RELATION BETWEEN BLOOD LEAD AND BLOOD PRESSURE IN GENERAL POPULATION LIVING AROUND SARGIPALI LEAD MINE AREA

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ABSTRACT

In various pollutants, especially heavy metals are drawing special attention for its cumulative poisoning effect in recent days. According to WHO health criteria (1995) mining smelting and refining as well as the manufacturing of lead obtaining compounds and goods, can give rise to lead exposure. Health hazards of the human environment include undue exposure to lead remains serious public health concerns (WHO, 1995). Presently lead poisoning was studied in a mining area of odisha. The study area taken is in between the radius of 5km. from the mining site. At least 2-3 villages located 1km distance from each other in different directions of core mining area were taken for the study. Males of different age groups living in different distances are considered for observation. The present study reflects the relationship in between PbB and BP in males living around the mining area. In general the blood lead level (PbB) is a good indicator of recent exposure, and current level of lead in human body (Ahmed and Elmubark, 1990, Rout & Naik 1996). The present study shows PbB level increases with increase in age up to 55years and slight decrease in PbB level is seen in the people aged above 56. The mean PbB level of general population living around 1k.m. distance show higher level than RML and PbB level decreases when distance from the mining site increases. There is considerable experimental evidence that low to moderate level of lead increase blood pressure, by increasing the resting tone of the vascular smooth muscles (Victory et al.,1982,Carmaignani et al., 1983, Rout & Naik 2013c). In the present study blood pressure was observed in males of age groups > 15 years. In males the BP of control area and people living in between 4-5 Km radius approaches to normal. It was observed that the people living nearer to mining and ore concentrating plant shows high BP value than those are living in distant places of same age group and hypertension is age dependant and also depends on body lead burden. The males of age group 15-55 years living in between 1 Km radius shows 'r' value >0.6 and P< 0.001 in case of systolic pressure. The males of aged 15-35 years living in 1-2 Km radius show P < 0.01, which shows a significant relation in between PbB and BP.

Keywords: Blood lead level (PbB), Blood pressure(BP), Atomic absorption spectrophotometer (AAS), Recommended maximum level (RML), Maximum acceptable level (MAL)

INTRODUCTION

In various pollutants, especially heavy metal pollutants, lead plays no known role in the body and trace of it impair the body physiology so draw special attention for its cumulative poisoning effect in recent days. According to WHO health criteria (1995) mining smelting and refining as well as the manufacturing of lead obtaining compounds and goods, can give rise to lead exposure. Health hazards of the human environment include undue exposure to lead remains serious public health concerns (WHO, 1995). In general the blood lead level (PbB) is a good indicator of recent exposure and current level of lead in human body (Ahmed

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and Elmubark 1990, Rout & Naik 2013c). There is considerable experimental evidence that low to moderate level of blood lead increase blood pressure, by increasing the resting tone of the vascular smooth muscles (Victory et al.,1982,Carmaignani et al., 1983). Perry and Erlanger (1978) have both found BP increases at much lower lead doses in rats. There is additional evidence that lead increases intracellular calcium concentration in hepatocytes (Pound et al., 1982), Osteoclasts (Rosen et al., 1983) and neuron (Kim et al., 1980, Rout 2016), suggesting a general effect of lead on intracellular calcium store. Since vascular tension is proportional to intracellular calcium concentration, this may be the etiology of leads effect on blood pressure. 564 men aged between 40-59 years from the American National and found larger correlation co-efficient for PbB and BP after adjusting for age, body mass and many nutritional and biochemical variables (Pirkle et al.,1985,Rout 2013e). Lead exposure is found to be a significant contributing factor in increased systolic and diastolic blood pressure and a quantifiable risk factor for stroke (Schwartz.J, 1989). Studies on workers in lead industries showed an increased incidence in hypertension which appears to correlate with lead exposure (Canterow and Trumper, 1989). Young rats appear to be particularly susceptible to both lead nephropathy and hypertension (Aviv et al., 1980). The present study tried to correlate the blood lead level and blood pressure to assess the exposure of human being to toxic metal around lead mine area and impact of body lead burden on hypertension. Though BP impairs the body physiology seriously, so the present study tried to show hazardous effect of lead on human health considering BP as a parameter.

MATERIALS AND METHOD

The study area is the sargipali lead mine area (fig-1) located in sundargarh district of odisha, India (22’ 02’30” N :83’55’17”E). The villagers of the villages around the mine are mainly tribes. It is a tropical area having maximum temp. of 45^0c & 09^0c In this study different villages around 5 Kms radius in different directions from mines were taken for sampling. 2-3 villages are taken as study area in the radius of 1Km, 2Kms, 3Kms, 4Kms, 5Kms approximately. The control area Manguspur village is approximately 10Kms away from mining site.

SAMPLE ANALYSIS

All blood samples were collected with the help of local medical personals from the people who donated the blood voluntarily. Blood samples were collected from vein in small glass bottle by adding dipotassium salt of EDTA (1mg/ml) and Neomycin sulphate (100µg/ ml) & Preserved at 4^0c. Out of this sample 3ml of blood was used for a single analysis. The lead in blood was complexed with APDC (Ammonium pyrrolidine dithiocarbamate) by adding 0.5ml of 2% APDC to it and extracted into 3ml of n-butyl acetate by proper shaking. Lead was then determined in organic phase by flames AAS following Australian standard method (AS-2411, 1980, Rout & Naik 2013b).

The blood pressure is measured by using diamond mercury desk sphygmomanometer in the people of aged ≥15 years.

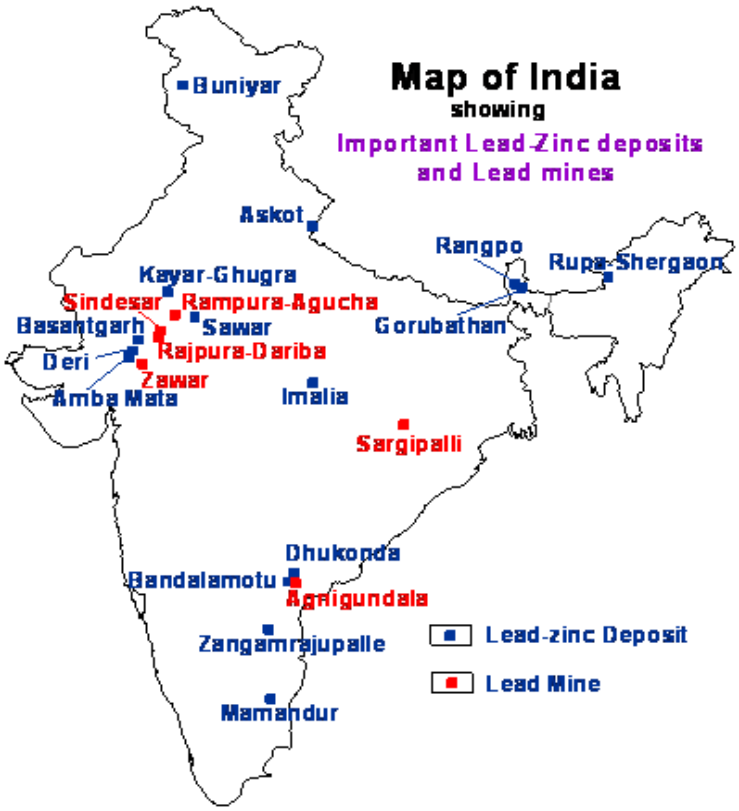

Figure 1. Location of the study area

RESULT AND DISCUSSION

Lead a typical heavy metal with cumulative and non-degradative characteristic, enters the blood, lymph and other organs where its concentration remains for a long time. In general the blood lead level (PbB) is a good indicator of recent exposure and current level of lead in human body (Ahmed and Elmubark, 1990).

Table 1. Lead level (µg/100ml) in blood of human male around Sargipali lead mine area

Distance in KM	*Age in year*		
Control 10	*15-35*	*36-55*	*≥56*
≤1	15-35	36-55	≥56
>1 - ≤2	10.13±3.21 N=47	9.81±3.19 N=59	8,25±4.06 N=53
>2 - ≤3	50.87±8.21 N=44	47.45±9.85 N=53	38.96±8.79 N=42
>3 - ≤4	40.13±11.37 N=56	40.23±10.73 N=71	33.63±9.94 N=63
>4 - ≤5	36.57±7.14 N=66	37,83±8.57 N=49	31.08±12.80 N=61
	34.63±12.21 N=62	34.17±10.53 N=79	25.67±8.97 N=81
	24.92±9.67 N=45	25.31±6.24 N=51	17.96±5.96 N=60

Data: Mean±SD

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The observation of blood lead content among adults in general population living around sargipali lead mine area is shown in table-1.The PbB in population living nearby to mining site shown higher level than those are living in relatively longer distance. The level of lead is inversely proportional to distance from mining site. The adults have higher Pb content than the young ones may due to cumulative ability of this metal. The mean PbB level of general population living around 1 K.m. distance show higher level than RML (40µg/100ml.) for adult (WHO, 1995). Among two villages studied between one Km radius, village Bharatpur which is adjacent to mine boundary shows 81% of adults PbB level greater than RML. The higher PbB Level may due to direct exposure to mining activities and eating vegetables and cereals cultivated by irrigating mines water (Khatua et al.,2015).

The mean PbB value in people aged ≥56 years shows less PbB value than peoples of aged group <56 years, this happens may due to less exposure to lead source in older age. This Phenomenon is observed in almost all peoples living in between five km study area. The PbB level in populations living in between 1 km radius shows much higher values than people of control groups, living in the village Manguspur which is located 10km away from mining area. The people living in the villages of 5km radius also shows higher values of PbB than control group indicates that they also living in area of high body lead burden. In males of 1km radius about 78% of adult of age group 15-35 years, 71% of adults of age group 36-55 years and 53% of old men of age group ≥56 years shows greater PbB values than RML. Even in males 29% of total adults PbB level exceeds 60 µg /100ml.

In male the mean PbB for old men in between 1-2km radius shows less value than RML, but the peoples of age group 15-55 years shows higher PbB level than RML. All the people living beyond 2kms radius shows PbB values < RML but 16% adults of the village Jhargaon which is nearby to the tailing dam shows higher PbB value than RML, even 8% of them shows PbB value ≥ 80µg/100ml . Only 8 adults shows greater PbB value than RML in the people living in between the radius of 4-5kms but no old men shows PbB value more than RML.

The mean PbB level of populations studied living in the radius of 4-5 km exceed median PbB level ranged between 80 -115 µg/lit of populations of Mumbai (Khandelker et al.1987) but less than the PbB values of Japan 210 µg/lit and Masta 247 µg/lit. (WHO, 1977).

There is considerable experimental evidence that low to moderate level of lead increase blood pressure, by increasing the resting tone of the vascular smooth muscles (Victory et al.,1982, Carmaignani et al., 1983). Perry and Erlanger (1978) have both found BP increases at much lower lead doses in rats.

There is additional evidence that lead increases intracellular calcium concentration in hepatocytes (Pound et al., 1982), Osteoclasts (Rosen et al., 1983) and neuron (Kim et al., 1980), suggesting a general effect of lead on intracellular calcium store. Since vascular tension is proportional to intracellular calcium concentration, this may be the etiology of leads effect on blood pressure. Pirkle et al. (1985) 564 men aged between 40-59 years from the American National and found larger correlation co-efficient for PbB and BP after adjusting for age, body mass and many nutritional and biochemical variables.

Lead exposure is found to be a significant contributing factor in increased systolic and diastolic blood pressure and a quantifiable risk factor for stroke (Schwartz.J, 1989). Studies on workers in lead industries showed an increased incidence in hypertension which appears to correlate with lead exposure (Canterow and Trumper, 1989). Young rats appear to be particularly susceptible to both lead nephropathy and hypertension (Aviv et al., 1980).

Table 2. Blood pressure (mmHg) in human male around Sargipali leads mine area

Distance in Km	*Age in year*					
	15-35		*36-55*		*≥56*	
	Systolic	*Diastolic*	*Systolic*	*Diastolic*	*Systolic*	*Diastolic*
Control 10	120.06±6.31 n=47	79.34±4.82 n=47	121.62±6.67 n=59	82.36±4.23 n=59	126.21±7.96 n=53	83.47±5.45 n=53
≤1	139.58±13.77 n=44	88.09±7.26 n=44	138.73±12.45 n=53	89.76±11.21 n=53	143.31±15.39 n=42	94.86±9.36 n=42
>1-≤2	135.66±12.89 n=56	87.70±7.33 n=56	134.99±14.76 n=71	88.27±8.56 n=71	138.03±15.62 n=63	93.33±9.89 n=63
>2-≤3	130.24±16.58 n=66	87.16±6.91 n=66	128.11±8.41 n=49	87.82±7.89 n=49	135.54±13.33 n=61	94.02±8.33 n=61
>3-≤4	129.67±12.39 n=62	83.92±4.68 n=62	128.36±10.59 n=79	84.93±7.43 n=79	135.32±10.36 n=81	89.71±6.84 n=81
>4-≤5	123.58±10.61 n=45	82.25±4.21 n=45	125.39±9.06 n=51	83.76±6.48 n=51	133.18±10.87 n=60	87.24±8.66 n=60

Data: Mean±SD

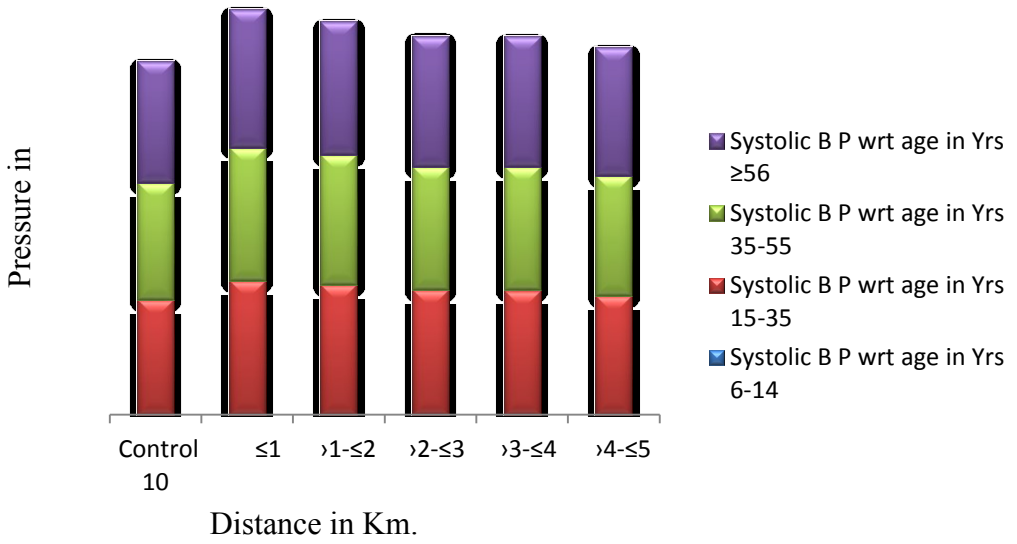

Figure 2. Systolic blood pressure in Human male around Sargipali leads mine area

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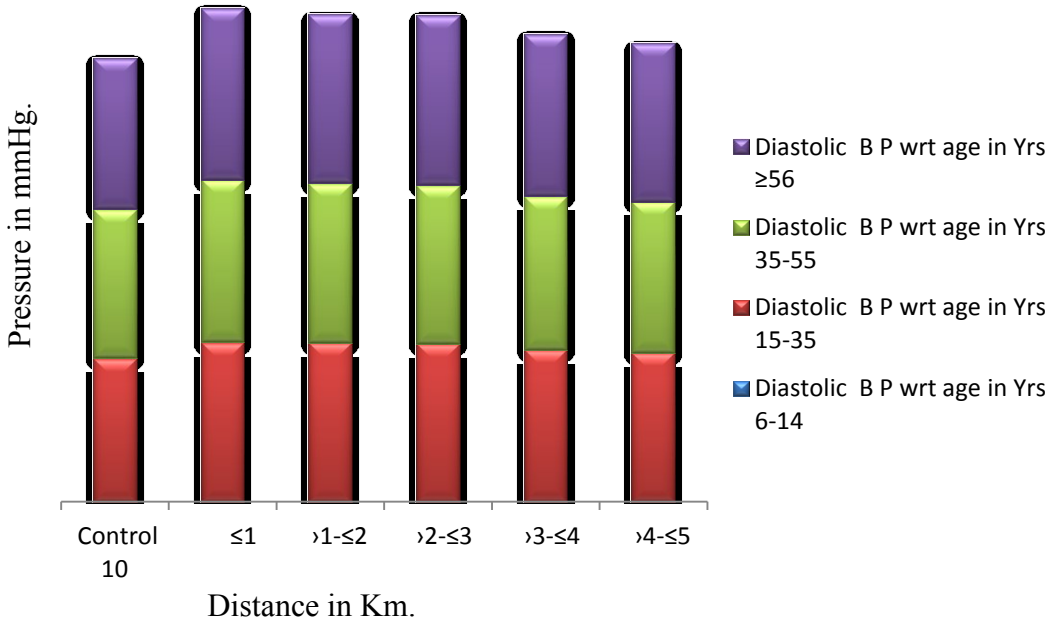

Figure 3. Diastolic blood pressure in Human male around Sargipali lead mine area

In the present study blood pressure was observed in males of age groups > 15 years (table -2). In males the BP of control area and people living in between 4-5 Km radius approaches to normal. In a particular distance the BP increases with increase in age (table-2, fig.2 & 3), the old men shows high BP than the young ones may due to ageing process. It was also observed that the people living nearer to mining and ore concentrating plant shows high BP value than those are living in distant places of same age group. This evident that body lead burden increases BP, this finding agree with the Carmignani et al.,1983. In males high BP was found in people of aged ≥56 years living in between 1 Km radius which approaches to normal people living in 4-5 Km radius of same age group with slight elevation of systolic pressure. It was observed that the hypertension is age dependant and also depends on body lead burden.

In most of the cases it was observed that the mean diastolic pressure approaches to normal where as the systolic pressure increases significantly, which does not agree with the findings of Schwartz (1989), who told that both the systolic and diastolic pressure increases with increase in body lead burden. In males living nearby to the mining site and tailing dam shows high BP which gradually approaches to normal in due increase in distance from mining site. The aged males shows high BP than young in relation to similar PbB and living in same location may because of hardening of artery due to calcium deposit in arterial cells as found by Pound et al. (1982).

The correlation co-efficient with significant level are calculated for both systolic and diastolic pressure in relation to PbB (table-3 and 4). A significant correlation was found in case of systolic pressure than diastolic pressure. The males of age group 15-55 years living in between 1 Km radius shows 'r' value >0.6 and P< 0.001 in case of systolic pressure. The males of aged 15-35 years living in 1-2 Km radius show P < 0.01, which shows a significant relation in between PbB and BP. Except the above discussed groups all other shows P > 0.01.

Table 3. Correlation co-efficient 'r' in between PbB and BP (systolic) of human male around Sargipali lead mine area

Distance in KM	*Age in year*		
	15-35	*36-55*	*≥56*
Control10	0.119	0.224	0.098
1≤	0.625*	0.615*	0.478 ↟
>1-≤2	0.523↑	0.521↑	0.351 ↟
>2-≤3	0.497 ↟	0.421 ↟	0.328
>3-≤4	0.498 Ω	0.362	0.323
>4-≤5	0.224	0.278	0.182

*-P<0.001 ↑-P<0.01 Ω- P<0.05 ↟<0.1

Table 4. Correlation co-efficient 'r' in between PbB and BP (diastolic) of human male around Sargipali lead mine area

Distance in KM	*Age in year*		
	15-35.	*36-55.*	*≥56.*
Control 10	0.123	0.178	0.147
1≤	0.558↑	0.579↑	0.465 ↟
>1-≤2	0.527 Ω	0.497 Ω	0.376
>2-≤3	0.425 ↟	0.420	0.289
>3-≤4	0.426 ↟	0.473↑	0.375 ↟
>4-≤5	0.356	0.368 ↟	0.184

*-P<0.001 ↑-P<0.01 Ω- P<0.05 ↟<0.1

In diastolic pressure (table-4) the males of aged 15-55 years living in between 1 Km radius shows high significant level with high correlation $r > 0.5$ & $P < 0.01$. People living in 4-5 Km radius shows low correlation, except in males of age group 36-55years ($r = 0.368$ & $P < 0.1$).

From the above discussion it is concluded that the diastolic pressure shows lower value of correlation than systolic pressure with PbB. The correlation co-efficient in between PbB and BP decreases with increase in distance and age. The significant level is codependent on age and body lead burden.

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