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Original Research Article

Nutritional status and prevalence of anemia in rural adolescents

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ABSTRACT

Background: In developing countries like India, the adolescents constituting one fourth of population are not given the due importance in terms of resource allocation on health care or research. Thus, painting a lopsided picture of adolescent's health and nutritional status is not truly reflective of ground realities. The objective of this study was to assess the nutritional status of the adolescent community residing in rural block and the prevalence of anemia among these adolescents.
Methods: The study was a community based cross sectional survey among adolescents of 10 to 19 years of both sexes, from October 2004 to March 2006. Nutritional status, hemoglobin and prevalence of anemia were observed.
Results: Under nutrition was found to be a significant problem in both sexes of rural adolescents. Anemia was more common in female than in male in both school going and non-school going.
Conclusions: The significant number of anemic is in the middle adolescent age group, could be explained by the fact that menarche is attained around 12 years and the first few cycles are irregular with increased blood loss. So, any policy towards low birth weight and neonatal mortality needs the policy makers to make a note of this alarming trend of anemia among adolescent girls.

Keywords: Nutritional status, Prevalence of anemia, School going and non-school going adolescents

INTRODUCTION

Adolescence is a period of growth from childhood to adulthood.[1] This period occupies a crucial position in the life of human beings on account of major physical, sexual and psychological changes. This period is characterized by an exceptionally rapid rate of physical and sexual growth.[2] The peak rates of physical growth are exceeded only during the fetal life and early infancy. There is not much individual variation in the growth during the fetal life and infancy. In contrast, there is much more individual variation both in timing and in the degree of growth during adolescent period.[2] This has importance in defining normality.

Traditionally, health planners/policy makers have been utilizing mortality indicators as indicators of health in the community. Allocation of resources for health is based on mortality indicators among infants, children below 5 years and women of reproductive age group.[3] Adolescents have the lowest mortality among different age groups. Therefore, the allocation of resources reserved on health needs of adolescents received and continue to receive very low priority. In developing countries like India, recently there has been a change in attitude of planners in view of the HIV pandemic affecting predominantly late adolescents and youth population. The priority was according to the research on reproductive health needs, HIV, sexually transmitted

diseases and basic research on the nutritional, psychological needs for the growth and development of adolescents is not been concentrated upon.[4]

Though many studies have been done in the nutritional needs of adolescents, few studies have shown that the prevalence of malnutrition is high in this group. The requirements of calories and micronutrients like iron, folic acid, vitamin B_{12}, zinc, copper, vitamin E and calcium is very high during the period of rapid physical growth like adolescence.[5] Few other studies have also shown that the prevalence of anemia was also high among the adolescents.[6]

Studies done in our country have also shown that the prevalence of anemia and malnutrition among adolescents are high. But most of these studies were done in the urban areas of India. These studies do not reveal the actual prevalence of anemia and malnutrition among adolescent in the rural areas, thus underestimating magnitude of the problems among adolescents, especially in the rural adolescents. It should be remembered that 60 to70% of the population in India are living rural areas.

In developing countries like India, the adolescents constituting one fourth of population are not given the due importance in terms of resource allocation on health care or research. Studies done in urban areas have concentrated on these children only.

Thus, painting a lopsided picture of adolescent's health and nutritional status is not truly reflective of ground realities. This study was planned with the aim of gathering basic nutritional data among rural adolescents in order to project the nutritional needs to the health planners. The objective of this study was to assess the nutritional status of the adolescent community residing in rural block and the prevalence of anemia among these adolescents.

METHODS

The study was a community based cross sectional survey which was conducted in Institute of child health and Hospital for Children, Chennai, from October 2004 to March 2006. Adolescents of 10 to 19 years of both sexes, Residents of that area and those with valid date of birth were included in the study. The migrating population of that area was excluded.

The samples were collected from Poonamallee block of Thiruvallur district with total population size 2,05,380 and 42,000 numbers of adolescent population. A total of 90 villages belonged to this block.

Based on the previous study by K. Anand et al prevalence rate of anemia (40%) and prevalence rate of under nourished (37.3%) sample size was calculated as 1600 with the standard error of 5%.[7] Since it is community based study Designer effect of two was considered. Hence the sample size was 3200. A total of 4067 samples were collected by systematic random sampling technique. Village chiefs and local health care providers were contacted first and permission was obtained to conduct health camps. Health camps were arranged in villages with the help of village chiefs and local health care providers. The adolescents were mobilized to attend health camps by means of prior sensitization. The sensitization meeting consisted of meeting village elders, leaders of local fans clubs and sensitizing them to the study. A convenient date for holding the health camp was fixed during this phase. In the next final meeting the place of camp, method of mobilization was finalized. Accordingly, adolescents were mobilized by local health care providers, leaders of various fan clubs, Anganwadi workers and local NGOs (Lions clubs), youth club leaders. Where the number of adolescents was less in particular village, they were mobilized to next nearest village where the camp was held. 48 of such camps were organized during the 2 yrs period.

Adolescents and their parents were informed about the purpose of the study one week in advance with the help of local health care providers and village chiefs. Remainder was given two days prior to examination. Informed consent from parents as well as from adolescents was obtained. Detailed clinical examination was conducted.

Those below the 5th percentile of so that the line of vision will be perpendicular to the body. An upper scale was brought down to the top most point on the head. Height was recorded to the nearest of 1cm. The same individual recorded height in all the camps. A bathroom scale was used to measure the weight. It was calibrated with known standard weights regularly. For standardization zero error was corrected every time. Weight was recorded to the nearest of 500 grams. The same individual recorded weight in all the camps. The blood Hemoglobin was estimated with the help of cyanmethemoglobin method. This was done with the help of calorimeter. The optical density was calculated. From the optical density, standard formula given by that particular age and sex were defined as undernourished (thinned).

Those in 85th to 95th percentile was defined as overweight for that particular age and sex. Those over the 95th percentile of that particular age and sex were defined as obese.

Those in the 5th to 85th percentile was defined as normal variants of that particular age and sex. Prevalence of stunting was calculated by using National Center for Health Statistics recommended formula. Those less than 3rd percentiles in each age group and in both sexes, were considered to be stunted.

Hemoglobin less than 12grams were defined to be anemic according to WHO Hemoglobin 7grams to 12grams were defined to be mildly anemic. Those having Hemoglobin

percentage of less than 7grams were defined to be severely anemic. Hemoglobin more than 12grams were defined to be normal. Heamoglobin was measured as per standard procedure.

Statistical analysis

All results were tabulated and percentage was arrived by using windows MS Excel application and analysis was performed by using SPSS version 11.0-Software. Descriptive statistics like frequencies and percentages were obtained. 95% confidence interval for the percentages was calculated. Chi-square test was done to compare between various groups. P value less than 0.05% was considered significant.

RESULTS

48 camps were conducted in 90 villages. Samples were collected and tabulated age wise, sex wise, school going and non-school going according to various stages of adolescent period in both sexes. A total of 4067 adolescents were enrolled for this study out of which 2017 were males and 2050 were females.

Table 1: Distribution of school going and non-school going adolescents in the study samples.

Age	Male			Female		
	S	NS	NS %	S	NS	NS %
10	202	6	2.8	189	3	1.56
11	191	5	2.5	208	4	1.8
12	198	8	3.8	196	7	3.4
13	187	7	3.6	203	10	4.6
14	187	13	6.5	185	20	9.7
15	180	22	10.8	165	32	16.2
16	163	37	18.5	180	35	16.2
17	156	42	21.2	136	64	32
18	102	101	49.7	65	144	68.8
19	108	102	48.5	48	156	76.4
Total	1674	343	17	1575	477	23.2

The distribution of school going and non-school going adolescents in the study samples are presented in Table 1. The non-school going constituted 17% among male and 23.2% among Female.

As the age was increased, the number of school dropouts/those who did not perceive higher studies increased steeply. That was at 17 years the percentage of children who stopped perceiving their study increased to almost 50% in males and 70% in females. The nutritional status is tabulated in Table 2. Males were more (43.1%) undernourished than female (32.5%). Males were significantly more undernourished than female in both the school going and non-school going groups (p value 0.07, 0.0003 respectively).

Age and sex wise distribution of undernourished among study population is presented in Table 3.

Table 2: Nutritional status: undernourished.

	Male			Female			P value
	Total	N	%	Total	N	%	
School going	1674	706	42.2	1575	479	30.4	0.00
Non-school going	343	163	47.5	477	187	39.2	0.02
Total	2017	869	43.1	2050	666	32.5	0.00
P value	0.07			0.0003			

Both School going and non-school going children are affected equally. Undernourished almost approaches 50% of the male adolescents as the age advances. Undernourished seems to be constant ranging from 27% to 37% among all the age groups of the school going female adolescents. The only exception to the rule is middle adolescence (14, 15 and 16 years of age) where it over between 17% and 19%. At 10 years undernourished

starts as 28.2% and approaches 52% by 18 years. While among non-school going group, there seems to be uniform pattern of under nutrition at a constant rate of around 50% excepting in the early adolescence where they were around 20- 30%.

Table 3: Undernourished: age and sex wise distribution of undernourished among study population.

Age	Male		Undernourished						Female		Undernourished					
	S	NS	S			NS			S	NS	S			NS		
			n	%	95% CI	n	%	95% CI			n	%	95% CI	n	%	95% CI
10	202	6	57	28.2	22.2, 34.5	3	50.0	10.0, 90.0	189	3	51	27.0	20.7, 33.3	1	33.3	-20.0, 86.7
11	191	5	65	34	27.3, 40.8	1	20.0	-15.1, 55.1	208	4	83	39.9	33.2, 46.6	2	50.0	1.0, 99.0
12	198	8	59	29.8	23.4, 36.2	2	25.0	-5.0, 55.0	196	7	73	37.2	30.5, 44.0	2	28.6	-4.9, 62.0
13	187	7	95	50.8	43.6, 58	2	28.6	-4.9, 62.0	203	10	66	32.5	26.1, 39.0	3	30.0	1.6, 58.4
14	187	13	89	47.6	40.4, 54.8	5	38.5	12.0, 64.9	185	20	34	18.4	12.8, 24.0	3	15.0	-0.6, 30.6
15	180	22	94	52.2	44.9, 59.5	11	50.0	29.1, 70.9	165	32	28	17.0	11.2, 22.7	5	15.6	3.0, 28.2
16	163	37	62	38	30.6, 45.5	15	40.5	24.7, 56.4	180	35	35	19.4	13.7, 25.2	10	28.6	13.6, 43.5
17	156	42	78	50	42.2, 57.8	22	52.4	37.3, 67.5	17	136	64	67	49.3	40.9, 57.7	27	42.2
18	102	101	53	52	42.3, 61.7	50	49.5	39.8,59.3	18	65	144	24	36.9	25.2, 48.7	74	51.4
19	108	102	54	50	40.6, 59.4	52	51.0	41.3, 60.7	19	48	156	18	37.5	23.8, 51.2	60	38.5

S – School going, NS – non-School going; n - Total numbers; CI - Confidence Interval

Table 4: Age and sex wise distribution of overweight adolescents.

Age	Male		Overweight						Female		Overweight					
	S	NS	S			NS			S	NS	S			NS		
			n	%	95% CI	n	%	95% CI			n	%	95% CI	n	%	95% CI
10	202	6	0	0.0	-	0	0.0	-	10	189	3	4	2.1	0.1, 4.2	0	0.0
11	191	5	0	0.0	-	0	0.0	-	11	208	4	16	7.7	4.1, 11.3	0	0.0
12	198	8	10	5.1	2.0,8.1	0	0.0	-	12	196	7	0	0.0	-	0	0.0
13	187	7	5	2.7	0.4, 5.0	0	0.0	-	13	203	10	0	0.0	-	0	0.0
14	187	13	11	5.9	2.5, 9.3	0	0.0	-	14	185	20	13	7.0	3.3, 10.7	0	0.0
15	180	22	6	3.3	0.7, 6.0	0	0.0	-	15	165	32	0	0.0	-	0	0.0
16	163	37	4	2.5	0.1, 4.8	0	0.0	-	16	180	35	5	2.8	0.4, 5.2	0	0.0
17	156	42	2	1.3	-0.5, 3.0	0	0.0	-	17	136	64	4	2.9	0.1, 5.8	6	9.4
18	102	101	3	2.9	-0.3, 6.2	2	2.0	0.7, 4.7	18	65	144	4	6.2	0.3, 12.0	0	0.0
19	108	102	2	1.9	-0.7, 4.4	0	0.0	-	19	48	156	3	6.3	-0.6, 13.1	0	0.0

S – School going, NS – non-School going; n - Total numbers; CI - Confidence Interval

Table 5: Age and sex wise distribution of hemoglobin in adolescents.

Age	Male										Female									
	>12 gms		7-12 grams				< 7 grams				> 12 grams grams		7-12 grams				< 7 grams			
			S		NS		S		NS				S		NS		S		NS	
	S	NS	n	%	n	%	n	%	n	%	S	NS	n	%	n	%	n	%	n	%
10	159	4	33	16.3	2	33.3	10	5.0	0	0.0	120	2	69	36.5	1	33.3	0	0.0	0	0.0
11	151	2	26	13.6	3	60.0	14	7.3	0	0.0	94	2	97	46.6	1	25.0	17	8.2	1	25.0
12	116	5	72	36.4	3	37.5	10	5.1	0	0.0	100	3	75	38.3	2	28.6	21	10.7	2	28.6
13	103	5	80	42.8	1	14.3	4	2.1	1	14.3	127	5	49	24.1	3	30.0	27	13.3	2	20.0
14	107	9	78	41.7	3	23.1	2	1.1	1	7.7	93	7	72	38.9	8	40.0	20	10.8	5	25.0
15	99	14	77	42.8	6	27.3	4	2.2	2	9.1	59	14	89	53.9	13	40.6	17	10.3	5	15.6
16	118	27	40	24.5	8	21.6	5	3.1	2	5.4	64	17	111	61.7	15	42.9	5	2.8	3	8.6
17	121	37	33	21.2	4	9.5	2	1.3	1	2.4	76	40	58	42.6	22	34.4	2	1.5	2	3.1
18	93	90	9	8.8	11	10.9	0	0.0	0	0.0	36	68	28	43.1	74	51.4	1	1.5	2	1.4
19	90	76	18	16.7	24	23.5	0	0.0	2	2.0	29	96	17	35.4	58	37.2	2	4.2	2	1.3

Among the non-school going female adolescent's middle adolescence shows similar trend with undernourished ranging from 15- 25%. While, the rest of the group have a range between 30% and 50%. Age and sex wise distribution of overweight adolescents is presented in Table 4. Among school going male adolescents 1.3-5.9% were overweight and among school going female adolescents overweight more in the 11 years (7.7%) and 14 years (7.0%).

Age and sex wise distribution of hemoglobin in adolescents is shown in Table 5.

Table 6: Distribution of undernourished among study population in various stages of adolescence.

Age	Male		Undernourished						Female		Undernourished					
	S	NS	S			NS			S	NS	S			NS		
			n	%	95% CI	n	%	95% CI			n	%	95% CI	n	%	95% CI
10-13	778	26	276	35.5	32.1, 38.9	8	30.8	13.1, 48.5	796	24	273	34.3	31.0, 37.6	8	33.3	14.4, 52.2
14-16	530	72	245	46.2	42.0, 50.4	31	43.1	31.7, 54.5	530	87	97	18.3	15.0, 21.6	18	20.7	12.2, 29.2
17-19	366	245	185	50.6	45.5, 55.7	124	50.6	44.3, 56.9	249	364	109	43.8	37.6, 50.0	161	44.2	39.1, 49.3

S – School going, NS – non-School going; n - Total numbers; CI - Confidence Interval

Table 7: Distribution of overweight in various stages of adolescence.

Age	Male		Overweight						Female		Overweight					
	S	NS	S			NS			S	NS	S			NS		
			n	%	95% CI	n	%	95% CI			n	%	95% CI	n	%	95% CI
10-13	778	26	15	1.9	0.9, 2.9	0	0.0	-	796	24	20	2.5	1.4, 3.6	0	0.0	-
14-16	530	72	21	4.0	2.3, 5.7	0	0.0	-	530	87	18	3.4	1.9, 4.9	0	0.0	-
17-19	366	245	7	1.9	0.5, 3.3	2	0.8	0.3, 1.9	249	364	11	4.4	1.9, 6.9	6	1.7	0.4, 3.0

S – School going, NS – non-School going; n - Total numbers; CI - Confidence Interval

Table 8: Distribution of hemoglobin among study population various stages of adolescence.

Age	Male									Female								
	>12grams		7-12grams				< 7grams			>12grams		7-12grams				< 7grams		
	S	NS	School going		Non-school going		School going		Non-school going	S	NS	S		NS		S		NS	
			n	%	n	%	n	%	n %			n	%	n	%	n	%	n	%
10-13	529	16	211	27.1	9	34.6	38	4.9	1 3.9	441	12	290	36.4	7	29.2	65	8.2	5	20
14-16	324	50	195	36.8	17	23.6	11	2.1	5 6.9	216	38	272	51.3	36	41.4	42	7.9	13	14.9
17-19	304	203	60	16.4	39	15.9	2	0.6	3 1.2	141	204	103	41.4	154	42.3	5	2.0	6	1.7

S – School going, NS – non-School going; n - Total numbers; CI - Confidence Interval

Among school going male adolescent's mild anemia was more common in 13 to 15 years' age group where as severe anemia was more common from 13 to 15 years in both school going and non-school going female adolescents. Distribution of undernourished in various stages of adolescence among study population is given in Table 6 which revealed 50.6% school going and non-school males were undernourished in late adolescent where as 43.8% school going females were undernourished in late adolescent. In both the groups and both sexes undernourishment was more common in late adolescents.

Table 9: Prevalence of anemia in school going and non-school going adolescents.

Anemia in school going and Non-school going	Male			Female			P value
	Total	n	%	Total	n	%	
S	1674	517	30.9	1575	777	49.3	0
NS	343	74	21.6	477	221	46.3	0
Total	2017	591	29.3	2050	998	48.7	0
P value	0.0006			0.25			

Table 10: Prevalence of stunting.

Age	< 3rd Percentile			
	Male		Female	
	(%)	N	(%)	n
10	76.9	160	69.80	134
11	33.60	66	63.08	135
12	65.04	134	54.10	110
13	56.60	111	46.94	100
14	63.80	129	59.02	121
15	40.09	81	52.28	103
16	36.50	73	30.69	66
17	31.30	62	46.50	93
18	29.06	59	29.66	62
19	29.0	58	29.0	60

Highest percentage (4%) of overweight male adolescents were found in mid adolescent stage where as it was highest (school going: 4.4% and non-school going: 1.7%) in late stage in case of females (Table 7). Table 8 shows the distribution of hemoglobin among study population various stages of adolescence. The percentage of mild anemia decreased with increase of adolescent stages in males and lowest anemic were seen in late stage in both the groups. In females, highest percentage (51.3%) of mild anemia in school going females was seen in mid stage and that of non-school going was seen in late stage of adolescent. Lowest percentage of anemic adolescent females were in late stage in both the groups. Female adolescents were significantly more anemic than males. In all the 3 groups, as compared among school going (Female: 49.3%; Male: 30.9; p 0.00), 46.3% as compared

to 21.6% among non-school going (p 0.00) and totally 48.7% as compared to 29.3% (p 0.00) respectively (Table 9). Among the male adolescent's school going was significantly more anemic (30.9%) than non-school going (21.6%) (p value 0.0006).

Among boys, prevalence of stunting was in declining trend from 76.9% at 10 years of age to 29% at 19 years of age (Table 10) and that among the girls was 69.8% at 10 years of age to 29% at 19 years of age. High prevalence of stunting in age group 10 in both between male and female and showing decreased trend as age advances probably indicate an element of constitutional delay. The average stunting was 46.18% in males and to 48.1% in females.

DISCUSSION

India is a signatory of millennium developmental goals (MDG) by 2020 and marches towards the achievement of goals. Health planners and policy makers allocate resources towards health care based on the infant, maternal mortality rates.

In spite of generous allocation of funds neonatal mortality rate and low birth weight in India are still at a very high level. This puts a question mark over the ability of our country MDG by 2020. It has already been recognized that malnutrition and anemia among the adolescents is the major contributory factor to Low birth weight. This study was an attempt to estimate the prevalence of malnutrition and anemia among the adolescents living in rural areas.

Overall prevalence of anemia in this study was 29.3% among male and 48.7% in females. Undernourishment is almost 50% in both sexes. Stunting was 46.18% in males and to 48.1% in females.

But in the study conducted by Anand et al in which there was prevalence of anemia 38%, 43.8% in boys and girls respectively.[7] Undernourished in their study was 43.8%, 30.8% in boys and girls respectively. Stunting in their study was 43.8% in boys and 30.1% in girls. This difference could be due to that the study done by them was only included school going adolescents. But in our study, we included non-school going also. The non-school going adolescents were more in numbers as the age advances.

In a study by Sabita Basu et al revealed that anemia among girls 23.9% and in boys 7.7%, undernourishment in girls 14.3% and boys 14.2%.[8] This difference also may be due to that non-inclusion of the non-school going adolescents their studies. Rajarathnam et al reported that the prevalence of anemia among girls was 45%, which was almost equal to our study report.[9] 50% of rural adolescent's female were undernourished in our study, which is similar to the study done by Srivastava et al.[10]

Malnutrition seems to be rampant among adolescent in all the developing countries and this study also highlights the same. This study also confirms that nutritional status of adolescents continues to be poor in this part of country as in other parts of country.[7] This difference might be due to the increased workload burden on non-school going adolescent girls rather than literacy. This study has shown that undernourishment was more common in boys than girls.

This study reflects the general pattern of anemia is more among girls than in boys and the general trend of anemia 45 to 55% as per NFHS- II data.[11] Though the cause of anemia was not within the preview of this study, it can be safely assumed that majority of them are nutritional and mostly iron deficiency type as derived from other studies.[8]

The significant number of anemic is in the middle adolescent age group, could be explained by the fact that menarche is attained around 12 years and the first few cycles are irregular with increased blood loss. So, any policy towards low birth weight and neonatal mortality needs the policy makers to make a note of this alarming trend of anemia among adolescent girls. It is disheartening to note that even adolescent boys are anemic. At present, it must be noted that there is no definite policy or interventional programs directed against male adolescents. In rural areas, adolescent pregnancy is more common due to early marriage in adolescent girls. Hence the interventions have to be done against anemia and under nutrition among the adolescent girls thereby preventing low birth weight and neonatal mortality.

CONCLUSION

Under nutrition was found to be a significant problem in both sexes of rural adolescents. Late adolescents were more undernourished in both sexes. Under nutrition was more common in boys than in girls. Anemia was more common in female than in male in both school going and non-school going. Anemia was more common in non-school going than in school going in both sexes. Severe anemia was more common in female of non-school going group.

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