

Dietary Inadequacy of Micronutrients in Adolescent Girls of Urban Varanasi: Call for Action

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Abstract: *Background:* Adolescent girls are vulnerable to dietary inadequacy in general and micronutrients (viz, Iron, Calcium, Vitamin A and C etc) inadequacy in particular due to variety of reasons including their own food preferences. Lack of protective foods in their diet can have serious consequences.

Objective: To assess dietary inadequacy of micronutrients in urban adolescent girls and to pinpoint their correlates.

Methodology: A community based cross sectional study was undertaken on 400 adolescent girls (10-19 years) of urban Varanasi, selected by adopting multistage sampling technique. Their socio-demographic and personal characteristics were obtained by interviewing parents or other responsible family member. Dietary intake of subjects was assessed by 24 hours recall oral questionnaire method and their micronutrients intake was computed by using nutritive value of Indian foods.

Result: In case of 72.8%, 71.2%, 88.2% and 6.2% subjects calcium, iron, Vitamin A and Vitamin C intakes were <50% of Recommended Dietary Allowances. Taking 10-14 years as reference risk of less iron intake was more (AOR; 3.66 CI: 1.30-10.30) in subjects aged 18-19 years. When Scheduled Caste was taken as reference category, risk of less iron intake was more in subjects from other caste category (AOR; 2.91, CI: 1.07-7.91). In comparison to subjects having sibling ≤ 4 risk of less calcium intake was more (AOR; 4.37 CI: 1.10-17.39) in subjects having sibling > 7 . With reference to vegetarians, odds of less vitamin C intake was more in nonvegetarian (AOR=2.01: CI-1.10-3.65) and eggitarian (AOR=2.53: CI-1.03-6.19).

Conclusion: Micronutrients deficiency in urban adolescents is quiet predominant and calls for community based interventions to streamline micronutrients supplementation and therapeutic strategies.

Keywords: Dietary habit, Dietary reference intakes, Recommended dietary allowances, Socioeconomic status, Under nutrition.

INTRODUCTION

Adolescents are defined by the World Health Organization (WHO) as persons aged 10-19 years [1]. It is the period of rapid physical and psychosocial growth. During the teen years, adolescents experience changes in their physical development at a rate of speed unparalleled since infancy [2]. From third year onward the expected growth velocity (weight) is 2.25 to 2.75 kg per year and gain in height is 5.0 to 6.0 cm per year [3]. During adolescence period, 50% of adult weight, 20% of adult height and 50% adult skeletal mass are acquired [4]. Adolescent girls have the potential to gain approximately 8.3 kg per year during peak rates of weight gain, (12.5 years of age on average). Average weight gains during puberty among females are between 7-25 kg, with a mean gain of 17.5 kg [5,6]. During one-year they are likely to gain 8.89 cm height on an average. Besides genetic factors, nutritional intake determines the extent of growth and maturation at this stage. Poor nutrition is often cited as a major reason for the delay in the onset of puberty in

Indian adolescents. Malnutrition has low visibility during childhood but the damage it can cause due to cumulative effect on puberty is often not appreciated. The additional requirements for iron, calcium and zinc for increments in skeletal mass, body size and bone density make 'nutrition' a critical factor in growth and development of adolescents.

In general adolescent girls are the worst sufferers of the ravages of various forms of malnutrition because of their increased nutritional need and low social power. Among modifiable factors of nutritional status dietary adequacy in terms of micronutrients is a paramount importance in general and in adolescent girls in particular. Quantity and quality of food strongly determine nutritional status of an individual which is more valid in case of adolescent girls. Any nutritional intervention for adolescent girls must give due to consideration to micronutrients intake.

In India, 22% babies born each year have low birth weight, which has been linked to maternal under-nutrition and anaemia among other causes [7] Diets of Indian adolescent girls are inadequate both in terms of quality and quantity [8]. Physical health of adolescent girls is basically determined by their nutrition. Eating

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habits and dietary behaviour picked up during adolescence have lifelong impact. Adolescence is the last chance to correct the growth lag and malnutrition [9].

Adolescent health has been a neglected area so far. Government initiatives only would not be sufficient to address their problems. Health of adolescents ultimately depends on their own actions, choices and behaviour. However, families, communities, governmental and nongovernmental organizations can not shrink from their responsibilities. Besides initiating several health and nutrition programmes empowerment of adolescents through family life and nutrition education is desired [10].

Several studies on diet surveys have shown that the diets of low income group population are inadequate when compared to recommended standards [11-14]. The common causes of malnutrition among adolescents in the poor community are less access to food and inadequate knowledge about dietary requirements [15].

According to a report of National Institute of Nutrition, in both the sexes, the proportions of adolescents consuming inadequate amounts were higher in case of micronutrients than that of protein, energy and total fat. More than two third of adolescents were consuming <70 per cent of RDA for vitamin A and riboflavin. Extent of deficiency with respect to iron was higher in boys than in girls [16].

The consumption of sweetened dairy products was positively associated with calcium intakes for children and adolescents. Consumption of presweetened cereals increased the likelihood of the children and adolescents meeting recommendations for the essential shortfall micronutrients calcium, folate, and iron, whereas the consumption of sugar-sweetened beverages, sugars and sweets, and sweetened grains decreased the likelihood of meeting the Dietary Reference Intakes (DRI) for these nutrients. Only children who were non consumers of sugar-sweetened beverages had a mean calcium intake that met the adequate intakes. Consumption of sweetened dairy products and presweetened cereals was positively associated with the number of dairy servings consumed per day for both age groups [17].

According to a study conducted on urban adolescent girls of Bangladesh [18] compared with the national dietary intake, the cereal intake was lower but protein containing foods like pulse and nuts, meat, fish,

milk and milk products were found very much near to the national intake. The intake of pulse and nut, meat, milk and milk product were 11.0 ± 4.5 , 8.0 ± 4.0 , 10.0 ± 4.0 gm per capita per day respectively, whereas corresponding national averages were 10.0, 6.0 and 13.0 gm per day. On the average, 95 % of calorie, 93.5 % of protein and 96.5 % of fat requirement were met. For micronutrient requirement, very low intake was observed with calcium (62 %) and iron (63 %).

In a study on adolescents of Vadodara city, it was seen that nutrient intake of the adolescent children was grossly inadequate in relation to energy, protein, iron and fiber which was more pronounced in the rural children than urban [19].

Mean nutrient intake of the selected government school girls was significantly lower when compared with Recommended Dietary Allowance of Indians. Nutritional inadequacy is one of the main causes of prevalence of malnutrition that can lead to higher incidence of diseases among adolescents [20].

The adolescent girls were consuming excess of energy, protein and fat but inadequate micronutrients like iron and beta-carotene [21].

With this background this study was contemplated on adolescent girls in urban Varanasi with following objectives: [A] To assess dietary inadequacy of micronutrients in urban adolescent girls [B] To pinpoint the correlates of micronutrients inadequacy in urban adolescent girls.

METHODS

Setting

This study was conducted in urban areas of Varanasi district having a population of 1599260 which is 43.43% of total population of Varanasi (3682194). Gender ratio of the district was 909 (Rural: 926; Urban: 887). Overall literacy rate was 77.08%: corresponding value for male and female subjects was 85.12% and 68.2%, respectively [22].

Study Design

A community based cross sectional design was adopted for this study.

Study Sample

Adolescent girls age group 10-19 years were considered for this study. This group was selected on

the consideration that adolescents in general and girls in particular are vulnerable because of variety of reasons [23] and least priority was accorded in planning and execution of nutrition services for adolescent girls. Even there is paucity of data on intake of micronutrients in this age group.

Sample Size

Sample size estimation for this study was based on the consideration of prevalence of under nutrition in adolescent girls to the extent of 60 percent and permissible level of error as 10 percent. This worked out to be 256. Taking design effect of 1.5 the required sample size became 384. Thus the total sample size was fixed to 400.

Inclusion Criteria

All subjects with assent of subjects and consent of parents were considered as study subjects.

Exclusion Criteria

Subjects not available even after 3 visits were excluded from this study.

Sampling Methodology

Selection of sample was done adopting multistage sampling as given below:

Step 1

Varanasi city comprises of five zones (*Kotwali, Dashaswamedh, Bhelupur, Adampur and Varunapar*). Out of these zones of Varanasi city, two zones (*Bhelupur and Varunapar*) were selected by simple random sampling technique.

Step 2

In the second stage, in each selected zone one ward was selected by the same procedure.

Step 3

In each selected ward two *mohallas* were selected by simple random procedure. The selected *mohallas* were *Sunderpur, Naria, Teliabag and Englisialine*, respectively.

Step 4

In the selected *mohallas* household were selected according to their probability proportion to size adopting simple random sampling. In a household with more than one family, a family was selected by random technique. From each selected family one adolescent

girl was selected. If a family had more than one adolescent girl, Lottery Method was used to select one of them. In case of non availability of adolescent girl in the selected family a nearby family having adolescent girl was taken.

Tools of Study

Predesigned and pretested proforma was used for this study. Information pertaining to socio-demographic and personal characteristics was recorded on this proforma. This comprised of following sections:

(A) Family Schedule

Included information pertaining to religion, caste, area of residence, type of family, total members in the family, number of adolescent girls and boys in the family, family income etc.

(B) Information Regarding Socio Economic Status

The major information given in this section for computing Socio Economic Status were per capita income, maximum education in the family, housing, family amenities, and consumption pattern of various items.

(C) Individual Interview Schedule

Included information pertaining to name, age, marital status, age at marriage of adolescent girl, literacy status and occupation of subject, father, mother and husband, number of siblings, personal history regarding menstruation.

(D) Information Regarding Dietary Assessment

a) Dietary Assessment through "24 Hour Dietary Recall Method"

Questionnaire contained different columns to note dietary intake during last 24 hours.

b) Dietary Practices

This section contained information regarding nature of diet, timing of meal, frequency of meal.

Techniques of Study

This study had approval of the Academic Bodies of Banaras Hindu University. Prior assent of study subjects and consent of her parents was taken before interviewing them. Socio-demographic information of study subjects was assessed by Interview technique. Measurement of Socio Economic Status was done through composite indicator [24] Weight for different

variables and sub variables were assigned for each item and maximum cut of levels (weight) for different categories. The following five broad categories of social and economic proxy variables were considered for the computation of SES of a family:

- (i) Monthly per capita income.
- (ii) Maximum education in the family.
- (iii) Type of house including number of rooms in the house.
- (iv) Family amenities and possession of prestigious durable goods.
- (v) Use/consumption pattern of various items.

Data for total family income was calculated by interviewing head or any responsible member of the family. If family had more than one income source, all sources were pooled together to get total family income. Separate procedures were adopted to estimate activities and the income from the other sources.

Dietary intake of study subjects was assessed by 24 Hours Dietary Recall Method. Micronutrients intake was estimated by using Nutritive value of Indian Foods [25]. and their adequacy was assessed with respect to Recommended Dietary Allowances (RDA). Information about nature of diet, frequency of meal and timing of meal was also elicited by interviewing them using predesigned and pretested proforma.

Analysis of Data

Data thus generated were analyzed with the help of Microsoft excel 2007 and SPSS version 16th software. Appropriate tables were generated. Statistical tests X^2 , and logistic regression were applied; AOR and CI were computed for inference.

RESULTS

Average daily consumption of calcium was 41.75% of estimated RDA. Mean (mg/day) iron intake of study subjects was 11.04 ± 5.19 ; this was 44.16% of estimated RDA. Vitamin A and C intake were 25.52% and 89.8% of respective RDAs (Table 1 and Figure 1).

Table 1: Average Micronutrient Intake of Study Subjects

Nutrient	Nutrient intake Mean \pm SD	Estimated RDA	% of RDA
Calcium (mg/day)	334.05 ± 180.30	800	41.75
Iron (mg/day)	11.04 ± 5.19	25.13	44.16
Vitamin A (μ g/day)	1225 ± 1162.8	4800	25.52
Vitamin C (mg/day)	35.92 ± 10.58	40	89.80

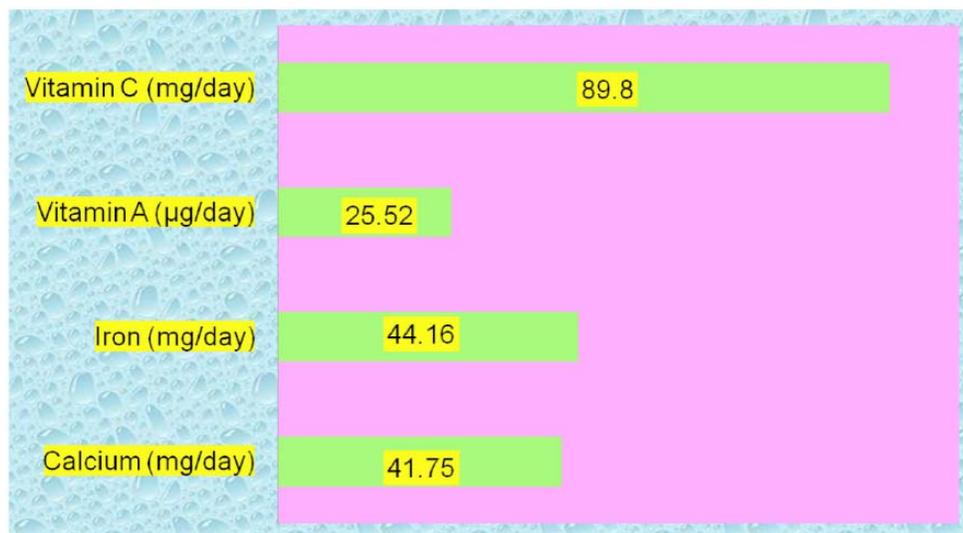


Figure 1: Average micronutrients intake of study subjects as percentage of RDA.

Table 2: Age Wise Calcium Intake of Study Subjects

Age group(years)	N	Mean intake (mg/day)	RDA	Percentage intake	Range
10-12	94	289.64 ±186.59	800	36.20	68.8-900
13-15	104	308.99 ±153.06	800	38.62	65-873.4
16-17	93	352.44 ±182.88	800	44.05	97.1-886.2
18-19	109	380.56 ±185.72	800	47.50	75.7-889.68
Overall	400	334.05 ± 180.30	800	41.75	65-900

Average calcium intake was 289.64±186.59, 308.99±153.06, 352.44±182.88 and 380.56±185.72 mg/day in 10-12, 13-15, 16-17 and 18-19 years age groups, respectively. In all age groups percentage intake of calcium was <50% of the RDA (Table 2).

Age wise iron intake of study subjects is given in Table 3. Mean iron intake of adolescent girls belonging to 18-19 years was 12.04±4.94 which was 57.33% of RDA value. Mean intake of iron as percentage of RDA was 36.70% in 10-12 years, 38.51% in 13-15 years and 45.11% in 16-17 years.

Vitamin A is an important nutrient required for optimum growth, integrity of mucus membrane and skin as well as vision. There existed wide variation in consumption of substances rich in vitamin A by adolescent girls. Average intake of vitamin A was least (1155± 921.5 mg/day) in the age group 10-12 years and maximum (1166±1306.4) in the age group 18-19

years. In all age groups vitamin A intake as percentage of RDA was less than 30% (Table 4).

Vitamin C plays a significant role in skeletal growth and for maintenance of healthy gums etc. Average intake of vitamin C in different age groups was compared with RDA and results are given in Table 5. Average vitamin C intake was least (33.23±10.92) in the age group 13-15 years age group and maximum (37.49±10.69) in 16-17 years age group. Vitamin C intake was more than 80.0% in all age groups.

In order to have an insight in the level of consumption of different micronutrients, intake by adolescent girls were expressed as percentage of RDA and the same is given in Table 6. As much as 72.8%, 71.2%, 88.2% and 6.2% subjects had calcium, iron, vitamin A and vitamin C intake ≤50% of RDA, respectively. In case of 7%, 9.5%, 7.2% and 64.85%

Table 3: Age Wise Iron Intake of Study Subjects

Age group(years)	N	Mean intake (mg/day)	RDA	Percentage intake	Range
10-12	94	9.91 ± 5.33	27	36.70	2.86-27.55
13-15	104	10.40 ± 4.96	27	38.51	2.90-28.09
16-17	93	11.73 ± 5.36	26	45.11	2.90-29.11
18-19	109	12.04 ± 4.94	21	57.33	2.77-24.34
Overall	400	11.04 ± 5.19	25.13	44.16	2.77-29.11

Table 4: Age Wise Vitamin A intake of Study Subjects

Age group(years)	N	Mean intake (ug/day)	RDA	Percentage intake	Range
10-12	94	1155± 921.5	4800	24.06	177.03-4900.2
13-15	104	1230 ±1054.4	4800	25.62	153.35-5118.15
16-17	93	1359 ± 1315.5	4800	28.31	201.8-4919.74
18-19	109	1166 ± 1306.4	4800	24.49	153.15-5208.45
Overall	400	1225 ±1162.8	4800	25.52	153.15-5208.45

Table 5: Age Wise Vitamin C Intake of Study Subjects

Age group(years)	N	Mean intake (mg/day)	RDA	Percentage intake	Range
10-12	94	35.56 ± 9.75	40	88.87	11.5-57.7
13-15	104	33.23 ±10.92	40	83.07	10.5-63.5
16-17	93	37.49 ± 10.69	40	93.70	10-60.7
18-19	109	37.47± 10.42	40	93.67	10.9-65
Overall	400	35.92 ± 10.58	40	89.8	10-65

Table 6: Micronutrients Intake of Adolescent Girls as Percentage of Recommended Dietary Allowances (400)

Percentage intake of RDA	Calcium		Iron		Vitamin A		Vitamin C	
	No	%	No	%	No	%	No	%
≤50	291	72.8	285	71.2	353	88.2	25	6.2
50.1-60	31	7.8	39	9.8	0	0.0	36	9.0
60.1-70	28	7.0	23	5.8	4	1.0	39	9.8
70.1-80	22	5.5	15	3.8	14	3.5	41	10.2
80.1-90	10	2.5	17	4.2	10	2.5	46	11.5
90.1-100	7	1.8	6	1.5	10	2.5	56	14.0
>100	11	2.8	15	3.8	9	2.2	157	39.2

subjects calcium, Iron, vitamin A and vitamin C intake was more than 80% of RDA, respectively.

In case of 78.2% subjects belonging to age group 10-14 years calcium consumption was <50% of the RDA; corresponding value for subjects in the age group 15-17 years and 18-19 years were 74.6% and 59.6%, respectively (Table 7). Calcium consumption as percentage of RDA differed significantly ($p<0.05$) in different age groups. There existed significant ($p<0.01$) association between calcium consumption and caste of the study subjects. As much as 85.9% SC, 75.5% OBC and 64.1% other caste category subjects had calcium consumption <50 percent of RDA. As much as 78.9% primary, 79.2% middle, 76.5% high school, 68.8% intermediate and 46.9% subjects undergoing graduation had calcium consumption <50percent of RDA. There existed no significant ($p>0.05$) association between religion, type and size of family, number of siblings, menstrual status of study subjects, total income of family, per capita income, socio economic status, literacy status and occupation of parents. Calcium consumption of study subjects expressed as percentage of RDA did not differ significantly ($p>0.05$) in vegetarian, nonvegetarian and eggetarian subjects. As much as 83.9%, 70.3%and 72.7% subjects having frequency of meal twice, thrice, four times a day, respectively, had calcium consumption <50% of the

RDA ($p>0.05$). In case of 72.2% subjects having fixed timings of meal calcium consumption was<50percent of RDA; corresponding value for subjects with irregular time of meal 71.7% ($p>0.05$).

In comparison to subjects having sibling ≤ 4 risk of less calcium intake was more (AOR 4.37; CI: 1.10-17.39) in subjects having sibling >7 . Effect of significant association of age, caste, subjects literacy on less calcium intake in univariate analysis got eliminated in logistic model (Table 8). The appropriateness of the model for correct prediction of calcium intake was 78.8% which is acceptable.

In case of 82.4%, 73.8% and 50.0% subjects belonging to age group 10-14, 15-17 and 18-19 years iron consumption was <50% of the RDA($p<0.01$). As much as 68.0% subjects from nuclear family and 76.4% subjects from joint family had iron consumption <50 percent of RDA. Iron consumption was significantly ($p<0.01$) more in menstruating than nonmenstruating girls; 32.8% menstruating and 13% nonmenstruating girls had iron consumption ≥ 50 percent of RDA. Iron consumption as percentage of RDA was also significantly associated with literacy status of subjects and nature of diet (Table 9).

In comparison to age group 10-14 years risk of less iron intake was more (AOR; 3.64;CI: 1.30-10.30) in

Table 7: Calcium Consumption of Adolescent Girls According to their Sociodemographic and Personal Characteristics

Parameters	n	Calcium consumption as percentage of RDA						x ²	df	p
		<50%		50-80%		>80%				
		No.	%	No.	%	No.	%			
AGE (Years)										
10 – 14	165	129	78.2	27	16.4	9	5.5	12.146	4	0.016
15 – 17	126	94	74.6	23	18.3	9	7.1			
18 - 19	109	65	59.6	34	31.2	10	9.2			
Religion										
Hindu	377	274	72.7	78	20.7	25	6.6	1.994	2	0.369
Muslim	23	14	60.9	6	26.1	3	13.0			
Caste										
SC	64	55	85.9	6	9.4	3	4.7	20.715	4	0.000
OBC	155	117	75.5	23	14.8	15	9.7			
Others	181	116	64.1	55	30.4	10	5.5			
Type of family										
Nuclear	256	181	70.7	57	22.3	18	7.0	0.710	2	0.701
Joint	144	107	74.3	27	18.8	10	6.9			
Family size										
≤ 3-6	207	144	69.6	50	24.2	13	6.3	5.062	4	0.281
7-12	149	115	77.2	24	16.1	10	6.7			
>12	44	29	65.9	10	22.7	5	11.4			
Sibling										
≤4	270	193	71.5	59	21.9	18	6.7	8.699	4	0.069
5-7	116	89	76.7	20	17.2	7	6.0			
>7	14	6	42.9	5	35.7	3	21.4			
Menstrual status										
Nonmenstruating	77	60	77.9	11	14.3	6	7.8	2.597	2	0.273
Menstruating	323	228	70.6	73	22.6	22	6.8			
Total income of family (Rs. / Month)										
≤ 4000	130	97	74.6	28	21.5	5	3.8	4.566	6	0.601
4001-8000	101	74	73.3	20	19.8	7	6.9			
8001-12000	53	39	73.6	10	18.9	4	7.5			
12001->16000	116	78	67.2	26	22.4	12	10.3			
Per capita income rupees per month) as per Poverty line Criteria										
≤780	163	123	75.5	31	19.0	9	5.5	1.831	2	0.400
>780	237	165	69.6	53	22.4	19	8.0			
Socio economic status										
Low+ Lower middle	100	77	77.0	17	17.0	6	6.0	3.470	4	0.482
Middle	170	124	72.9	36	21.2	10	5.9			
Upper Middle+ High	130	87	66.9	31	23.8	12	9.2			
Literacy status of Father										
Illiterate	6	3	50.0	2	33.3	1	16.7	6.978	6	0.323
Up to middle	79	64	81.0	10	12.7	5	6.3			
Up to intermediate	226	156	69.0	55	24.3	15	6.6			
Graduation to above	89	65	73.0	17	19.1	7	7.9			

(Table 7). Continued.

Parameters	n	Calcium consumption as percentage of RDA						x ²	df	p
		<50%		50-80%		>80%				
		No.	%	No.	No.	%	No.			
Mother Literacy										
Illiterate	109	79	72.5	21	19.3	9	8.3	10.792	6	0.095
Just literate to middle	138	88	63.8	40	29.0	10	7.2			
High school to intermediate	135	107	79.3	21	15.6	7	5.2			
Graduation and above	18	14	77.8	2	11.1	2	11.1			
Literacy status of subject										
Primary	76	60	78.9	10	13.2	6	7.9	25.327	8	0.001
Middle	77	61	79.2	15	19.5	1	1.3			
High school	102	78	76.5	17	16.9	7	6.9			
intermediate	96	66	68.8	21	21.9	9	9.4			
Graduation	49	23	46.9	21	42.9	5	10.2			
Father occupation										
Dead	15	10	66.7	4	26.7	1	6.7	2.466	6	.0872
Job	171	128	74.9	32	18.7	11	6.4			
Business	167	115	68.9	40	24.0	12	7.2			
Farmer/labour	47	35	74.5	8	17.0	4	8.5			
Mother occupation										
Dead	14	11	78.6	2	14.3	1	7.1	2.071	6	0.913
Job	28	19	67.9	6	21.4	3	10.7			
Business	20	13	65.0	6	30.0	1	5.0			
House wife	338	245	72.5	70	20.7	23	6.8			
Nature of diet										
Vegetarian	137	99	72.3	26	19.0	12	8.8	3.359	4	0.500
Non-Vegetarian	193	139	72.0	40	20.7	14	7.3			
Eggetarian	70	50	71.4	18	25.7	2	2.9			
Frequency of meal										
2 times	31	26	83.9	4	12.9	1	3.2	3.123	4	0.537
3times	259	182	70.3	59	22.8	18	6.9			
4times	110	80	72.7	21	19.1	9	8.2			
Timing of meal										
Fixed	241	174	72.2	52	21.6	15	6.2	0.621	2	0.733
Irregular	159	114	71.7	32	20.1	13	8.2			

subjects aged 18-19 years. Taking SC as reference category risk of less iron intake was more in subjects from other caste category (AOR; 2.91, CI: 1.07-7.91). The appropriateness of the model for correct prediction of iron intake was 81.0% which is acceptable (Table 10).

Vitamin A consumption of adolescent girls according to their socio demographic and personal characteristics is given in Table 11. In case of 18-19 years subjects vitamin A consumption as percentage of RDA was >80% in 11.0% subjects; corresponding value for 10-14 and 15-17 years were 5.5% and 6.3%,

Table 8: Result of Logistic Regression Analysis (Calcium Intake Status Verses Socio-Demographic Characteristics)

Particulars	variables	Percentage of observations	Beta	p-value	AOR	95.0% C.I.
Age (years)	10-14	40.2	-	-	-	-
	15-17	31.5	0.30	0.49	1.35	0.57-3.22
	18-19	27.2	0.47	0.34	1.60	0.60-4.28
Caste	SC	16.0	-	-	-	-
	OBC	38.7	0.54	0.27	1.72	0.65-4.54
	Others	45.3	0.74	0.12	2.10	0.81-5.44
Subject Literacy	Primary	19.0	-	-	-	-
	Middle	19.2	0.01	0.98	0.97	0.36-2.71
	High school	25.5	0.25	0.66	1.29	0.42-3.92
	Intermediate	24.0	0.58	0.32	1.79	0.57-5.62
	Graduation	12.0	0.82	0.23	2.26	0.59-8.67
Sibling	≤4	67.5		0.06		
	5-7	29.0	0.25	0.45	0.77	0.40-1.50
	>7	3.5	1.48	0.04	4.37	1.10-17.39

Table 9: Iron Consumption of Adolescent Girls According to their Sociodemographic and Personal Characteristics

Parameters	n	Iron consumption as percentage of RDA						x ²	df	p
		<50%		50-80%		>80%				
		No.	%	No.	%	No.	%			
AGE (Years)										
10 – 14	165	136	82.4	20	12.1	9	5.5	35.858	4	0.000
15 – 17	126	93	73.8	25	19.8	8	6.3			
18 - 19	109	55	50.0	33	30.3	21	19.3			
Religion										
Hindu	377	267	70.8	73	19.4	37	9.8	0.774	2	0.679
Muslim	23	17	73.9	5	21.7	1	4.3			
Caste										
SC	64	50	78.1	10	15.6	4	6.2	5.047	4	0.283
OBC	155	112	72.3	32	20.6	11	7.1			
Others	181	122	67.4	36	19.9	23	12.7			
Type of family										
Nuclear	256	174	68.0	60	23.4	22	8.6	7.189	2	0.027
Joint	144	110	76.4	18	12.5	16	11.1			
Family size										
≤ 3-6	207	140	67.6	48	23.2	19	9.2	4.730	4	0.316
7-12	149	113	75.8	23	15.4	13	8.7			
>12	44	31	70.5	7	15.9	6	13.6			

(Table 9). Continued.

Parameters	n	Iron consumption as percentage of RDA						x ²	df	p
		<50%		50-80%		>80%				
		No.	%	No.	No.	%	No.			
Sibling										
≤ 4	270	185	68.5	54	20.0	31	11.5	5.951	4	0.203
5-7	116	90	77.6	21	18.1	5	4.3			
>7	14	9	64.3	3	21.4	2	14.3			
Menstrual status										
Nonmenstruating	77	67	87.0	4	5.2	6	7.8	13.743	2	0.001
Menstruating	323	217	67.2	74	22.9	32	9.9			
Total income of family (Rs. / Month)										
≤ 4000	130	99	76.2	25	19.2	6	4.6	8.750	6	0.188
4001-8000	101	67	66.3	20	19.8	14	13.9			
8001-12000	53	40	75.5	10	18.9	3	5.7			
12001->16000	116	78	67.2	23	19.8	15	12.9			
Per capita income rupees per month) as per Poverty line Criteria										
≤780	163	124	76.1	28	17.2	11	6.7	3.951	2	0.139
>780	237	160	67.5	50	21.1	27	11.4			
Socio economic status										
Low + Lower middle	100	79	79.0	17	17.0	4	4.0	6.054	4	0.195
Middle	170	115	67.6	36	21.2	19	11.2			
Upper Middle+ High	130	90	69.2	25	19.2	15	11.5			
Literacy status of Father										
Illiterate	6	5	83.3	0	0.0	1	16.7	5.872	6	0.438
Up to middle	79	60	75.9	11	13.9	8	10.1			
Up to intermediate	226	156	69.0	46	20.4	24	10.6			
Graduation to above	89	63	70.8	21	23.6	5	5.6			
Mother Literacy										
Illiterate	109	81	74.3	16	14.7	12	11.0	5.584	6	0.471
Just literate to middle	138	90	65.2	35	25.4	13	9.4			
High school to intermediate	135	100	74.1	24	17.8	11	8.1			
Graduation and above	18	13	72.2	3	16.7	2	11.1			
Literacy status of subject										
Primary	76	64	84.2	7	9.2	5	6.6	37.347	8	0.000
Middle	77	64	83.1	9	11.7	4	5.2			
High school	102	74	72.5	21	20.6	7	6.9			
intermediate	96	62	64.6	23	24.0	11	11.5			
Graduation	49	20	40.8	18	36.7	11	22.4			
Father occupation										
Dead	15	11	73.3	1	6.7	3	20.0	4.695	6	0.584
Job	171	119	69.6	38	22.2	14	8.2			
Business	167	119	71.3	32	19.2	16	9.6			
Farmer/labour	47	35	17.5	7	14.9	5	10.6			

(Table 9). Continued.

Parameters	n	Iron consumption as percentage of RDA						x ²	df	p
		<50%		50-80%		>80%				
		No.	%	No.	No.	%	No.			
Mother occupation										
Dead	14	9	64.3	3	21.4	2	14.3	6.469	6	0.373
Job	28	20	71.4	5	17.9	3	10.7			
Business	20	10	50.0	8	40.0	2	10.0			
House wife	338	245	72.5	62	18.3	31	9.2			
Nature of diet										
Vegetarian	137	100	73.0	17	12.4	20	14.6	11.206	4	0.024
Non-Vegetarian	193	135	69.9	45	23.3	13	6.7			
Eggetarian	70	49	70.0	16	22.9	5	7.1			
Frequency of meal										
2 times	31	24	77.4	7	22.6	0	0.0	6.273	4	0.180
3times	259	189	73.0	46	17.8	24	9.3			
4times	110	71	64.5	25	22.7	14	12.7			
Timing of meal										
Fixed	241	177	73.4	47	19.5	17	7.1	4.329	2	0.115
Irregular	159	107	67.3	31	19.5	21	13.2			

Table 10: Result of Logistic Regression Analysis (Iron Intake Status Verses Sociodemographic Characteristics)

Particulars	Variables	Percentage of observation	Beta	Sig.	AOR	95.0% C.I.
Age (years)	10-14	40.2	-	-	-	-
	15-17	31.5	0.49	0.30	1.63	0.65-4.06
	18-19	27.2	1.30	0.01	3.66	1.30-10.30
Caste	SC	16.0	-	-	-	-
	OBC	38.7	0.69	0.19	1.10	0.71-5.58
	Others	45.3	1.07	0.04	2.91	1.07-7.91
Subject Literacy	Primary	19.0	-	-	-	-
	Middle	19.2	0.05	0.91	1.06	0.39-2.89
	High school	25.5	0.08	0.89	0.92	0.29-2.90
	Intermediate	24.0	0.42	0.50	0.66	0.20-2.20
	Graduation	12.0	0.13	0.85	0.88	0.22-3.53
Sibling	≤4	67.5	-	-	-	-
	5-7	29.0	0.54	0.13	0.58	0.29-1.18
	>7	3.5	0.96	0.17	2.61	0.66-10.31

respectively. None of other socio-demographic and personal variables (viz. religion, caste, type and size of family, number of siblings, menstrual status, total income of family, per capita income, SES, literacy

status of self and parents, occupation of parents, nature of diet, frequency and timing of meal) were significantly associated with vitamin A consumption expressed as percentage of RDA.

Table 11: Vitamin A Consumption of Adolescent Girls According to their Socio Demographic and Personal Characteristics

Parameters	n	Vitamin A consumption as percentage of RDA						x ²	df	p
		<50%		50-80%		>80%				
		No.	%	No.	%	No.	%			
AGE (Years)										
10 – 14	165	151	91.5	5	3.0	9	5.5	10.895	4	0.028
15 – 17	126	107	84.9	11	8.7	8	6.3			
18 - 19	109	95	87.2	2	1.8	12	11.0			
Religion										
Hindu	377	335	88.9	16	4.2	26	6.9	2.360	2	0.307
Muslim	23	18	78.3	2	8.7	3	13.0			
Caste										
SC	64	61	95.3	1	1.6	2	3.1	6.412	4	0.170
OBC	155	130	83.9	9	5.8	16	10.3			
Others	181	162	89.5	8	4.4	11	6.1			
Type of family										
Nuclear	256	221	86.3	15	5.9	20	7.8	3.528	2	0.171
Joint	144	132	91.7	3	2.1	9	6.2			
Family size										
≤ 3-6	207	177	85.5	12	5.8	18	8.7	5.968	4	0.202
7-12	149	138	92.6	5	3.4	6	4.0			
>12	44	38	86.4	1	2.3	5	11.4			
Sibling										
≤ 4	270	237	87.8	13	4.8	20	7.4	0.634	4	0.959
5-7	116	104	89.7	4	3.4	8	6.9			
>7	14	12	85.7	1	7.1	1	7.1			
Menstrual status										
Nonmenstruating	77	71	92.2	3	3.9	3	3.9	1.726	2	0.422
Menstruating	323	282	87.3	15	4.6	26	8.0			
Total income of family (Rs. / Month)										
≤ 4000	130	114	87.7	7	5.4	9	6.9	4.748	6	0.577
4001-8000	101	92	91.1	4	4.0	5	5.0			
8001-12000	53	45	84.9	1	1.9	7	13.2			
12001->16000	116	102	87.9	6	5.2	8	6.9			
Per capita income rupees per month) as per Poverty line Criteria										
≤780	163	144	88.3	7	4.3	12	7.4	0.031	2	0.985
>780	237	209	88.2	11	4.6	17	7.2			
Socio economic status										
Low + Lower middle	100	90	90.0	3	3.0	7	7.0	0.841	4	0.933
Middle	170	149	87.6	9	5.3	12	7.1			
Upper Middle+ High	130	114	87.7	6	4.6	10	7.7			
Literacy status of Father										
Illiterate	6	5	83.3	0	0.0	1	16.7	3.861	6	0.696
Up to middle	79	70	88.6	4	5.1	5	6.3			
Up to intermediate	226	200	88.5	12	5.3	14	6.2			
Graduation to above	89	78	87.6	2	2.2	9	10.1			

(Table 11). Continued.

Parameters	n	Vitamin A consumption as percentage of RDA						x ²	df	p
		<50%		50-80%		>80%				
		No.	%	No.	No.	%	No.			
Mother Literacy										
Illiterate	109	97	89.0	5	4.6	7	6.4	3.752	6	0.710
Just literate to middle	138	120	87.0	8	5.8	10	7.2			
High school to intermediate	135	118	87.4	5	3.7	12	8.9			
Graduation and above	18	18	100.0	0	0.0	0	0.0			
Literacy status of subject										
Primary	76	71	93.4	2	2.6	3	3.9	7.640	8	0.469
Middle	77	70	90.9	4	5.2	3	3.9			
High school	102	84	82.4	7	6.9	11	10.8			
intermediate	96	84	87.5	4	4.2	8	8.3			
Graduation	49	44	89.8	1	2.0	4	8.2			
Father occupation										
Dead	15	14	93.3	0	0.0	1	6.7	2.766	6	0.838
Job	171	153	89.5	6	3.5	12	7.0			
Business	167	144	86.2	9	5.4	14	8.4			
Farmer/labour	47	42	89.4	3	6.4	2	4.3			
Mother occupation										
Dead	14	12	85.7	2	14.3	0	0.0	9.654	6	0.140
Job	28	28	100.0	0	0.0	0	0.0			
Business	20	16	80.0	1	5.0	3	15.0			
House wife	338	297	87.9	15	4.4	26	7.7			
Nature of diet										
Vegetarian	137	120	87.6	7	5.1	10	7.3	2.051	4	0.726
Non-Vegetarian	193	170	88.1	10	5.2	13	6.7			
Eggetarian	70	63	90.0	1	1.4	6	8.6			
Frequency of meal										
2 times	31	28	90.3	3	9.7	0	0.0	5.037	4	0.284
3times	259	227	87.6	10	3.9	22	8.5			
4times	110	98	89.1	5	4.5	7	6.4			
Timing of meal										
Fixed	241	207	85.9	12	5.0	22	9.1	3.643	2	0.162
Irregular	159	146	91.8	6	3.8	7	4.4			

Vitamin C consumption of study subjects as percentage of RDA was not significantly associated with their age, religion, caste, type and size of family, number of siblings, menstrual status, literacy status of self and parents, father's occupation, nature of diet, frequency and timing of meal. Vitamin C intake of

adolescent girls having mother's occupation as house wife was >80% of RDA in 65.7%; corresponding value for subjects with mother's occupation as job and business were 53.6% and 75.0%, respectively ($p < 0.05$) (Table 12).

Table 12: Vitamin C Consumption of Adolescent Girls According to their Socio Demographic and Personal Characteristics

Parameters	n	Vitamin C consumption as percentage of RDA						x ²	df	p
		<50%		50-80%		>80%				
		No.	%	No.	%	No.	%			
AGE (Years)										
10 – 14	165	14	8.5	47	28.5	104	63.0	3.793	4	0.435
15 – 17	126	6	4.8	41	32.5	79	62.7			
18 - 19	109	5	4.6	28	25.7	76	69.7			
Religion										
Hindu	377	24	6.4	106	28.1	247	65.5	2.501	2	0.286
Muslim	23	1	4.3	10	43.5	12	52.2			
Caste										
SC	64	6	9.4	20	31.2	38	59.4	1.866	4	0.760
OBC	155	9	5.8	46	29.7	100	64.5			
Others	181	10	5.5	50	27.6	121	66.9			
Type of family										
Nuclear	256	17	6.6	71	27.7	168	65.6	0.650	2	0.722
Joint	144	8	5.6	45	31.2	91	63.2			
Family size										
≤ 3-6	207	15	7.2	54	26.1	138	66.7	4.772	4	0.311
7-12	149	9	6.0	44	29.5	96	64.4			
>12	44	1	2.3	18	40.9	25	56.8			
Sibling										
≤4	270	17	6.3	69	25.6	184	68.1	8.751	4	0.068
5-7	116	6	5.2	40	34.5	70	60.3			
>7	14	2	14.3	7	50.0	5	35.7			
Menstrual status										
Nonmenstruating	77	6	7.8	16	20.8	55	71.4	3.242	2	0.198
Menstruating	323	19	5.9	100	31.0	204	63.2			
Total income of family (Rs. / Month)										
≤ 4000	130	10	7.7	43	33.1	77	59.2	12.812	6	0.046
4001-8000	101	10	9.9	28	27.7	63	62.4			
8001-12000	53	1	1.9	20	37.7	32	60.4			
12001->16000	116	4	3.4	25	21.6	87	75.0			
Per capita income rupees per month) as per Poverty line Criteria										
≤780	163	12	7.4	57	35.0	94	57.7	6.055	2	0.048
>780	237	13	5.5	59	24.9	165	69.6			
Socio economic status										
Low+ Lower middle	100	4	4.0	38	38.0	58	58.0	13.067	4	0.011
Middle	170	17	10.0	47	27.6	106	62.4			
Upper Middle+ High	130	4	3.1	31	23.8	95	73.1			
Literacy status of Father										
Illiterate	6	1	16.7	1	16.7	4	66.7	7.328	6	0.292
Up to middle	79	5	6.3	18	22.8	56	70.9			
Up to intermediate	226	17	7.5	72	31.9	137	60.0			
Graduation to above	89	2	2.2	25	28.1	62	69.7			

(Table 12). Continued.

Parameters	n	Vitamin C consumption as percentage of RDA						x ²	df	p
		<50%		50-80%		>80%				
		No.	%	No.	No.	%	No.			
Mother Literacy										
Illiterate	109	7	6.4	26	23.9	76	69.7	8.192	6	03.224
Just literate to middle	138	6	4.3	46	33.3	86	62.3			
High school to intermediate	135	12	8.9	41	30.4	82	60.7			
Graduation and above	18	0	0.0	3	16.7	15	83.3			
Literacy status of Subject										
Primary	76	5	6.6	19	25.0	52	68.4	11.678	8	0.166
Middle	77	9	11.7	25	32.5	43	55.8			
High school	102	7	6.9	34	33.3	61	59.8			
intermediate	96	4	4.2	25	26.0	67	69.8			
Graduation	49	0	0.0	13	26.5	36	73.5			
Father occupation										
Dead	15	3	20.0	3	20.0	9	60.0	8.254	6	0.220
Job	171	9	5.3	47	27.5	115	67.3			
Business	167	8	4.8	51	30.5	108	64.7			
Farmer/ labour	47	5	10.6	15	31.9	27	57.4			
Mother occupation										
Dead	14	1	7.1	6	42.9	7	50.0	14.624	6	0.023
Job	28	6	21.4	7	25.0	15	53.6			
Business	20	0	0.0	5	25.0	15	75.0			
House wife	338	18	5.3	98	29.0	222	65.7			
Nature of diet										
Vegetarian	137	14	10.2	45	32.8	78	56.9	8.284	4	0.082
Non-Vegetarian	193	8	4.1	52	26.9	133	68.9			
Eggitarian	70	3	4.3	19	27.1	48	68.6			
Frequency of meal										
2 times	31	1	3.2	8	25.8	22	71.0	4.739	4	0.315
3times	259	20	7.7	80	30.9	159	61.4			
4times	110	4	3.6	28	25.5	78	70.9			
Timing of meal										
Fixed	241	12	5.0	75	31.1	154	63.9	2.574	2	0.276
Irregular	159	13	8.2	41	25.8	105	66.0			

Taking subjects without mother as reference odds of less vitamin C intake was less (AOR 0.09; CI:0.01-0.92) in subjects whose mother were engaged in job. In comparison to vegetarians, odds of less vitamin C intake was more in nonvegetarian (AOR 2.01; CI: 1.10-3.65) and eggitarian (AOR 2.53; CI:1.03-6.19). The appropriateness of the logistic model for correct prediction of vitamin C intake was 84.8% which is acceptable (Table 13).

DISCUSSION

In the post independent era of the planning process India primarily concentrated on maternal and child health. However, recently the focus is shifted on adolescents in general and girls in particular. By sheer number adolescents account for one fifth in the population. Seventy percent of the deaths in adulthood is linked to habits picked up during adolescence. Due

Table 13: Result of Logistic Regression Analysis (Risk of Less Vitamin C Intake Status Verses Sociodemographic Characteristics)

Particulars	Variables	Percentage of observations	Beta	Sig.	AOR	95.0% C.I.
Mother occupation	Dead	3.5	-	-	-	-
	Job	7.0	-2.39	0.04	0.09	0.01-0.92
	Business	5.0	-1.23	0.24	0.29	0.04- 2.26
	House wife	84.5	-2.15	0.05	0.12	0.01-1.04
Nature of diet	Vegetarian	34.3	-	-	-	-
	Non- Vegetarian	48.2	0.70	0.02	2.01	1.10-3.65
	Eggetarian	17.5	0.93	0.04	2.53	1.03-6.19

to the impact of urbanization and globalization the indigenous dietary practices are changing very fast and fast food culture is a potential threat in adolescents. Adolescents are sufferers of macronutrients deficiency [26]. However for their optimum health micronutrients adequacy is of paramount importance. This study amply highlighted that adolescent girls are more victims of micronutrients inadequacy. In conformity with the findings of present study micronutrients deficiency in the urban adolescent girls have been reported in several studies. In conformity with the findings of Bidad *et al* [27] calcium intake has been less in urban adolescent girls of Varanasi. Vitamin A and C intakes have been below RDA in adolescents factory workers [28]. In the present study average vitamin A consumption has been alarmingly low whereas this was not the case for vitamin C. According to a report [16] more than two third adolescent girls consumed Vitamin A less than 70% of RDA. Ascorbic acid adequacy was also reported in a study conducted in Bangladesh. However both present as well as another study [29] reported average intake of iron less than 50% of RDA. Bangladesh study reported that mean daily iron intake was observed to be less than 50 per cent of the RDA, whereas the ascorbic acid intake was adequate, leading to many adolescent girls having normal haemoglobin levels inspite of iron consumption being less than RDA.

A study on adolescent female factory workers in urban Bangladesh food intake data revealed a mean intake of calcium, iron, vitamin A, thiamin, riboflavin, niacin and vitamin C were below the RDA. Most of the energy and nutrients came from cereal and grains [27].

In a study the micronutrient intake of students, subjects were divided into 2 groups of 11-13 and 14-18 yr of age (to properly compare the intakes with the DRIs). In the first group (11-13 yr), students had mean

intakes lower for folic acid, vitamin E, calcium, magnesium, phosphorus, potassium and sodium. In the second group (14-18 yr), students had mean intakes lower than EAR for niacin, pyridoxine, folic acid, pantothenic acid, vitamin E, calcium, magnesium, phosphorus, potassium, sodium and zinc [26]. Comparing overweight and obese adolescent girls with others, overweight and obese adolescents had less carbohydrate, thiamin, niacin, iron and selenium intake ($P < 0.05$). In univariate analysis age, caste and literacy status of the subjects influenced significantly calcium intake. Significant association has been also observed between iron consumption and age, type of family, menstrual status, literacy status and nature of diet. Age was the only variable which was significantly associated with vitamin A consumption. The significant variables for consumption of vitamin C have been total income of family (Rs./month), per capita income, socio economic status and mothers occupation. However on logistic regression significant variable(s) were sibling more than 7 for calcium, age and caste for iron and mother occupation and nature of diet for vitamin C. The scenario just described clearly reflect that their has been similarity in dietary pattern of adolescent girls to a considerable extent. The initiatives taken for overcoming micronutrients inadequacy by public sector has been grossly inadequate. Strategies and action at individual, family and community level for overcoming micronutrient inadequacy are particularly nonexistent. There is urgent need to move from strategic and conceptual framework to concerned efforts and action in this direction.

CONCLUSION

Micronutrients deficiency both in terms of average and percentage intake of RDAs prevailed in the study subjects irrespective of age group. This was quite significant for calcium, iron and vitamin A. In contrast to

this average vitamin C intake was more than 80% of RDA in all age groups.

ACKNOWLEDGMENT

Authors acknowledge Prof. G.P. Singh of the Department of Community Medicine, Institute of Medical Sciences, Banaras Hindu University, for statistical help.

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