



TO ASSESS THE PREVALENCE OF MICRO-NUTRIENT DEFICIENCY AMONG RURAL SCHOOL CHILDREN AGED 10-12 YEARS

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Abstract

Micronutrient deficiencies are caused by inadequate dietary intake, increased losses from the body and/or increased requirements. Besides inadequate consumption of nutrient rich foods, dietary taboos, lack of access to health care and inefficient utilization of available micronutrients because of infections and parasitic infestations are also among other causes. Micronutrient deficiencies are especially relevant in school children since they are in a 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. The present study was done to assess the prevalence of micronutrient deficiency in Kanpur Dehat district. This study was conducted among 4 Government schools using interview techniques and anthropometric and clinical examinations. Results of the present study revealed that most of the children belong to low income group (60%) and middle income group (32%). About 36% of the parents of the children were agricultural farmers. Vitamin A deficiency (clinically seen by absence or presence of Bitot spot, and other symptoms present in eyes) was seen in 26 percent of children. Nutritional anemia (by pale, dry skin, and symptoms present in the nails) was seen in 66.7 percent. Vitamin C deficiency (symptoms present in gums and lips) was seen in percent and calcium deficiency (as seen by symptoms shown in the teeth such as caries, chalky and mottled enamel etc) was found in 65.3 percent of the children.

Key words : Micronutrient deficiency, school children, vitamin A Deficiency, nutritional anemia.

Introduction

Micronutrients are dietary components, often referred to as vitamins and minerals, which although only required by the body in small amounts, are vital to development, disease prevention and wellbeing. Micronutrient deficiencies are especially relevant in school children since they are in a 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.

Approximately twenty percent of the population in every country constitutes school age children (5-15 yrs). About 200 million children belong to this group and majority of them resides in underprivileged areas in rural India (WHO, 2000).

The school age period is nutritionally significant because this is the prime time to build up body stores of nutrients in preparation for rapid growth of adolescence. Childhood and adolescents are periods of continuous growth and development. During the preadolescent period

the child grows, on an average, 6-7 cm in height and 1.5 to 3 kg every year and simultaneously development and maturation of various tissues and organs take place. Good health is essential for learning and cognitive ability.

Micronutrients of known public health importance includes Vitamins A, E, C, D, B2, B6, B12, Iron, Iodine, Zinc, Copper, Selenium and Folate. Deficiencies in micronutrients such as iron, vitamin A and vitamin C can have devastating consequences. At least half of children worldwide ages 6 months to 5 years suffer from one or more micronutrient deficiency and globally more than 2 billion people are affected. According to the WHO, 'micronutrient deficiencies of iodine, vitamin A and Iron are of the greatest concern worldwide'. Recognition and attention to micronutrient deficiencies as a group of important public health issues are vital to preventing diseases and promoting health (Bowley, 2008).

Iron deficiency is the most common micronutrient deficiency in the world, affecting more than 30 percent of the world's population, an estimated 2 billion people

(Tulchinsky, 2010). Daily iron supplementation is recommended as a public health intervention in school-age children aged 60 months and older, living in settings where anaemia is highly prevalent, for preventing iron deficiency and anaemia (WHO, 2016). Xerophthalmia is the leading cause of preventable childhood blindness with its earliest manifestations as night blindness and Bitot's spots, followed by blinding keratomalacia, all of which are the ocular manifestations of VAD. Children need additional vitamin A because they do not consume enough in their normal diet. There are three general ways for improving vitamin A status: supplementation, fortification, and dietary diversification (Saeed *et al.*, 2013). Iodine is an essential nutrient for normal growth and development in humans. Iodine deficiency is the most common cause of preventable mental retardation in the world today. Globally, India has the largest number of children born vulnerable to iodine-deficiency (Iodine Network, Global scorecard, 2010). Vitamin C (ascorbic acid) plays a major role in human metabolism ranging from the synthesis of collagen, carnitine and norepinephrine to a large number of antioxidant activities (Padayatty *et al.*, 2003).

Despite the fact that several national nutrition programmes are in operation, especially for the benefit of children, the prevalence of micronutrient deficiencies, particularly among rural children, continues to be of public health concern. Nutritional status of the children depends on the education, occupation and socioeconomic status of the parents (Shivaprakash and Joseph, 2014). Children of low socio-economic position (SEP) consume poorer diets than those of high SEP (Dorota *et al.*, 2014).

Objectives

Keeping in view the magnitude of micronutrient malnutrition among school children, the objective of the study "to assess the prevalence of micronutrient deficiencies among rural schoolchildren (10-12 yrs) along with formulation of micronutrient rich products" are as follows:

1. To assess the anthropometric measurements, clinical signs and symptoms of the respondents;
2. To assess the twenty four hour dietary recall.

Materials and Methods

The present study was conducted in the Kanpur Dehat from four Government Schools under Block Mehta. From these four schools 150 children were selected and examined. The headmasters of the four schools were approached for the present study. The purpose of the study was explained to them and their consent was obtained for conducting the study among their school

children.

Tools of study

For study purpose a questionnaire cum-interview method was used to collect reliable data. This was designed keeping in mind the objectives of the study. The questionnaire cum interview schedule consisted of four sections:

Section 1 of questionnaire consisted of general information such as name, age, gender, education, family size, parental occupation and income etc

Section 2 comprised of the anthropometrical measurements and data such as height, weight, BMI and arm circumference.

Section 3 consisted of information about dietary intake.

Anthropometric measurements

A. Weight : The weight of the child was recorded with the help of weighing machine (bathroom scale) with precision up to 100gms. The weight of the study subjects was measured with minimal clothing, standing on the weighing machine bearing equal weight on both feet. Accuracy of the weighing machine was checked every time before starting the survey.

B. Height : The height was measured while the child was standing by the side of a wall upright with heels close to each other and arms hanging by the side of the body. The height was measured using an anthropometric rod.

C. Mid upper arm circumference : The measurement was taken on the left hand at the midpoint between the tip of the acromion of scapula and tip of the olecranon of the fore-arm bone. The midpoint was marked with a marker and the measurement was taken with the help of a measuring tape and the reading recorded to the nearest millimeter.

Results and Discussion

Table 1 reveals the distribution of the respondents according to the age group. The study comprised of 150 children between the age group of 10 to 12 years of age with predominance of boys 79 (52.7). Among the male category maximum number of respondents (48.1) belonged to 10 years of age and minimum (25.3) belonged to the age 11 years. In female category as well, maximum number of respondents (47.9) belonged to the age of 10 years and minimum (23.9) to the age of 12 years. Thus, it is evident that majority of the respondents belonged to the age of 10 years.

Table 2 indicates the education of the respondents according to the gender. In both male as well as female category, maximum number (83.5%) and (76.1%) respectively were studying in primary section i.e., class 5 and below. While 16.5 percent of males and 23.9 percent of females were studying in secondary classes i.e., class 6 to 8.

Table 3 indicates the distribution of the respondents according to their parental occupation. Maximum numbers of the parents of male respondents (38%) as well as that of the female respondents (33.8%) were farmers. This was followed by factory workers among male parents 22(27.8) and daily wage earners among female parents. Very few parent of the male children were engaged in other occupation 4(5.1) such as barber, cobbler etc, while that of female children as Milkman 4(5.6%).

The majority of the parental income belonged to the category below Rs 5000 in males (59.5%) as well as in females (60.6%). Very few of the children belong to the income group of 10,000 and above i.e. 8.9 percent of male respondents and 7 percent of female respondents. This indicate that majority of the children belonged to low income background.

Among the male respondents 45 (57%) belonged to a nuclear family of below 5 members. In female, majority 41(57.7%) belonged to a joint family of more than 6 members.

Anthropometric measurements of the respondents

Table 6 indicates the age wise distribution of respondents according to height. Average 137.8 cm of male and 142 cm of female belonged to 12 years of age while 132.7 cm height of male with 4.2 cm, standard deviation and 126.5 cm of female with 6.2cm SD belonged to 11 years of age. Average 128.5 cm of male with 3.6 cm SD and 121.8cm of female with 5.2cm SD belonged to the age of 10 years.

Mean height was found to be increasing with age. Kaushik (2012) founded that the mean height of both boys and girls increases with age (Kaushik *et al.*). The mean height of both boys and girls in all age groups were lower as compared to the ICMR reference standards. The coefficient of correlation with significance at 5% level of significance between age and height of male respondents was 0.4429* and that of female was 0.4772*. The values of correlation coefficient were found positively significant at 5% level of significance.

Mean weight of both boys and girls increased with age. Mean weight of male respondents ranged from 24.5

kg with 4.7 kg SD to 32.6 kg with 4.6 kg SD with average mean weight of 28.6 kg with 4.1 kg SD. The value of correlation coefficient was found positively significant (0.6215*).

In females, mean weight ranged from 23.7 kg with 2.5 kg SD to 36.2 kg with 4.2kg SD and the average mean weight was 29.4 kg with 3.7 kg SD. The value of correlation coefficient was found positively significant. (0.7971*).

The mean BMI of male respondents ranged from 15.09 to 17.1 with average mean BMI at 16.23 with 2.4 SD. The value of correlation coefficient was found to be statistically significant. Mean body mass index of female respondents ranged from 15.5 to 18.6 and the average mean was 17.1 with 2.9 SD. The value of correlation coefficient was found to be non-significant.

Mean MUAC of both boys and girls was found to increase with age. The mean of Mid upper arm circumference of male respondents ranged from 16.3 cm to 17.9cm. The average MUAC was found to be 17.1 cm with 1.4cm Standard deviation. The value of correlation coefficient was found to be significant at 5% level of significance. In female respondents the mean ranged from 17.7 cm to 18.3 cm with the average MUAC mean at 17.3 cm and 1.6 cm standard deviation. The value of correlation coefficient was found to be significant at 5% level of significance.

The 24 hour recall was used to find out the amount of essential nutrients intake by the respondents. The average intake of nutrients with the percentage of RDA and percentage deficit or increase is given here. Mean daily calorie intake was maximum (13177.7 ± 2190) in the male age group followed by the female (1266.6 ± 212.8). The deficit percentage was 39.8 for male and 36.9 percent for female. Less intake of energy may be attributed to less food intake.

Daily protein intakes by school children were 38.5 g/day for males and 38.6g/day for females which was less than the recommended levels. Khashi girls of Meghalaya were also reported to have lower protein (33.48g in 7-12 years) intake than RDA (Arghar, 2005).

The mean intake of fat by school children was 20.8g and 20.4g respectively for males and females respectively, which was lower than the recommended level of 35g.

Iron deficiency symptoms was exhibited by 35 percent of male respondents and 45 percent of female respondents with their average consumption of 18.8g for male and 19.8 g for female, which was lower than the recommended level. Lower intakes could be due to less

Table 1 : Distribution of respondents on the basis of age group.

Gender	Age			
	10	11	12	Total
Male	38(48.1)	20(25.3)	21(26.6)	79
Female	34(47.9)	20(28.2)	17(23.9)	71
Total	72	40	38	150
$\chi^2 = 0.217$				

Table 2 : Distribution of respondents according to Education.

Education	Male		Female		Total
	N	%	N	%	
Primary (upto class V)	66	83.5	54	76.1	120
Secondary (class VI to VIII)	13	16.5	17	23.9	30
Total	79	100.0	71	100.0	150
$\chi^2 = 1.31$ (df= 1)					

food intake especially green leafy vegetables.

Calcium is an important nutrient for the children of this age as they are growing children and calcium is required for the building and growth of stature. However, the average intake of calcium was 583.3 mg/day in males and 513.1 mg/day for female inspite the recommended amount of 800mg/day. A similar finding of lower calcium intake was reported by Chauhan (2001).

The average consumption of vitamin A were 326.6g for males and and 323.2g for females as against the Recommended allowance of 600g/day which accounts for 54.4 percent of RDA for male and 53.9 percent of RDA for female.

Daily mean intake of ascorbic acid by the male and female school children was 37.3mg and 33.4mg respectively which was lower than the recommended level. Lower intake values could be due to insufficient intake of green leafy vegetables, fruits and tomato etc.

Clinical examination

Clinical examination is based on changes, believed to be related to inadequate nutrition that can be seen or felt. Clinical examination was performed to assess the general health of the respondents.

It has been observed that 96.2 percent of male respondents and 94.4 percent of female respondents had a general healthy appearance. While 3.8 percent of male and 5.6 percent of female respondents were showing unwell appearance which may be due to some health complications arising due to nutritional deficiencies.

Lack of lusture of hair was noted to be 10.1 percent

Table 3 : Distribution of respondents according to parental occupation.

Parental occupation	Male		Female		Total
	N	%	N	%	
Farmer	30	38	24	33.8	54
Daily wage earner	17	21.5	19	26.8	36
Factory worker	22	27.8	11	15.5	33
Milkman	6	7.6	4	5.6	10
Others	4	5.1	13	18.3	17
Total	79	100.0	71	100.0	150
$\chi^2 = 9.21$ (df= 4)					

Table 4 : Distribution of respondents according to parental income.

Parental income	Male		Female		Total
	N	%	N	%	
Below 5,000	47	59.5	43	60.6	90
5,000-10,000	25	31.6	23	32.4	48
10,000 & above	7	8.9	5	7	12
Total	79	100.0	71	100.0	150
$\chi^2 = 0.168$ (df= 2)					

Table 5 : Distribution of respondents according to family size.

Family Size	Male		Female		Total
	N	%	N	%	
Nuclear	45	57	30	42.3	75
Joint	34	43	41	57.7	75
Total	79	100.0	71	100.0	150
$\chi^2 = 3.24$ (d.f. = 1)					

in males and 28.2 percent in females. Thinness and sparseness of hair was seen in 12.6 percent of male and 36.6 percent o female respondents.

The clinical examination of face indicated that 96.2 percent of male and 97.2 percent of female respondents had normal face while 3.8 percent of male and 2.8 percent of female showed diffused pigmentation on their face.

In males, 86.1 percent had normal eyes with no deficiency symptoms while 7.6 percent showed pale conjunctiva, 3.8 percent showed slightly dry cornea and 2.5 percent had a moderate brown patches on their cornea. In female, there was an incidence of bitot spot (1.4%), slightly dry cornea (1.4%) and moderate brown patches (1.4%). There was no incidence of night blindness among the respondents. These symptoms are caused or

Table 6 : Distribution of respondents according to height and their correlation with age.

Age	N	Male			N	Female		
		(Mean ± SD)	ICMR standard	% deficit		(Mean ± SD)	ICMR standard	% deficit
10	38	128.5 ± 7.6	138.5	-7.22	34	121.8 ± 5.2	138.9	-12.31
11	20	132.7 ± 4.2	143.4	-7.46	20	129.4 ± 6.5	145.0	-10.75
12	21	137.8 ± 9.0	148.9	-7.45	17	142 ± 8.8	150.9	-5.89
Total	79	133 ± 6.9			71	131 ± 6.7		
r = 0.4675*					0.7545*			

Table 7 : Distribution of respondents according to weight (kg) and their correlation with age.

Age	N	Male			N	Female		
		(Mean ± SD)	ICMR standard	% deficit		(Mean ± SD)	ICMR standard	% deficit
10	38	24.5 ± 4.7	32.3	-24.1	34	23.7 ± 2.5	33.5	-29.3
11	20	28.9 ± 3.1	35.3	-18.1	20	28.3 ± 4.6	37.1	-23.7
12	21	32.6 ± 4.7	38.7	-15.8	17	36.2 ± 4.2	42.9	-15.7
Total	79	28.6 ± 4.1			71	29.4 ± 3.7		
r = 0.6215*					0.7971*			

Table 8 : Distribution of respondents according to BMI (kg/m²) and their correlation with age.

Age	N	Male			N	Female		
		(Mean ± SD)	Reference value (50 th percentile of WHO standard)	% of reference		(Mean ± SD)	Reference value (50 th percentile of WHO standard)	% of reference
10	38	15.09 ± 3.6	16.5	91.4	34	15.5 ± 2.9	16.7	92.8
11	20	16.5 ± 1.0	17.0	97.1	20	17.2 ± 2.8	17.3	99.4
12	21	17.1 ± 2.6	17.6	97.2	17	18.6 ± 3.1	18.1	102.7
Total	79	16.23 ± 2.4			71	17.1 ± 2.9		
r = 0.2822*					0.4090*			

Table 9 : Distribution of respondents according to Mid upper arm circumference (cm) and their correlation with age.

Age	No.	Male			No.	Female		
		(Mean ± SD)	Reference value (25 th percentile of WHO standard)	% of reference		(Mean ± SD)	Reference value (50 th percentile of WHO standard)	% of reference
10	38	16.3 ± 1.3	17.6	-7.3	34	16.6 ± 1.2	17.7	-6.2
11	20	17.2 ± 1.3	17.9	-3.9	20	17.1 ± 1	18.2	-6.04
12	21	17.9 ± 2.3	18.1	-1.1	17	18.3 ± 2.8	18.5	-1.1
Total	79	17.1 ± 1.6	TOTAL	17.3 ± 1.6				
r = 0.38954*					r = 0.366803			

aggravated by deficiency of vitamin A in the diet.

The results of the clinical signs and symptoms of lips showed that 82.3 percent of male and 70.4 percent of female respondents had normal lips. 2.8 percent in female and 1.3 percent in male respondents showed

swollen lips. Angular stomatitis was seen more in female 21.2 percent than in male 13.9 percent. Cheilosis was evident in 2.5 percent of male and 5.6 percent of female respondents. Bleeding gums was seen only in 31 percent of male and 31 percent of female respondents. Vitamin C

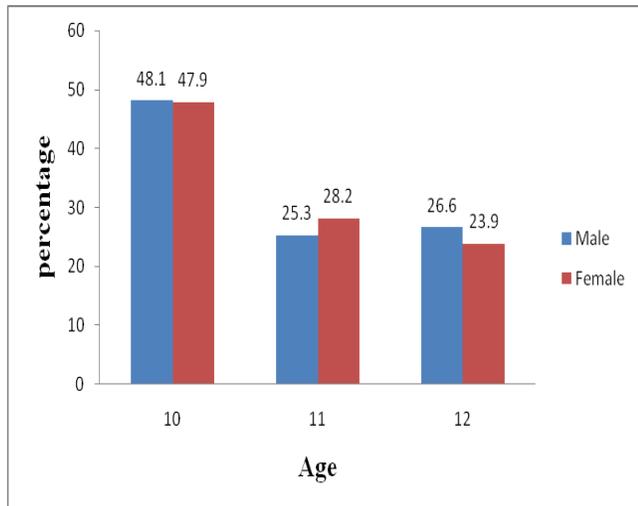


Fig. 1 : Distribution of respondents on the basis of age group.

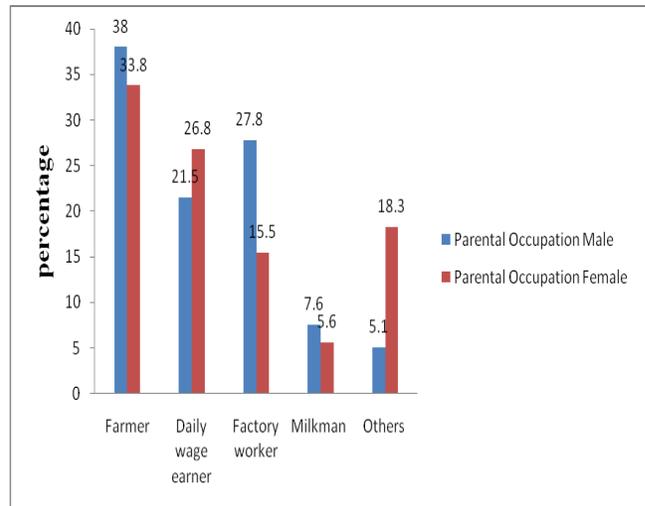


Fig. 3 : Distribution of respondents according to parental occupation.

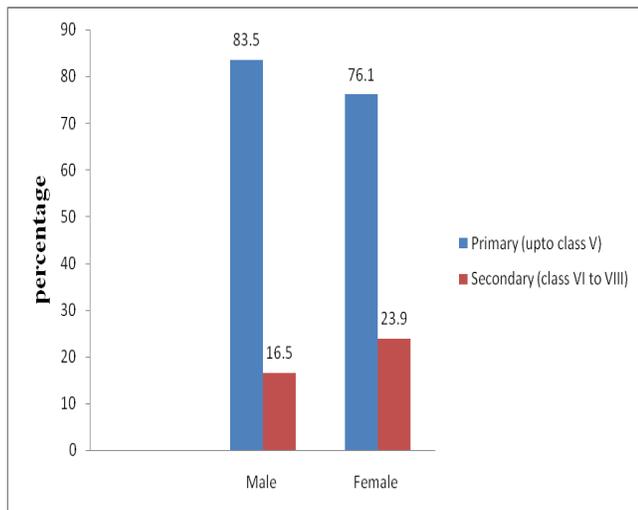


Fig. 2 : Distribution of respondents according to education.

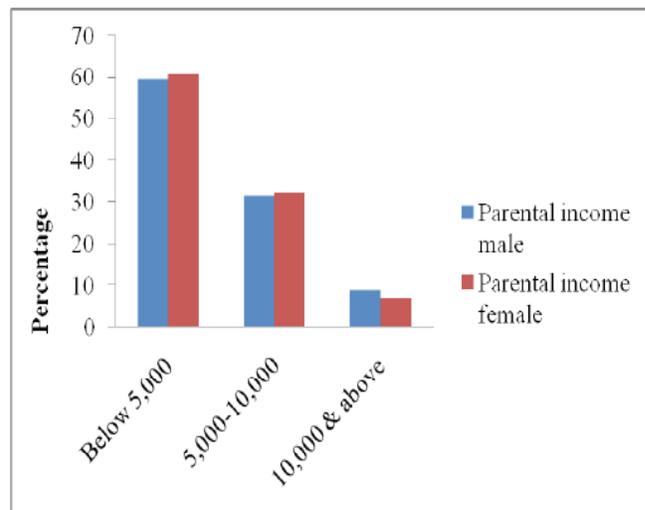


Fig. 4 : Distribution of respondents according to parental income.

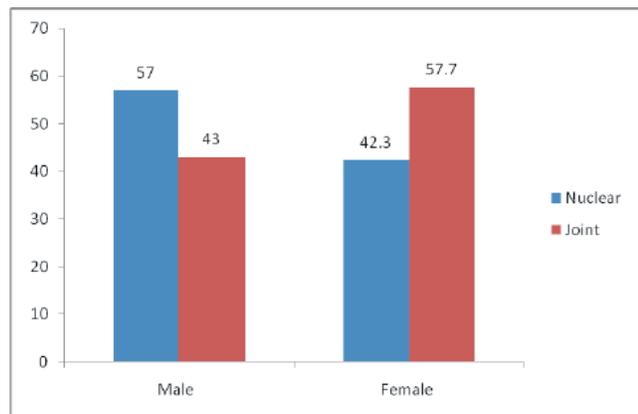


Fig. 5 : Distribution of respondents according to family size.

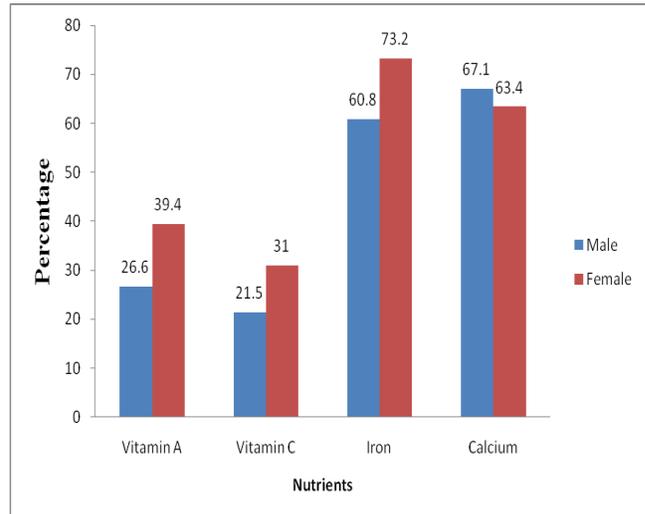


Fig. 6 : Prevalence of Micronutrient deficiency on the basis of clinical symptoms.

Table 10 : Average nutrient intake of the respondents as compared with Recommended Dietary Allowances (RDA).

Nutrients	Male (N=79)			Female (N=71)		
	Mean±SD	RDA	% deficit	Mean±SD	RDA	% deficit
Energy	1317.7±218.9	2190	-39.8	1266.6±212.8	2010	-36.9
Protein	38.5±6.1	39.9	-3.5	38.4±8.0	40.4	-4.9
Fat	20.8±8.8	35	-40.5	20.4±9.1	35	-41.7
Iron	18.8±6.7	21	-10.5	17.8±7.6	27	-34.0
Calcium	583.3±184.0	800	-44.3	513.1±177.2	800	-45.9
VitA	326.6±182.6	600	-48.6	323.2±95.1	600	-37.6
Vitamin C	37.3±13.3	40	-6.8	33.4±14.9	40	-16.5

Table 11 : Distribution of respondents according to clinical examination.

Clinical examination	Male		Female	
	Number	Percent	Number	Percent
General appearance				
Healthy	76	96.2	67	94.4
Unwell	3	3.8	4	5.6
Hair				
Normal	42	53.2	15	21.1
Lack of lusture	27	34.2	30	42.3
Thinness and sparseness	10	12.6	26	36.6
Face				
Normal	76	96.2	69	97.2
Diffused pigmentation	3	3.8	2	2.8
Eyes				
Normal	68	86.1	57	80.3
Pallor	6	7.6	11	15.5
Bitot spot	-	-	1	1.4
Slightly dry	3	3.8	1	1.4
Moderate brown patches	2	2.5	1	1.4
Lips				
Normal	65	82.3	50	70.4
Swollen	1	1.3	2	2.8
Angular stomatitis (mild/severe)	11	13.9	15	21.2
Cheilosis	2	2.5	4	5.6
Tongue				
Normal	69	87.3	63	88.7
Glossitis	3	3.8	2	2.8
Pale	7	8.9	6	8.5

*Table 11 continued...**Table 11 continued...*

Nails				
Brittle	10	12.7	13	18.3
Ridged	2	2.5	1	1.4
Peeling of skin around nail folds	9	11.4	8	11.3
Normal	58	73.4	49	69
Teeth				
Normal	26	32.9	29	40.8
Melted enamel (With white or brownish patches)	19	24	13	18.3
Caries	3	3.8	3	4.3
Chalky	31	39.3	26	36.6
Gums				
Normal	62	78.5	49	69.0
Swollen	2	2.5	-	-
Bleeding gums	15	19.0	22	31.0
Skin				
Normal	68	86.1	57	80.3
Flaky	2	2.5	2	2.8
Dryness	7	8.9	10	14.1
Follicular hyperkeratosis	2	2.5	2	2.8

and Vitamin B12 deficiency were noted through bleeding gums, glossitis, and angular stomatitis which is also an indication of anemia. Inadequate intake of green leafy vegetables and fruits owing to their poor economic status may be the reason behind the deficient symptoms.

The clinical examination of nails revealed that female respondents showed more number of brittle nails (18.3%) and peeling of skin around nails(11.3%) than their male counterparts having brittle nail (12.7%) and peeling of skin around nails (11.4%). Ridged nails was seen more

Table 12 : Prevalence of micronutrient deficiency on the basis of clinical symptoms.

Clinical symptoms	Male		Female		Total	
	Number	%	Number	%	N	%
Vitamin A	21	26.6	28	39.4	39	26
Vitamin C	17	21.5	22	31.0	39	26
Iron	48	60.8	52	73.2	100	66.7
Calcium	53	67.1	45	63.4	98	65.3
Iodine	-	-	-	-	-	-

in male (2.5%) than in female (1.4%). These symptoms may be caused by deficiency in the daily intake of vitamin A, vitamin C, calcium and iron.

Among boys, 32.9 percent had normal teeth, 24 percent had whitish or brownish patches, 3.8 percent had dental caries and 39.3 percent had chalky teeth. Dental caries was seen more in girls (4.3%) than among boys. Among girls, 40.8 percent had normal teeth, 18.3 percent had brown or white patches, and 36.6 percent had chalky teeth.

The signs and symptoms of skin indicated the deficiencies of vitamin A, other B complex vitamins, and essential fatty acids. Dry skin was seen in 8.9 percent of male and 14.1 percent of female. Flaky skin was seen in 2.5 percent of male and 2.8 percent among females. 2 percent among both male and female respondents had follicular hyperkeratosis.

Table indicates the prevalence of micronutrient deficiency on the basis of clinical signs and symptoms.

The prevalence of vitamin A deficiency was 26.6 percent and that of female was 39.4 percent. Vitamin A deficiency was known on the basis of symptoms present in eyes like dryness in eyes, bitot spot, moderate brown patches, dry and flaky skin and follicular hyperkeratosis of skin.

Signs and symptoms of vitamin C include bleeding and swollen gums etc. it was found that 21.5 percent of male and 31 percent of female respondents were suffering from vitamin C.

Assessment of iron deficiency was done on the basis of pale skin, pale nails and dull hairs. It was found in 60.8% of males and 73.2% of females.

Calcium deficiency was seen as per the symptoms shown in the teeth such as caries, chalky and mottled enamel etc. It was seen in 67% males and 63.4% of females.

Enlargement of thyroid gland is the only symptom for assessing iodine deficiency. There was no case of thyroid enlargement among any children in either of the

category. Rajju and Mittu (2014) reported that throid gland was found to be normal in all the subjects.

Conclusion

The present study showed various signs of deficiencies and ill health among school children of rural areas of Kanpur Dehat. Anemia, vitamin A deficiencies, undernutrition, calcium and vitamin C deficiency are the common health problems among them. It was found that the intake of all of the entire nutrients by the school children were lower than the prescribed recommended dietary allowances. A well balanced nutritious foods should be consumed by children to prevent micronutrient deficiencies and to attain a good physical and mental well being.

Knowledge and effective school health programs should be implemented to address these health problems. Regular anthropometric measurements should be taken in the schools so that a regular watch can be kept on the growth and development of the children. Above all children should be taught to live in a healthy and hygienic environment so that this generation of the country can grow healthy and disease free. Supplementation and fortification of foods should be also done to improve the nutritional status of the population.

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