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Research Article

Correlation of Blood Lead Levels, Anemia and Water Source in Children

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Abstract

Background: Exposure to lead and its consequences is a health risk frequently encountered in developing countries.
Aims & Objectives: This study was undertaken to ascertain whether the source of water poses a risk for high blood levels and consequently anemia.
Material & Methods: 30 children with proven anemia and an equal number of children without anemia were enrolled in the study and an atomic absorption spectrophotometer was used to analyse and quantify their blood lead levels. Their source of drinking water was also determined.
Results: Blood lead levels were significantly higher in anemic children. A high proportion of the children (38.2%) who had blood levels exceeding 20 mcg/dl received piped water.
Conclusion: The results indicate a high degree of lead contamination of piped water in the community.

Keywords: Blood Lead Levels, Anemia, Water Source

1. Introduction

Anaemia is a common health problem among infants and children. It is often associated with a decrease in some trace elements (iron, zinc, copper) and an increase in heavy metals such as lead.[1] Lead pollution is a major problem in developing countries. Childhood lead exposure is one of the most significant environmental health threats that affect children. Studies have estimated that more than half the children in India have blood lead levels > 10 mcg/dl.[2]

Environmental lead exposure occurs from automobile exhaust in areas of the world where leaded gasoline is still being used and from drinking water in areas where lead pipes are used. Exposure at home may occur because of ingestion of old leaded paint or of pigments and glazes used in pottery. Careless disposal of products containing lead may contaminate soil, particularly in urban areas. Lead plumbing can cause contamination of drinking water and contribute to increased blood lead concentration in children. Elevated lead levels in the body have been associated with renal and cardiovascular disease, hematologic toxicity and irreversible neurologic damage.[3]

Adverse health effects of anaemia in children include impaired psychomotor development and renal function, poor cognitive performance and mental retardation.[4] Adverse effects of lead include cognitive deficits, neurotoxicity, behaviour disorders, slow growth, reduced heme synthesis and impaired hearing. The intention of this study was to study the relationship between blood lead levels and anaemia and to determine if the source of water has a bearing on the incidence of anaemia and blood lead levels.

2. Methodology

Sixty children who visited the out- patient department or were admitted at Father Muller Medical College Hospital were included in this case control study. Thirty children with anaemia and thirty normal children were enrolled in the study. The study period was one and half years commencing from August 2011. A sample size of thirty was selected using purposive sampling technique. An equal number of children, without anemia were included as controls.

At the time of enrolment an informed written consent was obtained from the parents. Detailed history was elicited from the mother and child regarding various manifestations. Detailed clinical examination was done. Blood lead levels was estimated using atomic absorption spectrophotometer. Atomic absorption spectrophotometer is used for trace element analysis due to its high specificity and reduction of interference from other elements

2.1 Statistical Analysis

Collected data was analysed by frequencies, percentages and by chi-square test.

3. Results

The present study was conducted in Father Muller medical College Hospital Mangalore. Study was carried out on 30 patients who was found to have anemia during the period of August 2011 – March 2013 in this hospital and was compared with 30 control groups.

A detailed history was taken followed by a detailed clinical examination to assess clinical findings. 30 children in this study were proven cases of anemia. Relevant investigations were done to diagnose anemia.

Table 1: Relation between water source and lead levels

Blood lead levels (mcg/dl)	Water source				
	Piped	Hand pump	Well	Others	Total
Total	27 45.0%	13 21.7%	13 21.7%	7 11.7%	60 100%
<20	14 53.8%	1 3.8%	7 26.9%	4 15.4%	26 100%
≥20	13 38.2%	12 35.3%	6 17.6%	3 8.8%	34 100%

P value- 0.034

Figure 1: Relation between water source and lead levels

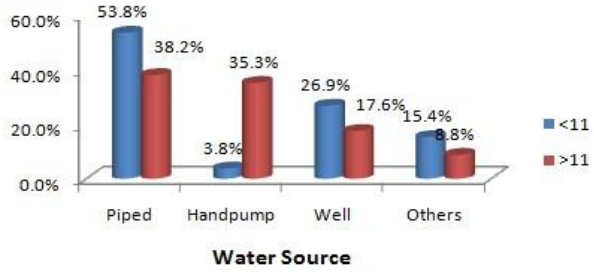


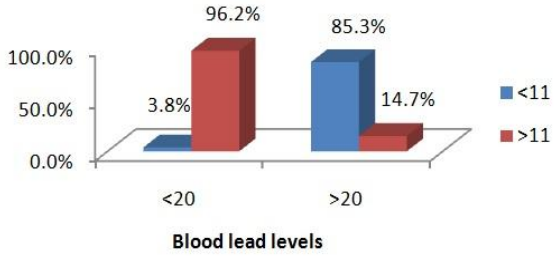
Table 2: Prevalence of anemia in relation to blood lead levels

Haemoglobin levels(g/dl)	Blood lead levels(mcg/dl)		Total
	<20	≥20	
<11	1 3.8%	29 85.3%	30 50.0%%
≥11	25 96.2%	5 14.7%	30 50.0%
Total	26 100%	34 100%	60 100%

Chi square- 39.095, p value- 0.000 Significant

Anemic children have higher blood lead levels as compared to control groups.

Figure 2: Relation between blood lead levels and anemic children



Most children with high blood lead levels have used water source from pipes.

4. Discussion

Lead pollution is a substantial health problem in a developing country like India. The effect of lead on the haematological system results inhibition of heme biosynthesis in anemia. The US centers for disease control and prevention has defined an elevated blood lead level in childrenas > 10 mcg/dl. This study, a hospital based prospective study of blood lead levels in children with anemia, includes analysis of blood lead levels in 60 children.

In our study, out of 34 children with high blood lead levels, 13(38.2%) children had drinking water source from pipes, 12 children(35.3%) had source from hand pumps, 6 (17.6%) from wells and remaining had other sources.

In the study done by Jain *et al*[5] and Amal *et al*[1], children with higher blood lead levels had consumed piped water but there was no statistical significance.

In our study, out of 26 children with blood lead levels <20mcg/dl, one (3.8%) child was anemic and remaining 25(96.2%) were controls with hemoglobin>11g/dl. Out of 34 children with blood lead levels >20mcg/dl, 29(85.3%) children are anemic and 5(14.7%) were controls.

Ahmed *et al*[6] concluded that lead exposed iron deficient children had significantly higher blood lead levels as compared to controls and observed that iron deficiency in combination with lead exposure synergistically elevates blood lead levels and susceptibility to its harmful effects in children.

The study done by Ahamed *et al*[7] indicated that elevated blood lead levels (>10mcg/dl) in children were significantly associated with risk of anemia.

Another study done by Jain *et al* [5] studied that children with lead levels >10microg/dl were 1.3 times as likely to have moderate anemia than children with lead levels <10microg/dl.The study done by Amal *et al*[1]concluded that approximately 63.33% of children had blood lead levels ≥ 10 µg/dl. At the blood lead level range of 10-20 µg/dl, a significant association was found for mild and severe anemia. Statistical analyses on data from the Third U.S. National Health and Nutrition Examination Survey was performed and Overall prevalence of BLLs ≥5 µg/dL among 1- to 5-year-old children was 25.6%.[8]

The relationship between blood lead concentration and performance on tests of arithmetic skills, reading skills, nonverbal reasoning, and short-term memory among 4,853 children ages 6-16 years was assessed, 172 children had blood lead levels exceeding 10 µg/dl and the data revealed an inverse relationship between blood lead levels and cognitive functioning.[9] In an study measurements of lead in paint, soil, dust, and blood, age of housing, and iron status were collected from 319 children ages 1-5 years. Blood lead levels were higher for iron-deficient children.[10]

Blood lead levels, hemoglobin, mean corpuscular volume (MCV), red cell distribution width (RDW), insurance status, and age were determined for 1275 children and concluded that iron deficiency was associated with excess blood lead levels.[11] In a study conducted in Bangalore, randomized, double-blind, controlled school-based feeding trial was done in 186 5- to 13-year-old iron-deficient children, and the study demonstrated that providing iron in fortified food to lead exposed children may reduce chronic lead intoxication.[12] Most significantly Mean lead levels in children with anemia in our study was 25.606µg/dl and children without anemia it was 21.971µg/dl.

5. Conclusion

This study demonstrates that higher blood lead levels are associated with anemia, what this study adds to the debate is the contamination of water sourced through pipes in a tier 2 Indian city and this could be the reality in many other cities in India. Even in children without anemia the blood levels were above 20 µg/dl especially in children receiving piped water. This reveals a high degree of water contamination and could pose a significant health hazard to millions of citizens in our country.

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