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Original Research Article

Prevalence of micronutrient deficiencies clinically in rural school going children

Hemant Pralhad Bharati, Saiprasad Onkareshwar Kavthekar*, Swati Saiprasad Kavthekar, Anil Bapurao Kurane

Department of Pediatrics and Pathology, DY Patil Medical College and Hospital, Kolhapur, Maharashtra, India

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***Correspondence:**
Dr. Saiprasad Onkareshwar Kavthekar,
E-mail: saiprasadka@yahoo.co.in

ABSTRACT

Background: Micronutrients are those vitamins and minerals required in very small quantities in our bodies which are essential for a number of different functions including growth and development. Micronutrient deficiencies (MD) are the conditions which are prevalent in the society and parents are unaware of the same due to their asymptomatic nature. The aim of this study was to study the prevalence of MD in school children in rural area of Kolhapur district.
Methods: This prospective study was carried out among 960 school children of, 8 randomly selected Government schools (120 from each school and from each class 30 children) between the age group of 5-10 years in rural Kolhapur, between July-September 2017. Clinical Features of MD for vitamin A (corneal dryness, Bitot's spot, skin lesions), for vitamin B (angular chelosis, glossitis, knuckle pigmentation), for vitamin C (bleeding gums, scorbutic rosary), for vitamin D (bow legs, rachitic rosary, pot belly, frontal bossing) and pallor, goitre, dental caries for iron, iodine and fluoride deficiency respectively were examined. The data was analysed statistically.
Results: The overall prevalence of MD was 35% with 37.45% in girls with highest (40.8%) in the age group of 8-9 years. The features of vitamin deficiency for vitamin B in 30%, for vitamin A in 15%, for vitamin D in 12%, for vitamin C in 2%. The features of mineral deficiency for iron and fluoride in 38.8% and 36.6% respectively were present. Commonest clinical features of vitamin deficiency were glossitis (15.6%), corneal dryness (9.6%), angular chelosis (7.5%) and knuckle pigmentation (6.9%). Multiple MD were seen in 12.7% of children.
Conclusions: Rural school children do suffer from MD significantly. These conditions should be timely evaluated as these are preventable and treatable.

Keywords: Deficiency, Micronutrient, School children

INTRODUCTION

Micronutrients are those vitamins and minerals required in very small quantities in our bodies, play leading roles in the production of enzymes, hormones and other substances.[1] Micronutrients of known public health importance include the following : zinc, iodine, iron, selenium, copper, vitamin A, B, C, D, B2, B6, B12 and folate.[2] Despite requiring only trace amounts micronutrients deficiency (MD) are widespread affecting approximately 2 billion people worldwide, the equivalent of a third of the world's population and a major contributor to childhood morbidity and mortality.[3-5] The lack of sufficient amounts of micronutrients affects health, function, and physical and cognitive development throughout the life cycle.[6,7] MD are caused by inadequate dietary intake, increased losses from the body, and/or increased requirements.[8] MD are specially relevant in children since they are in growth and development phase and have nutritional requirements that vary according to

the stage of growth and that are greater and clearly differentiated from those of adults.[9] Recent studies are emphasizing the importance of MD in developing countries and among school aged children in particular.[10,2] Parents are unaware of MD due to their asymptomatic nature. Treatable and preventable nature of these conditions needs to be emphasized. Therefore, the present study was aimed to study the prevalence of selected MD clinically in school aged children in rural area.

METHODS

This prospective study was conducted between 1st July 2017 to 30th September 2017 in 8 elementary schools in rural Kolhapur district among 960 children. Schools were chosen randomly and from each school 120 children and from each class 30 children were selected randomly from attendance register.

Children between the age group 5-10 years were selected for the study. The study was carried out after approval by Institutional ethical committee and permission from school headmaster. Informed consent from parents was also taken. The students were examined for clinical signs of vitamin and mineral deficiencies. Among vitamins features of vitamin A deficiency like corneal dryness, Bitot's spot, skin lesions (toad like skin, Phrynoderma), features of vitamin B deficiency like angular chelosis, glossitis, stomatitis, features of vitamin C deficiency like bleeding gums, scorbutic rosary, features of vitamin D deficiency like bow legs, rachitic rosary, pot belly, frontal bossing, and for minerals clinical signs like pallor, goitre, dental caries and acrodermatitis enteropathica for iron, iodine, fluoride and zinc deficiency respectively were examined. The results were analysed statistically.

RESULTS

In this study we examined 960 children from the age group of 5-10 years. The overall prevalence of MD was 35% with 37.45 was in girls (Table 1). The school going children between the age group of 8-9 years had highest incidence (40.8%) of MD (Table 2).

Table 1: Prevalence of micronutrient deficiency in rural school going children.

Sex	Number	Normal		Micronutrient deficient	
		Number	%	Number	%
Boys	490	330	67.35	160	32.65
Girls	470	294	62.55	176	37.45
Total	960	624	65.00	336	35.00

Table 2: Age wise micronutrient deficiency in rural school going children.

Age (years)	Total number	Micronutrient deficient	
		Number	%
5-6	240	96	40
6-7	240	82	34.2
7-8	240	60	25
8-9	240	98	40.8
Total	960	336	35

Table 3: Clinical features of micronutrient deficiency in rural school going children.

Micronutrients deficiency	Clinical Features			Total	
		No	%	No.	%
Vitamin A	Corneal dryness	100	9.6	144	15
	Bitot's Spot	24	2.5		
	Skin lesions	20	2.1		
Vitamin B	Angular Chelosis	72	7.5	288	30
	Glossitis	150	15.6		
	Knuckle pigmentation	66	6.9		
Vitamin C	Bleeding gums	12	1.3	19	2
	Scorbutic Rosary	07	0.7		
Vitamin D	Bow legs	22	2	115	12
	Rachitic Rosary	15	1.6		
	Pot belly	35	3.7		
	Frontal bossing	43	4.8		
Iron	Pallor	373	38.8	373	38.8
Iodine	Goitre	0	0	0	0
Fluoride	Dental Caries	352	36.7	352	36.7
Zinc	Acrodermatitis enteropathica	0	0	0	0
Multiple		122	12.7	122	12.7

The features of vitamin B deficiency (angular chelosis, glossitis, stomatitis) were present in 30%, features of vitamin A deficiency (corneal dryness, Bitot's spot, skin lesions) in 15%, features of vitamin D deficiency (bow legs, rachitic rosary, pot belly, frontal bossing) in 12%, features of vitamin C deficiency (bleeding gums, scorbutic rosary) in 2%. Features of Iron (pallor) and fluoride (dental caries) deficiency were present in 38.8% and 36.6% respectively and no case of goitre and acrodermatitis enteropathica were detected suggestive of no iodine and zinc deficiency respectively. Among clinical features of vitamin deficiency glossitis (15.6%), corneal dryness (9.6%), angular chelosis (7.5%) and knuckle pigmentation (6.9%) were commonly observed. Multiple MD were seen in 12.7% of children (Table 3).

DISCUSSION

Ideally MD is determined by a valid and reliable biomarker. Biomarkers are typically defined as biological measurements (i.e. blood, urine etc.) that are used to indicate normal biologic processes, pathogenic processes or pharmacological responses to therapeutic intervention.[11] Unfortunately biomarkers are not available for all, while other existing biomarkers are not practical or feasible for widespread assessment or for use outside clinical setting. Furthermore, biomarkers may be influenced by inflammation, infection, hydration status, age, kidney function, and analytical method. Finally, a number of issues exist concerning the use of cut points of biomarkers to determine deficiency and sufficiency as there is a distribution around the cut point. Cut points may differ by many factors (e.g. by age group or by analytical method) and the selection of which cut point to use is problematic. Hence, we decided to study clinical manifestations of MD instead of serum micronutrient levels.[12]

An early symptom of vitamin A deficiency (VAD) is delayed adaptation to the dark, night blindness, a result of reduced re-synthesis of rhodopsin, a retinal visual pigment. With advanced VAD the cornea keratinizes, becomes opaque, is susceptible to infection and forms dry scaly layers of cells (Xeropthalmia). The conjunctiva keratinizes and develops plaques (Bitot's spots). In later stages infection occurs, lymphocyte infiltrates and the cornea become wrinkled; it degenerates irreversibly (Keratomalacia and corneal ulceration) resulting in blindness. VAD causes epithelial changes in skin and manifested as dry, scaly, hyperkeratotic patches, commonly on the arms, legs, shoulders and buttocks (Phrynoderma).[13] Vitamin B complex includes a number of water soluble nutrients like Thiamine (B1), Riboflavin (B2), Niacin (B3), Pyridoxine (B6), Folate, Cobalamine (B12), Biotin and Pantothenic acid. Because diets deficient in any one of the B complex vitamins are often poor sources of other B vitamins manifestations of several Vitamin B deficiencies usually can be observed in same person. Clinical features of Riboflavin deficiency include chelosis, glossitis, keratitis, conjunctivitis and sebhorric dermatitis. Chelosis begins with pallor at the angles of mouth and progresses to thinning and maceration of the epithelium, leading to fissures extending radially into the skin. In glossitis the tongue becomes smooth with loss of papillary structure also seen in Folic acid deficiency along with anemia. Hyperpigmentation of the knuckles and palms is common observation with B12 deficiency.[14] A deficiency of vitamin C results in the clinical presentation of scurvy, the oldest nutritional deficiency disease to be recognized. Gum changes like bluish purple spongy swellings of the mucous membrane especially over the upper incisors and rosary at the costochondral junction with a sharper angulation seen in scurvy.[15] Rickets is principally caused by vitamin D deficiency. Widening of costochondral junctions results in rachitic rosary, which feels like the beads of a rosary as the examiners fingers move along the costochondral junctions from rib to rib. Growth plate widening is also responsible for the enlargement at the wrist and ankles. Frontal bossing, bow legs, skeletal deformities are other clinical presentation of rickets.[16] Pallor of the palms, palmer creases, nail beds and conjunctivae is the most important clinical sign of iron deficiency but is not usually visible until the haemoglobin falls to 7-8g/dl.[17] Other clinically important minerals like iodine, Fluoride and Zinc deficiencies manifest with goitre, dental caries and acrodermatitis enteropathica respectively.[18]

Despite the fact that several national nutritional programmes are in operation especially for the benefit of children the incidence of MD in our study was 35% with 37.45% in girls and 40.8% in 8 to 9 years age group. VAD was found 15% in the present study while Kamath P et al.[19] from Karnataka found 33.8%. Bitot's spots (2.5%) was higher than the WHO cut off point of 0.5%, indicating it to be a public health problem.[4] Raman et al found 10.8% school children from North India had clinical evidence of vitamin D deficiency, as compared to 12% in the present study.[20] Gomber S et al found vitamin B12, folic acid and iron deficiencies in 7%, 1%, and 39% respectively among school children of urban slums.[21] Iron deficiency is the most common MD in the world, affecting more than 30% of the world population, similar results were found in the present study.[22] Verma M et al reported a 51.5% prevalence of anemia among school children of Punjab.[23] Shivprakash et al observed conjunctival xerosis in 20.7%, bitots spots in 2.1%, skeletal changes in 1.4% and pallor in 25.4% of rural school going children.[24] 36.66% children had dental caries suggestive of one of the cause for Fluoride deficiency. In the present study we did not found a case of Iodine and Zinc deficiency.

The food consumption habits of the children were changed during the last few years and now they consume too much fat especially saturated fat and sweetened beverages. They do not eat enough fruits or vegetables and consequently do not consume enough fibre. Most school children of low socioeconomic families consume less milk, cheese, meat, vegetables and fruits. Only one fifth of children consume the recommended daily amount of fruits and vegetables.[25]

It is the responsibility of public health authorities to ensure that the general population and especially those under in poverty are assured of an adequate basic daily intake of minerals and vitamins. This can only be achieved through health education, nutritional education, regular health checkup and food fortification of micronutrients. Food fortification is cost effective and can reach many people who either do not or cannot comply with the individual approach of health education and healthy diet, due to its higher cost, or due to lack of knowledge or access.[26] An alternative to fortification of the food supply are home based fortification system in which micronutrients are added to foods that are already consumed within the home. This strategy often called 'Home Fortification' avoids the policy and food industry involvement and allows for targeted interventions in individuals in need. Most often food fortification involves adding multiple micronutrients to a semisolid food prepared at home.[12] National school feeding programmes can be one of the means for nutritional education and food fortification as well as a means of alleviating food insecurity among children.[27]

There were certain limitations of the present study. Nutritional status of the children depends on the education, occupation and socioeconomic status of the parents which was not assessed in this study. Also, detailed diet history of the children was not recorded, and presence of worm infestations were not investigated. Other MD like Chromium, Copper, Manganese, Molybdenum and Selenium could not be evaluated as their clinical manifestations are sparse.

CONCLUSION

Rural school children do suffer from MD significantly. These conditions should be timely evaluated as these are preventable and treatable.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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