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Original Research Article

Study of Vitamin D and Iron Deficiency in Malnourished Children

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Abstract: Protein Energy Malnutrition (PEM) refers to "an imbalance between the supply of protein and energy and the body's demand for them to ensure optimal growth and function. 30 children with diagnosis of protein energy malnutrition were selected from Sawala Gaon, Panvel, district Raigad, Maharashtra. The study shows that the levels of Total Protein and Albumin fall in Grade II of PEM. Vitamin D levels in 66.66% showing mean±S.D. as 12.09±4.46 ng/mL among the study group. The children of study group are anemic out of which 60 % have microcytic hypochromic anemia and 40 % have dimorphic anemia. The result shows that microcytic hypochromic anemia is more prevalent than dimorphic anemia. Out of all the cases, 83.33% cases showed decrease serum level of Ferritin and 70% showed decreased serum level of Iron. From the present study it is concluded that while correcting the Protein Energy Malnutrition in the children of Sawala Gaon with proteins and energy, care has to be taken for correcting rickets and anaemia with additional supplementation of Calcium, Vitamin D, Iron, Folic Acid and Vitamin B12.
Keywords: PEM, IDA, TIBC, UIBC.

INTRODUCTION

Protein Energy Malnutrition (PEM) refers to "an imbalance between the supply of protein and energy (inadequate calorie or protein intake) and the body's demand for them to ensure optimal growth and function. [1] Intervention strategies targeting vitamin D deficiency rickets, will give emphasis to children with protein energy malnutrition. Vitamin D deficiency rickets is mostly common in children with protein-energy malnutrition (PEM). In fact, the incidence of rickets has been reported to be higher in malnourished children.

The prevalence of anemia and Iron deficiency anemia (IDA) among children from IDA coexists among low-income population and poor socioeconomic background [2]. The World Health Organization (WHO) considers that more than 1 billion people worldwide suffer from vitamin D deficiency [3]. Iron deficiency anemia (IDA) affects 20% to 50% of the world's population. It is common in young children and prevalence has been reported to be as high as 60% among children less than 5 years of age in developing countries [4]. The present study is designed to estimate serum levels of Vitamin D, Iron, Ferritin and microscopic examination of Peripheral blood smear in the study group of Protein Energy Malnutrition (PEM) children of preschool age from the community.

AIM AND OBJECTIVES

- To Study Prevalence of Vitamin D deficiency and Iron deficiency in Protein Energy Malnutrition Children of Pre-School Age.
- To estimate serum Vitamin D, Iron, Ferritin, Protein, Albumin, TIBC, UIBC levels and examine Peripheral blood smear.

METHODOLOGY

The present study was conducted in the Department of Biochemistry in collaboration with Department of Community medicine at MGM's Medical College & Hospital, Kamothe, and Navi Mumbai. The study consist of total 30 children with diagnosis of protein energy malnutrition were selected from Sawala Gaon, Panvel, district Raigad, Maharashtra.

Exclusion criteria:

Patients more than 5years age and below 1 years age (Infants), on major immunosuppressive drugs, Infection with HIV, TB, asthma and other diseases were excluded.

Sample collection and processing:

About 5ml blood sample was collected from each subject after an overnight fast with all the aseptic precautions for biochemical investigations. Samples for

plain vial were centrifuged at 3000 rpm for 10 minutes in order to get serum and were kept at -70^0 C till analysis. All biochemical investigations were done at the central laboratory of MGM's Hospital, Kamothe, Navi Mumbai. The study was conducted after getting approval from Institutional Ethical Committee.

Parameters measured:

Following parameters were measured in the present study.

- **Serum vitamin D:** Estimeted on Cobas e411 analyzer by Electrochemiluminescence immunoassay.
- **Serum Total Protein:** Estimated on Semi automated analyzer by Biuret end point method.
- **Serum Albumin**: Estimated on Semi automated analyzer by BCG Dye End point method.
- **Serum Ferritin:** Estimated on Access 2 Beckman Coulter.
- **Serum Iron, TIBC and UIBC:** Estimated on Semi automated analyzer by Ferrozine method.
- **Examination of Peripheral Blood Smear:** peripheral blood smears Staining and observation under Microscope for anemia.

Statistical Analysis:

- Results were statistically analyzed by 'SPSS, Version 16'. All results are presented as mean ± S.D. A *'p'* value of less than 0.05 was considered significant.

RESULTS

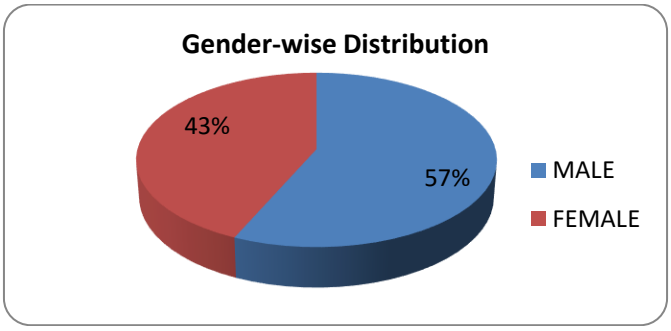

Fig-1: Gender-wise Distribution

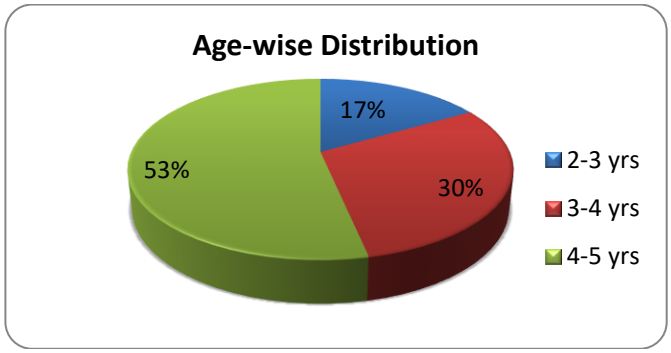

Fig-2: Age-wise Distribution

Table-1: Shows deficiency rate of Vitamin D and Iron in children

PARAMETER	NORMAL RANGE	TOTAL CHILDREN SCREENED	DEFICIENT	MEAN±S.D. ng/ml	PREVALENCE (%)
VITAMIN D	>20 ng/ml	30	20	12.09±4.46	66.66
FERRITIN	M-23.9 to 336.2 ng/ml and F-11.0 to 306.8 ng/ml	30	25	11.11±6.43	83.33
IRON	M-60 to 160 µg/dl and F-35 to 145 µg/dl	30	21	37.28±13.59	70
TIBC	250-400 µg/dl	30	27	149.2±32.39	90
UIBC	160-360 µg/dl	30	26	87.6±41.01	86.66

Table-2: Deficiency rate of anemia in children:

Total children screened	Microcytic hypochromic anemia	Prevalence (%)	Dimorphic anemia	Prevalence (%)
30	18	60	12	40

DISCUSSION

Protein energy malnutrition is a syndrome comprising basically of kwashiorkor, marasmus, and marasmic-kwashiorkor essentially, though some people have added underweight for age [11]. The Screening of children for Vitamin D and Iron status identifies presymptomatically and provides the opportunity to improve the life of affected children and their families. Well-established children screening infrastructure provides the opportunity to expand case detection to other serious conditions, thus increasing the potential for saving lives and improving the health and well-being of society.

The present study shows that the levels of Total Protein and Albumin are reduced to 4.44±0.77gm/dl and 2.75±0.31gm/dl with mean±S.D. which falls in Grade II of PEM. A study done by Chowdhury *et al.;* in 2008 showed decreasing levels of albumin with increasing severity of PEM. [12] They reported lowering of these serum total protein and albumin values in PEM could be explained on the basis of generalized protein deficiency leading to impaired synthesis. [13] There was reduction in total protein profile especially albumin in protein energy malnutrition, earlier reported by Lalwani *et al.;* in 1998 who attributed this to result from the consumption of diet deficient in protein [14]. Reduced serum protein level can result from increased protein catabolism commonly present in feverish conditions as stated by Nwanjo in 2004 [15]. Rahman MZ *et al.;* found that there is a significant decrease in serum total protein and albumin in PEM patients .The levels of serum total protein and albumin were decreased due to decreased protein intake and reduced hepatic biosynthesis of protein in the liver [16].

Vitamin D is a prohormone which becomes active on transformation to its hydroxylated derivatives. The normal range of serum Vitamin D as per the methodology is 20-100ng/mL our overall study group showed the mean±S.D. as 17.43±9.83 ng/mL which is below the normal range. The present study shows low Vitamin D levels in 66.66% showing mean±S.D. as 12.09±4.46 ng/mL among the study group. It is possible that protein-energy malnutrition may interfere with the metabolism of vitamin D and thus contribute to the development of rickets. Children of the poor communities depend entirely on sunshine for their vitamin D as they get very little from their diets. It is possible that malnourished children, being less active, may not be exposed to sunlight to the same extent as normal children as suggested by N Raghuramulu and Vinodini Reddy in 1980 [8] Liver is the major site of 25 hydroxylation of vitamin D and this has been shown to be impaired in patients with liver diseases **[**9] It has been suggested that vitamin D metabolism may also be altered in children with PEM due to hepatic changes. Plasma 25-OHD is bound to a specific serum globular protein which is essential for its transport to the kidney where it is further hydroxylated to 1, 25-dihydroxy vitamin D, Alteration in the concentration of the binding protein can modify the levels of 25-OHD. Imawari *et al.;* reported that the levels of the binding protein are significantly reduced in patients with liver diseases and that they correlate well with serum albumin. The concentration of this protein may be expected to be decreased in protein deficiency [10].

The study shows that all the PEM children of study group are anemic out of which 60 % have microcytic hypochromic anemia and 40 % have dimorphic anemia. The result shows that microcytic hypochromic anemia is more prevalent than dimorphic anemia. Out of all the cases, 83.33% cases showed decrease serum level of Ferritin and 70% showed decreased serum level of Iron. International Nutritional Anemia Consultative Group in 1977 suggested that Iron deficiency anaemia is due to iron losses as to poor iron intakes. Iron deficiency anemia may also cause due to infestation of intestinal parasites like hookworm, tapeworm and *Trichuris trichiura* [6]. In the present study, there are 60% cases of microcytic hypochromic anemia on peripheral blood smear which is also seen as low serum iron level in 70% of the cases suggesting that the population is more prone to Iron deficiency anemia either may be due to dietary reasons or due to secondary reasons as studied by various workers in PEM children. There are 40% cases of dimorphic anemia on peripheral blood smear which is seen due to Iron deficiency along with Vitamin B12 and Folic acid deficiency.

Anaemia resulting from folate deficiency is less prevalent than that from iron deficiency or iron loss. It occurs when folate intakes are low and when red cells are haemolysed or destroyed in conditions like malaria. The anaemia of both folate and vitamin B12 is macrocytic, with larger than normal red blood cells. In most countries vitamin B12 deficiency is uncommon as suggested by Nutritional Anemia Consultative Group in 1977 [6] Kumar T *et al.;* in 2014 observed that Iron, folate, and vitamin B12 status were important predictors

for plasma Hb concentration [5]. Kapur *et al.;* reveals microcytic hypochromic anemia (44.3%) was found to be the most common followed by normocytic normochromic anemia (42%), dimorphic anemia (10%) and macrocytic anemia (2.7%) [15]. Ahmed Zein and Assefa found a significantly higher prevalence of anemia in male children under the age of 5 years as compared to females [16].

CONCLUSION

PEM develops in children whose consumption of protein and energy (measured by calories) is insufficient to satisfy the body's nutritional needs. The present survey was made to study PEM children and made aware about their conditions to the community for those children's future development in that area. The study includes randomly selected 30 cases of PEM out of which 2/3 rd were diagnosed with low serum Vitamin D levels. Anemia was observed in all the 30 cases on peripheral blood smear out of which 60% were of microcytic hypochromic anemia and 40% were of dimorphic anemia. From the present study it is concluded that while correcting the Protein Energy Malnutrition in the children of Sawala Gaon with proteins and energy, care has to be taken for correcting rickets and anaemia with additional supplementation of Calcium, Vitamin D, Iron, Folic Acid and Vitamin B12.

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