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Assessment of Some Heavy Metals Among Petrol Station Attendants in Ekpoma and Its Environs

Airhomwanbor O. Kingsley[1], Dic-Ijiewere O. Ebenezer[2], Idehen I. Charles[1], Eidangbe A. Peace[1], Ehimare R. Isibor[2], Uwuigbe Matthew[1], Ohue, E. M.[1]

[1]Department of Medical Laboratory Science, Faculty of Basic Medical Sciences, Ambrose Alli University, Ekpoma, Nigeria

[2]Department of Chemical Pathology, Faculty of Clinical Sciences, Ambrose Alli University, Ekpoma, Nigeria

Email address

ebenexar@gmail.com (A. O. Kingsley)

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Abstract

Premium motor spirit (PMS), otherwise known as gasoline, is a volatile liquid that evaporates if left exposed to constitute ubiquitous chemical pollutants in the immediate environment. This study was carried out to assess the levels of heavy metals of petrol station attendants in Ekpoma and its environs. A total of 100 individuals (males and females) comprising of 60 apparently healthy petrol station attendants and control group consisting of 40 apparently healthy individuals were used for this study. Serum levels of iron (Fe), zinc (Zn), copper (Cu) and lead (Pb) were determined using standard methods. The mean±SD values of subjects' Fe (109.06±16.08 µg/dl), Zn (90.22±16.08 µg/dl), Cu (120.77±24.12 µg/dl) and Pb (1.27±0.16 µg/dl) and mean±SD values of controls' Fe (109.45±10.52 µg/dl), Zn (92.53±7.60 µg/dl), Cu (117.46±11.14 µg/dl) and Pb (0.33±0.09 µg/dl) were compared. The analysis showed a significant increase ($p<0.05$) in the serum level of lead of petrol station attendants when compared with controls. There was no significant difference ($p>0.05$) in the level of iron, zinc and copper of petrol station attendants when compared with controls. The results generated in this study have shown that petrol station attendants in the study area may be prone to lead toxicity.

Keywords

Petrol, Attendants, Lead, Heavy, Metal

1. Introduction

Premium motor spirit (PMS), otherwise known as gasoline, being a volatile liquid may evaporate if left exposed to constitute ubiquitous chemical pollutants in the immediate environment [1]. However, those occupationally exposed tend to be at greater risk [2-3]. PMS is a petroleum-derived volatile liquid mixture, gotten from the fractionation of petroleum. It is used primarily as fuel in the internal combustion engines and some electricity generating machines [4-5]. Gasoline consists mostly of aliphatic hydrocarbons, cyclic hydrocarbons and aromatic hydrocarbons. Additives such as tetraethyl lead, tetra methyl lead, methylcyclopentadienyl Manganese carbonyl (MMT), and ethanol are added to petrol to improve its quality (octane rating) or to prevent engine knocking.

Some constituents of PMS are toluene, pentane, octane, xylene, hexane, heptane, 2, 2, 4–trimehtylbenzene and others. Some constituents of gasoline such as benzene, toluene (which are non-aliphatic hydrocarbons) have been reported to be carcinogenic, which may be due to the free radicals they generate. It has been reported that a higher concentration of unsaturated hydrocarbons and a lower concentration of the saturated fractions accumulate in the blood of humans and animals equally exposed to petroleum vapour [6]. Acute-duration inhalations of gasoline have been associated with irritation, headache, dizziness, nausea, euphoria and drowsiness [4].

The volatile nature of petrol makes it readily available in the atmosphere any time it is dispensed, especially at petrol filling stations and depots. Petrol contains mixture of volatile hydrocarbons and so inhalation is the most common form of exposure [7]. Petrol vapour can reach supra-lethal concentrations in confined or poorly ventilated areas, although such exposures are rare [8]. The intentional inhalation of vapour ('sniffing' or 'huffing') has been extensively documented [9]. At low doses, petrol vapour is irritating to the eyes, respiratory tract and skin. Exposure to higher concentrations of vapour may produce CNS effects such as staggered gait, slurred speech and confusion. Very high concentrations may result in rapid unconsciousness and death due to respiratory failure [10]. Motorists are exposed to gasoline fumes during fuelling at gas stations, but the gas station attendants are more at risk by virtue of their occupational exposure [11].

Gasoline vapour is not safe when inhaled even for a brief period of time (seconds). Vapour concentrations, expressed in parts per million (ppm) or mass of total hydrocarbons per unit volume (mg/m^3) of air above open barrel in unventilated out-house on 'hot' day is 25,000, air around tanker during bulk-loading is between 50 and 320 while air around petrol pump in service station during fuelling of vehicles is between 20 and 200 ppm [11-12]. Gasoline fume contains aliphatic, aromatic and a variety of other branched saturated and unsaturated hydrocarbons which are a continued source of pollution in various occupational setting.

It has been demonstrated that after inhalation of petroleum vapour through chronic exposure, lower concentrations of saturated hydrocarbons are detected in human and animal blood than that of the unsaturated aromatic hydrocarbons. Both diesel and gasoline engine exhausts are known to contain, in either the particulate or the vapour phase, a variety of mutagenic and carcinogenic agents [13].

Occupational safety and health is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment [14]. It aims at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention of health problems caused by the working conditions amongst workers of departures; the protection of workers in their employment from risks resulting from adverse factors to health; and the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities. Occupational risk factors that have been reported to contribute to global illness and injury include; back pain, hearing loss, chronic obstructive pulmonary disease (COPD), asthma, trachea, bronchus lung cancer, injuries and leukemia [15].

The term "heavy metals" refers to any metallic element that has a relatively high density and is toxic or poisonous even at low concentration. "Heavy metals" is a general collective term, which applies to the group of metals and metalloids with atomic density greater than 4 g/cm^3 or 5 times or more, greater than water [16-20].

2. Materials and Methods

2.1. Area of Study

This study was carried out in Ekpoma, Esan-west Local Government Area of Edo State, Nigeria. Ekpoma is fairly an urban area with a state university situated in it. It is located at latitude 6.75°N and longitude 6.13°E with population of 61,870 [21]. The inhabitants are mainly students, civil servants and farmers.

2.2. Study Population

A total of 100 apparently healthy individuals (males and females) participated in the study. Test subjects comprised of 60 apparently healthy petrol station attendants (males and females), while the control subject comprised of 40 apparently healthy non petrol station attendants (males and females).

2.3. Inclusion Criteria

Only apparently healthy individuals were recruited for this study.

2.4. Exclusion Criteria

Petrol station attendants with visible ailment were excluded from this study.

2.5. Sample Collection

Five mililitres of venous blood was collected from the subjects/controls using sterile disposable syringes and needles at the anti cubital fossa vein by veni-puncture after sterilization with 70% alcohol with the use of tourniquet into appropriately labelled sterile plain containers and allowed to clot and retract. Serum samples were obtained within 2hours of sample collection following centrifugation at 4000rpm for 15minutes and separation of serum into another sterile plain container labelled correspondingly. Serum samples were then stored frozen at -20°C and were thawed in a water bath at 37°C for 10 minutes prior to analysis.

2.6. Analytical Techniques

The concentrations of serum copper, zinc, iron and lead were determined with atomic absorption spectrophotometer (AAS) as described by Walsh [22]. The heavy metals were determined with the AA500 Atomic Absorption Spectrophotometer.

2.6.1. Principle

The atoms of the elements, when aspirated into the atomic absorption spectrophotometer (AAS) vaporized and absorbed light of the same wavelength as that emitted by the element when in the excited state. The amount of light absorbed in the flame is proportional to the concentration of the element in the sample.

2.6.2. Procedures

The samples were thawed and 1:4 dilution of sample with

0.1N HCl was made for complete digestion of the proteins in which the trace elements were bounded to. It was then aspirated into the AAS flame, where it becomes atomized. A light beam is directed through the flame into a monochromator and onto a detector. The detector then measures the intensity of light absorbed by the atomized elements in the flame. Thus, the amount of light intensity absorbed in the flame is proportional to the element in the sample.

2.7. Data Analysis

The data generated from this study was analysed using SPSS statistical package to determine the mean, standard deviation as well as the comparison of the test with the control using Students't-test. The level of significance was set at α=0.05, and a p-value less than 0.05 (P<0.05) was considered statistically significant.

3. Results

The results of this study are presented in the table below.

Table 1 shows the mean±SD values of iron (Fe), zinc (Zn), copper (Cu) and lead (Pb) in both petrol station attendants and the control individuals. The analysis showed no significant difference (p<0.05) in the values of Fe (109.06±16.08 µg/dl), Zn (90.22±16.08 µg/dl) and Cu (120.77±24.12 µg/dl) of petrol station attendants when compare with controls values of 109.45±10.52 µg/dl, 92.53±7.60 µg/dl and 117.46±11.14 µg/dl respectively. There was a significant increase in the values of Pb (1.27±0.16 µg/dl) when compared with control values of 0.33±0.09 µg/dl.

Table 1. *Mean±Sd of Iron, Zinc, Copper and Lead of Petrol Station Attendants (Subjects) and Controls.*

PARAMETERS	CONTROLS Mean±SD N = 40	SUBJECTS Mean±SD N = 60	T-VALUE	P-VALUE
IRON (µg/dl)	109.45±10.52	109.06±16.08	0.134	P>0.05
ZINC (µg/dl)	92.53±7.60	90.22±16.08	0.847	P>0.05
COPPER (µg/dl)	117.46±11.14	120.77±24.12	-0.811	P>0.05
LEAD (µg/dl)	0.33±0.09	1.27±0.16*	-4.501	P<0.05

Mean±SD* is significant at p>0<0.05

Table 2 shows the mean±SD values of iron (Fe), zinc (Zn), copper (Cu) and lead (Pb) in both male petrol station attendants and the male control individuals. The analysis showed no significant difference (p>0.05) in the values of Fe (112.78±23.03µg/dl), Zn (93.93±23.03µg/dl) and Cu (126.34±34.55µg/dl) of male petrol station attendants when compare with male control values of 109.87±8.92µg/dl, 91.03±5.16µg/dl and 113.38±12.57µg/dl respectively. There was a significant increase (p<0.05) in the values of Pb (0.73±0.44µg/dl) when compared with male control values of 0.29±0.05µg/dl.

Table 2. *Mean±Sd of Iron, Zinc, Copper and Lead of Male Petrol Station Attendantsand Male Controls.*

PARAMETERS	MALE CONTROLS Mean±SD N = 16	MALE SUBJECTS Mean±SD N = 27	T-VALUE	P-VALUE
IRON (µg/dl)	109.87±8.92	112.78±23.03	-0.482	P>0.05
ZINC (µg/dl)	91.03±5.16	93.93±23.03	-0.496	P>0.05
COPPER (µg/dl)	113.38±12.57	126.34±34.55	-1.440	P>0.05
LEAD (µg/dl)	0.29±0.05	0.73±0.44*	-4.027	P<0.05

Mean±SD* is significant at p>0<0.05

Table 3 shows the mean±SD values of iron (Fe), zinc (Zn), copper (Cu) and lead (Pb) in both female petrol station attendants and the female control individuals. The analysis showed no significant difference (p>0.05) in the values of Fe (106.02±4.93µg/dl and Cu (116.21±7.40µg/dl) of female petrol station attendants when compare with female control values of 109.17±11.65µg/dl and 120.18±9.39µg/dl respectively. There was a significant deacrese (p<0.05) in the values of Zn (87.19±4.93µg/dl) when compared with female control values of 93.54±8.83µg/dl. There was a significant increase (p<0.05) in the values of Pb (1.64±1.56µg/dl) when compared with female control values of 0.36±0.10µg/dl.

Table 3. *Mean±Sd of Iron, Zinc, Copper and Lead of Female Petrol Station Attendantsand Female Controls.*

PARAMETERS	FEMALE CONTROLS Mean±SD N = 24	FEMALE SUBJECTS Mean±SD N = 33	T-VALUE	P-VALUE
IRON (µg/dl)	109.17±11.65	106.02±4.93	1.395	P>0.05
ZINC (µg/dl)	93.54±8.83	87.19±4.93*	3.466	P<0.05
COPPER (µg/dl)	120.18±9.39	116.21±7.40	1.786	P>0.05
LEAD (µg/dl)	0.36±0.10	1.64±1.56*	-4.732	P<0.05

Mean±SD* is significant at p>0<0.05

Table 4 shows the mean±SD values of iron (Fe), zinc (Zn), copper (Cu) and lead (Pb) in both female petrol station attendants and the male petrol station attendants. The analysis showed no significant difference ($p>0.05$) in the values of Fe (106.01±4.93µg/dl), Zn (87.18±4.93µg/dl) and Cu (116.21±7.40µg/dl) of female petrol station attendants when compared with male petrol station attendants values of 112.78±23.03µg/dl, 93.93±23.03µg/dl and 126.34±34.55µg/dl respectively. There was a significant increase ($p<0.05$) in the values of Pb (1.64±1.56µg/dl) of female petrol station attendants when compared with male petrol station attendants values of 0.73±0.44µg/dl.

Table 4. *Mean±Sd of Iron, Zinc, Copper and Lead of Female Petrol Station Attendantsand Male Petrol Station Attendants.*

PARAMETERS	FEMALE SUBJECT Mean±SD N = 40	MALE SUBJECTS Mean±SD N = 60	T-VALUE	P-VALUE
IRON (µg/dl)	106.01±4.93	112.78±23.03	-1.643	P>0.05
ZINC (µg/dl)	87.18±4.93	93.93±23.03	-1.643	P>0.05
COPPER (µg/dl)	116.21±7.40	126.34±34.55	-1.643	P>0.05
LEAD (µg/dl)	1.64±1.56*	0.73±0.44	2.933	P<0.05

Mean±SD* is significant at p>0<0.05

4. Discussion

Occupational safety and health is a cross-disciplinaryarea concerned with protecting the safety, health and welfare of people engaged in work or employment [14]. This present study assessed the level of some heavy metals in those that are occupationally exposed to gasoline (petrol station attendants) in Ekpoma Edo state. From this study, it was observed that there was no significant ($p>0.05$) difference in the levels of iron of petrol station attendants when compared with controls. Iron is vital for almost all living organisms, participating in a wide variety of metabolic processes, including oxygen transport, DNA synthesis, and electron transport. Iron concentrations in body tissues must be tightly regulated because excessive iron leads to tissue damage, as a result of the formation of free radicals [23].

From the study, there was no significant difference ($p>0.05$) in the levels of zinc and copper of petrol station attendants when compared with controls. This was not in agreement with works of Ma *et al.* [24] who recorded significant decrease in the levels of these elements in Sudan. Zinc and Copper are essentialantioxidants in the human body [25]. These traceelements are essential component of many enzymes andproteins involved in protection against oxidative stressdamage. Zinc deficiency associated with reduced immunity [26], DNA damage and increases other metals induced oxidative toxicity [27]. Copper is essential micronutrients for normal growth and protection of many organs and electron transport [28]. Copper deficiency increases risk of cellular oxidativedamage due to decreased activity of super oxidedismutase (SOD). The balance between antioxidant, such as copper and zinc, and rate of free radicals levels are essential factor to prevent organs and tissue from oxidative damages [29-30]. There was significant decrease in zinc level of female petrol station attendant when compared to the female controls. This reduction may be as a result of zinc participation in scavenging the free radicals that may be produced as a result of toxic effects of petrol fumes [31].

There was significant increase in the levels of lead ($p>0.05$) in petrol station attendants when compare with control individual. This is in agreement with the works of Dongre *et al.* [32] and Al-Rudainy [33]. The significant increase in lead may be as a result of its use in octane rating of petrol that is still in use in some developing countries [34]. Lead has been known to interfere with a number of body functions and primarily affects the central nervous, hematopoietic, hepatic and renal system producing serious disorders [35].

In conclusion, the petrol station attendants in the area studied were at risk of lead toxicity because of significant serum levels observed as compared to other heavy metals assessed in this study. We therefore recommend that Petrol station attendants should avoid direct inhalation of the fume from petrol by covering their nose with nose mask, The Nigerian government should place a ban on lead as an additive to consumer fuel for road-going vehicles and that Further studies on the significant decrease in zinc of female subjects but not in male subjects should be carried out to establish the cause(s) of this sex variation.

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