Section A-Research paper

A Review: Correlation between Zinc and Anaemia.

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A Review“ Correlation between Zinc and Anaemia.

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Abstract:

Zinc and iron are essential micro nutrients required for growth and health. Deficiencies of these nutrients are highly prevalent among populations, but can be alleviated by Nutritional supplementation. Many Cross-sectional studies in humans showed positive association of serum zinc levels with haemoglobin and markers of iron status.Zinc and iron are dietary essential trace elements. Zinc and iron interact competitively during intestinal absorption. Excess of Iron and Zinc inhibits each other. Association of Zinc and iron is important to assess in anaemic condition. Unfortunately few studies are available on absorption of iron in relation to zinc status .in humans, this review article is to Shed light on association between Zinc and iron to treat Anaemia .

Supplementation of Iron and Zinc together can treat anaemia could be the ideal strategy.In this paper, we review zinc biochemical and physiological functions, metabolism Including, absorption, excretion, and homeostasis, zinc bio availability (inhibitors and enhancers), human requirement, groups at high-risk, consequences and causes of zinc deficiency, evaluation of zinc status, and prevention strategies of zinc deficiency.

Key Words: Anaemia, Erythropoietin, RBCs, Zinc.

1. INTRODUCTION

As per the WHO 2019 estimation Prevalence of anemia in women 29.9%,of Women aged 15-49 years suffered from anemia in , Prevalence of anemia in Children 39.8%of children aged 6-59 months Prevalence of Anemia in children 60.2%of children 6-59 months in the African region were affected by anemia In 2019.(WHO 2019 estimated anemia)(1).

In India The data in National Family Health survey (NFHS) 2019-21 show that Among all age groups, the highest spike in anemia was reported among Children aged 6-59 months 67.1 per cent (NFHS-5) from 58.6 per cent (NFHS-4, 2015-16) (National Family Health survey (NFHS) 2019-21)(2)

Over the globe out of 2.36 billion individuals are affected by anemia particularly Children's and women's (3), In India prevalence is higher than rest of the Developing countries.(4). Maternal deaths are the secondary cause of Anemia.(5,6).

According to WHO Prevalence of anemia in women29.9%in 2019, Prevalence of Anemia in children 39.8% age 6-59 months years.

Prevalence of anemia in children 60.2% age 6-59 months years in the African Region in 2019.In INDIA 30 % or nearly 1/3 rd world's population is suffering From Anemia due to various causes.

2. Zinc deficiency in India

According to the International Zinc Nutrition Consultative Group (IZiNCG) Categorized India as a high-risk country for Zinc Deficiency based on >25% Dietary Zn inadequacy,(7).

Very few studies are available in Indian children's and women's showed high Prevalence of low Zinc levels (8-11).

As per the Ministry of Health and Family Welfare (MoHFW), Government of India, UNICEF, and Population Council. (12).

Zinc deficient cases has reduced in India over past few years,

Except among school children's it is high as (35%).Similar findings noted by Researcher Urvarshi Sharma and Neelam Yadav showed approximately 2 out of Three children showed low serum zinc level in Indian school children's. With high Prevalence of anemia of 92.9% found due to Zinc deficiency.(13).

Study done by priyal pathak et al noted that poor Zinc intake causes anemia Among Pregnant women.(14)

Since very few studies are available about zinc deficiency and its effect on Anemia. This Review article shed a light on zinc deficiency status on Anaemic Patients which further guide to treat the Anemia with zinc supplementation.

3. Zinc Biochemistry

Zinc is neutral compound act as redox neutral involved in biological reactions such as structural, catalytic and signaling compound. (15).

The "zinc finger" motif was first found in the transcription factor TFIIIA of *Xenopus* (16).

In zinc proteomes, there are multiple zinc binding sites are available (17,18)Zinc Acts as transporters (19)..

Zinc is identified in erythrocyte carbonic anhydrase enzyme as a zinc dependent.(20)

Zinc act as signalling mediator, released from cytoplasm situated near or occurring around the nucleus ie Perinucelar area including ER which is referred to as Zinc Wave.(21,22).

4. Functions of Zinc in Human Cells

Zinc supplementation has ability to improve human health to decrease diarrhea s, anemia, infections and Improve immune functions.(23,24,25,26).

Homeostasis of Zinc in human cells: Normally Adult human has 2-3 gm of Zinc, storage form of Zinc is stored in skeletal muscles, bone, liver, bone And skin and remaining 2-3%in other tissues.(27)

Human serum zinc concentration is only 0.1% remaining 80%found in loosely to Albumin and 20%tightly bound to α2-macroglobulin (28,29).

Zinc is absorbed in the cells through diet. Absorption of Zinc in the cells is Regulated by Duodenum and Jejunum, it increases when dietary intake is Limited)(30), when in excess Gastrointestinal secretion Increases its renal excretion (31,32).

Figure1 Functions of Zinc in human Cells

5. Zinc Deficiency

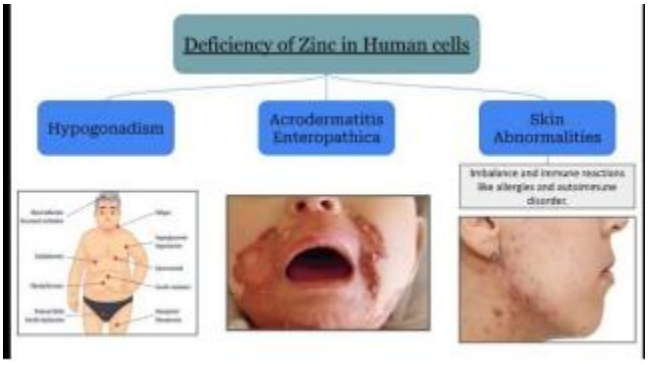
Zinc deficiency can be classified into severe or marginal zinc deficiency. Severe Zinc deficiency is occur due to defective intestinal absorption of Zinc has been Reported in patients suffering from chronic diarrhea, patients Being treated with penicillamine, patients receiving parenteral nutrition without Zinc, or following excessive alcohol consumption (33,34,35,36).Zinc deficient Individuals has poor immunological functions (37)

And it is interdependence with skin abnormalities, hypogonadism, cognitive Impairment, growth retardation, and imbalanced immune reactions which favour Allergies and autoimmune diseases(38,39).

In the cases of inherited Zinc homeostasis Acrodermatitis Enteropathica, has been Noticed which a can be fatal(40).

Marginal zinc deficiency caused due to nutritional zinc deficiency which is Characterized by slight weight loss, rough skin, oligospermia, and hyperammonemia.(41).

Figure: 2 Deficiency of Zinc in human Cells



6. Zinc in iron Metabolism

Zinc acts as the catalyst in iron metabolism in the activity of alpha-aminolevulinic acid dehydratase enzyme, which plays a role in heme synthesis (42).Zinc finger protein act as regulator in erythrocytes cell growth by gene expression specifically to erythropoiesis.(43,44).According to previous studies Independent of iron status Plasma Zinc is strong Determinant of Hemoglobin (45,46). Many Zinc dependent enzymes involved in Hemoglobin synthesis (47)and erythropoiesis stimulation (48).Study suggest that, Zinc stimulate an expression of (Metallothionene) genes, Formed more MT proteins and hence more binding sites of Zinc and Cu on Enterocytes .Cu has more affinity then Zinc for ligand (49).

As per the case study report, to maintain stable iron levels in the body, Metalloproteins (MT) such as Zinc, cadmium, copper forms disulfide bonds with MT proteins(50).Effect of Zinc supplementation in hypoxia Suggest that Zinc has potential to stimulate erythropoietin response to hypoxia by reducing proinflammatory cytokines (51,52).Since, Zinc and other metals such as copper, manganese, cobalt Supplementation enhances the iron level by reducing inflammatory modulators of red blood cells production (erythropoiesis).(53,54,55,56).

Several studies on Zinc metabolism in kidney disease has been well Documented by several investigators.

Zinc levels was lower in haemodialysis patients compared with controls (58)..

In Haemodialysis patients, Zinc showed beneficial effect. (60,61,62,63**)** ,by increasing haemoglobin and Haematocrit levels in haemodialysis patients (64).

Several studies proved in the past, correlation between Zinc and iron. In 1997, Ece

et al(42)and 2016, Özhan et al(43) Gürgöze et al. (44)
Reported that, the serum zinc level was lower in the IDA (Iron deficiency anaemia group) group, which was Statistically significant .furthermore study done by Kelkitli et al. proved that lower serum zinc levels in IDA Patients compared to Controls(65) .
Study done by 2019 Abdelhaleim et al. showed A significant correlation between the serum zinc level and MCV, MCH, TIBC, serum iron, and serum ferritin level has been Identified in patients with Iron Deficiency Anaemia. (66).

7. Conclusion

Worldwide Anaemia is a major cause of deficiency of Iron, Anaemia proven to be Fatal if not treated. Several studies showed Association between Iron deficiencies and Zinc level. Zinc has potential role in iron Absorption and erythropoiesis to cure Anaemia.

8. Summary

When Serum Zinc level correlate with serum iron level all the hematological Parameters showed higher levels .Zinc helps to increase erythropoiesis and possibly number of the RBCs production so Zinc supplementation can be used as enhancer of hemoglobin level, to treat anemia along with iron.

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1.Attained 20 days of Teaching Refresher course from Mumbai University " B " Grade (20 Feb To March 2017).

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Date	**Name of Course**	**Place**	**City**	**Country**
NPTEL on Line certification course 2019	Current Regulatory requirements for medical devices and IVDs in India.	IIT Madras	Mumbai	India
NPTEL on Line certification course 2019	Current Regulatory requirements for conducting clinical trials in India.	IIT Madras	Mumbai	India

3.Invited Speaker Government Dental College Mumbai GDC Mumbai 23/12/2022.

Conference Papers – Oral Presentations (2)

Title	**Name of Cone**	**City**	**Country**	**Year**
Prediction of Renal Injury risk by gene Expression of KIM-1, & NGAL In Type -2 Diabetic Nephropathy.	ACBI CON 2016	Mangalore	India	Nov -2016

Title	**Name of Cone**	**City**	**Country**	**Year**
Vitality of Proinflammatory Cytokine, Scavenger Protein and Atherosclerotic Plaque markers in risk prediction of Diabetic Nephropathy.	Med inspire 2019	Navi Mumbai Nerul	India	Feb -2019

1.Atecom based FDP attended in the working institutes from June 2021 tojuly2022.

2.Written and Practising Innovative Methods in teaching and Learning (Practicing).