

The Magnitude of Under-Nutrition and Associated Factors Among School-Going Adolescents in Agra, Uttar Pradesh

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Abstract

Background: Despite great advances and progress during recent years, under-nutrition remains important public health problem in India. Thinness is better indicator for under-nutrition than under-weight among adolescents and need to be studied in details. The objective is to find the magnitude of thinness and associated factors among school-going adolescents in Agra. **Material and Methods:** The study was conducted among 480 students aged 10-19 years which were selected through multistage random sampling across selected government and private schools in Agra. Cross-sectional surveys were conducted and the WHO's BMI-for-age criteria was used to classify subjects into thin and severe thin category. Appropriate statistical tests were applied for the analysis. **Results:** 12.50% of school-going adolescents in Agra city were thin while another 10% were severely thin. No statistically significant difference in the proportion of thinness was observed on the basis of age, sex, and class of study, whereas type of school, socio-economic class and mother's education were significantly associated with thinness among study subjects. Life style factors like involvement in moderate to vigorous physical activity daily, mode of transport to school and screen time; and dietary factors like number of meals per day, regularity of breakfast, amount of fruits & vegetables eaten per day, and consumption of cold drinks/beverages were found to have a significant association with thinness among school-going adolescents in Agra city. **Conclusion:** Dietary and life-style factors, which were significantly associated with thinness among school-going adolescents, need special attention and appropriate advice should be given to sufferers during routine school health services visit.

Keywords: Under-nutrition, life-style, dietary habits, BMI-for-age, thin, severe thinness.

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INTRODUCTION

Malnutrition refers to deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients.^[1] The condition encompasses both under-nutrition and over-nutrition. Over the past few decades; global focus has shifted from under-nutrition to over-nutrition due to increase in its prevalence especially in developed countries, but under-nutrition, still remains a major public health concern in many of the developing countries like India where food insecurity, lack of access to nutritious foods, and poor dietary habits are prevalent.

India has the largest adolescent population in the world, 253 million, and every fifth person is between 10 to 19 years.^[2] India stands to benefit socially, politically and economically if this large number of adolescents is safe, healthy, educated and equipped with information and life skills to support the country's continued development. According to a recent study by government of India; one in every four adolescent in India suffers from thinness, which in one of the visible form of under-nutrition.^[3]

Under-nutrition refers to a condition where individuals do not receive enough nutrients (calories, protein, vitamins, and minerals) for normal growth, development, and bodily functions. Anthropometric measurements have become a

widely used non-invasive and inexpensive practical technique of assessing nutritional status where height-for-age, weight-for-age, weight-for-height, and Body Mass Index for age (BMI-for-age) are some of the most commonly used parameters worldwide.^[4] Under-nutrition is often represented by under-weight, which is defined by weight-for-age criteria but has a limited value among adolescents. Thinness, on the other hand, is defined on the basis of BMI-for-age criteria, set by the WHO, and can be used as a proxy indicator for under-nutrition among adolescents. With this background; an epidemiological study was conducted to find the magnitude of under-nutrition and explore some of the dietary and life-style factors associated with it among school-going adolescents in Agra city.

MATERIALS AND METHODS

The present study was conducted among school-going

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adolescents of randomly selected public and private schools in Agra city where cross-sectional surveys were done to find the magnitude of under-nutrition and its associated factors. This was a descriptive and observational type of study which was conducted between October 2020 and September 2022. The study population comprised of all adolescents, in the age group of 10-19 years, who were attending all public and private schools of Agra city in Uttar Pradesh, India.

Sample size: The formula, $N = Z^2 \times (pq) / d^2$ was used for the calculation of sample size; where Z is standard normal deviate, p is prevalence of disease, q is 100 minus p, and d is allowable error. Using the anthropometric information from District Level Household and Facility Survey-4 (2011-2012) and Annual Health Survey (2014); Panda BK et al (2021) estimated that prevalence of thinness among adolescents in India was 24.8%. So, for $Z=1.96$, $p=24.8$, $q=100-p=75.2$, and $d=20\%$ of $p=4.96$, a sample size $n = 3.84 \times 24.8 \times 75.2 / 4.96 \times 4.96 = 315$ was calculated. For an effect size of 1.5; sample size came to 472. To compensate non-responders and for ensuring equal representation from public and private schools, boys and girls, and students from class 6th to 11th standard, a final tally of 480 was decided as adequate sample size for the present study.

Sampling Technique: A multistage random sampling was used for selection of schools, section of class, and desired number of students to reach the final sample. In first stage, two public schools – one boy's and one girl's school and one co-educational private school were selected randomly from the lists of schools in Agra city obtained from the district education department. In second stage, one section was selected from each class, 6th to 11th, randomly. In third stage; desired number of girl and or boy students was selected from selected section of class by a simple random sampling till the desired number was achieved. Students of class 12th were excluded due to their board examination and age group restriction among many of the pupils.

Inclusion Criteria: All adolescents, aged between 10 and 19 years, studying in 6th to 11th standard of selected public and private schools were included in the study.

Exclusion Criteria: Students who were absent due to any reason on the day of data collection or who were not willing to participate in the study were excluded from the study.

Methodology: At first, a preliminary visit was made to the selected school and the principal was informed about the objective and methodology of the study. After obtaining an informed written consent from him, a section of each class was selected randomly and its class teacher was informed about the study and a suitable place, date and time for collection of data was decided. At the time of data collection, verbal consent/assent was also taken from the study participants. During data collection, socio-demographic characteristics, life-style and dietary factors were recorded using a pre-designed and pre-tested, semi-structured, self-administered anonymous questionnaire. Physical examination was done in a separate room, in presence of an attendant/teacher of same sex. Weight and height of the subjects was recorded using a standard technique and body mass index (BMI) was calculated. The

BMI for age graphs for boys and girls, developed by the WHO, were used to classify each subject into one of the following categories: obesity (>97th percentile), overweight (85th-97th percentile), normal (15th-85th percentile), thinness (3rd-15th percentile), and severe thinness (<3rd percentile). Confidentiality of subjects was maintained throughout the study. Ethical approval was taken from institutional ethical committee of S. N. Medical College, Agra before commencing the study. Data thus collected was entered into Microsoft excel and transferred to SPSS software for analysis. Appropriate statistical tests were used in the study.

RESULTS

The present descriptive cross-sectional study was done to estimate the magnitude and factors affecting under-nutrition among school-going adolescents in urban Agra. The study was conducted among 480 school-going adolescents with equal number of students from each type of school (public and private), each class (6th to 11th standard), and each sex (male and female). The graph 1 shows that according to the W.H.O. classification, 12.50% students were thin while; another 10% were severely thin. So; overall prevalence of thinness (including severe thinness) as per the W.H.O. classification was found to be 22.5%. More than half of the students were early adolescents; while mean age of participants was 13.36 ± 1.96 years with a range of 10-18 (in completed years). 43.54% belonged to lower socio-economic class; while 2.91% belonged to upper class and rest were from middle class. Mothers of 23.54% students were illiterate; but mothers of majority of them were either graduate or post-graduate. Regarding life style factors; 54.38% of students were involved in physical activities for at least 60 minutes per day while 15.2% were cycling to reach their school. Majority 61.67% had sleep of 08-10 hours per day; while 48.13% used to watch screen for ≥ 2 hours per day. Only 2.91% reportedly used to smoke cigarette while 1.66% had ever consumed alcohol. In regard to dietary factors; 2/3rd of the students informed about taking less than 5 meals every day while 28.75% reportedly used to eat <400 grams of fruits and vegetables per day. 21.45% of the students were skipping their breakfast routinely; while 61.66% used to consume carbonated soft drink/cold drink regularly and 52.5% accepted having meal while studying or watching television.

[Table 1] shows that though the highest proportion of thinness was observed among male students in the age group of 17-19 years and in the higher classes, a statistically significant difference was not found between under-nutrition and sex, age-group and class of study. [Table 1] show that students of government school had higher prevalence of thinness (34.2%) in compared to students of private school (10.8%) with a p value=0.000. Similarly; a statistically significant difference was observed between under-nutrition and socio-economic status of the study subjects as highest proportion of thinness was observed in lower socio-economic class (32.1%) compared to upper (15.4%) and middle (15.1%) class. The study also found that a significant difference in the proportion of under-nutrition was observed with the level of mother's education among study subjects as lowest proportion of thinness was observed among subjects whose mothers were having an intermediate and above

level of education; while highest proportion of thinness was found among students whose mothers were illiterates (p=0.000).

[Table 2] shows that proportion of thinness was higher among subjects who were involved in moderate to vigorous physical activity every day for at least 60 minutes per day compared to their counterparts (p=0.006). Similarly; proportion of thinness was highest among those who were reaching their school by cycle; whereas it was lowest among those who used to reach their school by auto-mobile (p=0.000). The proportion of thinness was higher among those who used to watch screen (TV/mobile) for ≤ 2 hours per day compared to their counterparts (p=0.000). Rest of the life style factors studied like daily duration of sleep and consumption of alcohol & smoking, were found to have no statistically significant association with under-nutrition in the present study.

[Table 3] shows that dietary factors were having statistically significant association with under-nutrition among school-going adolescents as students who were taking less than 5

meals per day (p=0.000), not taking breakfast daily (p=0.000), taking <400 grams of fruits & vegetables per day (p=0.000), not consuming cold drinks/beverages (p=0.000), and not taking meal while studying or watching TV (p=0.005) have higher proportion of thinness compared to their counterparts.

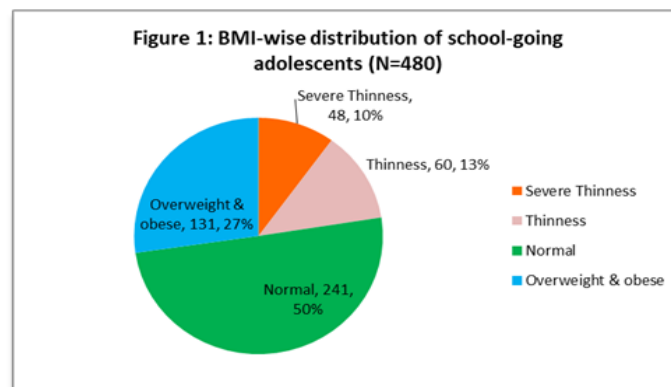


Table 1: Association of socio-demographic characteristics and under-nutrition among school-going adolescents (N=480)

Variables	Category	Body mass index (B.M.I.)		Total Number (%)	Chi-sq, df, p-value
		<15 th percentile n (%)	$\geq 15^{\text{th}}$ percentile n (%)		
Sex	Male	60 (25%)	180 (75%)	240 (50%)	1.71, 1, 0.18
	Female	48 (20%)	192 (80%)	240 (50%)	
Standard	6	14 (17.5%)	66 (82.5%)	80 (16.67%)	4.44, 5, 0.48
	7	15 (18.75%)	65 (81.25%)	80 (16.67%)	
	8	19 (23.75%)	61 (76.25%)	80 (16.67%)	
	9	18 (22.5%)	62 (77.5%)	80 (16.67%)	
	10	24 (30%)	56 (70%)	80 (16.67%)	
	11	18 (22.5%)	62 (77.5%)	80 (16.67%)	
School type	Private	26 (10.8%)	214 (79.2%)	240 (50%)	37.5, 1, 0.000
	Government	82 (34.2%)	158 (65.8%)	240 (50%)	
Age group (in years)	10-13	55 (21.8%)	197 (78.2%)	252 (52.5%)	3.70, 2, 0.15
	14-16	42 (21.2%)	156 (78.8%)	198 (41.25%)	
	17-19	11 (36.7%)	19 (63.3%)	30 (6.25%)	
Socio-Economic Status	Upper	2 (15.4%)	11 (84.6%)	13 (2.91%)	28.7, 2, 0.000
	Middle	39 (15.1%)	219 (84.9%)	258 (53.75%)	
	Lower	67 (32.1%)	142 (67.9%)	209 (43.54%)	
Mother's education	Illiterate	40 (35.4%)	73 (64.6%)	113 (23.54%)	25.7, 5, 0.000
	Primary school	19 (31.1%)	42 (68.9%)	61 (12.71%)	
	Middle school	11 (28.9%)	27 (71.1%)	38 (7.92%)	
	High School	10 (24.4%)	31 (75.6%)	41 (8.54%)	
	Intermediate	4 (12.1%)	29 (87.9%)	33 (6.87%)	
	Graduate/PG	24 (12.3%)	170 (87.7%)	194 (40.42%)	

Table 2: Association of life-style factors and under-nutrition among school-going adolescents (N=480)

Variables	Category	Body mass index (B.M.I.)		Total Number (%)	Chi-sq, df, p-value
		<15 th percentile n (%)	$\geq 15^{\text{th}}$ percentile n (%)		
Daily mod-to-vigorous activity	<60 min.	36 (16.7%)	179 (83.3%)	215 (44.79%)	7.39, 1, 0.006
	≥ 60 min.	72 (27.2%)	193 (72.8%)	265 (55.21%)	
Mode of transport to school	Cycling	35 (47.3%)	39 (52.7%)	74 (15.20%)	44.9, 2, 0.000
	Walking	43 (27.9%)	111 (72.1%)	154 (31.87%)	
	Automobiles	30 (11.9%)	222 (88.1%)	252 (52.91%)	
Daily sleeping hours	<8 hours	37 (20.9%)	140 (79.1%)	177 (36.88%)	0.40, 1, 0.52
	≥ 8 hours	71 (23.4%)	232 (76.6%)	303 (63.12%)	
Daily screen time	≤ 2 hours	76 (30.5%)	173 (69.5%)	249 (51.87%)	19.0, 1, 0.000
	>2 hours	32 (13.9%)	199 (86.1%)	231 (48.13%)	
Smoking cigarette	Yes	3 (23.1%)	10 (76.9%)	13 (2.71%)	0.004, 1, 0.94
	No	104 (22.3%)	363 (77.7%)	467 (97.29%)	
Alcohol consumption	Yes	2 (25%)	6 (75%)	8 (1.66%)	0.029, 1, 0.86
	No	106 (22.5%)	366 (77.5%)	472 (98.34%)	

Table 3: Association of dietary factors and under-nutrition among school-going adolescents (N=480)

Variables	Category	Body mass index (B.M.I.)		Total Number (%)	Chi-sq, df, p-value
		<15 th percentile n (%)	≥15 th percentile n (%)		
Meals per day	<5 times	93 (27.4%)	246 (72.6%)	339 (70.62%)	16.1, 1, 0.000
	≥5 times	15 (10.6%)	126 (89.4%)	141 (29.38%)	
Daily Eating breakfast	Yes	57 (15.1%)	320 (84.9%)	377 (78.54%)	54.8, 1, 0.000
	No	51 (49.5%)	52 (50.5%)	103 (21.45%)	
Daily fruits and vegetables ≥400 Gm	Yes	56 (16.4%)	286 (83.6%)	342 (71.25%)	25.5, 1, 0.000
	No	52 (37.7%)	86 (62.3%)	138 (28.75%)	
Consumption of cold drink	Yes	43 (14.5%)	253 (85.5%)	296 (61.67%)	28.1, 1, 0.000
	No	65 (35.3%)	119 (64.7%)	184 (38.33%)	
Eating while studying /watching T.V.	Yes	43 (17.3%)	205 (82.7%)	248 (51.67%)	7.83, 1, 0.005
	No	65 (28.0%)	167 (72.0%)	232 (48.33%)	

DISCUSSION

The present study found that 22.50% of school-going adolescents in Agra city were under-nourished (thinness-

12.5% and severe thinness-10%). During last decade, a prevalence of 9-56% was observed across different parts of India by authors as listed below:

Study	Place	Thinness/underweight
The present study (2022)	Agra City, UP	22.5%
Deshpande S et al (2021)6	Aurangabad, MH	24.85%
Kanjilal M et al (2021)7	Delhi	68%
Wangaskar SA et al (2021)8	Puducherry	15%
Panda BK et al (2021)5	Whole India	24.8%
Vashisht B M et al (2019)9	Rohtak, Haryana	15.2%
Iram A et al (2018)10	Aligarh, UP	9%
Ali D et al (2016)11	Kashmir Valley	35.7%

The timeline of these studies suggests that proportion of thinness/underweight is showing a decreasing trend among school-going adolescents in India. Studies conducted exclusively in government schools and hilly areas have particularly higher proportion of thinness/underweight compared to others.

Thinness and socio-demographic factors: Age: The highest proportion of thinness was found among late adolescents (17-19 years); but the trend observed on age wise analysis was not found to be statistically significant ($p=0.15$). Similar to the present study; Ahmad S et al (2018)12 and Goyal RK et al,^[13] (2010) also reported a higher proportion of underweight among late adolescent in North India and Ahmedabad respectively. In contrast to our study; Pandurangi R et al,^[14] (2022) found that the prevalence of thinness was more (27.6%) among early adolescent in compare to late adolescent (20.9%). The differences observed might be due to the different setting of the studies as their study was conducted in both urban as well as rural areas while the present study had only covered the urban parts of Agra city.

Sex: Gender-wise analysis shows that male students had higher proportion of thinness (25%) as compared to female (20%); but the observed difference was statistically not significant ($p=0.18$). Similarly; Kanjilal M et al,^[7] (2021) also found that proportion of thinness was higher among male than female among school-going adolescents in Delhi. A study by Wangaskar SA et al,^[8] (2021) in Puducherry also found that male had 1.4 times more risk of having under-nutrition as compared to girls. According to a report of Ministry of Health and Family Welfare (MoHFW)15 in 2021, 29.4% of boys and 18.9% of girls aged between 10-

19 years were found to be undernourished in India.

Type of school (government and private): The present study has found that students of government school had higher proportion of thinness (34.2%) as compared to private school (10.8%) with a p value of 0.000. Similarly; study by Ivanovitch K et al,^[16] (2020) also found that prevalence of thinness was higher among government school adolescent (13.3%) compared to private school participants (5.8%). The higher prevalence of thinness among students of government school might be due to their better physical activities, nutritional habits, and or life style.

Socio-economic status: Statistically significant difference was observed between under-nutrition and socio-economic status of the study participants ($p=0.000$). Highest proportion of thinness was observed in lower socio-economic class (32.1%); while lower proportions were observed in upper (15.4%) and middle class (15.1%) students. Ali D et al,^[11] (2016) observed that prevalence of thinness in Kashmir valley was 3.69 times higher in lower SE class than upper class on binary logistic regression analysis. Similarly; Ahmad S et al,^[12] (2018) observed that a major proportion (88.8%) of under-weight adolescents in North India were from lower-middle and lower socioeconomic class. A higher prevalence of thinness in lower SE class might be associated with a lesser dietary intake, access to carbonated drinks, and more physical activities including others.

Mother's education: It was observed that significant difference in proportion of thinness was found with mother's education as highest proportion of thinness was observed among subjects whose mothers were illiterates ($p=0.000$). In their study among school-going adolescents in North India, Ahmad S et al,^[12] (2018) found that prevalence of underweight was higher among those whose mothers were educated up to primary school as

compared to those who had an education of middle school or above. Ali D et al,^[11] (2016) in Kashmir Valley and Bhattacharya H et al,^[17] (2013) in Assam also found that prevalence of thinness was highest among adolescents whose mothers were illiterate which is in concordance with the present study.

Thinness and life style factors:

Daily physical activity: The present study found that proportion of thinness was significantly higher among subjects who were physically active in moderate to vigorous activities for ≥ 1 hours per day compared to their counterparts ($p=0.006$). Similarly; study by Goyal RK et al,^[13] (2010) also found that prevalence of underweight was higher among those who participated in daily physical activity (57.3%) in comparison to those who did not participated in physical activity (38.5%).

Mode of transport: The proportion of thinness was found to be significantly higher among those who used to reach their school by cycle (47.3%) compared to those who walk (27.9%) or use auto-mobile (11.9%) to reach the school ($p=0.000$).

Screen time: The present study also found that proportion of thinness was significantly more among those who used to spend ≤ 2 hours in watching screen (30.5%) everyday compared to their counterparts ($p=0.000$).

Other life style factors like daily sleeping hours, smoking and alcohol consumption were not found to have a statistically significant association with thinness among school-going adolescents in urban Agra.

Thinness and dietary habits: A significantly higher proportion of thinness was observed among school-going adolescents who were taking less than 5 meals per day ($p=0.000$), not taking breakfast daily ($p=0.000$), taking <400 grams of fruits & vegetables per day ($p=0.000$), not consuming cold drinks/beverages ($p=0.000$), and not taking meal while studying or watching TV ($p=0.005$) compared to their counterparts.

CONCLUSION

The present study has found that 12.50% of school-going adolescents in Agra city were thin while another 10% were severely thin. No statistically significant difference in the proportion of different forms of under-nutrition i.e. severe thinness and thinness among study subjects was observed on the basis of their age, sex, and class of study. Similarly; life style factors like daily sleeping hours, smoking and alcohol consumption as well as dietary factor like having meal while studying or watching TV were also not found to have a statistically significant association with thinness among study participants.

On the other hand; type of school, socio-economic class and mother's education were important socio-demographic factors which were found to have a statistically significant association with thinness in the present study. Among various life style factors studied; involvement in moderate to vigorous physical activity daily, mode of transport to school and screen time were found to have a statistically significant association; whereas dietary factors like number

of meals per day, regularity of breakfast, amount of fruits & vegetables eaten per day, and consumption of cold drinks/beverages were found to have a significant association with thinness among school-going adolescents in Agra city.

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Conflicts of interest

There are no conflicts of interest.

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