

Original Research Article

MALNUTRITION, LIFE-STYLE AND DIETARY HABITS OF SCHOOL-GOING ADOLESCENTS IN AGRA CITY

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ABSTRACT

Background: Malnutrition, consisting of under as well as over nutrition, is important public health problem among school going-adolescents in India. Proportion of various forms of malnutrition and related dietary and life-style factors need to be studied in details. **Objective:** to find the proportion of various forms of malnutrition and their association with prevalent life-style and dietary factors among school-going adolescents in Agra city. **Materials and Methods:** A cross-sectional study was conducted among 480 selected students of various government and private schools in urban Agra. BMI-for-age criteria by the WHO were used to classify various forms of malnutrition.

Results: Almost half of the school going adolescents in Agra city has a normal Body Mass Index (B.M.I.) for age; while 17.91% were overweight, 9.38% were obese, 12.50% were thin and 10% has severe thinness. Socio-demographic factors like type of school, socio-economic class and mother's education were significantly associated with malnutrition. Among life style factors; involvement in moderate to vigorous physical activity every day, mode of transport to school and screen time, and among dietary factors; number of meals per day, regularity of breakfast, amount of fruits & vegetables eaten per day, consumption of cold drinks/beverages and having meal while studying or watching TV were found to have a significant association with different forms of malnutrition.

Conclusion: In addition to type of school, socio-economic status and mother's education, various dietary and life-style factors are significantly associated with malnutrition among school-going adolescents and need special attention during routine school health services.

Keywords: Malnutrition, life-style, dietary habits, BMI-for-age, overweight, obese, thinness.

INTRODUCTION

Malnutrition, according to the World Health Organization (WHO), refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients. The double burden of malnutrition consists of both under-nutrition and over-nutrition.^[1] Malnutrition in India remains a significant public health concern, affecting millions of children and adolescents across the country which encompasses both under-nutrition such as

underweight/thinness, stunting, and micronutrient deficiencies and over-nutrition leading to overweight and obesity. Adolescence, a period between 10-19 years of age, is very critical period of physical and cognitive development, and malnutrition during adolescence period has far-reaching consequences for the immediate and long-term health and well-being of people.^[2]

Studies have found many causes for malnutrition among adolescents in India and common among them are: Inadequate diets and poor nutritional

intake, socio-economic factors and food insecurity, cultural and behavioral practices, lack of nutritional knowledge, health conditions and increased vulnerability like infections, including others. Consequences of malnutrition include impaired physical growth and development, reduced cognitive function and academic performance, weakened immune system and increased risk of chronic diseases such as obesity, diabetes, hypertension, and cardiovascular diseases later in life. To address these challenges, multi-pronged strategies involving improved nutrition education, access to healthy foods, school-based programs, and policy interventions are being formulated. For effective implementation of strategies, situational analysis is an initial step, based on which, specific actions can be initiated to tackle the issue more efficiently.

In India, many studies were conducted during recent times and wide variations in the proportion of different forms of malnutrition were observed throughout the country. Therefore; a study was planned to find the proportion of various forms of malnutrition among school-going adolescents in north Indian city of Agra and to find their association with various life-style and dietary factors prevalent among them.

MATERIALS AND METHODS

A school-based descriptive observational study was done in randomly selected public and private schools of Agra city in which cross-sectional surveys were conducted to find the magnitude of the problem of malnutrition, life-style and dietary habits of school-going adolescents. The study population comprised of all adolescents, in the age group of 10-19 years, attending all public and private schools of Agra city which is situated in western Uttar Pradesh in northern India. The study was conducted in a period of 2 years, between October 2020 and September 2022. A multistage random sampling (discussed later) was used for selection of schools, section of class, and desired number of students to reach the final sample. The selected schools were visited more than once, as per the need of the study, to ensure co-operation of school administration and collection of data. Actual survey for collection of data was conducted between January and June, 2022.

Assuming the combined prevalence of various forms of malnutrition as 30%, based on many recently published articles³⁻⁹, sample size of the present study was calculated by using the formula, $N = Z^2 \times (pq) / d^2$; where Z is standard normal deviate, p is prevalence of disease, q is 100 minus p, and d is allowable error. So for $Z=1.96$, $p=30$, $q=100-p=70$, and $d=20\%$ of $p=6$, a sample size $n=3.84 \times 30 \times 70 / 6 \times 6 = 224$ was calculated. For an effect size of 2; sample size was doubled to 448. 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: At first, separate lists of public and private schools of Agra was obtained from the district education department, from which; two public schools – one boy's and one girl's school and one co-educational private school were selected randomly. In the second stage; one section was randomly selected from each class, 6th to 11th. In third stage; desired number of girl and or boy students was selected from selected section of class by a simple random sampling. 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 10-19 years) of selected public and private schools, who were studying in 6th to 11th class, 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 paid to the selected school and the principal was informed about the objective and methodology of the study. Informed written consent was taken from the principal of the selected school. Once a section of class was selected for the study; its class teacher was contacted, informed about the study and suitable date and timing for collection of data was decided. At the time of data collection, verbal consent/assent was also taken from the study participants. Socio-demographic characteristics, life-style and dietary factors were recorded using a pre-designed and pre-tested, semi-structured, self-administered anonymous questionnaire. General and systemic examination was done in a separate room, in presence of an attendant/teacher of same sex. Weight and height of the subjects was taken 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

This cross-sectional study was undertaken to find the distribution of body mass index (BMI) and

factors affecting malnutrition among school-going adolescents in urban Agra. The study was conducted among 480 school-going adolescents with equal representation 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 half of the subjects were having normal Body Mass Index (B.M.I.) according to the W.H.O. classification i.e. B.M.I. for age between 15th & 85th percentile. Further; 17.91% were overweight; while 9.38% were obese. Thinness was present in 12.50% subjects while 10% were classified as severely thin.

More than half of the students were early adolescents (52.5%); while 41.25% were mid adolescents and 6.25% were late adolescents. Mean age of study participants was 13.36 ± 1.96 years with a range of 10-18 (in completed years). Maximum number of participants either belonged to Upper-Middle (45.62%) or Upper-Lower class (40.83%); while mothers of 40.42% students were graduates or post-graduates but 23.54% were illiterate. At least 60 minutes of physical activities were done by more than half (54.38%) of the students; but more than half (52.91%) were using an auto-mobile to travel to the school. 61.67% of them sleep for 08-10 hours daily; whereas 48.13% used to watch screen for ≥ 2 hours per day. 2.91% reportedly used to smoke cigarette while 1.66% reportedly have had consumed alcohol. Almost 2/3rd of the students were taking meals < 5 times per day while 28.75% reportedly used to eat < 400 grams of fruits and vegetables per day. 21.45% students were skipping their breakfast routinely; while 61.66% used to consume carbonated soft drink/cold drink. Similarly, nearly half of them (52.5%) accepted having meal while studying or watching television.

Table 1 shows that highest proportion of thinness was observed among 17-19 years of age group while highest proportion of overweight & obesity (B.M.I. for age is ≥ 85 th percentile) was found among 10-13 years of age group. Though age wise analysis showed a trend, it was not found to be statistically significant (p value = 0.080). Sex-wise analysis shows that male students have higher proportion of thinness as well as overweight & obesity in comparison to female; but the observed differences were statistically not significant (p value = 0.074). Similarly; statistically significant difference was not observed between malnutrition and class of study (p value = 0.445).

Students of government school had more thinness (34.2%) as compared to students of private school (10.8%); whereas proportion of overweight & obesity was 17.9% among students of government school but it was 36.7% among students of private

school (p value=0.000). Statistically significant differences in thinness and overweight & obesity were observed with socio-economic status of the study subjects. Highest proportion of overweight & obesity was observed in upper socio-economic class students (61.5%) while highest proportion of thinness was observed in lower-middle socio-economic class (38.1%). Similarly, lowest proportion of thinness was observed in upper-middle class (10.6%) while lowest proportion of overweight & obesity was found in lower-middle class (9.5%). Surprisingly; highest level of normal body mass index was observed among students of lower socio-economic class (p value= 0.000). The study also found that a significant difference in the proportion of thinness as well as overweight & obesity was observed with the level of mother's education among study subjects. Highest proportion of overweight & obesity was observed among subjects whose mother were graduates & post-graduates while highest proportion of thinness was observed among subjects whose mothers were illiterates (p=0.000).

Table 2 shows that proportion of thinness was higher among subjects who were physically active for ≥ 1 hours per day; while proportion of overweight & obesity was more among those were physically active for less than 2 hours per day (p=0.004). Similarly; proportion of thinness was higher among those who were reaching their school by cycle; whereas proportion of overweight & obesity was highest 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; while proportion of overweight & obesity was significantly higher among those whose daily screen time was more than 2 hours (p=0.001). Rest of the life style factors studied; duration of sleep and consumption of alcohol & smoking, were found to have no statistically significant association with malnutrition in the present study.

Table 3 shows that students who were taking less than 5 meals per day, not taking breakfast daily, taking < 400 grams of fruits & vegetables per day, not consuming cold drinks/beverages and not taking meal while studying or watching TV have higher proportion of thinness compared to their counterparts. On the other hand; students who were taking more than 5 meals per day, having breakfast daily, eating ≥ 400 grams of fruits & vegetables per day, consuming cold drinks/beverages and taking meal while studying or watching TV have higher proportion of overweight and obesity in compared to their counterparts.

Table 1: Association of socio-demographic characteristics and body mass index (N=480)

Variables	Category	Body mass index (B.M.I.)			Total N (%)	Chi-sq, df, p-value
		$< 15^{\text{th}}$ percentile n (%)	$15^{\text{th}} - < 85^{\text{th}}$ percentile n (%)	$\geq 85^{\text{th}}$ percentile n (%)		

Sex	Male	60 (25%)	108 (45%)	72 (30%)	240 (50%)	5.21, 2, 0.074
	Female	48 (20%)	133 (55.4%)	59 (24.6%)	240 (50%)	
Standard	6	14 (17.5%)	38 (47.5%)	28 (35%)	80 (16.67%)	10.3, 10, 0.411
	7	15 (18.75%)	37 (46.25%)	28 (35%)	80 (16.67%)	
	8	19 (23.75)	40 (50%)	21 (26.25%)	80 (16.67%)	
	9	18 (22.5%)	43 (53.8%)	19 (23.8%)	80 (16.67%)	
	10	24 (30%)	38 (47.5%)	18 (22.5%)	80 (16.67%)	
	11	18 (22.5%)	45 (56.3%)	17 (21.3%)	80 (16.67%)	
School type	Private	26 (10.8%)	126 (52.5%)	88 (36.7%)	240 (50%)	44.99, 2, 0.000
	Government	82 (34.2%)	115 (47.9%)	43 (17.9%)	240 (50%)	
Age group (in years)	10-13	55 (21.8%)	123 (48.8%)	74 (29.4%)	252 (52.5%)	8.33, 2, 0.080
	14-16	42 (21.2%)	101 (51%)	55 (27.8%)	198 (41.25%)	
	17-19	11 (36.7%)	17 (56.7%)	2 (6.7%)	30 (6.25%)	
Socio-Economic Status	Upper	2 (15.4%)	3 (23.1%)	8 (61.5%)	13 (2.91%)	54.40, 8, 0.000
	Upper Middle	23 (10.6%)	114 (52.8%)	79 (36.6%)	216 (45.62%)	
	Lower Middle	16 (38.1%)	22 (52.4%)	4 (9.5%)	42 (7.91%)	
	Upper Lower	65 (33.2%)	93 (47.4%)	38 (19.4%)	196 (40.83%)	
	Lower	2 (15.4%)	9 (69.2%)	2 (15.4%)	13 (2.70%)	
Mother's education	Illiterate	40 (35.4%)	50 (44.2%)	23 (20.4%)	113 (23.54%)	40.17, 10, 0.000
	Primary School	19 (31.1%)	30 (49.2%)	12 (19.7%)	61 (12.71%)	
	Middle school	11 (28.9%)	19 (50%)	8 (21.1%)	38 (7.92%)	
	High School	10 (24.4%)	26 (63.4%)	5 (12.2%)	41 (8.54%)	
	Intermediate	4 (12.1%)	20 (60.6%)	9 (27.3%)	33 (6.87%)	
	Graduate/PG	24 (12.3%)	96 (49.5%)	74 (38.2)	194 (40.42%)	

Table 2: Association of life-style factors and body mass index (N=480)

Variables	Category	Body mass index (B.M.I.)			Total N (%)	Chi-sq, df, p-value
		<15 th Percentile n (%)	15 th -<85 th Percentile n (%)	≥85 th Percentile n (%)		
Daily mod-to-vigorous physical activity	<60 minutes	36 (16.7%)	107 (49.8%)	72 (33.5%)	215 (44.79%)	11.23, 2, 0.004
	≥60 minutes	72 (27.2%)	134 (50.6%)	59 (22.3 %)	265 (55.21%)	
Mode of transport to school	Walking	43 (27.9%)	77 (50%)	34 (22.1%)	154 (31.87%)	51.01, 4, 0.000
	Cycling	35 (47.3%)	31 (41.9%)	8 (10.8%)	74 (15.20%)	
	Automobiles	30 (11.9%)	133 (52.8%)	89 (35.3%)	252 (52.91%)	
Daily sleeping hours	<8 hours	37 (20.9%)	90 (50.8%)	50 (28.2%)	177 (36.88%)	4.68, 4, 0.322
	8-10 hours	71 (24.0%)	148 (50.0 %)	77 (26.0%)	296 (61.67%)	
	>10 hours	0 (0%)	3 (42.9%)	4 (57.1%)	7 (1.45%)	
Daily screen time	≤2 hours	76 (30.5%)	124 (49.8%)	49 (19.7%)	249 (51.87%)	25.80, 2, 0.000
	>2 hours	32 (13.9%)	117 (50.6%)	82 (35.5%)	231 (48.13%)	

Smoking cigarette	Yes	3 (23.1%)	7 (53.8%)	3 (23.1%)	13 (2.71%)	0.13, 2, 0.939
	No	104 (22.3%)	235 (50.2 %)	128 (27.5%)	467 (97.29%)	
Alcohol consumption	Yes	2 (25%)	3 (37.5%)	3 (37.5%)	8 (1.66%)	0.59, 2, 0.743
	No	106 (22.5%)	238 (50.4%)	128 (27.1%)	472 (98.34%)	

Table 3: Association of dietary factors and body mass index (N=480)

Variables	Category	Body mass index			Total N (%)	Chi-Sq, df, p-value
		<15 th percentile n (%)	15 th -<85 th percentile n (%)	≥85 th percentile n (%)		
Meals per day	<5 times	93 (27.4%)	165 (48.7%)	81 (23.9%)	339 (70.62%)	19.83, 4, 0.001
	5 times	15 (12.8%)	61 (52.1%)	41 (35.0 %)	117 (24.37%)	
	>5 times	0 (0%)	15 (62.5%)	9 (37.5%)	24 (0.5%)	
Daily Eating breakfast	Yes	57 (15.1%)	206 (54.6%)	114 (30.2%)	377 (78.54%)	55.01, 2, 0.000
	No	51 (49.5%)	35 (34.0%)	17 (16.5 %)	103 (21.45%)	
Daily fruits and vegetables intake ≥400 Gm	Yes	56 (16.4%)	176 (51.5%)	110 (32.2%)	342 (71.25%)	30.56, 2, 0.000
	No	52 (37.7%)	65 (47.1%)	21 (15.2 %)	138 (28.75%)	
Consumption of cold drink	Yes	43 (14.5%)	149 (50.3%)	104 (35.1%)	296 (61.67%)	39.23, 2, 0.000
	No	65 (35.3%)	92 (50.0 %)	27 (14.7%)	184 (38.33%)	
Eating while studying/ watching T.V.	Yes	43 (17.3%)	128 (51.6%)	77 (31.0%)	248 (51.67%)	8.93,2,0.012
	No	65 (28.0%)	113 (48.7%)	54 (23.3 %)	232 (48.33%)	

DISCUSSION

The present study found that 50.2% of school-going adolescents in Agra city were having normal Body

Mass Index (B.M.I.); while 27.3% were over-nourished (overweight-17.91% and obese-9.38%) and 22.5% were under-nourished (thinness-12.5% and severe thinness-10%).

Study	Place	Thin/underweight	Overweight/obese
The present study (2022)	Agra City, UP	22.5%	27.3%
Kanjilal M et al (2021) ³	Delhi	68%	3.3%
Wangaskar SA et al (2021) ⁴	Puducherry	15%	16%
Panda BK et al (2021) ⁵	Whole India	24.8%	7.5%
Praveen G et al (2019) ⁶	Rural Hasan, KA	37.1%	7%
Iram A et al (2018) ⁷	Aligarh, UP	9%	12.8%
CNNS (2016-18) ⁸	Urban India	20.4%	9.7%
Deshpande S (2017) ⁹	Aurangabad, MH	24.85%	10%

The timeline of these studies suggests that proportion of overweight & obesity is increasing in India; while proportion of thinness is showing a decreasing trend among school-going adolescents during recent years. More ever; studies from rural background have found a higher proportion of thinness/underweight; while urban areas have shown a higher proportion of overweight & obesity in India.

Malnutrition and socio-demographic factors:

Age: The highest proportion of thinness was found among late adolescents (17-19 years); while proportion of overweight & obesity was found to be highest among early adolescent group (10-13 years). Though age wise analysis showed a trend, it was not found to be statistically significant (p value =0.080).

Similar to the present study; Ahmad S et al (2018),^[10] also reported a higher proportion of underweight among late adolescent and a higher proportion of overweight and obesity among early adolescents in North India. Similarly; Goyal RK et al (2010),^[11] observed that with increase in age, prevalence of underweight increased while prevalence of overweight & obesity decreased among adolescents. Similar observations were made by Pandurangi R et al (2022),^[12] who assessed that prevalence of overweight & obesity was higher among early adolescents in India as compared to late adolescents. In contrast to our study; Pandurangi R et al (2022),^[12] found that the prevalence of thinness was more (27.6%) among early adolescent in compare to late adolescent

(20.9%); whereas study by Sinha KV et al (2019),^[13] showed a higher proportion of overweight & obesity among late adolescent age groups in urban area of Rohtas, Bihar. The differences observed by the two above mentioned studies may be due to the different setting of study as both of them included 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%). Similarly; male had higher proportion of overweight and obesity (30%) in comparison to female (24.6%). Similarly; Kanjilal M et al (2021),^[4] also found that proportion of thinness as well as obesity & overweight was higher among male than female among school-going adolescents in Delhi. A study by Wangaskar SA et al (2021),^[5] 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),^[14] in 2021, 29.4% of boys and 18.9% of girls aged between 10-19 years were found to be undernourished in India. Similar results were found by Sinha KV et al (2019),^[13] who found that male participants had higher proportion of overweight & obesity (31.01%) as compared to female (16.67 %). In another study conducted by Kunwar R et al (2018),^[15] the prevalence of overweight & obesity among girls was found to be less than boys.

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%); whereas students of private school had higher proportion of overweight & obesity (36.7%) compared to students of government school (17.9%) (p value=0.000). Similarly to the present study Gupta DK et al (2011),^[16] also showed that males and privately-funded school children had significantly higher increase in prevalence and risk of being overweight and obese. Study by Sinha KV et al (2019),^[13] observed a significantly higher prevalence of overweight & obesity in private schools (38.91%) as compared to government school (20.65%) (p=0.001). Study by Ivanovitch K et al (2020),^[17] found that prevalence of thinness was higher among government school adolescent 13.3% compared to private school participants 5.8%, while prevalence of overweight and obesity was more among private school participants 15% as compared to government school participants 8.3%. Laxmaiah A et al (2017),^[18] also observed that prevalence of overweight & obesity among the adolescent studying in private school was significantly higher 9.6% than those studying in government school 3.2% (p<0.005). The higher prevalence of overweight and obesity among private school participants might be due to decrease in physical activities or change in nutritional habits, and or life style related issues.

Socio-economic status: Statistically significant difference in different types of malnutrition was observed with socio-economic status of the study subjects (p value= 0.000). Highest proportion of overweight & obesity was observed in upper socio-economic class students (61.5%) while highest proportion of thinness was observed in lower-middle socio-economic class (38.1%). Similarly, lowest proportion of thinness was observed in upper-middle class (10.6%) while lowest proportion of overweight & obesity was found in lower-middle class (9.5%). Ali D et al (2016),^[19] 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 whereas a higher prevalence of overweight & obesity was seen in upper SE class than in middle and lower SE class (p=0.001 and 0.001 respectively). Similarly; Ahmad S et al (2018),^[10] observed that a major proportion of overweight & obesity among school going adolescent in North India were from middle or upper socioeconomic class (70.9% and 79.7%); while 88.8% of underweight adolescent were from lower-middle and lower socioeconomic class. Laxmaiah A et al (2017),^[18] also observed a higher prevalence of overweight & obesity among the adolescent of high SE class (p=0.005). A higher prevalence of overweight and obesity in upper SE class may be associated with a more dietary intake, access to carbonated drinks, and lesser physical activity including others.

Mother's education: It was observed that significant differences in thinness as well as overweight & obesity were observed with mother's education level of study subjects. Highest proportion of overweight & obesity was observed among subjects whose mother were graduates & post-graduates while 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 (2018),^[10] found that prevalence of overweight and obesity was higher among middle schooled mothers (13.4%) as compared to primary schooled mothers (2.3%) while 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 (2016),^[19] in Kashmir Valley and Bhattacharya H et al (2013),^[20] in Assam also found that prevalence of thinness was highest among adolescents whose mothers were illiterate which is in concordance with the present study.

Malnutrition 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 while overweight & obesity was more among subjects who were physically active for less than 1 hour per day (p=0.004). Goyal RK et al (2010),^[11] 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%). Similarly; study done by Laxmaiah A et al (2017),^[18] found that the prevalence of overweight & obesity was significantly lower among physically active urban adolescents in Hyderabad (3.1%) in compared to the those who were not physically active (9.75%) ($p=0.004$). Study by Sinha KV et al (2019),^[13] also found that prevalence of overweight & obesity was significantly higher among those who did not participated in outdoors physical activity (30.98%) as compared to those who participated in outdoor physical activity (21.10%) ($p=0.001$). Study by Kumar SS et al (2020),^[21] in Tamil Nadu also observed that children who were physically active for less than 1 hour per day were more likely to be overweight & obese compared to children with physically active for ≥ 1 hour per day ($p=0.01$).

Mode of transport: In the present study, a significant association was observed between malnutrition and mode of transport to school. The study found that proportion of thinness was significantly more among those who used to reach their school by cycle (47.3%) while proportion of overweight & obesity was highest among those who were reaching school by auto-mobile (35.3%) ($p=0.000$).

Screen time: The present study also found that proportion of overweight & obesity was significantly higher among those whose daily screen time was more than 2 hours (35.9%) while proportion of thinness was significantly more among those who used to spend ≤ 2 hours in watching screen (30.5%) everyday ($p=0.001$). Similarly; Sinha KV et al (2019),^[13] found significant association between screen time and prevalence of overweight & obesity in Rohtas, Bihar; whereas Tiwari HC et al (2014),^[22] found that prevalence of overweight & obesity in Allahabad was 2.6 times higher among those who watched screen for ≥ 3 hours as compared to who did not watched or watched < 1 hour/day.

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

Malnutrition and dietary habits:

Daily intake of fruits & vegetables: The present study have found that proportion of thinness was highest among those who were not taking ≥ 400 gm of fruits and vegetables daily while proportion of overweight & obesity was highest among those who were taking ≥ 400 gm of fruits and vegetables daily. Similarly; Kanjilal M et al (2021),^[4] also found that proportion of obesity & overweight was higher among those who were eating vegetables daily while thinness was more among those who were not eating daily vegetables among school-going adolescents in Delhi.

Regularity of breakfast: In contrast to the findings of the present study, Bhattacharjee P et al (2017),^[23] found that proportion of obesity & overweight was higher among those who were skipping their breakfast as skipping of breakfast, according to them, might led to overall increase in the amount of food consumed during the day due to excess hunger. On the contrary; according to the present study, daily consumption of breakfast might lead to additional calories intake contributing to increase in proportion of overweight & obesity among such subjects.

Number of meals per day: The present study found that the proportion of overweight & obesity was significantly more among subjects who were taking more than 5 meals per day. Similarly; Viswanathan VT et al (2020),^[24] in Maharashtra also found that prevalence of overweight & obesity was 3.8 times higher among those who were eating 5 or more meals per day.

Consumption of cold drinks: The present study found that higher proportion of overweight & obesity was observed among those who were consuming cold drinks (35.1%) in compared to non-consumers (14.7%). Ahmad S et al (2018),^[10] and Bhattacharjee P et al (2017),^[23] reported that the prevalence of overweight & obesity among adolescents in Northern India and Greater Noida respectively was increased significantly with increase in consumption of cold/carbonated drinks. Similarly; Viswanathan VT et al (2020),^[24] in Maharashtra and Tiwari HC et al (2014),^[22] in Allahabad found that chances of overweight & obesity was increased by 4.5 times and 1.8 times respectively with consumption of cold/carbonated drinks.

Eating while studying/ watching T.V: Similar to the findings of present study, Vik FN et al (2013),^[25] found a positive association between prevalence of TV watching during meal with higher B.M.I. among children aged 10-12 years in European countries but the observed differences found in the present study were statistically non-significant.

CONCLUSION

The present study has found that nearly half of the school going adolescents in Agra city has a normal Body Mass Index (B.M.I.) according to the W.H.O. classification; while 17.91% were overweight, 9.38% were obese, 12.50% were thin and 10% has severe thinness. No statistically significant difference in the occurrence/proportion of various forms of malnutrition i.e. severe thinness, thinness, overweight and obesity was observed among study subjects on the basis of their age, sex, and class of study. Similarly; life style factors like daily sleeping hours, smoking and alcohol consumption were also not found to have a statistically significant

association with different forms of malnutrition 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 various forms of malnutrition 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, consumption of cold drinks/beverages and having meal while studying or watching TV were found to have a significant association with different forms of malnutrition among school-going adolescents in Agra city.

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