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Review Article

Magnitude of lead poisoning among unorganized battery workers

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ABSTRACT

Aim-A comparative study of renal functions and blood pressure of controls, organized and unorganized sector of battery workers was conducted to study the magnitude of lead poisoning in unorganized battery workers. **Methods:**Ninety subjects were selected for the study of which: Group A had 30 Controls; Group B had 30 organized battery workers and Group C had 30 unorganized battery workers. They were evaluated for their Blood lead level(BLL), Zinc Protoporphyrin(ZPP) and renal functions along with measurement of blood pressure. **Results and Conclusion:**This study shows that there is statistical significance between Group B and Group C in Blood Lead level ($p<0.001$), Zinc Protoporphyrin ($p<0.001$), Urea ($p<0.001$) and Uric Acid ($p<0.001$). There was significant difference in Blood Lead level, Zinc protoporphyrin and renal parameters between the two sector though there was no significant difference between the two in terms of blood pressure. This magnitude in unorganized sector was mainly due to the absence of precautionary principles. More than this lack of awareness among the battery workers was significant.

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1. Introduction

The major source of lead is from occupations where lead and lead based components are used, resulting in high prevalence of lead toxicity in the population exposed to such activities[1]. Lead poisoning from occupational exposure was first reported in 370 BC[2]. The battery industry is by far the principle consumer of lead, using an estimated 76% of annual primary and secondary lead production.

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

Organized sector of lead based battery workers are those workers who follow proper protective measures (includes full arm clothes, long boots, mask and gloves, proper handling of lead-contaminated work apparel, proper ventilators and showers).

Unorganized sector are those workers who do not follow these as they are unaware of all these measures (simple measures like-

separate clothing for work/home, taking showers before going home, not dining at the work place). This sector is of particular concern since the work is predominantly carried out at home or in unregulated workshops, often helped by women and children[2]. These are located in places where large number of people lives, especially children. They are of 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 as they wear the same clothes at home and at work[3].

A survey of recent literature in the medical publications database Pub Med has identified almost most studies of lead poisoning in workers manufacturing batteries as well as in workers, and their dependents, employed in battery salvaging in many countries. Yet lead poisoning in today's battery workers should not be seen as an unfortunate or inevitable product of the work process, rather it is the outcome of political and economic decisions made nearly three-quarters of a century ago, decisions that rejected the precautionary principle and ultimately failed to protect worker's health [4].

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There are many studies which showed the lead poisoning in battery workers [2]. But no studies have been done to compare the unorganized and organized sector of battery workers. Thus this study thus helps to assess the magnitude of lead poisoning in unorganized battery workers.

MATERIALS AND METHODS:

A comparative study with 30 subjects in each group:

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

Group B: Organized: Battery workers who were working in an organization that equips its workers all required protective wear.

Group C: Unorganized: Battery workers who were working in local battery manufacturing shops where there are no proper protective wear provided and were not even aware about the ill effect of Lead.

was undertaken to study the Blood Lead levels, ZPP, Renal function test blood pressure between three groups.

Blood Lead Level (BLL) Estimation using by Anodic stripping voltammetry [5,6] using ESA model 3010 B lead analyser, Zinc Protoporphyrin(ZPP) Estimation by Front Face Fluorometry[7] using a AVIV hematofluorometer. Urea, Creatinine and Uric acid were estimated with fully automated methods on Excel ERBA auto analyser. Ethical committee permission was obtained.

The Statistical software namely SPSS 15.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Analysis of variance has been used to find the significance of study parameters between three groups and Post hoc Tukey test has been used to find the pair wise significance of study parameters. Effect size has been computed to find the effect of exposure or absence of any precautionary principles has any effect on study parameters.

RESULTS

There was no significant age difference between the three groups. Samples were age matched with $p=0.651$.

Duration of Exposure

There was a huge difference between the duration of exposure between the Organized and the unorganized sector. This was found to be confounding variable between Group B and C. The overall duration of lead exposure was one of the major confounding variables related to effects of lead poisoning on kidney function and blood pressure according to the studies done by Restek-samarzija N et al[8]. Thus in the calculation of variables adjustment was made for the duration of exposure..

Table 3b shows that BLL was significantly elevated in group C (Unorganized sector) when compared to group B (Organized sector) after adjustment done for the duration of exposure.

Table 3b shows that ZPP was significantly elevated in group C (Unorganized sector) when compared to group B (Organized sector) after adjustment done for the duration of exposure.

Table 4b shows that there was moderate difference between group B (Organized sector) and group C (Unorganized sector) for systolic BP. But this difference was not present after adjusting for the duration of exposure.

Table 4b shows that there was no difference between group B (Organized sector) and group C (Unorganized sector) whether duration of exposure was adjusted or not for diastolic BP.

Table 5b shows that urea was significantly elevated in group C (Unorganized sector) when compared to group B (Organized sector) even after adjusting for the duration of exposure.

Table 5b shows that Uric acid is significantly elevated in group C (Unorganized sector) when compared to group B (Organized sector) even after adjusting for the duration of exposure.

Table 5b shows that there was no difference between group B (Organized sector) and group C (Unorganized sector) whether duration of exposure was adjusted or not

Table 1: Comparison of age in years between three groups

Age in years	Group A		Group B		Group C	
	No	%	No	%	No	%
Up to 20	1	3.3	2	6.7	4	13.3
21-25	6	20.0	8	26.7	6	20.0
26-30	15	50.0	8	26.7	9	30.0
31-35	1	3.3	9	30.0	1	3.3
36-40	3	10.0	2	6.7	6	20.0
>40	4	13.3	1	3.3	4	13.3
Total	30	100.0	30	100.0	30	100.0
Mean SD	30.639.01		28.975.68		30.538.26	

Table 2: Comparison of Duration of exposure between three groups

Duration of exposure	Group A	Group B	Group C
Range	-	1-9	1-34
Mean \pm SD	-	4.252.52	8.027.78

Table 3a: Pair wise Significance of Blood Lead level and ZPP between three groups

Significant values	Pair wise significance		
	Group A- Group B	Group A-Group C	Group B-Group C
Blood lead level	<0.001**	<0.001**	<0.001**
ZPP	0.001**	0.001**	0.001**

Table 3b: Comparison of Blood Lead level and Zinc protoporphyrin between three groups

	Group A	Group B	Group C	P value
Blood lead level	6.903.73	35.128.59	92.8038.13	<0.001** (Group B & C)
ZPP	34.632.31	68.007.76	134.4760.38	<0.001** (Group B & C)

Mean SD

Table 4a: Pair wise significance of blood pressure between three groups

Significant values	Pair wise significance		
	Group A- Group B	Group A-Group C	Group B-Group C
Systolic BP	<0.001**	0.025*	0.179
Diastolic BP	0.001**	0.111	0.241

Table 4b: Comparison of blood pressure between three groups

Blood pressure	Group A	Group B	Group C	P Value
Systolic BP	117.33±7.56	119.20±10.40	123.07±6.68	0.030* (Group B & C)
Diastolic BP	77.00±7.39	77.87±10.27	81.33±6.71	0.106 (Group B & C)

Mean SD

Table 5a: Pair wise significance of Renal function tests between three groups

Significant values	Pair wise significance		
	Group A- Group B	Group A-Group C	Group B-Group C
Systolic BP			
Urea	<0.001**	<0.001*	0.253
Uric acid	0.950	<0.001**	<0.001**
Creatinine	0.952	0.089+	0.164

Table 5b: Comparison of Renal function tests between three groups

Renal function tests	Group A	Group B	Group C	P Value
Urea	21.066.17	31.0410.41	34.366.97	<0.001** (Group B & C)
Uric acid	5.722.03	5.850.65	8.402.03	<0.001** (Group B & C)
Creatinine	0.930.14	0.950.27	1.050.23	0.075+ (Group B & C)

Mean SD

DISCUSSION

Though the results included controls, no discussion was made between the controls and others sectors. This is because the magnitude of lead poisoning in battery workers (organized and unorganized sector together) was already shown in many studies [2, 4]. Only discussion was made between organized and unorganized sector of battery workers to show the magnitude of lead poisoning in unorganized battery workers.

BLL and ZPP

The significant increase in the BLL is more significant than any other parameter between the organized and the unorganized sector because significant increase in a single parameter that is increased BLL is evident of Lead poisoning according to the Centre for Disease Control and Prevention [9].

Herman S D et al had shown ZPP is not sensitive marker of lead poisoning at lower blood levels that is between 10-25µg/dl. In this study both in organized and unorganized sector the BLL is higher than the controls. So this study does not prove the importance of ZPP as a sensitive marker of lead poisoning which is in accordance to the above studies [1].

Blood Pressure

It is already proven that the overall duration of exposure has some effect on the blood pressure [8]. It is also proven that the blood lead has more often been associated with increase in systolic blood pressure than the diastolic pressure[10]. In this study it was seen that the increase in systolic blood pressure was moderately significant (p=0.030*) between group B and group C, but after adjusting for the duration of exposure the systolic blood pressure was not statistically significant. (P=0.284) Some studies have shown that the increase in blood lead level was associated with increase in both the systolic and the diastolic blood pressure[11]. But in our study there was no difference in the Diastolic blood pressure between group B and group C irrespective of the duration of exposure.

Renal Parameters

Though the effect size was small between group B and group C for Urea, there was significant difference between the two ($p < 0.001^{**}$) which shows that the preventive measures had some effect on the blood Urea on the organized sector. Ven-Shing wang et al showed urea and uric acid can be shown as prognostic indicators of renal dysfunction in lead-exposed workers. It was shown that every increment of $10\mu\text{g}/\text{dl}$ in BLL produced an increase of $0.62\text{ mg}/\text{dl}$ of Urea[12]. In this study Urea was significantly increased in the lead workers when compared to controls which are similar to the previous studies done.

The Effect size was also very large between group B and group C for Uric acid along with significant difference ($p < 0.001^{**}$) which shows that the preventive measures had some effect on the blood Uric acid level on the organized sector. It was shown that for every $10\mu\text{g}/\text{dl}$ of increase in lead there was an increase of $0.085\text{mg}/\text{dl}$ of Uric acid[12]. Shadick et al have shown that the long-term accumulation of lead is associated with an increased uric acid level in middle aged and elderly men[13]. This study has also shown significant rise in Uric acid level in the organized and the unorganized battery workers.

The Effect size was small between group B and group C. There was no significant difference in Creatinine between group B and group C. In few studies it was seen that there was no any lead-related changes in serum creatinine concentration in people who were exposed to lead[14]. In few studies it was noticed that there was no deficient renal functions only[15], but few studies showed that there was elevated serum creatinine in presence of elevated blood lead level in exposed individual[16]. In this study there was no significant change in the creatinine value irrespective of the adjustment for the duration of exposure.

Conclusion

Though both organized and unorganized sector were affected with lead poisoning, the magnitude of lead poisoning in unorganized battery workers was huge compared to organized battery workers. This significant difference between the organized and the unorganized sector was mainly due to lack of awareness among workers about the ill effects of lead and the need of the precautionary principle. Simple measures like-separate clothing for work/home, taking showers before going home, not dining at the work place were not known to them which would prevent Lead poisoning.

Thus this study signifies the importance of all these preventive measures which should be a 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 by developing a policy which will safeguard the interest of these unorganized battery workers.

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