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Original Research Article

Alterations in haematological parameters among workers of fuel stations in White Nile State, Sudan

Abozer Y Elderdery[*1], Ahmed M Elnour[2], Nada Y Ali[2], Abeer A Elsaken[2], Remah E AbdElgabar[2], Romisa A Elbashier[2], Nawal EOmer[3]

[1]*Department of Clinical Laboratory Sciences, College of Applied Medical Sciences, Aljouf University, Saudi Arabia.*
[2]*Faculty of Medicine and Health Sciences, University of El Imam El Mahdi, Sudan.*
[3]*Khartoum Medical University, Sudan*

***Correspondence Info:**
Dr. Abozer Elderdery
Department of Clinical Laboratory Sciences
College of Applied Medical Sciences
Aljouf University, Saudi Arabia.
E-mail: abozer904@hotmail.com

Abstract

Benzene exposure is one of the main health concerns for occupations with risk of exposure to volatile solvents such as petrol pump workers. Human exposure to benzene is associated with multiple adverse health effects including pancytopenia, hence aplastic anaemia and an increased risk of developing cancer (acute myeloblasticleukemia). Morphological effect on RBCs (microcytosis) also occurs.

This cross sectional descriptive study involved workers at fuel stations in Kosti and Rabak cities, White Nile State, during December 2014-March 2015 and aimed to determine any alterations in haematological parameters among these employees. Workers at fifty fuel stations were recruited to participate, individually giving written informed consent. Venous blood (2.5 ml) was taken into EDTA containers and a full blood count (FBC) was done for each participant, using a fully automated haematology analyzer (Sysmex).

The results from the fuel stations workers include the following high prevalence of abnormalities: Fifty percent had low haemoglobin levels, 60 percent low RBS counts (although 30% were higher than normal), haematocrit readings showed 24% with reduced values and for MCV 92% were reduced. Half of the participants showed microcytic cytology.

The current study concluded that there are abnormalities in haematological parameters among fuel stations workers, particularly in Hb and RBC indices, as well as lymphocytosis and neutropenia. Workers at fuel stations should be protected from exposure to benzene by training with the equipment to minimising leakge and spillage and by wearing protective devices, such as masks and goggles. Further studies are necessary to determine the possible effects of benzene on haematological parameters among long-duration workers in fuel stations.

Keywords: Benzene, blood cells, haematological parameters, blood morphology.

1. Introduction

Complete blood count (CBC) is one of the most important haematology tests. CBC provides valuable information about the quantity of the different types of cells in the blood. The test might help in diagnosing several haematological disorders e.g. anaemia, certain cancers, kidney problems, and allergic reactions [1]. Benzene is one of the most broadly used chemicals in the synthesis of various polymers, resins and synthetic fibres. Furthermore, benzene is a common component of gasoline [2].

As a volatile organic compound, benzene is one of the main contributors to air pollutants. It is found in the environment as a contaminant from both human activities and natural processes. Benzene is also an intrinsic component of tobacco smoke, and tobacco smokers have a higher body burden of benzene than non-smokers [3]. The seriousness of poisoning caused by benzene depends on the amount , route and length of time of exposure ,as well as the age and pre-existing medical condition of the exposed person [2].

Human exposure to benzene has significant deleterious health effects and might be associated with the risk of blood abnormalities, including aplastic anemia, leukemia, lymphoma, pancytopenia and chromosomal aberrations [4]. Moreover, exposure to benzene can cause a wide range of adverse effects on the central nervous system, hematological, hepatic, renal, and lung functions [5]. Communities surrounding petroleum refineries have important health risks due to the probability of being exposed to elevated levels of benzene and other toxic chemicals [6]. Evidence suggests that benzene-induced toxicity involves several mechanisms, for instance oxidative stress, DNA damage, disruption of the cell

cycle and programmed cell death [7-9]. In addition, immune dysfunction has been hypothesized to synergise with benzene toxicity as benzene may interfere with cellular, humoral and innate immunity[10].

A major effect of long-term benzene exposure is on the blood. Besides causing anaemia, it can also cause excessive bleeding and increase the chance of infection. The Department of Health and Human Services (DHHS) has documented that benzene has a role in causing human leukemia[2]. Benzene exposure is also linked to the development of multiple hematological malignancies [11]. There is, however, scant information about the hematological effects of exposure to benzene [12].

CBC is recognized as a quick, easy and obtainable screening for checking the haematoxicity of benzene. The aim of the present study is to assess the effect of benzene on CBC in fuel station workers in Kosti and Rabak cities in White Nile State, Sudan.

2. Materials and methods

Fifty workers at fuel stations were recruited randomly from Kosti and Rabakcities, White Nile State, Sudan to participate in this study. Smokers, Alcoholism, and employees who had worked for less than 2 years were excluded. Data was collected by questionnaire. All participants completed individual informed consent forms.

2.5 ml of blood was taken from each individual in a sterile and clean EDTA container. The full blood count (FBC) was done, using fully automated haematology analyzer (Sysmex). The results were recorded in the master sheet and the information fed to the statistical software program SPSS (version - 21).

3. Results

Firstly, all contributors were males because females in Sudan do not normally work in fuel stations. Ages ranged from 20 to 59 years. Duration of employment varied from 3 to 17 years.

The findings from the workers of fuel stations including the following, all expressed as % of cases within (normal), below (↓) and above (↑) the reference range: Hb showed normal = 50%, ↓= 48%, ↑ = 2%, as displayed in **Figure 1**.

The blood cell counts are illustrated in **Figure 2** as follows: RBC normal = 60%, ↓=10% and ↑= 30%; White blood cell (WBC) count was normal = 90% and ↓=10%. Platelet (PLt) count was normal = 82%, ↓=16% and ↑=2%.

The RBC indices were described in **Table 1**: haematocrit was normal =72%, ↓=24% and ↑=4%; the mean cell volume (MCV) in fuel stations workers was normal = 30% and ↓=70%; the mean cell haemoglobin (MCH) was normal = 8% and ↓=92%; the mean cell haemoglobin concentration (MCHC) was normal = 90% and ↑=10%.

Table 2 summarizes results indicating that fifty percent of the participants showed a microcytic picture and 26% were normocytic. **Table 3** demonstrates results indicating that 94% of participants showed a normal platelet picture while, 6% were abnormal platelet.

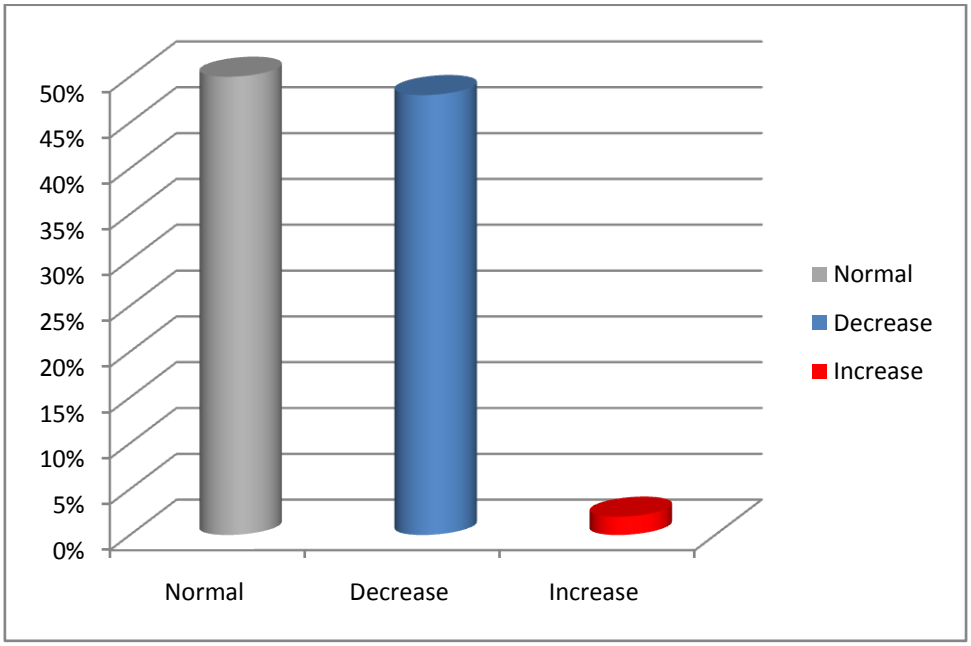

Figure 1: Haemoglobin concentration among study population

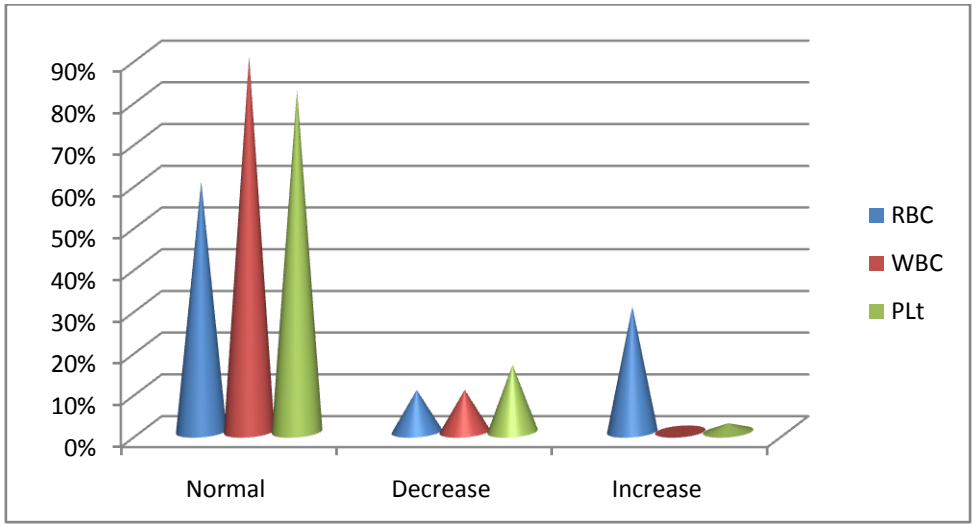

Figure 2: Count of blood cells among study population

Table 1: The RBCs count, RBCs indices and RBCs morphology among benzene fuel stations workers

Parameter	Result	Frequency (%)
RBC×10^6 cell /cumm	Normal (4.5_5.5).	
	Decrease (4.0-<4.5)	30 (60)
	Increase (>5.5-7.0)	5 (10)
	>5.5-6.0 = 8	15 (30)
	>6.0-7.0 =7	
PCV%	Normal (40 - 50)	32 (72)
	Decrease (30 - <50)	12 (24)
	Increase (<50 - 80)	6 (6)
	<50 - 60 =3	
	<60 - 80 =3	
MCVfl	Normal (80 - 100).	15 (30)
	Decrease (60 - >80)	35 (70)
	60 - < 70 = 4	
	70 - < 80 = 31	
MCH pg	Normal (27 - 32pg)	4 (8)
	Decrease (18 - <27)	46 (92)
	18-<22 = 6	
	22-26 = 40	
MCHC g/dl	Normal (31.5_34.5)	21(90)
	Increase (35-40)	5 (10)
RBCs morphology	Normocytic	13 (26)
	Microcytic	25 (50)
	Normocytic + stomatocyte	11 (22)
	Normocytic + target cells	1 (2)

Table 2: The TWBCs count and differential of WBCs among benzene fuel stations workers

Parameters	Result	Frequency (%)
TWBCs /cmm	Normal (4 - 11).	45 (90)
	4 – 7 = 34	
	>7 – 11 =11	
	Decrease (2 - 3.9)	5 (10)
Neutrophil counts	Normal (40 - 80%).	29 (58)
	Neutropenia	20 (40)
	Neutrophilia	1 (2)
Lymphocyte counts	Normal (20_40%).	11 (22)
	Lymphocytosis	39 (78)
Eosinophil counts	Normal (1 - 6%).	42 (84)
	Eosinophilia	8 (16)
Monocyte count	Normal (2 - 8%).	45 (90)
	Decrease	5 (10)

Table 3: The Platelets count and platelet morphology among benzene fuel stations workers

Parameters	Result	Frequency (%5)
Platelet count $\times 10^3$ /cmm	Normal (150_410) 150 - 260 = 24 >260 - 370 = 17	41 (82)
	Decrease (40 - <150)	8 (16)
	Increase (560)	1 (2)
Platelet morphology	Normal	47 (94)
	Abnormal	3 (6)

4. Discussion

Human exposure to benzene is associated with multiple toxicities affecting the haematological, hepatic, immunologic, and chromosomal functions and an increased risk of carcinogenesis. However, the precise mechanism of benzene induced toxic effects is not fully understood. Therefore, this study was conducted to investigate the changes in the haematological profile among non-smoking fuel station workers exposed to benzene for more than three years in Kosti and Rabak cities at White Nile State, Sudan.

From the results of this study, nearly the half of fuel stations workers(44%) were between 20 and 29 years of age; this finding is in agreement with the majority of fuel stations workers that, most of them in their twenties and thirties of age. Time of exposure clearly increases the chances of toxicity with petroleum products specially benzene. Two third (68%) of the participants here had experienced exposure duration between 3-5 years followed by 22% at 6-8 years, 3% between 9-11 years and only one for duration of exposure between >12 years. This may be due to the nature of the fuel stations environment. All fuel stations workers were men because usually women do not work in fuel stations in Sudan.

The present results revealed that, half (50%), of the participants were normal for Hb concentration, 48% had decreased values and only one (2%) showed increased Hb concentration. HCT in the current study results showed that the majority of participants (70%) were below the normal reference while in 30% of them the HCT was within the normal value (**Table 1**). These findings are inconsistent with results from one study done in Texas City in 2014, which reported that haemoglobin and hematocrit levels were elevated in benzene exposed subjects compared with the unexposed subjects [13]. Another study done in Sulaimaniya City in Iraq, showed an increase in Hb concentration among fuel workers when compared with the control subjects [14]. Some other recent findings are also not in agreement with our current study in that they showed elevated in Hb concentration [15-17].

Concerning RBCs counts, the present study showed that 60% of the participants were within the normal range, while 30 showed increased RBCs count. Only 5 (10%) showed decreased RBCs counts **(See Figure 2).** On the other hand the majority (90%) of the TWBCs fell within the normal range and the remaining (10%) showed a decreased value**.** 82% of fuel stations workers in this study showed normal PLTs count, 16% a decreased count and only 2% an increase in PLTs count, as shown in **Figure 2.** These findings are consistent with the previous study from Iraq, reporting that counts of RBCs, PLTs, and WBCs were within normal ranges and had no significant differences with those of controls [14]. In contrast the current study results are not in agreement with the previous study done in Texas City in 2014 concluded that WBC and platelet counts were significantly increased in benzene exposed subjects compared with those unexposed subjects [13].

The present study showed that (70%) of the fuel stations workers were below the normal range and the rest 30% within the normal MCV values**,** while 92% of the participants found below the normal range of MCH, (8%) within the normal range, as set out in **Table 1.** The status of MCHC showed the majority (90%) were within the normal range and the remaining 10% higher than the normal value **(See Table 1)**. These findings not in agreement with the study done in Iraq stated that, MCH and MCV were within the normal ranges, while our study is in agreement with the value of MCHC both in studies in normal value [14].

The current study showed (**Table 3)**that more than the half of neutrophil counts (n=29 representing 58%) were normal and 20 (40%) showed neutropenia. This table also described that the most of lymphocyte counts are increased (lymphocytosis) (n=39 representing 78%) and 22% were normal. Eighty-four percent of eosinophil counts were normal and 16% increased**.** In contrast, the study done in Sulimania city in Iraq stated that eosinophil counts in subjects exposed benzene for more than 15 years were significantly decreased (51). The majority of fuel stations workers (90%) in Kosti and Rabak cities gave monocyte counts in normal range and 10% decreased counts **(Table 3).** These results are consistent with the Sulimania city study, which concluded that differential WBC counts were within the normal ranges and had no significant differences with those of controls[14].

Regarding cell morphology 50% of the participants showed a microcytic picture and a quarter (26%) show normocytic picture; 94% of the participants had normal platelet parameters, while 6% were abnormal **(See table 2).**

5. Conclusion

This study concluded that there are variations in haematological parameters among fuel stations workers, particularly in Hb and RBCs indices, as well as lymphocytosis and neutropenia, although the changes are not entirely consistent with other related studies Workers at fuel stations should be subjected to periodic blood tests and protected from exposure to benzene by wearing protective devices, such as

masks and goggles. Further studies are necessary to determine the possible effects of benzene on haematological parameters among long-duration workers in fuel stations.

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