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Comparative calcium levels in high exposed and low exposed group of lead based battery workers

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Abstract

Introduction: A comparative study of calcium and phosphorus was conducted in high exposed and low exposed groups of lead battery workers to study the effect of lead exposure in these groups as there were very few systematic study reports available in the Indian scenario.

Materials and Method: Subjects were selected and classified as
Group A →controls;
Group B→ high risk exposure
Group C→low risk exposure. They were evaluated for their blood lead level (BLL), zinc protoporphyrin (ZPP), Hb, Calcium, Phosphorus, Blood pressure, Total Proteins and albumin. Selections of subjects were in accordance to the protocol developed.

Results: This study showed that there is statistical significance between high risk and low risk in BLL ($p<0.001$), ZPP ($p<0.001$), Hb ($p<0.001$) and Calcium ($p<0.001$). There was no significant difference between the two groups in Phosphorus ($p=0.280$). Other parameters included Blood pressure, Total protein, albumin and Phosphorus had no significant difference.

Conclusions: There was significant difference in BLL, ZPP and calcium between the high risk and low risk group. This difference was mainly due to the absence of precautionary principles, absence of proper disposal methods and lack of knowledge among workers about the ill effects of lead. Thus study reveals the need for self-regulation and a government policy.

Keywords: Lead, BLL ZPP, Calcium, High risk group, Low risk group

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Introduction

Lead was one of the first metals known and used by man. It is a normal constituent of the earth's crust.(1) Lead occurs naturally as a sulfide in galena. It is soft, bluish-white, silvery gray, malleable metal with a melting point of 327.5 °C [2]. Its easy workability, low melting point, ability to form carbon metal compounds, hold pigments well, very easily recycled, stands up well to the outside weather elements, a high degree of corrosion resistance, it is inexpensive makes it most widely used metal. Lead intoxication was recognized as early as 2000 BC and now it is the number one environmental pollutant all over the world causing health hazards.(3,4,5)

The battery industry is by far the principle consumer of lead, using an estimated 76% of annual primary and secondary lead production.(6)

Today occupational exposure to lead remains a big problem in developing country like India. Occupational lead exposure is likely unregulated in these countries with little monitoring of poisoning being done.

1. Low risk sector of lead based battery workers are those workers who are required by law to follow proper protective measures and proper disposal methods as per environmental guidelines.
2. High risk sector are those workers are those who do not follow any of these.

The high risk sector is of particular concern since the work is predominantly carried out at home or in unregulated workshops, often helped by women and children.(7) These are located in places where large number of people lives, especially children. They are particular concern since these non-regulated businesses deliver the lead right into the homes or yards where children live or play. Children can also be exposed when the working parent brings the lead dust home from work.(1)

There are very few systematic studies available which is done on importance of these precautionary principles or need for educating the workers in developing countries.(8) This could be done only when the workers were selected based on high risk and low risk sector of battery workers along with controls.

The high risk sector, which often operated at or near home, is usually described as "backyard" or "cottage"-Lead industry. Lead poisoning from household members from lead dust brought home on work clothes has also been reported from these unorganized workplaces.

Toxic Manifestations of Lead: Lead acts on multiple enzyme systems of different organs by expressing its toxicity by several mechanisms.(9) Their toxic manifestations are being considered primarily due to the imbalance between pro-oxidant and antioxidant

homeostasis and also due to a high affinity of these metals for thiol groups of functional proteins.[10]

Bone is the largest depository of the body burden of lead. Approximately 90-95% of the lead is stored in calcium-dependent skeletal pools with slow turnover.[11] Human bone appears to have at least two kinetically distinct lead compartments.[9] Skeletal lead is mobilized during a number of physiological and pathological conditions involving increased bone turnover such as age, endocrine status, osteoporosis, menopause, renal diseases and in particular during pregnancy and lactation. This lead when mobilized moves into the blood compartment and exerts its toxic effects.[12] Lead may directly or indirectly alter several aspects of bone cell function by changing the circulation levels of the hormones, particularly 1, 25-dihydroxy cholecalciferol (Vitamin D3), which is involved in stimulating the synthesis of osteocalcin leading to alteration of bone cell function by perturbing the ability of bone cells to respond to hormonal regulation.

The uptake and metabolism of calcium is modified by lead toxicity. Blood lead level and dietary calcium has been showed to be inversely correlated in children as well as in adults.[13] Though lead replaces calcium it does not have the function of calcium

Materials and Method

Materials: Subjects were workers in and around the city of Bangalore.

They were divided into 3 groups:

Group A: Non-lead based worker: (Controls) workers who worked in other organization other than lead based industry (normal subjects).

Group B: Low risk group: Battery workers who were working in an organization that equips its workers all required protective wear and use of proper disposal methods.

Group C: High risk group: Battery workers who were working in local battery shops where there are no proper protective wear provided for them and no proper disposal methods.

Methods: BLL Estimation using *by* Anodic stripping voltammetry,[14,15] ZPP Estimation by Front Face Flourometry.[16] Other parameters were done using fully automatic methods using Excel ERBA auto analyzer.

Study Design: A comparative study with 54 subjects in Group A (Non-lead based worker), 54 subjects in Group B (Low risk group –Battery workers) and 50 subjects in Group C (High risk sector-battery workers) was undertaken to study the BLL, ZPP, ALAD along with calcium, phosphorus, Total protein and Albumin between three groups.

Results

Table 1: Comparative values of low and high lead exposure groups

Variable	Low			High			p-value
	n	Mean	SD	N	Mean	SD	
Age in Y	54	28.85	7.07	50	30.92	8.58	0.185
Years of Expo	54	3.89	3.52	50	3.27	4.12	0.409
Diastolic	54	76.76	10.31	50	80.68	7.39	0.027**
Systolic	54	119.59	12.99	50	120.40	9.52	0.720
Lead	54	21.61	9.82	50	77.84	34.26	<0.001**
Hb%	54	12.77	1.56	50	10.97	1.82	<0.001**
ALAD	54	41.10	8.29	50	25.38	7.48	<0.001**
ZPP	54	59.31	14.28	50	94.62	53.58	<0.001**
Proteins	54	7.34	0.49	50	7.23	0.84	0.418
Alb	54	4.13	0.23	50	4.15	0.28	0.705
Glo	54	3.21	0.37	50	3.06	0.71	0.207
Cal	54	8.71	0.39	50	8.05	0.60	<0.001**
Pho	54	3.93	0.63	50	3.82	0.37	0.280

** $p<0.05$ statistically significant

Table 2: Comparative values of low lead exposure group and control group

Variables	Low			Control			p-value
	n	Mean	SD	n	Mean	SD	
Age in Y	54	28.85	7.07	44	26.70	7.51	0.149
Years of Expo	54	3.89	3.52	44	0.00	0.00	<0.001**
Diastolic	54	76.76	10.31	44	77.82	6.83	0.54
Systolic	54	119.59	12.99	44	117.43	7.03	0.324
Lead	54	21.61	9.82	44	5.22	2.50	<0.001**
Hb%	54	12.77	1.56	44	14.20	1.62	<0.001**
ALAD	54	41.10	8.29	44	49.65	6.72	<0.001**
ZPP	54	59.31	14.28	44	23.66	6.03	<0.001**
Proteins	54	7.34	0.49	44	7.52	0.51	0.077
Alb	54	4.13	0.23	44	4.15	0.32	0.721
Glo	54	3.21	0.37	44	3.35	0.38	0.053
Cal	54	8.71	0.39	44	9.17	0.76	0.001**
Pho	54	3.93	0.63	44	3.84	0.67	0.492

Table 3: Comparative values in High lead exposure group and control group

Variables	High			Control			p-value
	n	Mean	SD	n	Mean	SD	
Age in Y	50	30.92	8.58	44	26.70	7.51	0.014**
Years of Expo	50	3.27	4.12	44	0.00	0.00	
Diastolic	50	80.68	7.39	44	77.82	6.83	0.055
Systolic	50	120.40	9.52	44	117.43	7.03	0.087
Lead	50	77.84	34.26	44	5.22	2.50	<0.001**
Hb%	50	10.97	1.82	44	14.20	1.62	<0.001**
ALAD	50	25.38	7.48	44	49.65	6.72	<0.001**
ZPP	50	94.62	53.58	44	23.66	6.03	<0.001**
Proteins	50	7.23	0.84	44	7.52	0.51	0.042**
Alb	50	4.15	0.28	44	4.15	0.32	0.977
Glo	50	3.06	0.71	44	3.35	0.38	0.014**
Cal	50	8.05	0.60	44	9.17	0.76	<0.001**
Pho	50	3.82	0.37	44	3.84	0.67	0.867

This study showed that there is statistical significance between high risk and low risk in BLL (p<0.001), ZPP (p<0.001), Hb (p<0.001) and Calcium (p<0.001). There was no significant difference between the two groups in Phosphorus (p=0.280). Other parameters included Blood pressure, Total protein, albumin and Phosphorus had no significant difference. This difference is because lack of preventive measures and absence of knowledge about the ill effects of lead. The results were similar with one of a very few studies which showed the importance of preventive measures and importance in educating the battery workers about the ill health effects of lead.[8]

Thus this study signifies the importance of these preventive measures which should be the responsibility of both the employer and the employee. Developing an international monitoring and analytical quality control policy should be the prime target for the Government.

References

1. L S Ibels, C A Pollock. Lead Intoxication. Medical Toxicology 1: 387-410.
2. Kowetha A Davidson et al; Toxicity Summary for Lead (Inorganic); OAK Ridge reservation Environmental Restoration program; December 1994.
3. Ibels L S, Pollock C A. Lead Intoxication. Med Toxicol. 1986 Nov-Dec;1(6):387-410.
4. Herman S D'Souza, Geraldine Menezes and Venkatesh T. Fatal Lead Exposure: Encephalopathy in a child. Indian Journal of Clinical Biochemistry, 2002;17(1):9-11.
5. Pranay Kathuria. University of Oklahoma College of Medicine. Lead Nephropathy. E Medicine 2008(5); 28-36.
6. US Geological Survey, Mineral commodity summaries, Jan 2001;97.
7. Nawrot T S Thijs L, Den Hond E M, Roels H A, Staessen J A. An epidemiological re-appraisal of the association between blood pressure and blood lead; a meta-analysis. Hum Hypertens 2002 Feb;16(2):123-31.
8. Vishal Babu G N, Raviraja A, Thuppil Venkatesh. Magnitude of lead poisoning among unorganized battery workers
Int J Biol Med Res. 2014;5(2):4129-4132.

9. Carl A Burtis, Edward R A. "Toxic Metals". Tietz textbook of Clinical Chemistry-3rd edn. WB Saunders Company: 989-991.
10. Flora S J. Flora G, Saxena G and Mishra M. Arsenic and Lead induced free radical generation and their reversibility following chelation. Cell Mol Biol 2007 Apr 15;53(1):26-47.
11. Lenntech Water treatment & air purification Holding B.V. Chemical properties, Health effects and Environmental effects of Lead; 206-210.
12. William E Blumberg, Josef Elsinger, Angelo A Lamola and David M Zuckerman. The Hematoflourometer. Clin Chem 1977;23(2):270-274.
13. David Martin, Thomas A Glass, Karen Bandeen-Roche, Andrew C Todd, Welping shi and Brian S Schwartz. Association of Blood Lead and Tibia lead with Blood pressure and Hypertension in a community sample of older adults. American Journal of Epidemiology 2006 Vol 163; No. 5: 467-578.
14. Wu T, Buck G M, Mendola P. Blood lead levels and sexual maturation in US girls. Third National Health and Nutrition Examination Survey. 1988-1994. Environ Health Perspect 2003;111(5):737-741.
15. Centers for Disease Control and Prevention (CDC). Preventing Lead poisoning in young children. U S Department of Health and human services; 1991.
16. Yang Y, Ma Y, Ni L, Zhao S, Li L, Zhanj J et al. Lead exposure through gestation-only caused long-term learning/memory deficits in young adult offspring. Exp Neurol 2003;184:489-95.