Hematological assessment of benzene exposure among employees in Ras-Elmengar depository of El-Brega Company, Benghazi

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Abstract:

Background: Benzene is a toxic chemical, and it is human carcinogenic, it found in the natural and in industry, its exposure can cause hematological health problems as result of metabolites formation in the liver and bone marrow.
Aim: this study aimed to evaluate the hematological health effects of benzene exposure among workers in loading and uploading stations at Ras-Elmengar depository of Elbrega Company, Benghazi, Libya.
Methods: this study was cross sectional design, and the study sample was 30 participants, 15 exposed workers and 15 non-exposed employees. They were asked to fill a questionnaire about socio-demographic data and symptoms of benzene exposure, also, they were asked to withdrawal a blood samples by a laboratory technician to test Complete blood counts and these data was analyzed by using SPSS.

Results: the findings demonstrated a significant difference in CBC of exposed and non-exposed group, which there were reduction in WBC, RBCs and HCT of workers who exposed to benzene. Moreover, there were a positive correlation between the hematological effects of benzene exposure and BMI, years of experience, smoking habits of the workers.

Conclusion: the exposure to benzene has negative effects on the workers' blood; and this effect is associated with work duration, furthermore, it is correlated with BMI and smoking habits of the workers. Therefore, safety measure must be applied to protect the empolyees in the company.

Key words: benzene, blood test, hematological effects, exposure.

Introduction:

Benzene is colorless and highly flammable liquid, it is known as benzol. It present in the soil, water and air, and it evaporates quickly into the air (HSE, 2012). Its sources are natural source such as crude oil and industrial sources such as coal tar and petroleum. In addition, it found in gasoline, cigarette smoking (ATSDR, 2007).

Benzene consider a public health concern because it is one of the cancer causes (IARC, 1987), which is classified as human carcinogenic (group 1) (IARC, 2009).

It enters the human body though the skin, ingestion and lungs and passes into the bloodstream. Then, it can be stored in the fat tissue and bone marrow, or it can be metabolized into other products in the liver and bone marrow, which are known as metabolites (AW, 2013).

Some of these metabolites leaves the body within 48 hours of exposure such as conjugated phenols exerted in the urine (AW, 2013). While other metabolites could be bio-activated by myeloperoxidases and other heme-protein peroxidases to reactive semiquinones and quinones, these products cause reactive oxygen species (ROS) formation (Elsayed, 2015).
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ROS involves superoxide radical anion, hydroperoxyl radical, hydrogen peroxide (H2O2), and the highly reactive hydroxyl radical (Elsayed, 2015). These could lead to reduce the levels of all cellular elements in the bone marrow and the peripheral blood, and it can be manifested as pancytopenia and a plastic anemia (Health Council of the Netherlands, 2014). Also, it can lead to bleeding and affect on the immune system function, and that can rise the chance for getting infection (CDC, 2013).

Furthermore, chronic exposure to benzene lead to decrease in the erythrocytes and leukocytes production, and that resulting in anemia (WHO, 1993), also, it causes myeloid leukaemia, thrombocytopenia (AW, 2013).

Moreover, exposure to benzene can cause neurotoxicity (Pumo, 2006), immunitoxicity (Bogadi-Šare, 2000) and it can cause damage to the liver and kidney (El-Shakour, 2015) The health surveillance of benzene in the human body include periodic tests for complete blood counts, test of t, t-muconic aid in the urine (AW, 2013).). This study will focus on the haematological effects of benzene exposure.

Aim of study: to evaluate the haematological effects of benzene exposure on the workers in loading and uploading stations at Ras-Elmengar depository of Elbrega Company, and evaluate its relation with some vaiables (BMI, smoking and years of experience).

Methods and material:
A cross sectional study was conducted in Rar-elmengar depository of Al-brega Company, Benghazi, Libya. The sample involved 30 workers, they were classified into two groups;

exposed group included all workers in loading and uploading stations, and non-exposed group included the workers in the offices, which were 15 workers in each group.

The sample was homogenous, which all the workers were male. The data was collected by using multiple choices questionnaire and taking blood sample from the participants after getting approval permission from this company.

The questionnaire included six socio-demographic questions and eight questions about acute health effects on benzene exposure.

The blood sample was taken by specialized technician to test Complete Blood Count CBC and assess the differences between two groups; this data was collected from 4 to 22 of June 2017, and then analyzed by statistical package for social sciences software version 22.

Results:

Table 1 present the demographic information of the participants, all the sample was men, and the largest proportion of exposed and non-exposed group were their age between 41 and 50 years, and the largest proportion of control group was overweight with body mass index 30 or more, While the majority of cases have a normal weight with BMI 25-29.99.

Table 1: Participants' demographics

Variables		Exposed group	Non exposed group
Gender	Male	15	15
	Female	0	0
Age	20-30	2	2
	31-40	3	4
	41-50	9	6
	51-60	1	3
	More than 61	0	0
Body Mass Index (BMI)	18.5 – 24.99	4	4
	25- 29.9	6	4
	30 or more	5	7
Experience years	0-5	3	3
	6-10	3	0
	11-15	2	1

	16-20	2	2
	21-25	3	5
	More than 26	2	4
Smoking habits	Never	4	4
	Current smoker	9	7
	Previous smoker	2	4

Table 2 shows the blood parameter values of benzene-exposed workers, these values are classified into three categories; below normal, normal and above normal. This study found that 5 out of 15 workers have lower Red Blood Cell (RBC) and 6 workers have low value of White Blood Cell, in addition, 10 exposed workers have lower haematocrit value, on the other hand, the values of haemoglobin, platelets and corpuscular volume (MCV) were normal among exposed group.

Table 2 Complete blood counts of benzene exposed workers

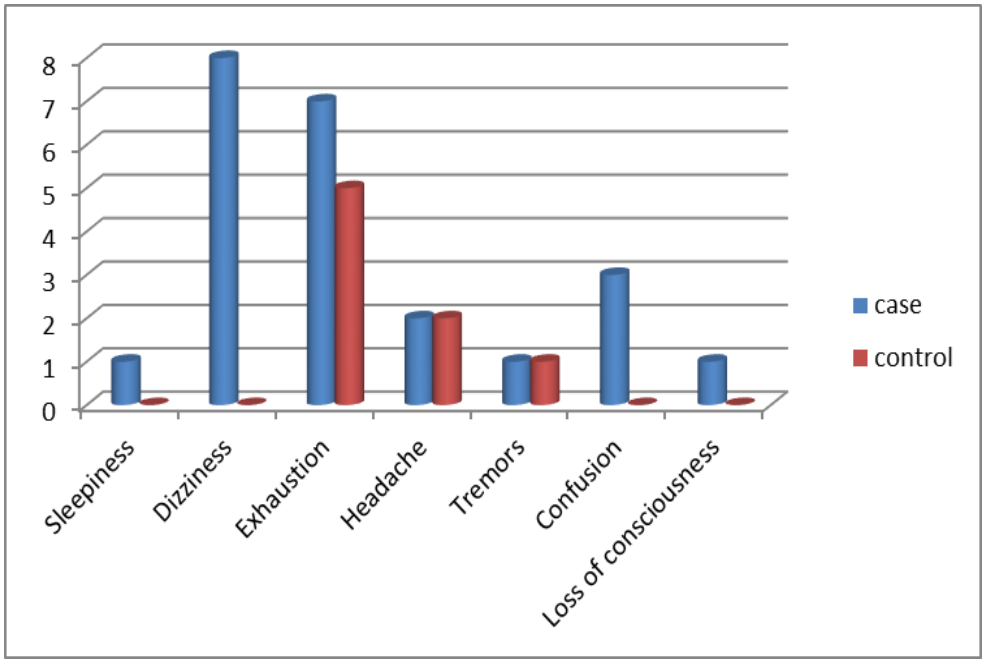
Blood parameters	**Category**	**Frequency**
RBC	Below normal	5
	Normal	10
	Above normal	0
WBC	Below normal	6
	Normal	7
	Above normal	2
HCT	Below the normal	10
	Normal	5
	Above normal	0
HB	Below normal	0
	Normal	15
	Above normal	0
PLT	Below normal	0
	Normal	15
	Above normal	0
MCV	Below normal	0
	Normal	15
	Above normal	0

According to table3, the current study suggested that there was no differences in HGB, HCT, PLT and MCV between the exposed and the unexposed groups, however, there was a significant differences between them in RBC and WBC counts because P value were less than 0.05.

Table 3: haematological parameters of exposed and non-exposed group using chi-square test:

Parameter	Mean	P value
RBC	4.8	0.01
HGB	14.5	0.07
WBC	7.09	0.02
HCT	43.5	0.06
PLT	276.4	0.06
MCV	89.2	0.06

Furthermore, the symptoms of benzene exposure appears among exposed group more than case group, and the most common symptoms were Exhaustion and Dizziness (see figure 1).



Frequency of benzene exposure symptoms among cases and control groups

Additionally, ANOVA test was used to compare the association between the hematological effects of benzene on exposed and non-exposed group and demographic variables, which are age, BMI, level of education, smoking habits, and years of experience.

Furthermore, Table 4 demonstrated that there is a significant association between hematological effects of benzene (on cases versus control group) and workers' Body Mass Index, since the P value for all blood parameter were less than 0.05.

Table 4: Association between hematological effects of benzene (cases and control group) and workers' BMI using ANOVA test:

	ANOVA	P- value
RBC	255.751	0.000
HGB	211.667	0.000
WBC	8.861	0.006
HCT	248.921	0.000
PLT	12.251	0.002
MCV	1877.294	0.000

According to table 5, there was a positive relationship between work duration and effects of benzene on the exposed workers' blood because P value < 0.05.

Table 5: Association between hematological effects of benzene (cases and control group) and workers' years of experience using ANOVA test:

	ANOVA	P- value
RBC	484.277	0.000
HGB	3994.696	0.000
WBC	11.194	0.002
HCT	459.255	0.000
PLT	62.546	0.000
MCV	2646.956	0.000

Moreover, table 6 indicated that smoking habits was significantly correlated to the hematological effects of benzene, since P were less than 0.05.

Table 6: Association between hematological effects of benzene (cases and control group) and workers' smoking habits using ANOVA test:

	ANOVA	P- value
RBC	507.879	0.000
HGB	400.033	0.000
WBC	13.806	0.001
HCT	455.115	0.000
PLT	44.314	0.000
MCV	2764.725	0.000

Discussion:

The present study showed decline in the counts of WBC, RBC and HCT, this result come in agreement with studies have been conducted by Rothman et al. (1996) and Ibrahim et al. (2014), they found a significantly decrease in total RBC and WBCs, in addition to decrease in platelets levels. Besides, Qu et al. (2003) indicated that exposure to benzene lead to decrease the levels of RBC, WBCs, and neutrophils. Moreover, Agabeldour et al. (2015) found some effects from benzene exposure on blood counts of exposed workers, which they found drop in Reticulocytes, HCT and red cell indices in all workers. Furthermore, Kirkeleit et al. (2008) found a clear relation between chronic benzene exposures with hematological effects, they indicated reduce in neutrophil, lymphocyte and platelet counts of peripheral blood. Conversely, Liao (2015) studied the effects of benzene on the workers blood over 5 years from 2001 to 2005, they suggested that there is no relation between benzene exposure and blood parameters, which he found that no differences in CBC between exposed and non-exposed. However, he found that eosinophils level was higher among exposed group.

In addition, the current study demonstrated that BMI of the workers associated significantly with effects of benzene on peripheral blood (table 3). This finding is in agreement with Kamal and Rashid study in 2014, they found a significant correlation between benzene exposure effects and workers' BMI. On the other hand, Rothman et al., (1997) did not find any significant changes between the blood parameters of exposed workers and their BMI.

Additionally, the findings of present study showed a significant association between experience years and effects of benzene on peripheral blood of exposed workers. In more details, it demonstrated that increases of the workers' experience years' means that increasing the effects of benzene exposure on blood (table 4). Similarly, study reported in Pakistan (Kamal & Rashid, 2014), they found indicated a positive association between the blood and years of experience. Besides, Kozlova and Volkova (1960) indicated that extent of the benzene hematological effects were correlated with exposure duration, which the severity changes in blood counts were observed among workers how exposed to high levels and exposed for long period of time. Contrary, Ibrahim et al. (2014), they demonstrated that benzene exposure duration did not statistically correlated with blood and urine parameter of the exposed workers.

Furthermore, the results of current study demonstrated a positive relationship between smoking habits and hematological effects of benzene exposure, which it found clear differences between workers who were smokers and who were not smoker (table 5). The reasons for that could be a benzene content in Cigarette smoking, which increase the level of exposed benzene. (Goldstein and witz, 2009). Moreover, Kamal & Rashid (2014) indiated that smoking habits has appositive correlation with hematologic effects of benzene. Besides, Hajimiragha et al. (1989) and, Pekari et al. (1992) indicated that cigarette smoking is a potential factor for low benzene monitoring. Alternatively, Rothman et al., (1997) carried out study on benzene poisoning and risk factor, they found the smoking status was not significantly associated with benzene poisoning.

Conclusion:

The present study indicated that there were a drop in RBC, WBC and HCT counts of workers who exposed to benzene. In addition, it indicated that years of experience, BMI and smoking habits of the works are significantly correlated with effects of benzene on the blood. Therefore, this study recommended periodical health examination of the workers with routinely complete blood counts test to detect the early haematological effects of benzene exposure.

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