Are Roadside Petrol Dispensers at higher risk of lead and Cadmium Toxicity? A study from Gombe State, North East, Nigeria

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ABSTRACT

Background:*Lead and cadmium are important occupational and environmental pollutants. Increase plasma levels of these toxic metals were found to be associated with chronic diseases. Lead causes chronic diseases through generation of reactive oxygen species (ROS) and alteration of antioxidant defense system in occupationally exposed workers through its effects on cell membrane and DNA, while the toxic effects of cadmium are mediated via blocking the biocatalytic antioxidant actions of copper, zinc and cobalt.*

Aims And Objectives: *Evaluate risk of lead and Cadmium toxicity among roadside dispensers of petrol in Gombe state, Nigeria.*

Materials And Methods: *Plasma levels of heavy metals (lead and cadmium) were compared between 90 road side dispensers of petrol and 90 controls. Lead and cadmium ware analyzed using Atomic Absorption Spectrophotometer (AAS).*

Results: *The mean age of the exposed and control groups were 29.03 ± 3.7years and 29.24 ± 3.5 years respectively. The mean plasma levels of lead (20± 0.54 µg/dl) and cadmium (20± 0.45 µg/dl) were significantly higher (p< 0.001) among the road side dispensers of petrol compared to the controls (10± 0.24 µg/dl and 10±0.2 µg/dl respectively)*

Conclusion: *Our data has demonstrated higher level of lead and cadmium in road side dispensers of petrol compared to the controls. This is an indication that roadside petrol dispensing is associated with high plasma lead and cadmium and may predispose to diseases associated with those heavy metals. We suggest that legislation on road side petrol dispensing should be enforced to reduce incidence of long term complications from exposure.*

BACKGROUND

Exposure to toxic chemicals in petrol is a major occupational health concern worldwide[1] due to its frequent utilization in automobiles and other machines especially in developing nations.[2] One of such exposures is among roadside petrol dispensers which are common sight in Nigeria, most especially in the Northern part of the country.[3] Most local petrol dispensers have little knowledge on the safe handling and transportation of chemicals and do not use any form of protection against the fumes emanating from the petrol which they dispense. They almost always stay by the road side waiting for their customers which in itself is associated with increased levels of exposure to petrol and its constituents. [4-5]

Lead and cadmium are important occupational and environmental pollutants and which appear to be of public health importance in Nigeria when compared to other heavy metals.[6]Chronic toxicity to these heavy metals can be acquired through exposure to petrol. Increased plasma levels of these toxic metals have been associated with many chronic diseases.[6-7] Lead causes chronic diseases through generation of reactive oxygen species and alteration of antioxidant defense

system in occupationally exposed workers through its effect on cell membrane and DNA. The toxic effects of cadmium are mediated via blocking the biocatalytic antioxidant actions of copper, zinc and cobalt.[6]

In Nigeria, especially in the north, must studies were carried out on acute exposure to lead, associated with gold mining in Zamfara among children.[8-9] None, to our knowledge involved chronic exposure to lead and cadmium, especially among roadside dispensers of petrol. An understanding of the plasma levels of these heavy metals among exposed individuals will help in generating data useful for the prevention and timely intervention of chronic heavy metal toxicity especially among roadside petrol dispensers.

AIMS AND OBJECTIVES

The aim of this study was to evaluate the risk of lead and cadmium toxicity among roadside dispensers of petrol in Gombe, Nigeria.

MATERIALS AND METHODS

SETTING

The subjects in the study were drawn from Gombe State, North-East Nigeria using multi-staged sampling technique.

DESIGN

This was a cross sectional analytical study approved by the Gombe State Ethical Committee. Ninety healthy known road side dispensers of petrol were recruited and also ninety age and sex matched controls.

INCLUSION CRITERIA

Only apparently healthy, full time roadside dispensers of petrol were included in the study.

EXCLUSION CRITERIA

People who had other occupational exposure to heavy metals were excluded from the study. These include those working in welding, battery, painting, auto mechanics industries.[8]Petrol station attendants were also excluded from the study.

SELECTION OF CONTROLS

Sex and age matched controls were selected from the general population in the same environment.

SAMPLE COLLECTION AND LABORATORY PROCEDURES

Structured questionnaire requesting bio data, anthropometric measurements, duration of petrol dispensing and use of apparel was administered by the researcher at the site of petrol dispensing participants were asked to fast for sample collection the following morning.

5mls of fasting venous blood was collected from each participant into a heparinised plastic sample bottle. Plasma was separated by centrifugation and frozen within 30minutes at -20C[10] till the time of analysis.

Plasma levels of heavy metals (lead and cadmium) were analyzed using Atomic Absorption Spectrophotometer (AAS)[10] and levels were compared between 90 road side dispensers of petrol and 90 controls.

Statistical analysis

The data was analyzed on a computer using the system for SPSS version 20.00 for windows. The mean (X) and standard deviation (SD) for age, lead and cadmium of the gasoline of exposed and non-exposed were computed for comparison.

Student T-test was used to determine significant difference between means of the two groups. Pearson correlation coefficient was used to establish correlation between the plasma levels of the heavy metals (lead and cadmium) and the duration of exposure to gasoline. The level of significance was fixed at the 5% probability level.

RESULTS

The mean age of the exposed and control groups was 29.03 ± 3.7 and 29.24 ± 3.5 years respectively. Ninety respondents were roadside dispensers of petrol. Among the controls, 20 (22.2%) were teachers, 25(27.8%) were famers, 17(18.9%) were students and 28(31.1%) were other occupations. None of the exposed population used protective apparatus. The demographic data for the study participants can be seen in

Table 1

Table 1: Occupational distribution of the control group

Occupation	Frequency	Percent (%)
Trader	34	37.8
Teacher	10	11.1
Farmer	9	10.0
Student	17	18.9
Others	20	22.2
Total	**90**	**100.0**

The mean plasma levels of lead (20± 0.54 µg/dl) and cadmium (20± 0.45 µg/dl) were significantly higher (p< 0.001) among

the road side dispensers of petrol compared to the controls (10± 0.24 µg/dl and 10±0.2 µg/dl respectively).

Table 2: Student's t- test for equality of means between exposed and controls

VARIABLE	EXPOSED MEAN (SD)	CONTROLS MEAN (SD)	p-VALUE
Lead(ug/dl)	20(0.54)	10(0.24)	.000
Cadmium(ug/dl)	20(0.45)	10(0.19)	.000

There was positive correlation between the duration of exposure and heavy metals (lead and cadmium) ($p > 0.05$). Table 3

TABLE 3: Pearson correlation of duration of exposure (hours) and other measured parameters

VARIABLE	r	p
Cadmium	0.108	0.12
Lead	0.107	0.32

Discussion

Lead and cadmium are part of the main threats to human health from heavy metal exposure.[2] Toxicity occurs at lower levels than previously anticipated.[2] The health effects of these heavy metals have been regularly reviewed for a long period of time[11-12].

In this study, it was found that lead and cadmium levels were significantly higher among the petrol exposed group compared to the controls. This finding was similar to other studies where Bayraktar et-al[13] found significantly higher levels of lead in petrol exposed subjects compared to controls, similar findings were made by Naeher et-al.[14]

The plasma levels of lead and cadmium found in this study were far above the U.S Centers for Disease Control and Prevention's advisory level of concern (10 ìg/dl)[15], many have even suggested that lead and cadmium should not have threshold limits and that their ideal plasma levels should be zero.[7] The significantly higher levels of lead and cadmium among the exposed group is therefore far from the ideal.

In Nigeria, especially in the North most studies are about lead and cadmium and were related to acute toxicities associated with mining activities.[8-9] These studies found high levels of toxicity in more than 90% of children in villages around mining sites. This study, found occupational exposure that is chronic in nature and mainly affects adults. Lead and cadmium toxicity may be both occupational and environmental, both acute and chronic and may affect both children and adults. Exposures to these heavy metals has been found to be associated with oxidative stress and several chronic diseases including malignancies.[16-20] Some studies have demonstrated association of lead toxicity with iron deficiency anemia, low birth weight and chronic hearing loss, kidney and bone diseases.[21-22] The toxicity is higher among children due to higher intestinal absorption and more permeable blood brain barrier. Therefore, the observed higher levels of these heavy metals in the exposed group in our study may predict oxidative stress and risks associated with it.

The association of lead toxicity with oxidative stress has been further demonstrated by some studies that show reduction of plasma lead after supplementation with the antioxidant vitamin C.[23]

There is a strong need for going further to find out the effect of antioxidant supplementation on the heavy metal toxicity demonstrated among road side dispensers of petrol. This is because many studies have shown a decrease in oxidative stress in people who are exposed.[24-26] If found to be useful; antioxidant supplementation can be advocated to reduce the risk of heavy metal toxicity among the people that are exposed to petrol. This may be effected by the consumption of fruit and vegetables that are rich in antioxidants ranging from tomatoes, grapes, orange, melon and tea.[27-30]

CONCLUSION

The data from this study has demonstrated higher level of lead and cadmium in road side dispensers of petrol compared to the controls. This is an indication that roadside petrol dispensing is associated with high plasma lead and cadmium and may predispose to diseases associated with those heavy metals.

The roadside petrol dispensers should be educated about the risk of chronic lead and cadmium toxicity involved in their trade. Legislation on roadside petrol dispensing should also be enforced to reduce incidence of long term complications from exposure.

REFERENCES

1. WHO/UNEP. Public health impact of pesticides used in agriculture. WHO Geneva. 1989.
2. Järuo L. Hazards of heavy metal contamination. *Brit Med Bull*. 2003;68(1):167-82
3. Adamu S, Akinosun O, FM. A, Kuti M, El- Bashir J, Abubakar J. Antioxidant Trace Metals Among Roadside Petrol Dispensers In Gombe State. *Brit J of Med & Med Researc*. 2016;14(3):1-7.
4. Navasumrit P, Chanvaivit S, Intarasunanont P, Arayasiri M, Lauhareungpanya N, Parnlob V, etal. Environmental and occupational exposure to benzene in Thailand. *Chem Biol Interact*.[doi: 10.1016/j.cbi.2005.03.010]. 2005;153-154:75-83.
5. Capleton AC, Levy LS. An overview of occupational benzene exposures and occupational exposure limits in Europe and North America. *Chem Biol Interact*. 2005:153-4.,43-53.
6. Orisakwe O. Lead and Cadmium in Public Health in Nigeria: Physicians Neglect and Pitfall in Patient Management. *N Am J Med Sci* 2014 Feb; 6(2): 6170. 2014;6(2):61-70.
7. Anetor JI. High Blood Levels In The General Nigerian Population: Causes And Implications. National Conference on the Phase-out of Leaded Gasoline in Nigeria Abuja, Nigeria 2001;November15-16:27-37.
8. Getso KI, Hadejia IS, Sabitu K, Nguku PM, Poggensee G, Aliyu HM, et al. Prevalence and Determinants of Childhood Lead Poisoning in Zamfara State, Nigeria. *J of Health and Poll*. 2014;4(6):1-9.
9. Majiya H, Nuhu A, Sallau Ms, Majiya H, K Mohammed A. Zamfara lead poisoning saga: Comparison of lead contamination level of water samples and lead poisoning in Bagega Artisanal gold mining district, Nigeria. J of chem and pharma researc. 2015;2015:7-12
10. Turgut S, Polat A, Inan M, Turgut G, Emmungil G, Bican M, et al. Interaction between anemia and blood levels of iron, zinc, copper, cadmium and lead in children. *Indian J of Pediatr*. September, 2007;75:31-4.
11. Wani A, Ara A, Usmani J. Lead toxicity: a review. *Interdiscip Toxicol* 2015;8(2):55-64.
12. Cadmium Review. Nordic Council of Ministers. January 2003. Report no. 1. Issue no. 04.
13. Bayraktar NM, Karagözler AA, Bayraktar M, Titretir S, Gözükara EM. Investigation of the blood biochemical status of gas station workers. *Toxicol and Envirom Chem*. 2006;88, 4, 1 October , Pages 587-594(4):587 - 94.
14. Naeher L, Aguilar-Villalobos M, Miller T. Blood lead survey of children, pregnant women, professional drivers, street workers, and office workers in Trujillo, Peru. *Arch Environ Health*. 2004;59(7):359-62.
15. Luke PN, Manuel A, Todd M. Blood Lead Survey of Children, Pregnant Women, Professional Drivers, Street Workers, and Office Workers in Trujillo, Peru. *Archives of Environmental Health*. 2004;59(7):359-62.
16. Matoviæ V, Buha A, Bulat Z, Dukiæ-Æosiæ D. Cadmium toxicity revisited: focus on oxidative stress induction and interactions with zinc and magnesium. *Arh Hig Rada Toksikol*. 2011;62(1):65-76.
17. P J. Mechanisms of cadmium carcinogenesis. *Toxicol Appl Pharmacol* 2009;238(3):272-9.
18. He X, MG. C, Ma Q. Activation of Nrf2 in defense against cadmium-induced oxidative stress. *Chem Res Toxicol* 2008;21(7):1375-83.
19. Garçon G, Leleu B, Zerimech F, Marez T, Haguenoer J, Furon D, et al. Biologic markers of oxidative stress and nephrotoxicity as studied in biomonitoring of adverse effects of occupational exposure to lead and cadmium. *J Occup Environ Med*. 2004;46(11):1180 - 6.
20. Khan D, Qayyum S, Saleem S, Khan F. Lead-induced oxidative stress adversely affects health of the occupational workers. *Toxicol Ind Health*. 2008;24(9):611-8.
21. Keramat MR, Sadeghian MH, Mood M. Correlation Between Iron Deficiency and Lead Intoxication in the Workers of a Car Battery Plant. Intern J of Hematol and Oncol. 2010;20(3):169-74.
22. Majid M, Ahmad SF, Mohammadzadeh A. The evaluation of the effect of maternal blood lead

concentration on the incidence of delivery of low birth weight neonates. *SJKU* 2009;14(1):41-6.

23. Shahrabi J, Dorosty A, Jalali M, Sadrzadeh H, Farvid M. Effect of 2-Week Ascorbic Acid Supplementation on Plasma Lead Levels in Workers Occupationally Exposed to Lead. *JRUMS* 2006;5(2):75-84.

24. Zal F, Mostafavi-Pour Z, Amini F, Heidari A. Effect of vitamin E and C supplements on lipid peroxidation and GSH-dependent antioxidant enzyme status in the blood of women consuming oral contraceptives. *Contraception*. 2012;86(1):62 - 6.

25. Guo C, Liu P, Lin K, Chen P. Nutritional supplement therapy improves oxidative stress, immune response, pulmonary function, and quality of life in allergic asthma patients: an open-label pilot study. *Altern Med Rev*. 2012;17(1):42-56.

26. Mazloom Z, Hejazi N, Dabbaghmanesh M, Tabatabaei H, Ahmadi A, Ansar H. Effect of vitamin C supplementation on postprandial oxidative stress and lipid profile in type 2 diabetic patients. *Pak J Biol Sci*. 2011;14(19):900-4.

27. Xaplanteris P, Vlachopoulos C, Pietri P, Terentes-Printzios D, Kardara D, Alexopoulos N, et al. Tomato paste supplementation improves endothelial dynamics and reduces plasma total oxidative status in healthy subjects. *Nutr Res*. 2012;32(5):390-4

28. Han KC, Wong WC, Benzie IF. Genoprotective effects of green tea (Camellia sinensis) in human subjects: results of a controlled supplementation trial. *Brit j nutri*. 2011;105(2):171-9.

29. Chidambara Murthy KN, Singh RP, Jayaprakasha GK. Antioxidant activities of grape (Vitis vinifera) pomace extracts. J Agric and Food Chem. 2002 50(21):5909-14.

30. Ko SH, Choi SW, Ye SK, Cho BL, Kim HS, Chung MH. Comparison of the antioxidant activities of nine different fruits in human plasma. J Med Food 2005;8(1):41-6.