Blood lead level among fuel station workers at Khartoum city

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Abstract

Lead is one of the oldest heavy metals; it is the most widely studied occupational and environmental toxin. The aim of this study is to determine the levels of lead in blood of 50 Sudanese males employed in fuel stations in Khartoum city with mean age (30.1±1.4yrs), and 42 non exposed healthy men as control with mean age (28.0±1.3yrs). This study was conducted between the period from November 2013 and March 2014. Flameless atomic absorption was used for blood lead measurement. The study showed that the mean blood lead the fuel station workers was (33.6±2.2µg/dl; range: 10.5–97.5µg/dl), while in the non-exposed healthy control men was (8.1±0.31µg/dl; range: 5.0–14.1µg/dl). Blood lead is significantly elevated in the fuel stations workers in Khartoum City (P value = 0.000). Fuel pump filling workers are at risk of lead exposure toxicity and its health complications. A policy action to improve working conditions and to phase out the problem of the lead in fuel stations is recommended.

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Introduction

Occupational lead toxicity is a public health problem that has been persistent for decades. (1). Human exposure to lead is estimated to account for 143000 deaths every year and 0.6% of the global burden of disease (2). Lead from the environment is transferred to blood by a variety of routes; from emissions in the form of fine particles that are inhaled and absorbed through the lungs, by ingestion, and through dermal exposure (3). Lead is a cumulative toxicant that affects multiple body systems, including the neurological, hematological, gastrointestinal, cardiovascular and renal systems (2). Lead perturbs multiple enzyme systems; it interferes with the enzyme ferrochelatase, blocking the incorporation of iron into the protoporphyrin molecule (4). Lead interferes with the critical phases of the dehydration of aminolevulinic acid; the result is a decrease in heame production (5). Blood lead is the most reliable index of exposure; since 90 percent of lead in blood is bound to red blood cells. Much of the airborne lead is from petrol to which it is added as antiknock (6). Slightly increased blood lead level which previously considered harmless can have harmful effects in adults, such as decreased renal function and increased risk for hypertension. The reference blood lead levels for adults; levels ≥10 µg/dl are considered elevated (7). Severe lead poisoning, often producing encephalopathy with significant residual damage to the central nervous system and delayed sexual maturation (8). Adults with lead poisoning have increased incidences of depression, aggressive behavior, and antisocial behavior. Men with lead poisoning tend to have lower sperm counts, defects in sexual performance, frank impotence and infertility (4). Adverse health effects associated with very high blood lead levels underscore the need for increased efforts to prevent lead exposure at workplaces and in communities (7). In general, it is clear that urbanization was associated with an increased prevalence of elevated blood lead levels (2, 5). Although USA and the European Union have banned lead as an additive to consumer fuel for road-going vehicles, lead continues to be used in petrol in many countries in the Middle East. Petrol station workers are constantly in contact with leaded benzene and gasoline during their daily lives (3). Some researchers have demonstrated that clinical or subclinical toxic effects can occur below the limit of 50 µg/dl in the whole blood (9). Race may have a role, because black non-Hispanic appears to have the greatest risk of developing lead poisoning (10). Future health and environmental actions are needed, not only to remediate known areas of lead pollution, but also to investigate other sources of potential

health risks (11). Occupational lead exposure has been identified to be at alarming levels and urgent intervention measures are recommended (12).

Methods and materials

The study was carried out among Sudanese working in fuel station in Khartoum city, in the period between November 2013 and April 2014. A total of 92 subjects who were employed in 14 fuel stations were included in this study. These fuel stations supply benzene and gasoline in the center of Khartoum city. A questionnaire was used to collect information about past and present medical histories for each subject, including age, during of employment, cigarette smoking, drinking habits, disease history and overall duration of lead exposure. The study group was comprised of 50 subjects fuel stations workers, who have been working for at least 6 months, all of them were males with no clear clinical complains. The average work hours per week were

72 hours. The second group included 42 subjects who comprised the control group who were healthy none lead exposed. They were matched with cases for sex (males) and age. All of these controls were citizens of Khartoum town, not working or living nearby fuel stations or an industrial area. Ethical clearance was obtained from the ethical committee in Alneelain University. The informed consents were taken before blood collection. Five milliliters of venous blood were collected from all subjects in a plain container using vacutainer. Flameless atomic absorption was used for the measurement of serum copper. Statistical data analysis was done using Statistical Package for Social Sciences (SPSS version 16).

Results

Comparing blood lead results obtained from the fifty fuel station workers with the forty two non exposed healthy subjects using t test. The mean lead (Pb) was found (33.6 ± 2.2µg/dl) for the exposed workers versus (8.1 ± 0.3 µg/dl) for healthy non exposed controls (P value = 0.000), while the mean age was (30.1±1.4yrs) for fuel station workers versus (28.0±1.3yrs) for non

exposed healthy men (Table 1). Of the fifty exposed men; the average work hours per week were 72 hours. The study revealed that; among the exposed men 3(6%) were hypertensive, 2(4%) with dermatitis, 1(2%) with peptic ulcer. When the fuel stations workers were categorized according to the duration of exposure; the highest blood lead (43.9µg/dl) was found in the subjects with more than 14 years of exposure (Table 2). Grouping the fuel stations workers according to their weekly working hours; the highest blood lead values (41.5µg/dl) was found in those men with 36-48hours per week exposure, and the lowest blood lead (17.5µg/dl) was appeared in a worker with less than 24 hours per week exposure (Table 3).

Table (1): Comparative study of blood lead (Pb) level in Sudanese fuel station workers and non exposed healthy control men

Parameters	Fuel station workers (n=50) (Mean ± Std)	Non exposed healthy controls (n= 42) (Mean ± Std)	P value
Age (years)	30.1±1.4	28.0±1.3	
Lead (Pb) (µg/dl)	33.6±2.2 Range (10.5–97.5µg/dl)	8.1±0.3 Range (5.0–14.1µg/dl)	0.000

Table (2): Descriptive study of blood lead concentrations in relation to duration of exposure in fuel station workers group

Duration of exposure (months)	No. of exposed men	Mean of lead concentration (µg/dl)
<24	20	38.6
25-48	12	30.6
49-72	5	19
73-96	1	33
97-120	2	32.7
121-144	4	22.8
145-168	2	29.9
>168	4	43.9
Total	50	

Table (3): Descriptive study of blood lead level in relation to weekly working hours in fuel station workers group

Weekly working hours (hours)	No of exposed workers	Mean of blood Lead concentration(µg/dl)
24	1	17.5
36	2	41.5
42	2	41.5
48	4	38
52	4	29.2
72	37	33.8
Total	50	

Table (4). Distribution of blood lead levels in fuel station workers and their controls

Blood lead (µg/dl)	Fuel stations workers n (%)	Controls n (%)
0-	9(18)	36(85.7)
10-	17(43)	6 (14.3)
20-	11(22)	0.0
40-	7(14)	0.0
50-	4(8)	0.0
60- 97.5	2(4)	0.0

Discussion

Lead and its compounds are potentially toxic; its toxicity can cause aberrant function to multiple human organs. It inhibits many enzymes, including pyruvate dehydrogenase, and enzymes of the heam synthetic pathway. Blood lead is the most reliable index of exposure, because 90 percent of lead in blood is bound to red blood cells (6).

Data from the present study show significant increase in the levels of lead in the blood of Sudanese fuel station workers (33.6±2.2µg/dl), when compared to non-exposed healthy men (8.1±0.3 µg/dl) with P value (0.000); (Table 1 & Table 4). This findings are consistent with that previously reported by Al-Rudainy 2010 (3) from Basrah city in Irag with mean blood lead of 14.1µg/dl ranged (7.5 – 56.0µg/dl), AlShamri et al 2010 (13) from Najaf city in Iraq too, Bahrami et al 2002 (14) from Hamadan City of Iran who found the blood lead levels in workers and control group as 30.1µg/dl and 17.3 µg/dl, respectively and Freije and colleagues 2009 (15) from Bahrain Kingdom concluded significant elevation of blood lead in the fuel stations worker; while in disagreement with that reported by Yakub et al. 2009 (16) from Karachi city of Pakistan who found the blood lead in petrol- pump workers as (12.9± 3.7µg/dl) and Schafer el al. 2005

(17) from USA with mean blood lead levels (3.5±2.4µg/dl) in gasoline exposed workers. Depending on the duration of the working; the highest blood lead concentration (43.9µg/dl) was found in the fuel stations workers with more than 14 years of exposure (Table 2), consisting with the fact that duration of exposure to leaded fuel was significantly correlated with the blood lead level (13,14).

No enough information about lead addition to gasoline and benzene used in Khartoum city was obtained by the authors. Occupational exposure to lead is prevalent among fuel station workers in Khartoum. As recommended by WHO (18); medical surveillance for all lead-exposed workers in Khartoum which includes, quarterly and semiannual blood lead measurements should be adopted.

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