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A study on lead toxicity among the workers in an unorganized sector of lead-acid battery industry

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Abstract: *Aims of the study:* (1)-To study various manifestations of lead toxicity at different levels of exposure among the Lead-Acid battery workers and (2)-To study various factors contributing to the toxicity of lead among the workers. *Results:* High amounts of lead were detected in the blood samples of the workers. The commonest lead related symptoms observed among the workers were malaise (32.1%), fatigue (25.9%), arthralgia (20.9%), abdominal colic (16%) and headache (13.6%). Smoking found to be an important contributory factor in the lead related manifestations. An inverse association of practice of hygiene with mean blood lead value was observed among heavily exposed workers. A statistically significant difference was observed between heavily exposed and moderately exposed to lead regarding presence of pallor, malaise symptom, presence of one or more lead related symptoms, blood lead levels, haemoglobin values, etc. *Conclusion:* A majority of Lead-Acid battery workers (64.19%) were highly exposed to lead by their nature of work. The prevalence of toxicity was more among the heavily exposed than the moderately exposed. Minimizing the exposure during the work is very important factor to protect the health of the workers.
Keywords: Lead- Acid Battery workers, Mean lead levels, Plumbism.

Introduction

Lead (Pb) is one of the important metals causing potential health hazard to the human community especially in occupational setups. First clinical description of lead poisoning (Plumbism/ Saturnism) was made in the first century BC. Lead exposure accounts for almost 1% of the global burden of disease, with the highest burden in developing regions [1]. Lead is ubiquitous in nature, affects virtually every system in the body. Lead toxicity depends on levels on exposure including the duration of the exposure. No level of lead is considered "safe" or "abnormal". Recent evidence also suggests that there may be no safe level [2].

The onset of clinical lead intoxication is usually insidious and is associated with moderately elevated blood lead levels over 20ug/ dl. It begins with lethargy, malaise, irritability, abdominal pain. It may progress to complaints of severe stomach aches, constipation, sporadic vomiting, loss of balance, sleepiness and headaches. Further advanced poisoning results in repeated vomiting, extreme abdominal pains and seizures ending with coma and death [3]. The toxic effects of lead vary greatly, manifesting as subtle changes in neurocognitive function in low-level exposure or as the potentially fatal encephalopathy of acute lead poisoning [4]. The principal use of lead is in Lead-Acid batteries (63%) [5-6]. Workers in this industry are exposed to lead and its toxicity. The workers absorb lead from inhalation of fine lead dust or fumes, contamination of food eaten at the work place or by absorption through the skin. Among the workers in the unorganized setups, some are exposed heavily to lead due to their nature of work, which is recycling and charging whereas some are low exposed because they only recharge the batteries.

In this study an attempt has been made to emphasize on risks to human health associated with exposure to lead in an occupational environment and compare and contrast between the two different exposure groups. Kurnool city is located near NH-5, and well known for unorganized, Lead-Acid battery industry in the form of battery recycling and

charging shops. The study was taken up to evaluate the toxic effects of lead, if any among the workers involved in this profession.

Material and Methods

Study design: Cross- Sectional Study.

Study population: The study was conducted among a total of 61 Lead-Acid battery workers in Kurnool city.

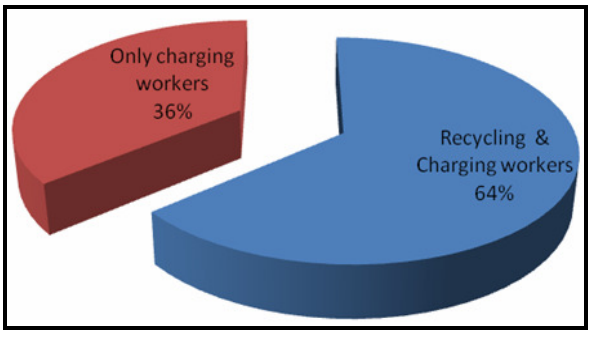
Data Collection: Data was collected with a pre-designed and pre-tested proforma. Data was collected regarding their nature of work, protective measures adopted during work and life style habits, followed by clinical examinations and hematological investigations. Due to technical and financial constraints blood lead estimations by 3010 ESA Blood lead analyzer were done to only 35 workers, who were selected by systematic random method. Toxic manifestations were compared between heavily exposed and moderately exposed along with other contributing factors.

Statistical analysis: The analysis was carried out with SPSS Version16.0, for Windows. Chi-square tests, Standard error of difference between means and Z tests were done for significance.

Results

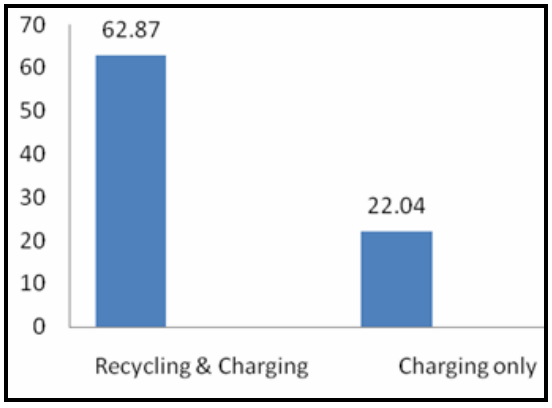
Among a total of sixty one Lead- Acid battery workers, 39 (64%) were heavily exposed (Recycling & Charging) and another 22 (36%) were considered as moderately exposed (Charging only) to lead by the nature of their work (Fig 1).

Fig-1: Distribution of Lead-Acid Battery Workers



Mean blood lead level (micro gram/ dl) was 52.37 ± 56.08. The mean blood lead value (micro gram/ dl) among heavy exposure group was very high (62.87 ± 49.86) when compared to the levels of moderate exposure group (22.04 ± 20.61). The difference was statistically significant (Z= 3.42, P value < 0.05) (Fig 2).

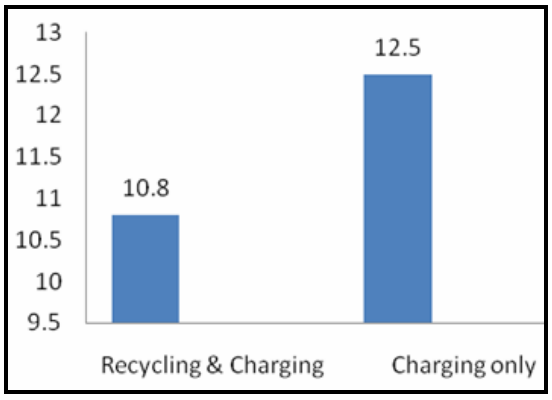
Fig-2: Mean Blood Lead levels (micro gram/ dl) by Nature of Work



Z= 3.42, P value < 0.05, statistically significant

Mean Blood Haemoglobin (gm/ dl) of the Workers was 12.0 ± 3.79. Mean haemoglobin value was 1.7 gm/dl higher among workers of moderate exposure group than heavy exposure group. Statistically the difference was significant (Z=2.61, P value <0.05) (Fig 3).

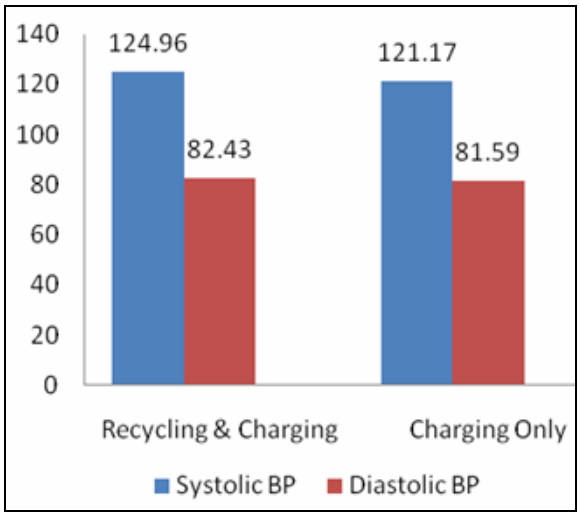
Fig-3: Mean Blood Haemoglobin (gm /dl) of the Workers by Nature of work



Z=2.61, P value <0.05, statistically significant

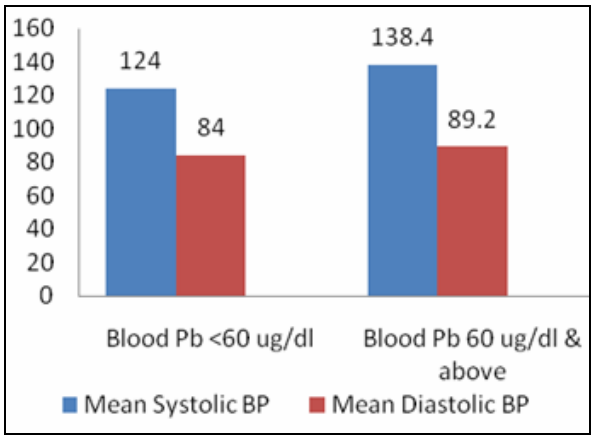
Mean blood pressures among the heavy exposure group was found to be higher (systolic by 3.79 mm Hg and diastolic by 0.84 mm Hg) than the moderate exposure group (Fig 4).

Fig-4: Mean Blood pressures (in mm Hg) by Nature of Work



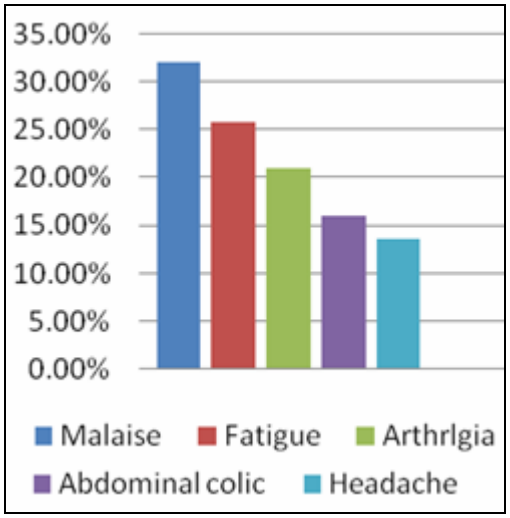
Mean systolic blood pressure value among the workers with blood lead levels 60 micro grams/ dl and above was very high (138.4 mm Hg) when compared to the workers with values below 60 micro gram/dl (124 mm Hg) which was statistically significant (SE of difference between two means was 7.16) (Fig 5).

Fig-5: Mean Blood pressure values by Blood Lead levels



The commonest symptoms observed among the battery workers were malaise (32.10%), fatigue (25.92%), arthralgia (20.99%), abdominal colic (16.05%) and headache (13.58%) (Fig 6).

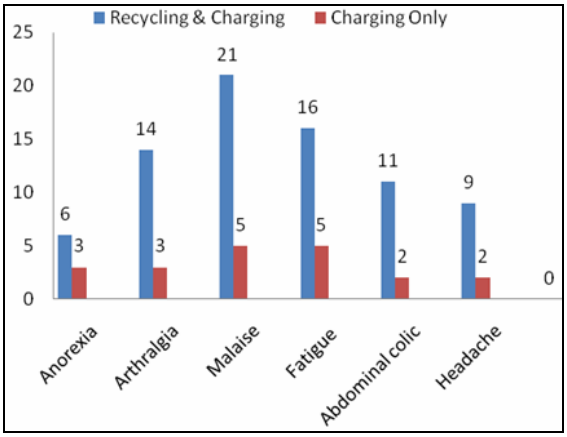
Fig-6: Commonest lead related symptoms among the Battery Workers



The lead manifestations like numb & cold fingers, pins & needles, Burton's lines on gums, wrist drop, foot drop, hepatomegaly or splenomegaly were not observed among the study subjects.

When individual symptoms were considered, the number of sufferers appears to be high among heavily exposed than moderately exposed. But when statistically tested only the presence of malaise was significantly different between both the groups (P Value < 0.05), (Fig 7).

Fig-7: Lead related symptoms by Nature of Work



Among heavily exposed workers, an inverse association was observed between hygiene and mean blood lead levels but the difference was not statistically significant (Table-1).

Table-1: Mean Blood Lead levels by Nature of Work & Level of Hygiene		
Nature of work (Number of workers Investigated)	**Lead value (ugm/ dl) Mean ± 2 SD among Unhygienic Workers (Number of Workers)**	**Lead value (ugm/ dl) Mean ± 2 SD among Hygienic Workers (Number of Workers)**
Recycle & Charging (26)	64.46 ± 54.27 (17)	59.87 ± 41.80 (9)
Charging Only (9)	17.97 ± 8.28 (3)	24.08 ± 24.34 (6)
P value: > 0.05; Not Significant.		

Among the heavily exposed, 30 workers (76.92%) were found to be having atleast one lead related symptom where as only 8 workers (37.93%) of moderately exposed group having the same. The difference was statistically extremely significant (x^2=9.85, P value < 0.005).

When the lead related symptoms were studied in relation to habit of smoking 88.24% of the workers with smoking habit and 56.25% of the non-smokers were manifesting atleast one lead related symptom. The difference was statistically significant (x^2=5.89, P value < 0.05).

The sign of pallor was present among 15 (38.46%) of heavily exposed workers and only 2 (9.09%) of moderately exposed and the difference was statistically significant ((x^2= 6.04, P value < 0.05).

When the relation of clinical manifestations to hygiene was studied no significant difference was observed between the hygienic workers and unhygienic workers.

Discussion

In the present study, high blood lead levels (range of 11-109.4ug/ dl) were observed among the Lead Acid Battery workers. The study results are in concordance with the similar study done by S. Chakravorthi & S. bhar (1981) on battery workers, where high lead values around 145ug/dl were observed [7].

Green (1978) showed blood lead concentrations in the range of 0-20 ug/dl as normal limit [8]. Thus the present study reports with high blood lead levels indicate that the battery workers are at risk due to their occupation. In the present study mean blood pressures among the heavy exposure group was found to be higher (systolic by 3.79 mm Hg and diastolic by 0.84 mm Hg) than the moderate exposure group. Batumen (1983) proved the association of hypertension with renal impairment even at blood lead levels of 15-25 ug/ dl [9]. Sharp (1986) proved the relation for both the systolic pressure (7.5mm Hg increase) and diastolic pressure (4.7 mm Hg increase) to even very low level blood concentrations (2-21 ug/dl) [10].

Diagnosis of lead poisoning should be based on clinical findings and supported by biochemical evidence of excessive lead absorption and if possible by evidence of unusual exposure [3]. Granick (1985) reported that blood lead concentrations were higher in smokers than non-smokers [11]. The present study results in concordance with the above study showed higher blood lead values in the smokers than non-smokers by 3.07 ug/dl.

A statistically significant association was observed between smoking habit and presence of clinical symptoms (88.24% of the smokers and 56.25% of the non-smokers were having symptomatic manifestations), thus indicating strong association and supporting the above study. Studies conducted by Centers for Disease Control, US (1991) revealed the protective role of maintenance of hygiene among the lead workers and children to prevent the lead absorption through various routes of entry [5].

In the present study, the mean blood lead value among the heavily lead exposed battery workers with improper maintenance of hygiene (64.46 ug/dl) was more than the workers with proper maintenance of hygiene (59.87 ug/dl) and in agreement with the above study.

The results of the present study confirm the existence of lead toxicity in the Lead- Acid

battery workers. The level of toxicity among the workers varies with the level of exposure to lead during their occupation. The life style habits also play a role in the manifestations of lead toxicity. There is a need for carrying out epidemiological studies and necessary health actions against the problem.

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