Section: Biochemistry

Original Research Article

ESTIMATION OF HAEMOGLOBIN, SERUM IRON AND SERUM CALCIUM AMONG OCCUPATIONAL PAINT WORKERS

Received : 20/12/2023
Received in revised form : 04/02/2024
Accepted : 21/02/2024

Keywords: lead (Pb), haemoglobin, iron, calcium.

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DOI: 10.47009/jamp.2024.6.1.393

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (1); 1984-1986

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Abstract

Background: Occupational paint workers are prone for adverse effects of Lead (Pb) as paints are rich in Lead. Lead can inhibit absorption of other essential trace metals like iron, calcium, zinc etc leading to deficiency of these trace metals in blood. Lead also inhibits certain enzymes of haem synthesis leading to iron deficiency anaemia among occupational paint workers. The objective is to assess blood Haemoglobin level, serum Iron and serum Calcium level among 50 occupational paint workers and 50 healthy controls. **Materials and Methods:** 5 ml of venous blood sample taken from each case and control, haemoglobin estimated by cell counter and serum iron, serum calcium estimated in autoanalyzer. **Result:** There is statistically significant reduction in blood haemoglobin, serum iron and serum calcium level among occupational paint workers compared to controls. Conclusion: Occupational paint workers are prone for developing iron deficiency anaemia, reduction in serum iron and calcium level, hence awareness has to be increased among paint workers regarding preventive measures, regular health check-up and nutrient diet.

INTRODUCTION

Anemia has become highly prevalent now a days among Indians and associated with its effects such as cognitive function impairment, psychomotor development delay and intellectual disability.[1] Today, paints are universally recognized as one of the major sources of Lead exposure. Lead based paints are widely used in many countries. Lead is used in paints to impart color, to make it durable, corrosion resistant and to improve drying. Most of the enamel paints tested have exceeded the regulatory limit level of Lead.[2] Lead is one of the most toxic heavy metals which can cause acute or chronic poisoning through environmental and occupational exposure while working on window frames, doors, kitchen, bathroom boards, exterior walls, metal surfaces, interior walls, ceiling etc.[3] Lead can enter body of paint workers easily through Lead contaminated air and soil via breathing, skin, affecting human health.[4]

As per Massachuretts Lead registry, 82% were determined to have high blood lead levels from occupational construction workers.[5] Haematological system is the main target of Lead toxicity as RBCs have high affinity for Lead. Experimental studies revealed that Lead impairs haem synthesis by decreasing the activity of three enzymes viz, δ-ALAS (aminolaevulinic acid synthase), δ-ALAD (Aminolaevulinic acid dehydratase) and Ferro chelatase which result in inhibition of haem synthesis and anaemia.[6]

Lead also affects the absorption of essential trace metals like Iron, Calcium, Zinc etc.by binding with variety of proteins that are involved in processes of uptake that may lead to low serum Iron and Calcium level. Iron plays a major role in many biochemical reactions like electron transport chain, haemoglobin synthesis, Lead also inhibit the insertion of Iron into protoporphyrin leading to Iron deficiency anaemia.[3] Lead inhibits the enzymes responsible for vitamin D activation (1-α hydroxylase) there by reducing serum Calcium level.[7]

Present study helps in finding the effect of paint on occupational paint workers Hb%, serum Iron level and serum Calcium level. This may help in educating paint workers regarding preventive measures, lifestyle modification and dietary habits to stay safe and healthy.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

MATERIALS AND METHODS

Study is done on 50 Cases; Occupational male paint workers with at least 2 years of exposure and 50 Controls; healthy males of similar age group with some other occupation. workers with any chronic diseases and workers under medication are excluded from study.

It is a comparative case control study. Study is done over a period of 4 months from September 2023 to December 2023, at Raichur, Karnataka. 3ml of venous sample taken from each person with consent under aseptic precaution. Blood Hb%, serum iron level and serum calcium level estimated for all samples.

Tests; blood hemoglobin estimated at cell counter, Serum total iron level and serum calcium level estimated at autoanalyzer.

Statistical analysis: results are evaluated with students t test, a Pearson correlation tests done to determine statistical significance, statistical analysis was conducted with software SPSS 10.0, results are expressed as mean +- and $p < 0.05$ was considered as statistically significant.

RESULTS

Our study showed a statistically significant reduction in blood Hb % among occupational paint workers compared to controls. And also, there is statistically significant reduction in serum total Iron level and serum Calcium level among occupational paint workers compared to controls.

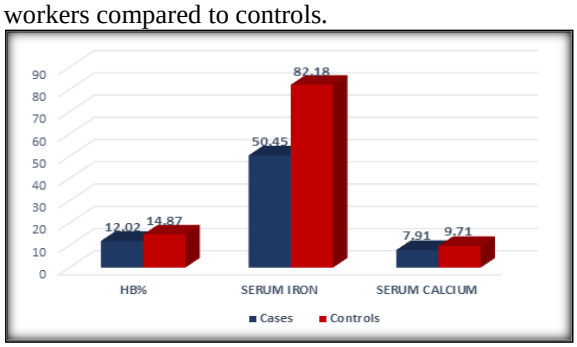

Figure 1: Comparison of Hb%, serum Iron, serum Calcium among cases and controls

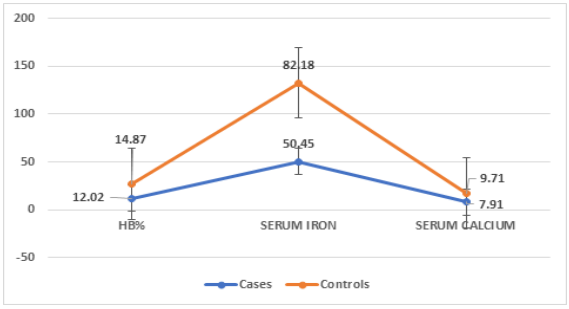

Figure 2: Comparison of Hb%, serum Iron, serum Calcium among cases and controls

Table 1: statistical comparison between cases and controls.

Variables	Cases (mean ± SD)	Controls (mean ± SD)	p value
Hb (g%)	12.02 ± 0.565	14.87 ± 0.72	< .001
SERUM IRON (µg/dl)	50.45 ± 5.59	82.18 ± 18	< .001
SERUM CALCIUM (mg/dl)	7.91 ± 0.47	9.71 ± 0.72	< .001

DISCUSSION

Lead is a toxic heavy metal being harmful to health. Driers used in paints contains polymers of lead, cobalt etc. [8] In 2008 Abhay Kumar,[2] analysed a total of 69 paint samples of popular brands of India for lead concentration, 84% of enamel paints exceeded the regulatory level of Lead.[9-15]

Our study shows the long-term effect of Lead present in paints among occupational paint workers. Our study showed fall in blood Hb%, serum Iron level and serum Calcium level among occupational paint workers compared to healthy persons who were not exposed to Lead occupationally.[16-22]

Haematological system is the main target of Lead toxicity as RBCs have high affinity for Lead. Experimental studies revealed that Lead impairs haem synthesis by decreasing the activity of three enzymes viz, δ -ALAS (aminolaevulinic acid synthase), δ -ALAD (Aminolaevulinic acid dehydratase) and Ferro chelatase which result in inhibition of haem synthesis and anaemia.[6,23]

Lead also affects the absorption of essential trace metals like Iron, Calcium, Zinc etc by binding with variety of proteins that are involved in processes of uptake that may lead to low serum Iron and Calcium level. Iron plays a major role in many biochemical reactions like electron transport chain, haemoglobin synthesis, Lead also inhibit the insertion of Iron into protoporphyrin leading to Iron deficiency anaemia.[3] Decline in serum Iron level shows propensity toward anaemia that is Iron deficiency anaemia. Our result is in accordance with study done in 2016 by Ipsita Mazumdar, K. Goswami,[3] estimated blood Lead level and haematological indices among paint factory workers, they found high blood Lead level in them compared to non-exposed controls and significant low Hb%. Also, significant decrease in serum Ferritin, Iron, RBC, WBC, MCV, MCHC among paint workers.

R. M. Tripathi et al,[9] performed a study on Mumbai children during 1996-1998, observed a negative correlation between the blood Lead and Iron level. M Clark, J Royal,[10] conducted a study on children admitted to cook county hospital with high Lead level

ISSN (O): 2687-5365; ISSN (P): 2753-6556

in 1981-1983. Children with high Lead level were found with Iron deficiency.

Lead in turn alter the homeostasis and function of essential metals.[11] Lead and calcium compete at the plasma membrane for transport systems such as calcium channels and calcium pump. Lead interacts with a number of calcium dependent calmodulin, protein kinase, calcium dependent potassium channels. The effect of Lead on neurotransmission is relevant to Lead induced human neuropathy and encephalopathy.[12] Reduced absorption of calcium through gut due to high lead level can be a reason for low serum calcium level. Lead inhibits the enzymes responsible for vitamin D activation (1-α hydroxylase) there by reducing serum calcium level.[7]

M Ahamed et al,[6] conducted a comparative study between children with high Lead level and children with low Lead level. They found significant negative correlations of blood Lead level with δ-ALAD, Iron and Calcium. Kuldip Upadhyay,[7] did a systematic search from PubMed Medline, Scopus and Embase digital databases, showed Lead exposed group exhibited higher mean blood Lead level and significantly lower serum Calcium with higher trend of parathyroid hormone and lower vitamin D compared to controls.

Deficiency or excess of trace elements may lead to disturbances in absorption, distribution, metabolism and elimination of other trace elements, the low level of dietary nutrients leads to increased absorption of toxic elements like Lead specially among paint workers,[1] hence dietary supplementation of Iron, Calcium, Zinc may decrease the lead absorption. A study done among children with blood lead level > 100 micro g/L, showed blood Lead level are inversely related to blood Iron level.[1]

CONCLUSION

Toxic effects of lead among occupational paint workers are seen on various systems. Present study is an effort to find out relationship between occupation of painting with hematological disturbances. Our study shows occupational paint workers are prone to develop Iron deficiency anemia and can have low serum Iron level and low serum Calcium levels. These adverse effects are due to reduced GIT uptake of trace metals like Iron, Calcium, Zinc etc, as inhibited by Lead. low serum Iron level and due to reduced production of delta -ALAD by Lead can leads to anaemia that is Iron deficiency anaemia.

Present study helps to educate occupational paint workers regarding preventive measures like wearing gloves while working, consuming diet rich in calcium, Zinc, Iron which can inhibit the uptake of Lead, using Lead free paints, and regular health checkups to improve quality of life.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556