

Prevalence of malnutrition among adolescent girls in North Kerala: A cross-sectional study

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Abstract

Background: Nutritional status of adolescent girls have important role in having a healthy womanhood in future. Malnutrition retards pubertal changes, impairs scholastic performance, and increases risk for infectious diseases. National Nutrition Mission was started in 2017 in India with the goal of improving the nutritional status of children. In this context, the present research was conducted to assess the nutritional status of adolescent girls in North Kerala as a baseline study. **Methods:** A cross-sectional study was conducted during May 2019 to March 2020 in Kannur, Kasargod, Wayanad and Malappuram districts of Kerala to assess malnutrition among adolescent girls in terms of anemia and body mass index (BMI). **Results:** A total of 395 adolescent girls participated in the study. Their age ranged from 10 to 19 years, with a mean of 13.8 years and standard deviation 2.5 years. The present study observed that 28% had malnutrition. The prevalence of anemia among adolescent girls (n=388) was found to be 40%. Proportion of anemia among those who attained menarche (51.8%) was significantly high compared to those who didn't attain menarche (24.4%). A significantly high proportion of those who didn't take iron and folic acid (IFA) tablets weekly were thin (16.5%) compared to those who took IFA tablets weekly (9.9%). **Conclusion:** The present study observed that anemia and malnutrition are significant problems among adolescent girls and specific measures need to be initiated to tackle the situation.

Key words: Adolescent girls, Anemia, Malnutrition, North Kerala

Introduction

A woman's nutritional status from adolescent period has important implications for her health as well as the health of her children. Anemia is the most common nutritional problem affecting children, adolescents and women. Anemia can lead to reduced productivity, greater susceptibility to infections, and slow recovery from illnesses. National Nutrition Mission (NNM) was started by Govt. of India in 2017, with the aim to reduce malnourishment from the country in a phased manner. Among the 315 districts covered in 2017-19 in India, 4 districts were from Kerala, i.e. Kannur, Wayanad and Malappuram and

Kasargod.[1]As per the NFHS4 report, over one-third of women (34%) were anemic in the state, while the level of anemia was much lower among men (only 12% overall) in every group and higher than NFHS-3. [2.3] Malappuram (38.6%), Kannur (37.3%) and Kasargod (35%) have a value higher than the state average value of 34.2%. [3] A situational analysis of nutritional status of the priority groups in these districts was thought as useful in the process. The present study was planned with the objective of estimating malnutrition in terms of body mass index and anemia among adolescent girls in four districts of Kerala.

Materials and Methods

The present anganwadi based cross-sectional study was conducted among adolescent girls in four districts of North Kerala namely Kasargod, Kannur, Wayanad and Malappuram. The study was conducted to determine the prevalence of malnutrition among adolescent girls in North Kerala, in terms of body mass index and presence of anemia. Malnutrition was assessed using World Health Organization body mass index (WHO-BMI) chart and presence of anemia was detected using hemoglobinometer. The study was conducted by investigators from Community Medicine Departments of three tertiary care institutions in different districts, with support from Women and Child Development Department (WCD), Government of Kerala. The present study was part of a large project which was to estimate the malnutrition among children (0-6yrs), adolescent girls, pregnant women and lactating women in North Kerala.

Sample Size and Sampling:

Sample size was calculated using the formula, $N = 4pq/d^2$. Prevalence of underweight among children in Kerala (NFHS - 4) was 16%. [3] The present study was part of a large project which was to estimate the malnutrition among children (0-6yrs), adolescent girls, pregnant women and lactating women in North Kerala. The prevalence of underweight among children was selected to calculate the sample size as it required the maximum number of samples when sample size calculation was done separately for each category. With 20% relative precision, sample size was obtained as 525. Sample required from each district = $525 \div 4 = 131.25 = 132$ The number of study population required from each district = 132

The priority districts - Kannur, Kasargod, Malappuram and Wayanad were selected for the first phase of the study. Each of the four districts was categorized into different strata with four strata (namely rural, urban, tribal and coastal stratas) in Kannur, Kasargod and Malappuram, and three strata in Wayanad (namely rural, urban and tribal strata). Two anganwadi centers (AWC) from each stratum were randomly selected with the help of WCD and Child Development Project Officer (CDPO) of each stratum, and allotted for data collection. So eight AWC each from Kannur, Kasargod and Malappuram and six AWC from Wayanad were selected for the study, expecting equal representation from each stratum. Calculated sample size could not be met due to lock down during COVID pandemic and equal representation from all strata was not obtained. Majority of the participants were from rural (46.8%) and coastal (22.5%) strata. Participants from urban area and tribal area constituted 17.7% and 12.9% respectively.

Study tools: Study tool development was done by faculty from Community Medicine department of the three participating tertiary care institutes. Field testing of the study tool was done in all the four districts and modifications done accordingly. The study tool was validated by Head of the

Community Medicine department of participating institutes.

Data collection: Data collection was started in May 2019 and continued upto March 2020, till COVID lock down. Data collection was conducted by faculty, junior residents and interns of the participating medical colleges. Training for data collection and hemoglobin estimation was provided to all individuals involved in data collection.

A schedule for each district was prepared by Principal investigators in consultation with CDPOs. Adolescent beneficiaries were asked to attend the anganwadi on the scheduled day. Maximum data collection was done on the same day. A second or third visit was organized in case of absentees. House visit was also made, if anybody could not attend anganwadi on the scheduled day. Procurement of instruments was done centrally at the tertiary institute of the Principal investigator and distributed to the districts. Filled data collection tool was collected centrally at tertiary institute of the Principal investigator.

A total of 395 subjects were studied.

Tools used:

1. Weight: Weight was measured in kilograms with the subjects barefoot and wearing light weight clothes, using an electronic weighing scale periodically calibrated with an accuracy of 0.1 kilogram.

2. Height: Measurement was taken by the side of the wall by placing a horizontally held wooden board touching the top of the head. A measuring tape was used.

3. Haemoglobinometer: True Hb Hemoglobin Monitoring kit based on the principle of reflectance photometry was used for this study. Sensitivity and specificity of True Hb for capillary blood varies from 82.1%- 89.4 % and 66.3- 77.9% respectively as learned from different studies. This low sensitivity and specificity may lead to misclassification of subjects; still this method was used considering feasibility in a field based study.

4. Demographic characteristics and associated factors: This was assessed by standardized study tool.

Ethical considerations: The proposal was presented and permission for the study was obtained from Institutional Research and Ethics Committee, at the tertiary care institute of the Principal investigator [IEC No. 2/2019/IEC/GMCK, dated 24/05/2019]. Informed consent form and assent forms were prepared and presented in the Institutional Ethics committee and sanction obtained. Consent/assent as appropriate was obtained from the participant before enrolment in the study.

Data Management and analysis: Data entry and analysis was done at tertiary care institute of the Principal investigator. Data was entered in excel sheet, cleaned and analyzed using SPSS version 24. Quantitative and qualitative variables were described using mean with standard deviation and frequency with percentage, respectively. Inferential statistical tools like Chi-square test and Fisher's exact test were used to test significance.

Operational definitions:

1. Adolescent girl: Girl children in the age group between 10-19 years, from the anganwadi area, who is registered with anganwadi/beneficiary of anganwadi.

2. Nutritional status: Nutritional status of adolescent girls was categorized using WHO-BMI chart as follows- Severe thinness (Less than -3 S.D of BMI for age), Thinness (Less than -2 S.D and more than or equal to -3 S.D), Normal (More than or equal to -2 S.D and less than or equal to +1 S.D), Overweight (More than +1 S.D and less than or equal to +2 S.D) and Obesity (More than +2 S.D of BMI for age).[4]

3. Anemia: Adolescent girls 10-11yrs of age are categorized as anemic if their haemoglobin level is < 11.5g/dl, and adolescent girls 12-19yrs of age are categorized as anemic if their haemoglobin level is < 12g/dl.[5]

4. Socio-economic status (SES): B G Prasad SES scale updated for the year 2019 was used to ascertain SES class.

5. Educational and occupational categories: as in Modified Kuppuswamy SES scale

6. Immunization status - Completed till age /Partial/unimmunized. Completed till age- Child who has taken all the vaccines recommended for his/her age in NIS.

7. Menorrhagia- regularly timed menstrual bleeding with duration of flow > 5 days with or without excessive bleeding or passage of clots. [6]

8. Dysmenorrhea- cramping pain accompanying menstruation and affecting daily activities.[7]

Results

The present study was conducted in four districts of North Kerala- Kannur, Kasargod, Wayanad and Malappuram. A total of 395 adolescent girls were included in the study. Their age ranged from 10 to 19 years, with a mean of 13.8 years and standard deviation 2.5 years.

Majority of the study participants belonged to 10-14years. Out of 395 adolescent girls, 158 (40%) were from Kannur, 43 (10.9%) from Malappuram, 55 (13.9%) from Wayanad and 139 (35.2%) from Kasargod. Majority (185, 46.8%) of the study participants were from rural area, 89 (22.5%) from coastal, 70 (17.7%) from urban and 51 (12.9%) from tribal area.

Table 1 shows the distribution of study population by general characteristics.

Regarding the marital status of the study population, it was observed that 382 (96.7%) were unmarried, 12 (3%) were married and one (0.3%) was a widow. Two of the adolescent girls had part time job.

The present study observed that 225 (57.7%) of the girls had attained menarche.

Nutritional status of adolescent girls, categorized as per WHO-Body Mass Index (BMI) criteria: The present study observed that 72.4% of adolescent girls had normal BMI, and 27.6% had malnutrition. It was observed that among the study population, 53 girls (14%) were thin and 29 girls (7%), severely

Table 1: Distribution of study population by different characteristics

Parameter	Frequency (%)
Age group	
10 - 14yrs	252 (63.8)
15 - 19yrs	143 (36.2)
Religion	
Hindu	235 (59.5)
Muslim	151 (38.2)
Christian	9 (2.3)
Socio-economic status (B G Prasad scale)	
1	31 (7.8)
2	87 (22)
3	80 (20.3)
4	80 (20.3)
5	117 (29.6)

thin. This study also found that among the study population, 19 girls (5%) were overweight and 8 girls (2%), obese.

Table 2 shows that a higher proportion of adolescent girls in the age group of 15-19 years are in normal category compared to 10-14years age group. A higher percentage of overweight girls are in 10-14years age group compared to 15-19years age group, whereas a higher percentage of girls in 15-19years have thinness. Pearson's correlation co-efficient between age and BMI is 0.220 ($p < 0.001$), implying a weak positive and significant correlation between age and BMI. No significant association was found between BMI and the following- paternal or maternal educational status or occupational status, maternal marital status, type of family and number of children in the family.

It is observed from Table 2 that proportion of girls with normal BMI was significantly higher among those who had menarche compared to those who didn't. Thinness, severe thinness and overweight were found to be high among those who have not attained menarche. This difference in BMI status between girls with and without menarche was found to be statistically significant.

A significantly higher proportion of those who didn't take IFA tablets weekly were thin compared to those who took IFA tablets (Table 2). It was also observed that a higher proportion of those who took IFA tablets weekly had overweight. This finding was statistically significant. The following parameters

Table 2: Association between BMI and various parameters

Variable		BMI					TOTAL	P Value
		Normal	Thinness	Severe thinness	Overweight	Obese		
Age Group	10-14 yrs	176 (69.8%)	28 (11.1%)	22 (8.7%)	18 (7.1%)	8 (3.2%)	252 (100%)	0.001* ⁺
	15-19 yrs	110 (76.9%)	25 (17.5%)	7 (4.9%)	1 (0.7%)	0	143 (100%)	
Attained menarche	No	109 (65.3%)	25 (15.0%)	19 (11.4%)	11 (6.6%)	3 (1.8%)	167 (100%)	0.03* ⁺
	Yes	177 (77.6%)	28 (12.3%)	10 (4.4%)	8 (3.5%)	5 (2.2%)	228 (100%)	
Weekly Intake of IFA Tablets	No	158 (72.5%)	36 (16.5%)	16 (7.3%)	5 (2.3%)	3 (1.4%)	218 (100%)	0.03* ⁺
	Yes	123 (71.5%)	17 (9.9%)	13 (7.6%)	14 (8.1%)	5 (2.9%)	172 (100%)	

*Significant +Chi-square test

Table 3: Multivariable analysis of factors associated with malnutrition

Variable	Category	Crude OR	p value	Adjusted OR	(95% confidence interval)	p value
Age group (yrs)	10-14	Reference	0.131	Reference	0.56 –1.84	0.958
	15-19	0.70		1.02		
Menarche	No	Reference	0.007	Reference	0.31 –0.93	0.028
	Yes	0.54		0.54		
IFA tablet weekly	Yes	Reference	0.823	Reference	0.62–1.53	0.917

were not found to have significant association with nutritional status- socio-economic status, immunization status, consumption of evening cooked meal from Anganwadi center,

and receiving health education on nutrition. The logistic regression analysis in Table 3 shows that in the unadjusted analysis, attaining menarche was found to be significantly associated with malnutrition, whereas age group and intake of IFA were not significant. In the adjusted analysis, attaining menarche continued to be significant factor associated with malnutrition. After adjusting for age group and IFA intake, it is seen that attaining menarche had a 46% lower odds of malnutrition, compared to those who had not attained menarche.

Out of 395 adolescent girls, hemoglobin estimation was done only for 388 girls as others were not willing for test. The present study observed that 156 girls (40%) had anemia.

Table 4 shows that prevalence of anemia was significantly higher in 15 -19yr age group (53.5%) compared to 10 - 14yr age group (32.5%). Pearson's correlation co-efficient between age and Hb was -0.224 (p<0.001), implying a significant, weak

negative correlation between age and Hb. It is also observed from Table 4 that proportion of anemia among those who attained menarche was significantly higher (51.8%) compared to those who didn't attain menarche (24.4%). No statistically significant association was found between anemic status and the following factors- maternal and paternal educational status, maternal and paternal occupational status, socio-economic status, marital status of mother, type of family and number of children in the family.

From Table 5 it is seen that both age group and attaining menarche were significantly associated with anemia in the unadjusted analysis. In the adjusted analysis, only attaining menarche remained significantly associated with anemia. After adjusting for age group and IFA intake, attaining menarche was associated with 2.82 times odds of anemia compared to those who had not attained menarche. So, attaining menarche is associated with lower odds of malnutrition and higher odds of anemia in the multivariable analysis.

Table 4: Association of anemic status with different variables

Variables	Anemia		Total	P value
Age group				
10-14yrs	166 (67.5%)	80 (32.5%)	246 (100%)	< 0.001* ⁺
15-19yrs	66 (46.5%)	76 (53.5%)	142 (100%)	
Attained menarche				
No	124 (75.6%)	40 (24.4%)	164 (100%)	<0.001* ⁺
Yes	108 (48.2%)	116 (51.8%)	224 (100%)	

*Significant ⁺Chi-square test

Table 5: Multivariable analysis of factors associated with anemia

Variable	Category	Crude OR	p value	Adjusted OR	95% confidence interval	p value
Age group (yrs)	10-14	1	<0.001	1	0.810–2.258	0.248
	15-19	2.389		1.353		
Menarche	No	1	<0.001	1	1.668–4.768	<0.001
	Yes	3.330		2.82		
IFA tablet weekly	Yes	1	0.843	1	0.628–1.480	0.867
	No	1.042		0.964		

Discussion

Adolescence is characterized by rapid physical growth and social and psychological adaptations. Adolescent girls are vulnerable to malnutrition due to increased nutritional demands at this stage of life cycle. The physiological changes like menarche contribute to higher risk of anemia among adolescent girls. The present study observed that less than a quarter of the study population (21%) were underweight and less than half (40%) had anemia.

In a school based cross-sectional study conducted in a rural area in Palakkad district in Kerala in 2017, it was found that out of 244 study participants, 37% of boys and 25.2% of girls were undernourished. That study also observed that 10% each of

boys and girls were overweight or obese. The study participants belonged to 9-14yrs age group and the study was based on WHO age and gender specific cut-offs for BMI for classification.[8] Compared to this study in Palakkad, the present study in North Kerala reflects a slightly better nutritional status for adolescent girls.

A cross-sectional study was done among 10-16yrol adolescent children in 2020 in Idukki district of Kerala. The study was based on WHO BMI cut-offs and found that the prevalence of thinness was 23.7%. It was also observed that thinness was more among children belonging to 10-13yrs (27.4%) compared to children belonging to 14-16yrs of age (20.7%).[9] The present study in North Kerala observed lower

malnutrition among adolescent girls, compared to the study in Idukki. These differences in nutritional status might be due to socioeconomic and behavioural factors, which have to be probed with further research.

In a cross-sectional study conducted by Goyal PA and Talwar I among 1045 adolescent children in Haryana state of India, it was observed that 44.3% were underweight and 1.3% overweight.[10] This study done in Haryana found a statistically significant association between nutritional status of adolescent girls and mother's educational status. No statistical association was found between nutritional status of adolescent girl and paternal educational status, parent's occupation and monthly family income. 10 A descriptive study done by Anju Kayathri S et al in 2020 among 135 adolescent girls in Kochi, Kerala it was found that 63.7% of girls had normal BMI.[11] In the present study done in North Kerala, 79% of adolescent girls had normal BMI, showing a better nutritional status. In a study done in North-Eastern Nigeria among 250 adolescent girls in secondary school, it was observed that 36% were underweight and statistically significant association was found between BMI of girls and monthly family income, maternal educational status, age group and area of residence. [12] In contrary to these studies, the present study in North Kerala did not find any statistically significant association between nutritional status of adolescent girls and the educational status of their mothers. The inferential statistical tests in the study in North Kerala may not be reliable as the calculated sample size was not met.

In the present study in North Kerala, it was observed that malnutrition in terms of overweight and severe thinness was high among 10-14yrs age group, and more girls in 15-19yrs had normal nutritional status [Table 2]. This difference was found to be statistically significant. This is consistent with the study done in Haryana, in which younger age group was found to have more malnutrition. 10 Another statistically significant observation was that in the group of adolescent girls who were taking Iron and folic acid (IFA) tablets weekly, only 9.9% had thinness, whereas 16.5% of adolescent girls who were not taking IFA tablets were thin (Table 2). The present study in North Kerala did not find any statistically significant association between BMI and the following- paternal or maternal educational status, parent's occupational status, maternal marital status, type of family, number of children in the family, immunization status of the girl child, and presence of menorrhagia.

In the present study, it was found that younger age group (10-14yr) had lower proportion of anemia (32.5%) compared to 53.5% anemia among older children (Table 4). This finding was statistically significant. The present study also found that when 24.4% of girls without menarche had anemia, the proportion of anemia among girls with menarche was almost double (51.8%, Table 4). This difference was statistically significant. Older children and those with menstrual periods had higher proportion of anemia compared to younger age groups and

those without menarche.

In a study done in Thrissur district of Kerala in 2018-2019 among 194 adolescent girls (10-19yrs), the prevalence of anemia was found to be 26.3%. That study also observed a lower prevalence of anemia in late adolescence, and that those who received IFA supplementation had lower prevalence of anemia.[13] These findings are not similar to the present study in North Kerala. One of the reasons for this difference might be because adequate sample size was not met in the present study. Other reasons like difference in estimation of anemia, dietary practices, compliance to IFA tablet, etc., need to be explored with further research.

In a study done by Rakesh et al, to assess prevalence of anemia among 880 students of 6th to 9th standard in Ernakulam district of Kerala in 2018, the prevalence of anemia was estimated to be 44%. That study also observed that higher age groups had higher proportion of anemia.[14] The findings in the present study in North Kerala among adolescent girls is consistent with this finding, with proportion of anemia 40% and higher proportion of anemia among older age groups. Similar prevalence of anemia (39.6% to 41.5%) is reported in studies done in other states of India. [15, 16]

In a community based study to assess the nutritional status of tribal girls in Hyderabad, 44% were found to be anemic and 60.1% were underweight. Study in Hyderabad observed that anemia was more (52.24%) among younger age group (10-13yrs).[17] This finding is not consistent with the observation in the present study in North Kerala. It might be due to geographic and socio-cultural differences in the study population.

The present study in North Kerala did not find any statistically significant association between presence of anemia and presence of menorrhagia, consumption of IFA tablets, immunization status and consumption of cooked meal from Anganwadi. The present study could not meet the calculated sample size due to COVID lock down, and hence the inferential statistical test results are to be viewed with caution.

More detailed research studies are required to identify the reasons behind high prevalence of anemia before menarche so that appropriate preventive measures like nutrition education; diet modification, deworming etc can be instituted. Further research is also needed to identify the reason for presence of anemia even after IFA supplementation so that targeted measures can be initiated to prevent anemia. It would be beneficial if future studies include parameters to assess compliance to IFA tablets, measures to identify incorrect practices in IFA consumption, conditions which impair iron absorption, etc. so that cause-specific interventions could be made to improve the nutritional status of adolescent girls.

Limitations

The calculated sample size could not be met due to lock down during COVID pandemic. Failure to achieve the calculated sample size may have affected the precision of estimates and it might have reduced the ability of the study to detect statistically significant associations. As sample size could not

be met, equal representation from all strata was not obtained. Majority of the participants were from rural strata. Sensitivity and specificity of True Hb used in the present study was 82.1%-89.4 % and 66.3- 77.9% respectively. This low sensitivity and specificity might lead to error in diagnosis of anemia, so there is chance of misclassification of subjects. The study may have limitations due to errors in participant response to questions on consumption of Anganwadi cooked meal and intake of weekly IFA tablet due to recall bias. More detailed research is needed to study dietary practices of adolescent girls, to quantify consumption of cooked meal from anganwadi, to assess compliance of weekly IFA tablet consumption, and to identify reasons behind high prevalence of anemia even after IFA supplementation.

Conclusion

The present study observed that anemia is a significant problem among adolescent girls in North Kerala and specific measures need to be initiated to tackle the situation. Malnutrition in the form of thinness is also an important issue which needs to be addressed. Timely interventions to improve the nutritional status will help to improve the productivity and quality of life, will prevent non-communicable diseases, and will also ensure a healthy mother and baby in the future.

Conflict of interest: There are no conflicts of Interest.

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