking and alcohol intake), and use or neglect of personal protective devices in the workplace ***(Neghab et al., 2015)***.

Conclusion

It could be concluded that exposure to gasoline may be associated with significant decrease of RBCs count and total protein level and significant increase of ALT, AST and urea levels among workers in fuel stations and these effects increase with advancing in age and most of them get worse with increased duration of work at fuel stations and the smoker worker.

Recommendations

Our study recommends that fuel station workers should wear protective wears, regular monitoring investigations and follow up for workers should be done with improved working conditions and using natural gas for cars as an alternative to gasoline.

References

Abdelrahman A, Mutaz I, ALnair , and et al., (2016): Assessment of liver function test in benzene station workers in Khartoum State_Sudan. International Journal of Current Research; 8(5): 30683-30685.

Al Jothery A and Al-hassnwi T (2017): Changes in the hematological profile among workers at petrol stations in Babil Province/Iraq. Mesopotemia Environmental journal; 3: 25-32.

Awadalla A, Ahmed N, and Yagoob A (2017): The effects of Petroleum Products on Renal Function among Petroleum Filling Workers

Stations in EL-Obied City. EuropeanN JournalL of Pharmaceutical and Medical Research (ejpmr); 4(10): 395-399.

Azeez O, Akhighe R, and Anigbogu C (2013): Oxidative stress in rat kidney exposed to petroleum hydrocarbon. J. Nat Sci Med; 4: 149-154.

Bahadar H, Mostafalou S, and Abdollahi M (2014): Current understandings and perspectives on non-cancer health effects of benzene: A global concern. Toxicol Appl Pharmacol; 276(2):83-94.

Bin-Mefrij M and Alwakeel S (2017): The effect of fuel inhalation on the kidney and liver function and blood indices in gasoline station workers. Advances in Natural and Applied Sciences; 11(1): 45-50.

D'andrea M and Reddy G (2014): Hematological and hepatic alterations in nonsmoking residents exposed to benzene following a flaring incident at the British petroleum plant in Texas City. Environ Heal [Internet]; 13:1–8.

Ekpenyong C (2017): Effect of Cymbopogon citratus Decoctions on Gasoline Vapour-induced Reproductive Toxicity in Female Rats. Journal of Pharmaceutical Research International; 1: 8.

Ekpenyong C and Inyang M (2017): A Cross-Sectional Survey of Estimated Glomerular Filtration Rate, Acid-Base Balance and Electrolyte Status among Workers Exposed to Petroleum Products. J Nephrol Kidney Dis; 1(2): 1008.

Ekpenyong C and Nsuhoridem S (2017): Ameliorative potential of Cymbopogon citratus decoctions on gasoline vapour-induced nephrotoxicity. The Natural Products Journal; 7: 37-46.

Eltom A and Hamd H (2017): Assessment of liver enzymes level among Sudanese Gasoline Station Workers. Sch J App Med Sci; 5(31): 738-743.

Getu S, Shiferaw E, and Melku M (2020): Assessment of hematological parameters of petrol filling workers at petrol stations in Gondar town, Northwest Ethiopia: a comparative cross-sectional study. Environmental Health and Preventive Medicine, 25:44.

Hesterberg T, Long C, Sax S, and et al., (2011): Particulate matter in new technology diesel exhaust (NTDE) is quantitatively and qualitatively very different from that found in traditional diesel exhaust (TDE). Journal of the Air & Waste Management Association; 61(9): 894-913.

Lezama R, Escorcia E, Torres A, and et al., (2001): A model for the induction of aplastic anemia by subcutaneous administration of benzene in mice. Toxicology; 162(3): 179-191.

Lippmann S, Richardson D, and Chen J (2011): Elevated serum liver enzymes and fatty liver changes associated with long driving among taxi drivers. American journal of industrial medicine; 54(8): 618-627.

Mahmood N (2012): Relationship between exposure to petrol products and the trace metal status, liver toxicity and hematological markers in gasoline filling workers in Sulaimani city. J Environ Occup Sci.;1(1):6-11.

Momoh J and Oshin T (2015): Severe hepatotoxicity and nephrotoxicity of gasoline (petrol) on some biochemical parameters in Wistar male albino rats. American Journal of Biochemistry; 5: 6-14.

Neghab M, Hosseinzadeh K, and Hassanzadeh J (2015): Early liver and kidney dysfunction associated with occupational exposure to sub-threshold limit value levels of benzene, toluene, and xylenes in unleaded petrol. Saf Health Work; 6(4):312-316.

Nwanjo H and Ojiako O (2007): Investigation of the potential health hazards of petrol station attendants in Owerri Nigeria. J Appl Sci Environ Manage;11(2):197-200.

Okoro A, Ani E, Ibu J and et al., (2006): Effect of petroleum products inhalation on some haematological indices of fuel attendants in Calabar metropolis, Nigeria. Niger J Physiol Sci; 21:71-75.

Rahul N, Vyas S, Sankhla M and et al., (2017): Biochemical assessment of the hepatic functions of the petrol pump workers of Jaipur city. National Journal of Physiology, Pharmacy and Pharmacology; 7(10): 1099-1103.

Rao P, Ande A, Sinha N and et al., (2016): Effects of Cigarette Smoke Condensate on Oxidative Stress, Apoptotic Cell Death, and HIV Replication in Human Monocytic Cells. PLoS One; 11(5): e0155791.

Refat A, Hassan A, El-Laithy N and et al., (2008): Occupational Renal Dysfunction Among Asphalt Workers in Sharkia Governorate: An Epidemiological Study. Zagazig Journal of Occupational Health and Safety; 1(1): 32-45.

Uboh F, Ebong P, and Umoh I (2009): Comparative hepatoprotective effect of vitamins A and E against gasoline vapor toxicity in male and female rats. Gastroenterology Res;2(5):295-302.

Ukaejiofo E (2006): Biochemical and haematological assessment of workers exposed to some petroleum products in Enugu Urban, Enugu State, Nigeria. Nigerian Journal of Medicine;15: 151-155.

Voss J, Roller M, and Mangelsdorf I (2003): Nephrotoxicity of organic solvents. A literature survey. Federal Institute for Occupational Safety and Health. Friedrich-Henkel-Weg 1-25, D-44149. Dertmund, Germany.

Zamanian Z, Sedaghat Z, and Mehrifar Y (2018): Harmful outcome of occupational exposure to petrol: Assessment of liver function and blood parameters among gas station workers in Kermanshah city, Iran. International journal of preventive medicine, 9: 100.

تقييم معلمات الدم ووظائف الكبد والكلى بين العاملين في محطات الوقود بمحافظة سوهاج، مصر

مروه أحمد حسب النبى[١] وسهير على محمد[١] وحسناء احمد ابوالوفا[٢] وحسام حسن خلف[١] و ولاء احمد علام[١]

الملخص العربى

المقدمة:

المقدمة: في محطات الوقود يتسبب الجازولين في مجموعة واسعة من التأثيرات السمية على أنسجة الجسم والتغيرات الكيميائية الحيوية، التي تشكل مخاطر صحية جسيمة على البشرية.

الهدف: تهدف هذة الدراسة الى تقييم تأثير الجازولين على مقاييس الدم وظائف الكبد والكلى بين عينة من العاملين فى محطات الوقود بمحافظة سوهاج، مصر.

طريقة البحث: تم إجراء دراسة مقطعية على ١٠٠ من الذكورالعاملين فى محطات الوقود و٥٠ من الذكور الذين لايعملون فى محطات الوقود بمحافظة سوهاج لمدة عام فى الفترة من أبريل ٢٠١٩ إلى مارس٢٠٢٠ .لكل مشارك تم اجراء مقابلة واستبيان مفصل وعمل صورة دم كاملة ووظائف كبد وكلى.

النتائج: اظهرت النتائج عن وجود فروق ذات دلالة احصائية عالية بين مجموعة الدراسة والمجموعة الضابطة بالنسبة الى عدد كرات الدم الحمراء ومستويات ALT و AST والبروتين الكلى و اليوريا. كما وجد تأثير ذو دلالة احصائية للتدخين على عدد كرات الدم الحمراء وعدد كرات الدم البيضاء ومستوى AST ومستوى الكرياتينين ومستوى اليوريا لمجموعة الدراسة. وقد تبين وجود ارتباط ايجابى ذو دلالة احصائية بين المعلمات المدروسة لصورة الدم الكاملة وظائف الكبد والكلى وأعمار العاملين في محطات الوقود و وجد ارتباط ايجابي فقط بين مستوى ALT ومدة العمل في محطات الوقود.

الاستنتاج: بناء على ذلك نستنتج ان التعرض للجازولين ربما يرتبط بشكل كبيربنقص فى كرات الدم الحمراء والبروتين الكلى وزيادة مستوى ALT وAST واليوريا بين العاملين في محطات الوقود وهذه الآثار تزداد بالتقدم فى العمرواغلبهم يزدادوا سوءا بزيادة فترة العمل في محطات الوقود وكون العامل مدخن. التوصيات: وتوصى هذه الدراسة بتحسين ظروف العمل واستخدام الغاز الطبيعى للسيارات كبديل للجازولين.

١. قسم الطب الشرعى والسموم الاكلينيكية - كلية الطب جامعة سوهاج

٢. قسم الباثولوجيا الاكلينيكية والكيميائية – كلية الطب جامعة سوهاج