

Original Article

Diet quality and nutritional status of rural adolescent girl beneficiaries of ICDS in north India

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This study assessed the diet quality and nutritional status of beneficiaries of Adolescent Girl scheme, a national programme targeted towards their nutrition/health needs. 209 girls (aged 11-21 years) from six rural blocks - Delhi (Alipur, Kanjhawala and Mehrauli), Haryana (Madhosinghana), Rajasthan (Deeg) and Uttar Pradesh (Fatehpur Sikri) comprised the sample. Weight and height were measured and dietary intake data were gathered by one day 24 Hour Recall coupled with Food Frequency approach. Incidence of thinness ('BMI for age' <5th percentile) and stunting ('height for age' <3rd percentile) was 30.6% and 29.7%. The subjects followed a two-meal pattern and their diets were monotonous and cereal-based. 49.3% of them were found to have energy intake less than 75% of RDA while a substantial proportion of them had inadequate nutrient intake (NAR <0.66) with respect to most of the micronutrients especially iron (84.7%), folic acid (79.4%) and vitamin A (73.2%). The mean daily intake of milk and milk products, pulses, green leafy vegetables, other vegetables and fruits was grossly inadequate meeting only 47%, 36%, 26%, 34% and 3% of the suggested allowances; that of fats/oils and roots/tubers was somewhat adequate meeting 65% and 72% of the allowances while the intake of cereals and sugar was almost adequate revealing a deficit of only 7% and 3%. The study reveals not only a high incidence of under-nutrition but also an inadequate energy/micronutrient intake among the beneficiaries of Adolescent Girl scheme. Therefore, sustained efforts are needed to strengthen the scheme for improving its field-level implementation.

Key Words: dietary intake, diet quality, nutritional status, adolescent girl, rural communities, India

Introduction

World Health Organization (WHO) has defined 'adolescence' as the period between 10 and 19 years.¹ Adolescent girls, constituting nearly one tenth of Indian population, form a crucial segment of the society.² Their current nutritional status will decide the well being of the present as well as the future generations. Under-nutrition among these girls is associated with reduced lean body mass, lack of muscular strength and decreased work capacity.³ Moreover, under-fed girls are at risk of being stunted mothers who are likely to suffer obstetric complications and to deliver low birth weight babies.⁴ In the absence of effective nutritional interventions, the low birth weight girls become the next generation of stunted mothers, thus, perpetuating the vicious cycle of malnutrition. Nevertheless, second decade of life is the only time following infancy when the growth rate is very rapid and an individual acquires 35% of adult weight and 11-18% of adult height.⁵ In other words, adolescence provides a second opportunity for girls to attain 'catch up growth' and break the intergenerational cycle of malnutrition provided there is a significant increase in their nutrient intake.⁶

However, the state of rural adolescent girls in India is quite dismal. Despite the increased nutritional requirements during adolescence,^{7,8} their average nutrient intake is much below the recommended allowances.^{9,10} It has been estimated that 35% of rural girls, at 17 years of age, are un-

derweight (<38 kg) and 23% are under height (<145 cm) which is recognized as obstetric risk factor.¹¹

Till late, the nutritional needs of these girls had been sadly ignored in our developmental programmes; the focus had rather been only on the preschool children and the mothers.¹² It was in the year 1991 that the Government of India took the initiative of including adolescent girls as the beneficiaries of Adolescent Girl (AG) scheme under the Integrated Child Development Services (ICDS) programme. One of the largest in the world in terms of its reach, ICDS scheme is a comprehensive programme for delivery of an integrated package of services to achieve the overall development of children.¹³ In spite of its shortcomings; it has been quite successful in achieving its objectives.¹⁴

The AG scheme, on the other hand, focuses on out-of-school adolescent girls (ICDS defines 11 to 18 years olds as adolescents) and aims to improve their nutritional status. Under the AG scheme, there are two sub schemes- AG I for 11 to 15 years old girls and AG II for all girls aged 11 to 18 years.¹⁵

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This scheme has now been revised as 'Kishori Shakti Yojna' and expanded to two thousand blocks covering 1.3 million girls. The revised scheme provides the states, union territories and districts an option to either continue with the earlier AG scheme or develop their own plan of action to meet their area-specific needs.¹⁶ The present study was undertaken in blocks where AG scheme was in implementation.

While ICDS scheme and its impact on child beneficiaries have been studied extensively,¹⁷⁻¹⁹ the studies on AG scheme²⁰⁻²¹ are limited and there is paucity of data on the nutritional status of its beneficiaries. Therefore, this investigation was undertaken to assess the diet quality and nutritional status of adolescent girl beneficiaries of AG scheme.

Materials and methods

This cross-sectional study was carried out in the capital of India (Delhi) and its neighbouring states (Rajasthan, Uttar Pradesh and Haryana) where the scheme had been in operation before 1995-96. From Delhi, all the three blocks namely, *Alipur*, *Kanjhawala* and *Mehrauli* where the scheme had been in implementation were included in the study. In case of other states, one block per state i.e. *Deeg* (Rajasthan); *Fatehpur Sikri* (Uttar Pradesh) and *Madhosinghana* (Haryana) were selected. The study area, thus, covered six blocks in four states.

Sampling

Purposive sampling was used to identify the blocks; the criteria of selection being the existence of AG scheme for at least five years at the time of data collection and the convenience of visiting the area. On the other hand, random sampling techniques were employed to select the beneficiaries from the identified blocks. Using random sampling, two circle areas per block were selected from which nine *Anganwadi Centres* (the focal point for delivery of ICDS services) were identified. From each of the identified *Anganwadi Centres*, 2 or 3 beneficiaries of AG I were selected and in case of AG II, 16 to 20 girls per block were included in the study giving preference to the target beneficiaries (out-of-school adolescent girls belonging to low socio-economic group). The sample comprised of 209 adolescent girl beneficiaries of whom 147 were from AG I and 62 from AG II (while AG I was operational all the six blocks under study, AG II was operating only in *Alipur*, *Kanjhawala*, *Fatehpur Sikri* and *Madhosinghana*).

Prior to data collection, necessary permission was sought from the Department of Social Welfare in the respective states and the informed oral consent of adolescent girl respondents as well as that of their parents was obtained and their anonymity has been preserved.

Assessment of dietary intake and diet quality

The data on dietary intake of the subjects were gathered by one day 24 Hour Recall; Food Frequency Questionnaire was employed for validating the dietary data. Mean daily intake of the subjects was computed and compared with the suggested amounts of various food groups in a balanced diet for Indian girls aged 13 to 15 years.²² The nutrient intake was calculated using the computerized

programme based on food composition tables. Thereafter, mean nutrient intake was assessed and compared with the recommended dietary allowances (RDA) for the respective age groups (10-12 years, 13-15 years, 16-18 years and above 18 years).²³

In order to assess the diet quality, the adequacy of nutrient intake by each subject was computed in terms of Nutrient Adequacy Ratio (NAR) using

$$\text{NAR} = \frac{\text{Subject's nutrient intake of a day}}{\text{RDA of the respective nutrient}}$$

Thereafter, the subjects were categorized as those having an adequate (≥ 1.00), fairly adequate ($0.66 < 1.00$) or inadequate (< 0.66) NAR for various nutrients. Since NAR is not a good indicator for assessing the adequacy or inadequacy of energy intake therefore, energy intake data were expressed as percent of RDA for the particular age group. In the present study, 25% below the RDA has been employed as the cut-off for estimating energy inadequacy while 25% above the RDA has been used to identify subjects with excess energy intake.²⁴

Weight/height measurement and BMI

Height (to the nearest 0.1 cm) and weight (to the nearest 0.5 kg) were measured using Libra scale and the anthropometric rod. Body Mass Index (BMI) was subsequently computed by dividing the weight in kilograms by the square of height in metres (kg/m^2). Mean weight, height and BMI were calculated for different age categories. The anthropometric nutritional status was assessed by 'BMI for age' and 'height for age' as per National Centre for Health Statistics (NCHS)/WHO standards. The subjects with 'BMI for age' less than 5th percentile were categorized as thin and those with 'BMI for age' ≥ 85 th percentile were considered to be at risk of being overweight while subjects having 'BMI for age' between 5th and 85th percentile were categorized as normal. The subjects with 'height for age' less than 3rd percentiles were considered to be stunted.³

Statistical analysis

The data were analysed using Statistical Package of Social Sciences (SPSS, version 9). Statistical measures such as frequency, percentage, mean, range, standard deviation and t test were employed to describe and analyse the data.

Results

Profile of the subjects

Mean age of the subjects was 13.6 years (ranging from 11 to 21 years); the proportion of adolescent beneficiaries (11-18 years) being 95.2%. Younger beneficiaries (11-15 years) constituted 78.5% while 16-18 year old formed 16.7 % of the sample; only 4.8% were aged above 18 years. Of them, 19% were illiterate and 29% school drop-out; only four were married but none had attained motherhood. They were predominantly Hindu (97%) and nearly 60% of them belonged to the scheduled castes, scheduled tribes or other backward classes. 55% reportedly had their family income less than 2000 Rupees per month (45 Rupees = 1 US Dollar) and thus belonged to low socio-economic group as per income categorization.²⁵

Table 1. Socio-economic and demographic profile of the subjects (N=209)

Characteristics	No.	%	Characteristics	No.	%
Age (in years)			Religion		
11-12	88	42.1	Hindu	203	97.1
13-15	76	36.4	Muslim	6	2.9
16-18	35	16.7	Caste		
>18	10	4.8	SC/ST	71	34.0
Schooling status			OBC	54	25.8
Never gone to school	39	18.7	Others	84	40.2
School drop-out	60	28.7	Family income (Rupees†)		
School going	110	52.6	≤1000	59	28.2
Last class passed			1001 - ≤ 2000	55	26.3
None	39	18.7	2001 - ≤ 4000	54	25.8
I - V	62	29.7	> 4000	41	19.7
VI - VIII	66	31.5	Family occupation		
X - XII	39	18.7	Agriculture	34	16.3
> XII	3	1.4	Labour	79	37.8
Marital status			Service	59	28.2
Unmarried	205	98.1	Business	17	8.1
Married	4	1.9	Others	20	9.6

† 45 Rupees = 1 US Dollars

Nearly half (54%) of the subjects were from the families engaged in agriculture, agricultural labour or non-agricultural labour (Table 1).

Food intake

Data indicate that most of the subjects followed a two-meal pattern; their diets were vegetarian, cereal based and monotonous. The mean daily intake of cereals, pulses, milk and milk products, sugar and fats/oils was 250 g, 22 g, 234 g, 20 g and 16 g while that of roots/tubers, green leafy vegetables, other vegetables and fruits was 72g, 26g, 34g and 3g respectively (Fig 1). Data reveal that the mean daily intake of milk and milk products, pulses, green leafy vegetables, other vegetables and fruits was grossly inadequate meeting only 47%, 36%, 26%, 34% and 3% of the suggested amounts; that of fats/oils and roots/tubers was somewhat adequate meeting 65% and 72% of the allowances while the intake of cereals and sugar was almost adequate revealing a deficit of only 7% and 3%.

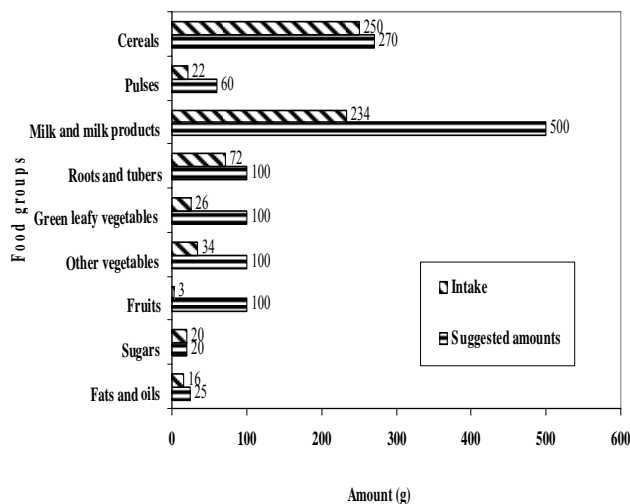


Figure 1. Mean daily intake versus suggested amounts of various food groups (N=209)

Energy/nutrient intake and diet quality

Table 2 shows the mean nutrient intake of the subjects by age. In case of 11-18 year old subjects, the mean daily intake of energy was 68.0% to 75.3% of the RDA and that of protein was between 68.3% and 79.8%. Mineral and vitamin intake data indicate that with the exception of calcium and thiamin, the intake of all other nutrients was below the recommended allowances especially, vitamin A, folic acid and iron where the intake was only half to two-third of the RDA. The energy and nutrient gap (particularly for protein, riboflavin and niacin) was found to be more pronounced in case of the younger subjects (10-12 and 13-15 years old) than those aged 16 years and above. However, in case of iron and folic acid, the diets of older subjects were rather deficient.

Energy intake data, expressed as percent of RDA for the particular age group, are presented in Table 3. Data indicate that nearly half of the subjects (52.2%) had inadequate energy intake (<75% of RDA) while only one subject (0.5%) had excessive energy intake (>125% of RDA). Block-wise data reveal that three-fourth of the subjects from *Deeg* (72.8%) and *Mehrauli* (73.4%); about half from *Alipur* (55.5%) and *Fatehpur Sikri* (52.8%) and less than two-fifth from *Kanjhawala* (42.2%) and *Madhosinghana* (30.6%) had inadequate energy intake

Table 4 reveals nutrient intake data expressed as nutrient adequacy ratio (NAR). Findings indicate that though a large majority of the subjects had adequate or fairly adequate NAR (≥ 0.66) with respect to protein (83.7%), calcium (94.7%), thiamin (98.1%), riboflavin (60.8%), niacin (87.1%) and vitamin C (56.9%); only a small number had adequate/fairly adequate intake with respect to vitamin A (26.8%), folic acid (15.8%) and iron (15.3%).

Nutritional status

The mean weight, height and BMI by age of the subjects are presented in Table 5. Data indicate that the mean weight in all the age groups was below the NCHS stan-

Table 2. Mean nutrient intake of the subjects by age (N=209)

Nutrient	10-12 years (n=88)			13-15 years (n=76)			16-18 years (n=35)			> 18 years (n=10)		
	RDA [†]	Mean \pm SD [‡]	% adequacy	RDA	Mean \pm SD	% adequacy	RDA	Mean \pm SD	% adequacy	RDA	Mean \pm SD	% adequacy
Energy (kcal)	1970	1340 \pm 350 (587 – 3129)	68.0	2060	1417 \pm 309 (525 – 2139)	68.8	2060	1552 \pm 391 (543 – 2261)	75.3	2225	1603 \pm 297 (1250 – 2149)	72.1
Protein (g)	57	41.3 \pm 12.3 (10.1 – 104.0)	72.5	65	44.4 \pm 11.0 (9.8 – 67.2)	68.3	63	50.3 \pm 14.4 (15.2 – 72.3)	79.8	50	51.9 \pm 12.0 (34.5 – 75.4)	103.8
Calcium (mg)	600	563 \pm 278 (101 – 1656)	93.8	600	623 \pm 282 (227 – 1426)	103.8	500	750 \pm 358 (166 – 1343)	150.0	400	651 \pm 301 (161 – 1205)	162.8
Iron (mg)	19	13.5 \pm 5.4 (1.6 – 40.0)	71.0	28	15.2 \pm 6.1 (1.6 – 34.4)	54.3	30	18.4 \pm 9.3 (3.7 – 51.1)	61.3	30	17.9 \pm 7.0 (13.0 – 36.5)	59.7
Vitamin A (μ g RE)	600	399 \pm 549 (32 – 2626)	66.5	600	423 \pm 513 (59 – 2017)	70.5	600	413 \pm 505 (57 – 2212)	68.8	600	299 \pm 273 (96 – 845)	49.8
Thiamin (mg)	1.0	1.33 \pm 0.39 (0.32 – 3.2)	133.0	1.0	1.39 \pm 0.39 (0.18 – 2.28)	139.0	1.0	1.59 \pm 0.44 (0.42 – 2.18)	159.0	1.1	1.72 \pm 0.30 (1.34 – 2.14)	156.4
Riboflavin (mg)	1.2	0.74 \pm 0.25 (0.20 – 1.7)	61.7	1.2	0.78 \pm 0.20 (0.29 – 1.29)	65.0	1.2	0.87 \pm 0.30 (0.31 – 1.57)	72.5	1.3	0.87 \pm 0.30 (0.31 – 1.57)	66.9
Niacin (mg)	13	10.7 \pm 3.3 (1.2 – 26.0)	82.3	14	11.2 \pm 3.5 (1.3 – 20.2)	80.0	14	12.9 \pm 3.7 (3.4 – 18.1)	92.1	14	13.8 \pm 2.5 (11.1 – 17.2)	98.6
Folic acid (μ g)	70	49.5 \pm 23.0 (18.0 – 140.4)	70.7	100	49.4 \pm 20.9 (6.5 – 115.2)	49.4	100	52.6 \pm 19.6 (16.2 – 125.3)	52.6	100	52.8 \pm 9.4 (36.3 – 65.3)	52.8
Vitamin C (mg)	40	37.0 \pm 26.5 (1.5 – 133.3)	92.5	40	39.9 \pm 56.3 (1.5 – 460.3)	99.8	40	39.4 \pm 30.8 (3.4 – 108.4)	98.5	40	31.7 \pm 10.2 (19.7 – 51.1)	79.3

[†] RDA – Recommended Dietary Allowances; [‡] SD – Standard Deviation. Figures in parenthesis indicate range

Table 3. Block-wise data on the adequacy of energy intake (N=209)

Block	N	Distribution of the subjects by energy intake (% RDA [†])						
		<50	50-<60	60-<75	75-<90	90-<110	110-<125	125-<140
Alipur	40 (100)	5 (12.5)	3 (7.5)	14 (35.0)	14 (35.0)	3 (7.5)	0 (0.0)	1 (2.5)
Kanjhawala	45 (100)	3 (6.7)	2 (4.4)	14 (31.1)	11 (24.5)	14 (31.1)	1 (2.2)	0 (0.0)
Mehrauli	30 (100)	2 (6.7)	4 (13.3)	16 (53.4)	7 (23.3)	1 (3.3)	0 (0.0)	0 (0.0)
Deeg	22 (100)	4 (18.3)	5 (22.7)	7 (31.8)	6 (27.2)	0 (0.0)	0 (0.0)	0 (0.0)
Madhosinghana	36 (100)	0 (0.0)	0 (0.0)	11 (30.6)	11 (30.6)	12 (33.2)	2 (5.6)	0 (0.0)
Fatehpur Sikri	36 (100)	3 (8.3)	5 (13.9)	11 (30.6)	8 (22.2)	7 (19.4)	2 (5.6)	0 (0.0)
Grand total	209 (100)	17 (8.1)	19 (9.1)	73 (35.0)	57 (27.3)	37 (17.7)	5 (2.4)	1 (0.5)

[†] RDA – Recommended Dietary Allowances. Figures in parenthesis indicate percentages

Table 4. Subjects by adequacy of protein, mineral and vitamin intake (N=209)

Nutrient	Nutrient Adequacy Ratio (NAR) [†]		
	Inadequate (<0.66)	Fairly adequate (0.66 – <1.00)	Adequate (≥1.00)
Protein	34 (16.3)	119 (56.9)	56 (26.8)
Calcium	11 (5.3)	48 (23.0)	150 (71.7)
Iron	177 (84.7)	21 (10.0)	11 (5.3)
Vitamin A	153 (73.2)	16 (7.7)	40 (19.1)
Thiamin	4 (1.9)	14 (6.7)	191 (91.4)
Riboflavin	82 (39.2)	109 (52.2)	18 (8.6)
Niacin	27 (12.9)	102 (48.8)	80 (38.3)
Folic acid	176 (84.2)	24 (11.5)	9 (4.3)
Vitamin C	90 (43.1)	50 (23.9)	69 (33.0)

[†]NAR- Nutrient Adequacy Ratio. Figures in parenthesis indicate percentages

ard but the subjects aged 13-14 years were significantly ($p<0.01$) heavier than the preceding age group. The deficit at eleven years of age was 1.8 kilogram which widened to 3.3 kilogram after eighteen years of age. In all, 67.5% of the subjects were found to have 'weight for age' less than the 5th percentile. The mean height in the age groups of 11-14 years was below the NCHS standard but the subjects aged 13-14 years as well as 14-15 years were significantly ($p<0.01$) taller than the preceding age groups. Overall, 29.7% of the subjects were found to be stunted ('height for age' < 3rd percentile). Though the mean BMI of the subjects in the all the age groups was higher than the 5th percentile of NCHS standard, 44 % of 13-14 year olds and 53% of 14-15 year olds were found to be thin. On the whole, 30.6% of subjects were thin ('BMI for age' < 5th percentile), 0.5% were overweight ('BMI for age' ≥ 85th percentile) and 68.9% had normal weight (BMI for age' 5th – < 85th percentile).

Table 6 presents block-wise data on prevalence of stunting and thinness and it reveals substantial differences in the nutritional status of the subjects from various blocks under study. In contrast to *Deeg*, *Fatehpur Sikri* and *Mehrauli* where the incidence of thinness (63.6%, 38.9% and 33.3%) as well as stunting (40.9%, 55.6% and 30.0%) was quite high, a lower proportion of subjects from *Alipur*, *Kanjhawala* and *Madhosinghana* were found to be thin (27.5%, 15.6% and 22.2%) and stunted (20.0%, 28.9% and 13.9%).

Nearly half (42.6%) of the subjects had attained puberty; the reported mean age at menarche was 13.8 years; though block-wise differences existed. The beneficiaries from Delhi blocks were found have a lower mean age at menarche (13.3 to 13.9 years) as compared to those from the rural blocks of *Madhosinghana*, or *Fatehpur Sikri* (14.0 to 14.6 years). Among the subjects from *Deeg*, only one had entered puberty. Data further reveal that of the post-menarche girls only 21% had prior knowledge regarding menarche and majority felt scared at its onset (Table 7).

Discussion

The aim of this study was to assess the diet quality and nutritional status of the beneficiaries of Adolescent Girl scheme. The findings indicate that dietary intake met only two-third to three-fourth of the energy and protein requirements. These findings are consistent with the results of a study conducted among poor adolescent girls in rural Rajasthan²⁶ where the energy and protein intake was 64-74% and 65-77% of the recommended allowances respectively. However, a lower caloric intake (55-64% of the RDA) has been reported by another study carried out on young girls belonging to a low socio-economic group in Delhi.²⁷

The food intake, in the present study, was low particularly with respect to pulses, milk and milk products. This could be the possible reason for the energy and protein deficit in the diets. Moreover, the diets were cereal based and vegetarian so, the quality of protein can be expected to be rather low. The intake of fruits and vegetables particularly, that of green leafy vegetables was also found to be grossly inadequate which could possibly have led to the deficient micronutrient intake. Overall, the diets were lacking in most of the micronutrients - iron, vitamin A and folic acid in particular. These findings are comparable to other micro and macro studies indicating a substantial nutrient gap in the daily diets of Indian adolescent girls.^{4, 5, 28}

The energy and nutrient gap, in our study, was found to be somewhat wider in case of younger subjects (10-15 years old) than those aged above 16 years; these findings are consistent with those of a national study.¹⁰ However, in case of iron and folic acid, the intake had either decreased or registered only a minor increment with age. To make the situation worse, the diets were cereal based as well as vegetarian and lacked in promoters of iron; thus, the bio-availability of iron was probably quite low. It is a well known fact that during adolescence, the iron requirements increase due to the changes in body mass,

Table 5. Age-wise data on mean weight, height, BMI along with prevalence of stunting and thinness (N=209)

Age(yrs)	N	Weight for age (kg)		'Weight for age' < 5 th percentile n (%) ¶	Height for age (cm)		Stunted (‘height for age’ < 3 rd percentile) n (%) ¶	BMI † for age (kg/m ²)		Thin (‘BMI† for age’ < 5 th percentile) n (%) ¶
		NCHS‡ standard (5 th percentile)	Present study Mean ± SD (Range)§		NCHS‡ standard (3 rd percentile)	Present study Mean ± SD (Range)§		NCHS‡ standard (5 th percentile)	Present study Mean ± SD (Range)§	
11-<12	34	30.5	28.7 ± 5.2 (19.0 – 42.5)	20 (58.8)	138.1	136.9 ± 7.6 (113.5 – 147.5)	10 (29.4)	14.60	15.19 ± 1.58 (11.99 – 19.53)	7 (20.6)
12-<13	54	34.1	30.2 ± 6.6 (21.0 – 45.0)	33 (61.1)	144.2	139.8 ± 9.5 (123.0 – 161.0)	14 (30.0)	14.98	15.28 ± 1.98 (12.07 – 21.28)	12 (22.2)
13-<14	34	37.8	34.8** ± 6.3 (24.5 – 49.5)	25 (73.5)	147.6	146.0** ± 7.1 (131.2 – 159.3)	12 (35.3)	15.36	16.19* ± 1.81 (13.48 – 21.21)	15 (44.1)
14-<15	17	41.0	37.0 ± 5.4 (25.5 – 47.0)	12 (70.6)	149.0	151.8** ± 5.5 (140.9 – 158.9)	11 (64.7)	15.67	15.98 ± 1.70 (12.84 – 18.65)	9 (53.0)
15-<16	25	43.4	42.4* ± 6.7 (34.0 – 63.0)	17 (68.0)	149.8	154.2 ± 4.7 (144.2 – 161.2)	9 (36.0)	16.01	17.82* ± 2.63 (13.92 – 21.39)	9 (36.0)
16-<17	19	44.7	42.5 ± 4.0 (37.0 – 55.0)	14 (73.7)	151.0	153.2 ± 6.1 (140.2 – 164.0)	3 (15.8)	16.37	18.16 ± 1.76 (15.24 – 23.34)	7 (38.8)
17-<18	16	45.3	43.1 ± 5.2 (36.5 – 54.0)	11 (68.8)	152.4	152.6 ± 4.6 (144.2 – 164.3)	2 (12.5)	16.59	18.51 ± 2.04 (15.25 – 21.71)	2 (12.5)
≥ 18	10	45.3	42.0 ± 5.7 (32.0 – 55.0)	9 (90.0)	152.5	152.0 ± 4.4 (143.5 – 160.5)	1 (10.0)	16.71	18.11 ± 2.15 (15.23 – 22.46)	3 (30.0)
Total	209	–	35.7 ± 8.3 (19.0 – 63.0)	141 (67.5)	–	146.2 ± 9.79 (113.5 – 164.3)	62 (29.7)	–	16.50 ± 2.34 (11.99 – 26.39)	64 (30.6)

† BMI – Body Mass Index; ‡ NCHS – National Center for Health Statistics; § figures in parenthesis indicate range; ¶ figures in parenthesis indicate percentages. * $p < 0.05$; ** $p < 0.01$ (comparison with the preceding age group)

Table 6. Block-wise data on the incidence of thinness and stunting (N=209)

Blocks	N	Thin (‘BMI† for age’ < 5 th percentile)	Stunted (‘height for age’ < 3 rd percentile)
Alipur	40	11 (27.5)	8 (20.0)
Kanjhawala	45	7 (15.6)	13 (28.9)
Mehrauli	30	10 (33.3)	9 (30.0)
Deeg	22	14 (63.6)	9 (40.9)
Madhosinghana	36	8 (22.2)	3 (13.9)
Fatehpur Sikri	36	14 (38.9)	20 (55.6)
Total	209	64 (30.6)	62 (29.7)

† BMI – Body Mass Index. Figures in parenthesis indicate percentages

Table 7. Mean age at menarche and related information (N=209)

Blocks	N	Pre-pubertal	Post-pubertal	Mean age at menarche (yrs)	Among the post-pubertal			
					Prior knowledge of menarche		Scared at menarche	
					Yes no. (%)	No no. (%)	Yes no. (%)	No no. (%)
Alipur	40	25 (62.5)	15 (37.5)	13.27	0 (0)	15 (100)	9 (60.0)	6 (40.0)
Kanjhawala	45	21 (46.7)	24 (53.3)	13.54	5 (20.8)	19 (79.2)	18 (75.0)	6 (25.0)
Mehrauli	30	19 (63.3)	11 (36.7)	13.91	4 (36.4)	7 (63.6)	5 (45.5)	6 (54.5)
Deeg	22	21 (95.5)	1 [#] (4.5)	14.00	1 (100)	0 (0)	1 (100)	0 (0)
Madhosinghana	36	9 (25.0)	27 (75.0)	14.00	5 (18.5)	22 (81.5)	13 (48.2)	14 (51.8)
Fatehpur Sikri	36	25 (69.4)	11 (30.6)	14.61	4 (36.4)	7 (63.6)	6 (54.5)	5 (45.5)
Total	209	120 (57.4)	89 (42.6)	13.82	19 (21.3)	70 (78.7)	52 (58.4)	37 (41.6)

Figures in parenthesis indicate the percentages. [#] Only one subject from Deeg had entered puberty

expanded blood volume and increased respiratory enzymes; the onset of menstruation one year after the peak growth further increases these requirements.²⁹ But in the absence of adequate dietary intake of iron, the girls become highly prone to anaemia. In India, the prevalence of anaemia among adolescent girls has been reported to be 75-90 %.^{30,31}

To combat this public health problem of iron deficiency anaemia, Government of India has launched National Nutritional Anaemia Control Programme which provides iron and folic acid tablets to girls and women only after they conceive and very often when they reach the third trimester of pregnancy. This strategy has been found ineffective in a micro-level study³² and a possible reason for this inefficacy could be the prior prevalence of anaemia in women at the time of conception. In the light of these findings, it has been proposed to start iron supplementation for the girls from the adolescent period itself to build their stores for present as well as the future demands.³³⁻³⁵ There is also evidence to show that iron and folic acid supplementation enhances growth of 10-14 year old girls in India.³⁶

Nearly 31% of the subjects, in the present study, were found to be thin and an almost similar proportion stunted. These findings are comparable to other micro-level studies carried on adolescent girls in different parts of India.^{37,38} Stunting has important implications for adolescent reproductive health of girls as it can lead to obstructed labour during child birth due to a small birth canal.³⁹ On the other hand, thinness can result in poor pregnancy outcome especially in terms of low birth weight and increased risk of infant mortality.⁴⁰ The poor nutritional status, in the present study, could be attributed to the inadequate food intake as majority of the subjects belonged to poor families. Lack of access to sufficient food and inequities in food allocation have been reported as the key causes of malnutrition in poor households of India.⁴¹ Moreover, there is evidence to prove that subjects

living in poorer households are more likely to be underweight than those living in households with higher socioeconomic status.⁴²

Though the study presents a grim picture of the nutritional status of rural poor adolescent girls yet, adolescence provides a unique opportunity to help these girls to attain their full growth potential. National Nutrition Monitoring Bureau (NNMB) surveys have indicated that girls from poor communities gain over 5 centimetre in height and 6.8 kilogram in weight between the ages of 14 and 18 years.⁴³ Further, a follow up study of rural girls in Andhra Pradesh aged, 5 to 18 years, has shown that despite continuing poverty, girls who arrive their fifth year with considerable height deficit register impressive increments in height by the time they are 18 year old.⁴⁴ This higher rate alone may not be enough to complete the 'catch-up growth'; nevertheless, additional growth may be achieved by nutritional interventions during this period. Therefore, nutritional supplements must be provided to undernourished girls prior to the onset of menarche so that they are able to achieve their full growth potential. In view of the dual burden of malnutrition facing the country Government of India, in its Tenth Plan, has emphasized on screening the adolescent girls for malnutrition (under nutrition or over nutrition) and tackling their nutritional problems through targeted interventions.⁴⁵

Age at menarche is also an indicator of nutrition and health status of the girls as poor nutritional status delays menarche.⁴⁶ In the present study, the significantly higher mean weight and height of the subjects aged 13-14 years (as compared to those aged 12-13 years) may be indicating a delayed menarche. It is a known fact that menarche follows nearly 1.3 years after an increase in height and weight velocity.⁴⁷ However, as compared to other blocks the lower age at menarche, reported by the subjects from Delhi blocks in our study, may be attributed to socio-economic factors, dietary intake as well as the exposure to urban life and television. Similar findings have been

reported by other studies where the mean age at menarche was 14 years for rural and 13 years for urban girls/women.^{48, 49} In the present study, the awareness regarding menstruation was reported to be poor; these findings are consistent with those of a study covering 400 rural girls (aged 10-16 years) in north India.⁵⁰

In conclusion, the present study reveals not only a high incidence of under nutrition but also the dietary inadequacy of the subjects particularly in respect of energy, protein and micronutrient intake. If this is the scenario among the ICDS adolescent girl beneficiaries who had been receiving nutritional supplement for almost a period of six months, the status of non-beneficiaries can be expected to be worse. During the course of study, a process evaluation of the scheme was also carried out which revealed that its implementation was rather weak. The functionaries had neither received proper training and nor were they fully aware of the services to be provided. The delivery of services was partial and through inadequate activities.

Therefore, need of the hour is to plan and implement innovative developmental programmes to address the nutrition and health needs of rural adolescent girls in a comprehensive manner. These programmes should include provision of food supplements (particularly for 11 to 14 year olds for 'catch up growth'), iron-folate as well as nutrition and health education. Some of these interventions, though proposed in the existing Adolescent Girl scheme (now revised as '*Kishori Shakti Yojna*') are not being implemented adequately. Hence, continuous efforts are needed at the national level to strengthen the scheme by greater involvement of the beneficiaries; capacity building of its functionaries and flexibility in the services, activities and utilization of funds so as to improve its field level implementation. Active participation of the adolescent girl beneficiaries must be sought by engaging them in food production through the establishment of nutrition gardens which may help in increasing the availability of food, green leafy vegetables in particular. They should also be involved in the preparation of low-cost nutritious food using the locally available ingredients and also be encouraged to respect and retain the traditional food knowledge and sustainable food systems. Such a holistic approach shall not only address the nutritional needs of these girls (the would-be-mothers) but shall go a long way in breaking the intergenerational cycle of malnutrition.

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