DIETARY PRACTICES, NUTRIENT ADEQUACY AND NUTRITION STATUS AMONG ADOLESCENTS IN RURAL AREAS OF TIRUPATI

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Abstract

Background: Adolescence is a unique stage in the life cycle as it is receptive to developing new ideas and lifestyle behaviours and to adopting and consolidating sound and healthy dietary habits. This study aimed to estimate the prevalence of thinness and stunting among adolescent girls and to identify the factors predicting the occurrence of thinness and stunting.
Methods: The present study was a community-based cross-sectional study conducted among adolescent girls between 10-19 years old. A total of 188 adolescent girls participated in the study. Socio-demographic, environmental factors and dietary habits were collected. BMI for age and Height for age were calculated to assess the nutritional status. Multivariate binary logistic regression was used to identify the predictors of thinness and stunting.
Results: In this study prevalence of thinness and stunting was 17% (95%CI: 11.9%-23.2%) and 7.98% (95%CI: 4.5%-12.8%) respectively. Thinness was significantly high among girls with family size of more than 5, habit of skipping meal and taking NAR calories of less than 70%. Stunting was significantly high among girls with family size less than 5, habit of skipping meals and habit of spiritual fasting, and taking NAR calories of less than 70%.
Conclusions: It is concluded from the study that a considerable proportion of adolescent girls were present with thinness and stunting. It is recommended that appropriate measures need to be taken to prevent thinness and stunting as this group constitutes a sizeable portion of the Indian mothers of our next generation and their health and well-being are significantly important for improving the nutritional health of women of the nation.

Keywords: Adolescent girls, rural area, anthropometry, thinness, stunting, Nutritional adequacy.

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1. Introduction

Adolescence is transitional period of life between childhood and adulthood and it is characterized by rapid physical growth and development and requirements of all nutrients increase during this period.[1,2] Adolescent period is defined as 10-19 years by WHO.[1,3] Globally adolescent population constitutes 1.2 billion and 16% of the total population and is one of the largest and most vulnerable cohorts. In India, there are 253 million adolescents that is making up 20% of the total population.[3] Health and wellness of adolescents are important as they gain up to 50% of their adult weight, more than one-fifth of their adult height, and approximately 50% of their adult skeletal mass.[4,5] Therefore, if adolescent nutritional requirements fail to be met, it might result in malnutrition, which has a negative impact on their rapid physical growth and development.[6]

Adolescence is a unique stage in the life cycle as it is receptive to the development of new ideas and lifestyle behaviours and to the adoption and consolidation of sound and healthy dietary habits where intervention can be done. Interventions in the form of improving their knowledge and practices of optimal and adequate nutrition intake during adolescence can delay or prevent nutrition-related illnesses in adulthood and later part of life. Their eating habits and lifestyle factors along with underlying psychosocial factors are particularly important threats to optimal nutrition.[7,8] Appropriate nutrition during adolescence has the unique opportunity to break the vicious cycle of social problems that are passed from one generation to the next generation such as gender discrimination, poverty, violence, poor health, and malnutrition.[9]

Nutritional deficiencies among adolescent girls have self-perpetuating consequences. Undernourished adolescent girls are likely to give birth to undernourished children resulting in the vicious cycle of intergenerational malnutrition if great attention is not given to adolescent girls' nutritional needs. Poor nutrition status among adolescents is also an important determinant of poor health outcomes.[10, 11,12]

Short-term complications of undernutrition are low weight for age, increased risk of infections, and poor academic performance in schools. Long-term consequences of undernutrition are poor general health in the adult period and reduced economic productivity, which in turn, affects the country's socio-economic development.[4,5] The nutritional status of adolescents contributes significantly to the health status of the community and country in which they reside. One of the major public health problems faced by developing countries today is undernutrition.[13]

Besides this, adolescent girls remain a largely neglected segment of the population. Their health has been neglected for many years. As a result, their needs are often ignored though they are mothers of the future generation. Attention needs to be directed at the link between adolescent girls' nutrition and immediate and long‐term health issues to prevent the worst consequences of malnutrition.[14,15,16.17] With this background, this study aimed to estimate the prevalence of thinness and stunting among adolescent girls and to identify the factors predicting the occurrence of thinness and stunting.

2. Materials and Methods

The present study was a community-based cross-sectional study conducted among adolescent girls of age between 10-19 years. The study participants were selected from rural field practice area (RHTC) of SVIMS-Sri Padmavathi Medical College for women for a period of 2 months. RHTC Mangalam covers a population of 44,246 with 7 Health sub-centres (HSCs). Among these 7 HSCs, 3 HSCs were selected randomly and the study sample was collected from these sub-centres according to population proportion to size. From each selected HSC data was collected by doing door-to-door surveys till reaching the sample size.

The sample size(N) was calculated by using the formula: $\mathbf{N=Z_{\alpha/2}^2P(1-P)\div E^2}$ (Z=1.96 for 95% of the confidence interval, P is estimated prevalence in study population(the prevalence of thinness using BMI for age <-2SD using NCHS/WHO standards was 36.54% in one of the studies on rural adolescent girls in India, which was taken into consideration for sample size estimation).[18] E= relative precision, here taken as 20% of prevalence. So, the study sample was 188. **Inclusion criteria:** Adolescent girls of age between 10-19 years who are permanent residents of the study area and willing to participate in the study, **Exclusion criteria:** Individuals of age below 10 years and above 19 years, Individuals with congenital anomalies, any acute are chronic medical condition which may compromise anthropometric measurements, individuals who are not willing to participate and individuals who are staying at home irregularly (<4 days in a week). Study instruments were standard calibrated measuring tape and weighing machine for anthropometry, predesigned semi-structured questionnaire.

A door-to-door survey was conducted in the study area, after explaining about aims and objectives of the study, informed consent was taken from parents or guardians. The interview was conducted at the residence of girls using a predesigned and semi-structured questionnaire. It included information on socio-demographic factors, family size and type of family, place of cooking, source of drinking water, water purification methods, practice of hand washing with soap after toilet, addictions, and dietary practices like type of diet, habit of skipping

meals, food fads, junk food, spiritual fasting, taking iron supplements.

Operational definitions:
Adolescent age was stratified as Early adolescents: adolescents in the age group of 10-13 years, Middle adolescents: in the age group of 1416 years, and Late adolescents: in the age group of 17–19 years.

Height: Height in centimeters was marked on a wall with the help of a measuring tape. All girls were measured against the wall without footwear and with heels together and their heads positioned so that the line of vision was perpendicular to the body. A scale was brought down to the topmost point on the head. The height was recorded to the nearest 1 cm.
Weight: A digital weighing scale was used to measure the weight and calibrated it against known weights regularly. The zero error was checked for and removed if present, every day. Their weight was recorded to the nearest 500 grams.[19,20]
BMI: BMI of each participant was computed by using the formula weight (kg)/ height (m^2). Study participants were classified based on WHO BMI for age charts and classified into thinness (<-2 SD), normal (in between -2SD and +1SD) and overweight and obese (>+1SD and >+2SD respectively). Height-for-age <− 2SD was considered as stunting.[21] Socioeconomic status (SES) was assessed by modified BG Prasad's socio-economic scale.[22]
Dietary intake was assessed by 24-hour dietary recall method and calorie, protein and iron intake were calculated. The Nutrition Adequacy Ratio (NAR) of calories, protein, and iron was calculated by ratio of an individual's nutrient intake to the current recommended allowance of the nutrient for his or her age and sex and represented as a percentage. Once the NAR is calculated for each nutrient, the Mean Adequacy ratio (MAR) was calculated by averaging all the NAR values together.[23]
Ethical Approval: This study was approved by the Institution Ethics Committee, SVIMS, Tirupati. (Roc.No.AS/11/IEC/SVIMS/2019: IEC No.974 dated 18.11.2019). Written consent from parents or guardians and the adolescent girls was obtained before data collection. The anonymity and confidentiality of the participants were strictly maintained.

3. Statistical analysis

The collected data was entered into Microsoft Excel. Categorical variables like socio-demographic factors, environmental factors, and dietary practices were presented as numbers and percentages. NAR of calories, proteins, iron, and MAR were presented as mean and standard deviations. The association between socio-demographic factors, environmental factors, and dietary practices with the presence of thinness and stunting was assessed through bivariate analyses. Shapiro–Wilk test was used to test the normality. If the data was normally distributed Student t-test was used to significant difference between 2 means. If the data was not normally distributed Mann Whitney's U test was used. Multivariate binary logistic regression was performed to identify the predictors of thinness and stunting. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp was used to calculate statistics. A p-value <0.05 was considered significant.

4. Results

A total of 188 adolescent girls participated in this study. The prevalence of thinness and stunting was 17% (95% CI:11.9%-23.2%) and 7.98% (95% CI:4.5%-12.8%) respectively.

Table 1: Distribution of Thinness and stunting according to Socio-demographic and environmental factors

Variable		**Total**	**Thinness No.**	**% (95% CI)**	**P value**	**Stunting No.**	**% (95% CI)**	**P value**
Adolescent groups	Early Middle Late	64 88 36	10 16 6	15.6 (7.7-26.8) 18.2 (10.8-27.8) 16.7 (6.4-32.8)	0.916	3 10 2	4.7 (0.9-13.1) 11.4 (5.6-19.9) 5.6 (0.7-18.7)	0.272
Religion	Hindu Muslim Christian	169 12 7	30 2 0	17.8 (12.3-24.4) 16.7 (2.1-48.4) 0	0.472	13 1 1	7.7 (4.2-12.8) 8.3 (0.2-38.5) 14.3, (0.4-57.9)	0.819
Family size	<5 ≥5	105 83	7 25	8.4 (3.5-16.6) 26.3 (17.8-36.4)	**0.005**	13 2	12.4 (6.8-20.2) (2.4, 0.3-8.4)	**0.012**
Type of family	Nuclear Joint	159 8 21	28 2 2	17.6 (12.0-24.4) 25 (31.9-65.1)	0.539	15 0 0	(9.4, 5.4-15.1) 0 0	0.226

	Three generation			9.5 (1.2-30.4)				
Socio economic status	Upper Upper Middle Middle Lower Middle	9 61 91 27	1 11 13 7	11.1 (0.2-48.3) 18 (9.4-29.9 14.3 (7.8-23.2) 25.9 (11.1-46.3)	0.519	0 4 10 1	0 6.6 (1.8-15.9) 11 (5.4-19.3) 3.7 (0.9-18.9)	0.433
Type of house	Pucca Semi Pucca Kutcha	99 87 2	17 15 0	17.2 (10.3-26.1) 17.2 (9.9-26.8) 0	0.813	5 10 0	5.1, (1.7-11.4) 11.5, (5.7-20.1) 0	0.247
Place of cooking	With in the living room Separate kitchen	38 150	8 24	21.1 (9.5-37.3) 16 (10.5-22.9)	0.472	5 10	13.2 (4.4-28.1) 6.7 (3.2-11.9)	0.187
Source of drinking water	Municipal water Water tanker Canned water	18 2 168	4 0 2	22.2 (6.4-47.6) 16.7 (11.4-23.2) 0	0.680	4 1 10	22.2 (6.4-47.6) 50 (1.3-98.7) 6 (2.9-10.7)	**0.005**
Purification of water	Not purifying Boiling Filtering	181 3 4	32 0 0	17.7 (12.4-24.0)	0.474	15 0 (0) 0 (0)	8.3 (4.7-13.3) 0 0	0.730
Hand washing after toilet	Yes No	184 4	32 0	17.4 (12.2-23.7) 0	0.360	14 1	7.6 (4.2-12.4) 25 (0.6-80.6)	0.204
Addictions in the family	Yes No	119 69	24 8	20.2 (13.4-28.5) 11.6 (5.1-21.6)	0.131	9 6	7.6 (3.5-13.9) 8.7 (3.3-18.0)	0.782

It is observed from Table 1 that, Thinness and stunting were more common among the middle adolescent group. Thinness was more common among Hindus, family size of >5, Joint families, lower middle socioeconomic status, girls living in pucca and semi-pucca houses and stunting was more common in girls living in the pucca house. Thinness and stunting were more common among families with place of cooking present within in living room compared to cooking in a separate kitchen. Thinness and stunting were common among girls with sources of drinking water being municipal water and water tanker respectively. Both thinness and stunting were common among families with not doing purification before consuming drinking water. Stunting was common among family size of <5, nuclear families, and middle socio-economic status girls with no habit of hand washing after using toilet. Thinness was more common among families with addictions like smoking, tobacco chewing and alcoholism etc.

Table 2: Distribution of Thinness and stunting according to different nutritional factors

Variable		**Total**	**Thinness No.**	**(%, 95% CI)**	**P value**	**Stunting No.**	**(%, 95% CI)**	**P value**
Type of diet	Veg Mixed	25 163	5 27	20 (6.8-40.7) 16.6 (11.2-23.2)	0.670	1 14	4 (0.1-20.4) 8.6 (4.8-14.0)	0.430

Habit of skipping meal	Yes No	52 136	21 11	40.4 (27.0-54.9) 8.1 (4.1-14.0)	**<0.001**	8 7	15.4 (6.9-28.1) 5.1 (2.1-10.3)	**0.020**
Food fads	Present Absent	105 83	20 12	19 (12.0-27.9) 14.5 (7.7-23.9)	0.406	7 8	6.7 (2.7-13.3) 9.6, (4.3-18.1)	0.455
Junk food	Yes No	5 183	0 32	0 17.5 (12.3-23.8)	0.305	0 15	0 8.2 (4.7-13.2)	0.505
Spiritual fasting	Yes No	51 137	10 22)	19.6 (9.8-33.1) 16.1 (10.4-23.3	0.565	9 6	17.6 (8.4-30.9) 4.3 (1.6-9.3)	**0.002**
Iron supplements	Yes No	39 149	3 29	7.7 (1.6-20.9) 19.5 (13.4-26.7)	0.082	2 13	5.1 (0.6-17.3) 8.7 (4.7-14.5)	0.461
NAR calories	<70 ≥70	100 88	24 8	24 (16.0-33.6) 9.1 (4.0-17.1)	**0.007**	6 9	6, (2.2-12.6) 10.2 (4.8-18.5)	0.286
NAR Proteins	<70 ≥70	55 133	8 24	14.5 (6.5-26.7) 18 (11.9-25.7)	0.561	5 10	9.1 (3.0-19.9) 7.5 (3.7-13.4)	0.717
NAR Iron	<70 ≥70	171 17	31 1	18.1 (12.7-24.7) 5.9 (0.2-28.7)	0.200	13 2	7.6 (4.1-12.7) 11.8 (1.5-36.4)	0.546
MAR	<70 ≥70	107 81	19 13	17.8 (11.0-26.3) 16 (8.8-25.9)	0.758	8 7	7.5 (3.3-14.2) 8.6 (3.6-17.0)	0.770

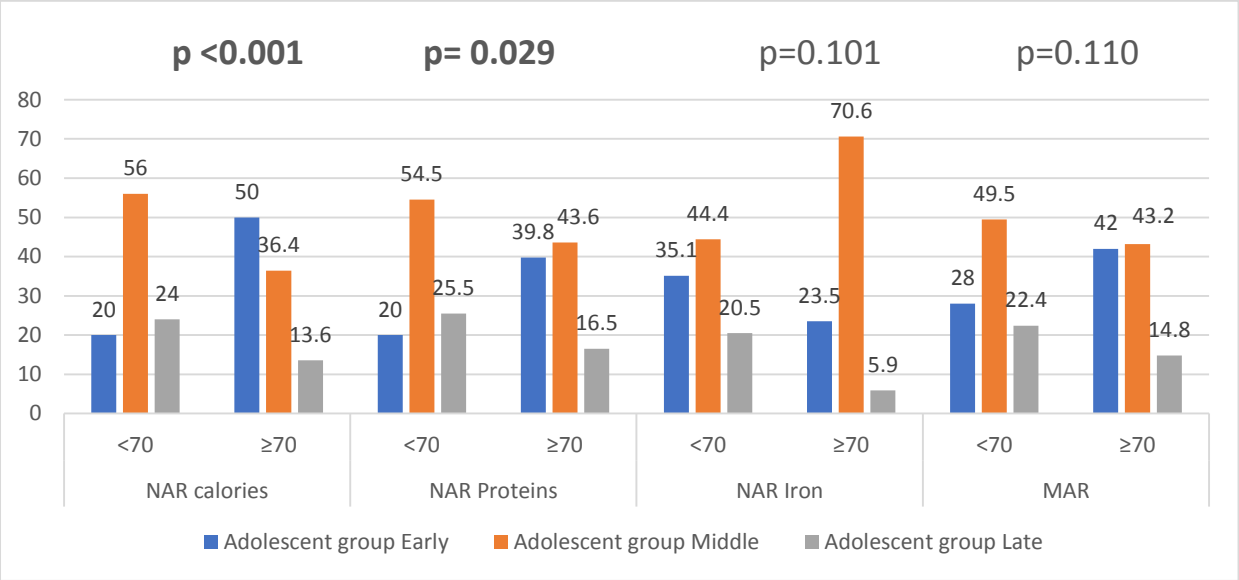
Table 2 showed that thinness was commonly observed among pure vegetarian girls compared to girls with mixed diet. Thinness and stunting were significantly high among girls with the habit of skipping meals. Thinness was common among girls with food fads and do not have the habit of taking Junk food, the habit of spiritual fasting and not taking Iron supplements. Stunting was common among girls without food fads, who do not have the habit of taking Junk food, habit of spiritual fasting and not taking Iron supplements. Thinness was significantly high among girls with NAR calories of less than 70%, NAR proteins of more than 70%, NAR Iron of less than 70% and MAR of less than 70%. Stunting was common among girls with NAR calories, NAR Iron, and MAR of more than 70%. But Stunting was common among NAR proteins of less than 70%.

Table 3: Distribution of Thinness and stunting according to means of NAR calories, proteins, Iron and MAR

Variable	**Thinness**		**P value**	**Stunting**		**P value**
	Yes Mean±SD	**No Mean±SD**		**Yes Mean±SD**	**No Mean±SD**	
NAR calories	69.61±12.39	72.65±14.88	0.281	75.07±15.90	71.79±14.4	0.274
NAR Proteins	78.01±17.26	77.93±17.78	0.979	72.64±18.11	78.40±17.58	0.226
NAR Iron	52.69±10.22	55.05±12.91	0.334	56.75±10.45	54.47±12.67	0.498
MAR	66.77±11.19	68.24±12.94	0.551	68.35±11.65	67.96±12.75	0.911

The mean calorie intake of all study participants, underweight and stunted were 1653.44±326.55, 1583.42±268.36 and 1760.20±378.45. The mean protein intake of all study participants, underweight and stunted were 39.95±9.05, 39.78±9.78, and 38.19±10.84. The mean iron intake of all study participants, underweight and stunted were 14.59±3.35, 14.06±2.73 and 14.56±2.60. Table 3 showed that mean NAR of calories, mean NAR of Iron and MAR were low among Thin girls but mean NAR of protein was high among thin girls. Mean NAR of calories, mean NAR of Iron and MAR were high among stunted girls but mean NAR of protein was low among stunted girls. (Table 3)

Figure 1: Distribution of age group of adolescents according to NAR calories, proteins, Iron and MAR



It is observed from the above Figure 1 that most of the middle age group adolescent girls have NAR calories (56%) and NAR proteins (54.5%) have less than 70% compared to early and late adolescent age groups. This difference was statistically significant. NAR Iron (44.4%) and MAR (49.5%) of less than 70% (56%) were also common among middle age group adolescent girls.

Table 5: Distribution of NAR calories, proteins, Iron and MAR according to different nutrition factors

Variable		**Total**	**NAR calories**	**NAR Proteins**	**NAR Iron**	**MAR**
			<70 Number (%, 95% CI)	**<70 Number (%, 95% CI)**	**<70 Number (%, 95% CI)**	**<70 Number (%, 95% CI)**
Type of diet	Veg	25	12 (48, 27.8-68.7)	9 (36, 17.9-57.5)	19 (76, 54.8-90.6)	14 (56, 34.9-75.6)
	Mixed	163	88 (54, 46-61.8)	46 (28.2, 21.5-35.8)	152 (93.3, 88.3-96.6)	93 (57.1, 49.1-64.8)
P value			0.576	0.426	**0.005**	0.921
Habit of Skipping meal	Yes	52	32 (61.5, 47.0-74.7)	11 (21.2, 11.1-34.7)	49 (94.2, 94.1-98.8)	29 (55.8, 41.3-69.5)
	No	136	68 (50, 41.3-58.7)	44 (32.4, 24.6-40.9)	122 (89.7, 83.3-94.3)	78 (57.4, 48.6-65.8)
P value			0.156	0.131	0.333	0.844
Food fads	Yes	105	57 (54.3, 44.3-64.0)	34 (32.4, 23.6-42.2)	94 (89.5, 82.0-94.7)	56 (53.3, 43.3-63.1)
	No	83	43 (51.8, 40.6-62.9)	21 (25.3, 16.4-36.0)	77 (92.8, 84.9-97.3)	51 (61.4, 50.1-71.9)
P value			0.735	0.289	0.441	0.265
Junk Food	Yes	5	1 (20, 0.5-71.6)	3 (60, 14.7-94.7)	5 (100, 47.8-100)	4 (80, 28.4-99.5)
	No	183	99 (54.1, 46.6-61.5)	52 (28.4, 22.0-35.5)	166 (90.7, 85.5-94.5)	103 (56.3, 48.8-63.6)
P value			0.132	0.126	0.475	0.291
Spiritual fasting	Yes	51	36 (70.6, 56.2-82.5)	18 (35.3, 22.4-49.9)	49 (96.1, 86.5-99.5)	34 (66.7, 52.1-79.2)
	No	137	64 (46.7, 38.2-55.4)	37 (27, 19.8-35.3)	122 (89.1, 82.6-93.7)	73 (53.3, 44.6-61.9)
P value			**0.004**	0.267	0.135	0.099
Iron supplements	Yes	39	24 (61.5, 44.6-76.6)	10 (25.6, 13.0-42.1)	33 (84.6, 69.5-94.1)	25 (64.1, 47.2-78.8)
	No	149	76 (51, 42.7-59.3)	45 (30.2, 22.9-38.3)	138 (92.6, 87.2-96.3)	82 (55, 46.7-63.2)

P value		0.241	0.577	0.121	0.309

It is observed from Table 5 that the majority of girls with mixed diet have NAR calories, NAR iron, and MAR of less than 70% but most of the vegetarians have NAR proteins of less than 70%. Most of the girls with the habit of skipping meals have NAR calories and NAR iron of less than 70% but most of the girls without the habit of skipping meals have NAR proteins and MAR of less than 70%. Most girls with food fads have NAR calories and NAR proteins of less than 70% but the majority of girls without food fads have NAR of Iron and MAR of less than 70%. Most of the girls with the habit of taking junk foods have NAR proteins, NAR Iron and MAR of less than 70% but most of the girls without the habit of taking junk foods have NAR calories of less than 70%. Most of the girls with the habit of spiritual fasting have NAR calories, NAR proteins and NAR Iron and MAR of less than 70%. Most of the girls who are taking iron supplements have NAR of proteins, NAR Iron of less than 70% but majority of girls who are taking iron supplements have NAR calories and MAR of less than 70%.

Table 6: Multivariate binary logistic regression of thinness and stunting with nutrition factors and NAR calories, proteins, Iron and MAR

Variable		**Thinness**		**Stunting**	
		U OR (95% CI)	**A OR (95% CI)**	**U OR (95% CI)**	**A OR (95% CI)**
Adolescent groups	Early Middle Late	1. 1.200 (0.505-2.851) 1.080 (0.357-3.265)	1 0.387 (0.111-1.346) 0.395 (0.089-1.743)	1 2.607 (0.687-9.996) 1.196 (0.190-7.514)	1 2.721 (0.474-15.631) 1.235 (0.148-10.320)
Family size	<5 ≥5	1 3.393 (1.386-8.303)	1 3.656 (1.108-2.061) *	1 5.723 (1.254-6.123)	1 7.354 (1.360-39.776) *
Socio economic status	Upper Upper middle Middle Lower middle	1 1.760 (0.199-15.553) 1.333 (0.154-11.564) 2.800 (0.295-26.566)	1 0.883 (0.068-11.538) 0.631 (0.051-7.855) 3.581 (0.251-50.997)	-	-
Type of diet	Mixed Veg	1 1.259 (0.435-3.647)	1 1.937 (0.448-8.369)	0.443 (0.056-3.529)	1 0.463 (0.049-4.389)
Food fad	No Yes	1 1.392 (0.637-3.043)	1 1.828 (0.647-5.165)	1 0.498 (0.170-1.462)	1 0.416 (0.099-1.756)
Habit of skipping meal	No Yes	1 7.698 (3.361-17.632)	1 11.76 (3.814-0.289) *	1 3.351 (1.149-9.774)	1 4.431 (1.100-17.847) *
Spiritual fasting	No Yes	1 1.275 (0.557-2.918)	1 1.438 (0.460-4.496)	1 2.565 (0.879-7.483)	1 6.609 (1.460-29.922) *
Iron Supplements	No Yes	1 0.345 (0.099-1.198)	1 0.164 (0.034-0.790)	1 0.565 (0.122-2.618)	1 0.160 (0.017-1.475)
NAR calories	>70 <70	1 3.158 (1.337-7.459)	1 7.236 (1.79-29.213) *	1 1.785 (0.069-5.232)	1 12.06 (1.890-76.269) *
NAR proteins	>70 <70	1 0.773 (0.324-1.846)	1 0.554 (0.149-2.059)	1 1.230 (0.400-3.780)	1 1.617 (0.308-8.495)
NAR Iron	>70 <70	1 3.543 (0.453-27.73)	1 2.529 (0.217-29.427)	1 1.427 (0.176-11.57)	1 0.601 (0.041-8.897)
MAR	>70	1	1	1	1

	<70	1.129 (0.521-2.447)	0.700 (0.169-2.906)	1.567 (0.514-4.777)	4.069 (0.636-26.010)

*Significant

Multivariate binary logistic regression was done to identify the independent risk factors of thinness and stunting. It is shown that family size of more than 5, habit of skipping meals and consuming NAR calories of less than 70% are significant independent predictors of Thinness among adolescent girls. However, family size of more than 5, habit of skipping meals, spiritual fasting, and taking NAR calories of less than 70% are significant independent predictors of stunting among adolescent girls.

5. Discussion

In this study, the prevalence of thinness and stunting among rural adolescent girls was estimated and also factors predicting the occurrence of thinness and stunting were identified. World Health Organisation (WHO) suggested that the primary goal of nutritional assessment be to assess health conditions and to improve human health through the implementation of specific nutritional intervention programmes.[24] Undernutrition is still a significant public health concern and a significant contributor to health problems in adolescent girls.[25] Undernutrition assessment is of great significance in India, and adolescent girls are the target population for nutrition intervention programmes to improve their nutritional status as well as overall health condition because they are future mothers, and their nutritional status influences the nutrition status of young girls. A significant proportion of adolescents are suffering from different grades of undernutrition.[26,27,28] Adolescents' poor nutritional status, especially that of girls, has significant implications for their physical work capacity and unfavorable reproductive consequences. This condition might be due to inadequate nutrient intake, lack of access to a variety of foods, and limited purchasing power, lack of dietary awareness and adolescent ignorance are potential causes.[29]

In this study prevalence of thinness and stunting was 17% (95% CI: 11.9%-23.2%) and 7.98% (95% CI: 4.5%-12.8%) respectively. Thinness in this study was high compared to NFHS-3 (9.9%)[30] and NFHS-4(9%)[31] and stunting was less compared to NFHS-3 (31.2%)[30] and NFHS-4 (34.4%).[31] Prevalence of thinness was less compared to the study done by Darakshan Ali et al (35.7%)[8], Roy S et al (39.6%)[32] and high compared in a study done by Aregawi Amha (12.6%)[29], Nisha Rani et al (12%)[33] and Tewodros Getaneh Alemu et al (8.5%).[34] Stunting in this study was less compared to study done by Rika Rachmalina (17.9%)[35], Roy S et al (26%)[32,] and Tewodros Getaneh Alemu et al (24.2%).[34] These findings may be due to differences in the age group included in the study (in this study 10-19 years age group included), rural, and urban differences (in this study only rural adolescents were included), different criteria to classify thinness and stunting (In this study BMI for age with less than -2SD was considered as thinness and height for age less than -2SD was considered as stunting).

Several studies have reported that the prevalence of thinness and stunting were found to be significantly higher among adolescent age groups and major nutritional problems among adolescents in India.[27,36.37] Several studies observed that high prevalence of stunting among adolescent girls from Assam (51.9%)[36], West Bengal (52.5%)[38], Wardha (50.7%)[39], North India (37.2%)[40] and North Bengal (51.2%)[41]. The National Nutrition Monitoring Bureau (NNMB) data showed that approximately 39% of adolescents from rural areas were stunted.[27] A relatively very high prevalence of stunting (≥40%) was reported for Indian adolescents.[27,36,37,38,42,43] The primary cause of stunting might be long-term, cumulative health and nutritional deficiencies as well as inadequate nutrient intake throughout early childhood among adolescents.[25,27,36]

In the present study thinness and stunting were more common among middle age group adolescents (18.2% and 11.4% respectively). Thinness was more common among lower middle socioeconomic status families (25.9%) and stunting was common among middle socioeconomic status families (11%). Similar findings were observed in a study done by Darakshan Ali et al[8] the prevalence of thinness was significantly associated with SES. It was observed that the prevalence of thinness was higher in the lower SE class (53.8%) followed by the middle class (22.4%) and upper class (16.7%). The higher prevalence of thinness in lower SE classes may be because of poor dietary intake due to economic constraints than those from higher SE classes. Similar findings were reported by Maiti S et al in West Bengal where the prevalence of thinness (27.1%) was highest in Socioeconomic class IV.[42] However Das DK et al did not find any association between socioeconomic status and the prevalence of thinness among adolescent girls in West Bengal.[38]

The mean calorie intake of all study participants, thinned and stunted were 1653.44±326.55, 1583.42±268.36, and 1760.20±378.45 respectively. The mean protein intake of all study participants, thinned and stunted were 39.95±9.05, 39.78±9.78, and 38.19±10.84 respectively. The mean iron intake of all study participants, thinned and stunted were

14.59±3.35, 14.06±2.73, and 14.56±2.60 respectively. Median calorie intake among all adolescents and underweight was 1531.3 (1265.3–1865.1) and 1556.6 (1281.2–1853.9) observed in a study done by Rachmalina R et al.[45] In the same study, 7.4%, and 12% of adolescent girls of normal weight and underweight girls were consuming adequate amounts of calories respectively and 65.3% and 83% of adolescent girls of normal weight and underweight girls were consuming adequate amounts of protein respectively.[45] In another study done by Rumana Akter et al, the Median dietary intake of energy was 2001.3 (523.3-6610.7). Prevalence of inadequate dietary intake of calories and iron were 39.6% and 28.4% which were less compared to this study (24% and 18.1%).[46]

On multivariate binary logistic regression analysis, it is shown that family size of more than 5, the habit of skipping meals and consuming NAR calories of less than 70% were significant independent predictors of Thinness among adolescent girls. However, family size of more than 5, the habit of skipping meals, spiritual fasting, and taking NAR calories of less than 70% were significant independent predictors of stunting. However, Darakshan Ali et al observed that there was a significant association existed between thinness and SES with a higher prevalence seen in lower SE class than upper class. However, the association of the prevalence of thinness with residence, type of family, mother's literacy, mother's occupation and type of school was not found to be statistically significant.[8]

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