REGRESSION ANALYSIS BETWEEN BLOOD LEAD AND IQ OF VILLAGERS LIVING AROUND SARGIPALLI LEADMINE AREA

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ABSTRACT

Blood Samples Collected from five different villages around a derelict Lead mine area of Sundargarh district of Odisha state, India, were analyzed by AAS for lead contents. The village Bharatpur is nearby to mining site and other villages are of 1km distance from each other in between 5km radius. The village Jhimirmaul is nearby to tailing dam and river Ichha nala, which is the main drainage system of the mine. A total of 363 blood samples were collected and IQ of each individual was analyzed using AAMR Adaptive Behavior Scale from the villages such as Bharatpur (BP), Sargipalli (SP), Jhargaon (JG), Jhimirimoul(JM), and Sribhubanpur (SB).Finally regression analysis between the two variables was made and obtained that IQ values are linear functions of Blood lead Concentration suggesting impact of Plumbism on Neural Coordination and Cognitive behavior.

Keywords: Blood Lead, Cognitive Behaviour, IQ, Sargipalli, Lead Mine Area

INTRODUCTION

Lead is a hazardous neurotoxicant with a wide range of adverse effects on human health and behavior, such as increasing learning disabilities, behavior problems, and aggressive behavior, as well as affecting cardiovascular functioning and other physiological processes. It is Lead Exposure and Behavior relatively well established that lead has particularly strong behavioral effects on young children, and that some of these effects persist as individuals age. It is also the case that leaded gasoline provided the major source of lead exposure for the U.S. population through the early 1980s, that individual lead levels were high enough to expect broad societal effects on health and behavior, and that these lead levels declined drastically as lead was phased out of gasoline. Together, these facts indicate that one might expect lead to have had substantial effects on behavior at the societal level, and substantial effects on temporal changes in such behavior. Animal models to study Cognitive behavior are found to be incomplete with Plumbism which remains in correlations and speculations in the laboratories (Winneke, G. 2011). Various attempts have been made to know the effect of Lead toxicity on behavioral and neurobiological parameters. In previous studies on *Clarias batrachus*, the model catfish, the respiratory behavior has been extensively studied (Rout P.C. 2013). Effects of various agents on neural disorders have been extensively studied.

In the present piece of study, our aim was to estimate the blood lead levels in village people living around a lead mine of Sundargarh district of Odisha state, find the IQ of each individual and try to find the Regression analysis curve between the two parameters.

MATERIAL AND METHODS

The Study area

The present study concentrate on blood lead level (PbB)) in population living around Sargipali lead mine area of Odisha which operating from 1983 till date by the Hindustan Zink

Limited company. Five villages around the 5km were taken as case study area for sampling as shown in the trace map. The village Bharatpur is nearby to mining site and other villages are of 1km distance from each other in between 5km radius. The village Jhimirmoul is nearby to tailing dam and river Ichha nala, which is the main drainage system of the mine.

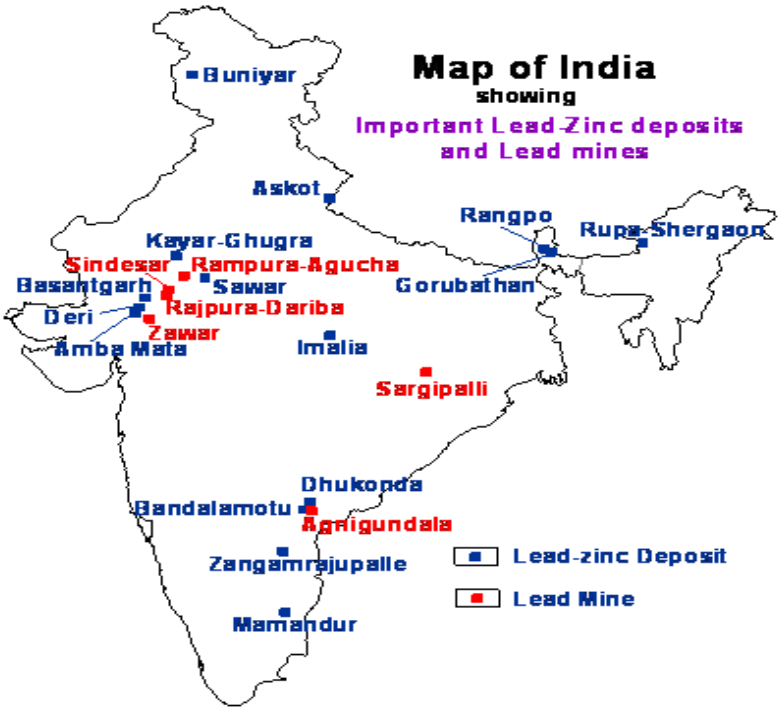

Fig.1 Location Map of the Study Area.

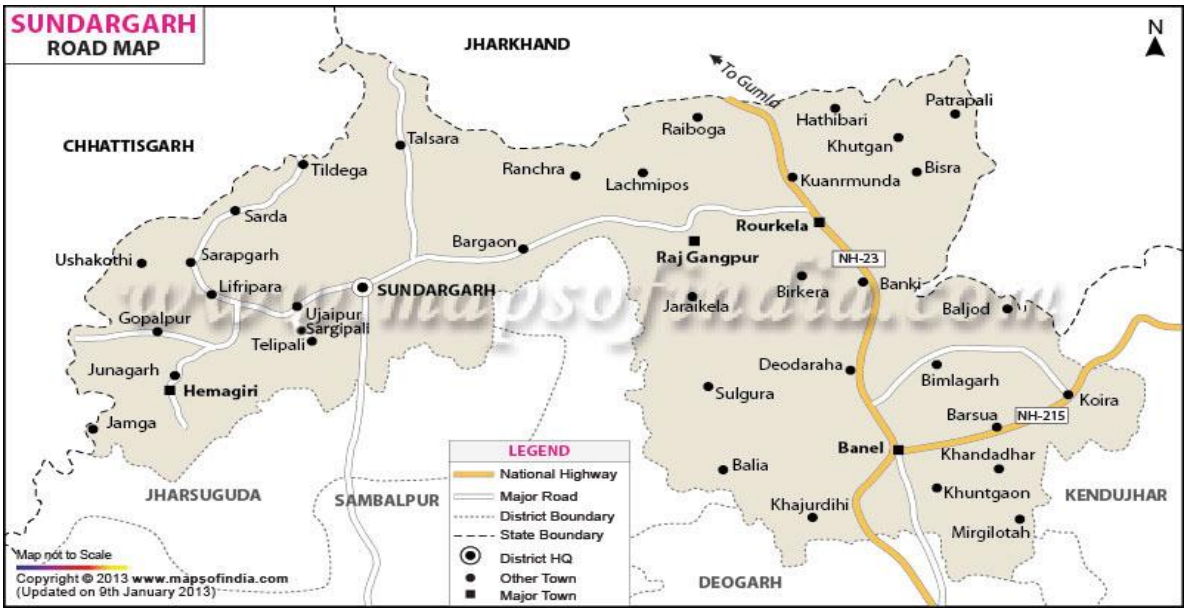

Fig.2 Road Map to Sagipalli, Sundargarh

Analysis of Blood Samples for Lead

It was followed according to Australian standard (AS2411 - 1980) for AAS. After collection the heparinized blood samples were kept at 4°C. During analysis 3ml of thoroughly mixed blood sample were immediately dispensed to the centrifuge tube. The lead in blood was made

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complexes with APDC by adding 0.5 ml of 2% APDC to it and extracted into 3 ml of n-butyl acetate by proper shaking. Lead was determined in the organic phase by AAS within one hour.

Calculation was done by the help of calibration curve using standard solution.

$$\textbf{Lead Content} = \frac{\text{OD of the sample}}{\text{Standard Value}} \ \mu\text{g/gm/ml of the tissue.}$$

Measurement of IQ

The IQ measurement was carried strictly following Wechsler Scale of Intelligence (1967) in various cases as follows:

Wechsler Intelligence Scale for Children standardized on a group of boys and girls aged between 5 and 16. It contains 13 subtests organized into two major areas: the Verbal Scale includes Information, Similarities, Arithmetic, Vocabulary, Comprehension, and Digit Span (optional) subtests; the Performance Scale includes Picture Completion, Picture Arrangement, Block Design, Object Assembly, Coding, and the optional subtests of Mazes, and Symbol Search.

Wechsler Adult Intelligence Scale individually administered test was used on individuals in an age range of 16 years and above. There are 11 subtests: Verbal Scale - Information, Similarities, Arithmetic, Vocabulary, Comprehension, and Digit Span; Performance Scale - Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol.

Regression analysis

Regression analysis was made between Blood Lead Concentration (PbB) and Intelligence Quotient (IQ), following Debajyoti Das(1981) . Simple regression curves were plotted taking blood lead (PbB) as independent variable and IQ as dependant variable.

RESULTS AND DISCUSSION

Blood Lead levels and IQ of different village people are reflected in the table1.

Villages Studied	*Blood Lead Levels (µg/ml) ±SEM (X)*	*Mean IQ ±SEM (Y)*	*Correlation (r) between PbB & IQ* r_{XY}	*Regression of Y on X* b_{Yx}	a_{YX}	Y^r	s_{YX}
Bharatpur (BP) ≤1KM	0.471±0.11 n=78	43 ±7.4	-0.384†	-24.366	31.524	31.524+11.476X	55.742
Sargipalli (SP) ≤2KM	0.323±0.12 n=94	47 ±8,7	-0.431⊥	-43.234	14.876	14.876+14.231X	43.277
Jhargaon (Jg) ≤3KM	0.296±0.14 n=36	62 ±8.5	-0.564†	-12.453	34.157	34.157+13.245X	12.322
Jhimirmoul (JM) ≤1KM	0.394±0.15 n=61	45 ±6.7	-0.124	-.32.257	35.987	35.987+14.431X	45.321
Sribhubanpur (SB) ≥5KM	0.180±0.09 n=98	65 ±7.8	-0.113	-25.143	15.966	15.966+15.241X	13.987

† P≤0.001, ⊥ P≤0.05

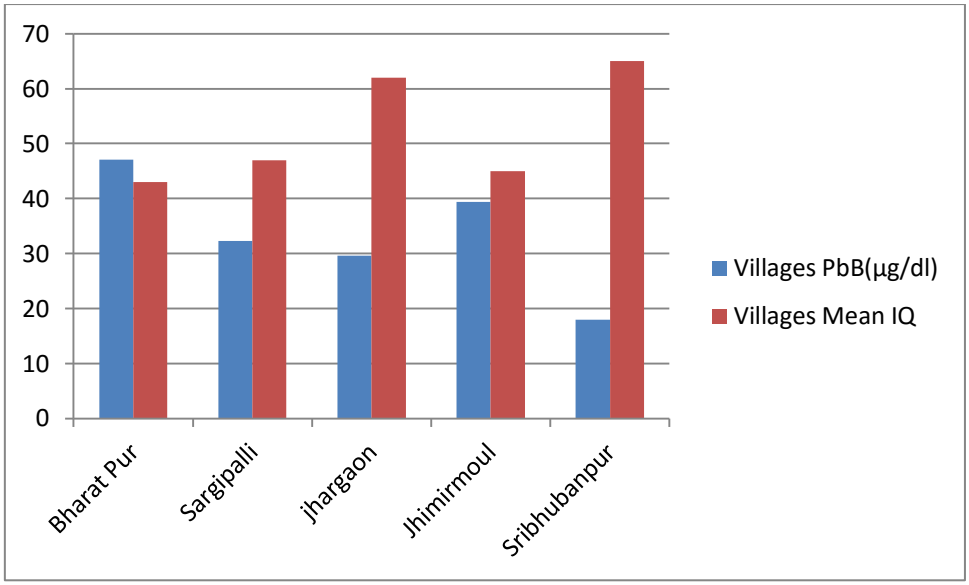

Figure 3. Blood Lead Levels (PbB) in µg/dl and Mean IQ in different Village People around Sargipali Lead Mine Area

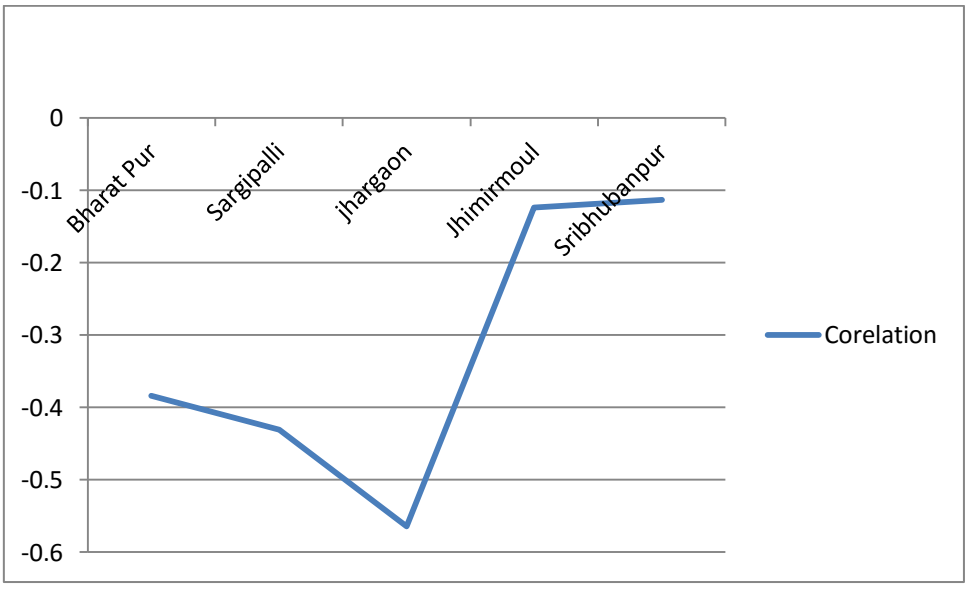

Fig. 4 Corelation (r) between Blood Lead Levels (PbB) in and Mean IQ in different Village People around Sargipali Lead Mine Area

The association between lead exposure during early development and subsequent deficits in cognitive development and behavior is widely accepted (Banks et.al. 1997). Neurological research indicates that exposure to lead impairs brain development and disrupts neurotransmitter function in ways that impair cognition and reduce impulse control. Early childhood exposure (before age 6) appears to be most harmful to psychological and cognitive development, and there is evidence that these effects persist to a great degree.

Many studies have found an association between higher lead levels and aggressive behavior, impulsivity, hyperactivity, and attention impairment. Increased lead levels are also associated with decreased mental skills, including reduced IQ, reduced verbal competence, increased reading disabilities, and reduced academic performance. Needleman and Bellinger (1981) report that children with above-average (but still moderate) lead levels are more than three times as likely to be distractible, hyperactive, impulsive, and to have low overall functioning.

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With regard to IQ, an increase in blood lead level of 1 μg/dL is estimated to produce a decrease in IQ of approximately one-half of a point. Coscia et al. (2003) argue that by contributing to weak verbal, reading, and other abilities, lead exposure "deflects such youth's development in an antisocial direction." Moreover, researchers in psychology and neuro-toxicology have established direct links between higher childhood lead exposure and a greater likelihood of adult criminal behavior. Economists have also contributed to the discussion; Reyes (2007) uses a panel of U.S. states to show a strong association between lead exposure and violent crime rates at the national level. Nevin (2000) uses a national time series to show relationships among the time trends of lead, crime, and teen pregnancy, and Masters, Hone and Doshi (1998) employ a single cross-section to look at the relationship between lead and crime. Overall, the literature suggests that there may be a substantial elasticity of crime with respect to lead, possibly as high as 0.8.

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