Original Article

Double burden of malnutrition among school-going adolescent girls in North India: A cross-sectional study

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Abstract

Context: Double burden of malnutrition comprising both undernutrition and overnutrition is nowadays emerging as a major public health concern among adolescent girls in India. **Aim:** The present study was conducted to determine the prevalence of underweight, overweight, and obesity among school-going adolescent girls along with dietary and physical activity-related factors associated with them. **Settings and Design:** The present cross-sectional survey was conducted among 2400 school-going adolescent girls (10–19 years) in Barabanki district of Uttar Pradesh. **Subjects and Methods:** Multistage sampling technique was used for enrolment of the study subjects. Data were collected on sociodemographic profile, physical activity, dietary intake, and anthropometry. WHO body mass index (BMI)-for-age cutoff classification of girls was used for assessment of underweight, overweight, and obesity. **Statistical Analysis Used:** Statistical analysis was done with the Epi Info software. Multinomial logistic regression analysis was used to ascertain various predictors of underweight, overweight, and obesity among adolescent females ($P < 0.05$ was considered as significant). **Results:** The proportion of underweight, overweight, and obese students were 47.0%, 5.9%, and 2.7%, respectively. The girls in mid and late adolescent age group were significantly less susceptible for being underweight for age (odds ratio [OR] 0.28; 95% confidence interval [CI] 0.22–0.36; $P = 0.00$). The girls belonging to middle and upper socioeconomic strata were about 35 times more susceptible toward obesity (OR 35.12; 95% CI 13.33–92.49; $P = 0.00$) and 12 times more susceptible toward being overweight (OR 12.46; 95% CI 13.33–92.49; $P = 0.00$) as compared to those in lower income groups. The probability of overweight and obesity were about 3 times (OR 3.13; 95% CI 1.76–5.55; $P = 0.00$) and 10 times (OR 9.66; 95% CI 4.00–23.35; $P = 0.00$) higher among adolescent girls who reside in urban areas as compared to rural one. Apart from these, non-Hindu religion, nuclear type of family, parent's education profile of middle school and above, and engagement in physical activities more than 2 h a day were other factors found to be directly associated with increased chances of overweight/obesity (OR > 1; $P < 0.05$). **Conclusions:** The high prevalence of the double burden of malnutrition revealed the need of the hour to modify and strengthen the existing adolescent health programs of India so as to deal with both the facets of nutrition spectrum substantially.

Keywords: Adolescent, malnutrition, obesity, overweight, underweight

Introduction

Adolescents are defined as young individuals aged between 10 and 19 years.[1] Globally, there are around 1.2 billion adolescents, comprising one-fifth of the total global population.[2] About 87% of adolescents reside in developing countries.[2] There are about 243 million adolescents in India, representing 21% of the whole population in the country.[3]

This period of adolescence transition from childhood to adult requires better nutritional needs rich in macronutrients and micronutrients for combating rapid growth spurt and increased

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physical activity. The National Family Health Survey revealed that in the age group of 15–19 years, about 41.9% girls were thin while 4.2% girls were overweight.[4] The adolescent girls as compared to boys are often more preponderate toward eating disorders such as anorexia nervosa or binge eating due to intervening factors like body dissatisfaction and depression.[1] High prevalence of thinness (low BMI-for-age) is reported as one of the major nutritional health problems among adolescents in India along with a significant proportion of the population being affected by overweight and obesity.[5] Coexistence of both under- as well as overnutrition occurring simultaneously within a population is referred to as double burden of malnutrition.[6] Nowadays, double burden of malnutrition is an emerging public health problem resulting as a consequence of nutritional transition.[7] On one side, undernourished adolescents are likely to face short stature with diminished immunity, while on other side overweight and obese adolescents are at higher risk for developing noncommunicable diseases.[8] Malnutrition further leads to devastating impact not only on the physical and mental health of female adolescents but also acts as a risk for future generation in cycle of continuum of care.[7]

More or less, all the national health programs have adolescent's domain in itself and primary-care physicians including the medical officers working at primary and secondary level government health facilities are the nodal officers for their catchment areas and act as backbone for efficiently running these programs such as Rashtriya Kishor Swasthya Karayakram, Rashtriya Bal Swasthya Karayakram, Reproductive Maternal Newborn Child and Adolescent Health (RMNCH+A), Adolescent Reproductive and Sexual Health, and other school-based screening programs. Adolescent population especially the females are quite vulnerable in relation to accessibility and utilization of available health-care sources.[9] When viewed grossly, both underweight as well as overweight have been found to be associated with the number of communicable and noncommunicable comorbidities. The patient visiting nowadays to out-patient department has a major proportion of adolescents presenting with direct and indirect health problem associated with malnutrition.

In spite of the problem of double burden of malnutrition being so widely distributed among adolescent females, only few studies are present in this context and in poor performing states like Uttar Pradesh; minimal reliable data are available. In view of this impending public health problem, the present study was conducted to determine the prevalence of underweight and overweight/obesity among school-going adolescent girls and to assess the associated dietary and physical activity related factors.

Subjects and Methods

Study design

Cross-sectional design was implemented in this study.

Study settings

The study was conducted amongst private schools, government schools, and intermediate colleges of Barabanki district in the state of Uttar Pradesh.

Study population

School-going adolescent girls of 10–19 years were the study population.

Duration of the study

The study was conducted from June 2016 to May 2017.

Sample size

Sample size was estimated using the formula for estimation of proportion, that is, z^2pq/e^2, where p is the prevalence of overweight, $q = 1 - p$, and e is the allowable error.[10] Sample size calculated was about 2400, assuming prevalence (p) of overweight among adolescent as 4.17[11] and with an absolute precision of 20%.

Sampling technique

Multistage sampling was used for enrolment of subjects in study.

Stage I: Barabanki district was divided into urban and rural Barabanki and out of total eight blocks in rural Barabanki, two were randomly selected.

Stage II: Two government/government-aided and two private schools were randomly selected from the urban area and two schools were randomly selected from each of the rural blocks. Thus, in total eight schools were selected.

Stage III: In each of the eight selected schools, list of female students enrolled in 6–12th class (comprising adolescent age group) was obtained. The students were randomly selected from each school and from each class based on probability proportionate to the size of population method.

Data collection

Prior permission was obtained from the district level authorities and principals of the schools before conducting the study. The study subjects were informed about the study and were also assured of full confidentiality. A predesigned, pretested, self-administered questionnaire prepared in Hindi (local language) and English was given to the students according to their medium of instruction. Each and every question was elaborated by the investigators and the students were asked to fill in their responses. The questionnaire included questions related to their biosocial profile and various factors related to dietary habit and physical activity of students. The age of each student was reverified from the school records. Students who were absent on the day of interview and those students unwilling to participate in the study were excluded. Then, study subjects were taken one by one to a separate room allotted by school authorities within the

premises, for their anthropometric measurements. Privacy was maintained and the measurements were taken in the presence of a female paramedical health worker and a female school teacher.

Operational criteria for assessment of underweight, overweight, and obesity

For the assessment of overweight and obesity, the WHO BMI-for-age cutoff classification of girls was used,[12] with the criteria: overweight: >+1 SD (equivalent to BMI 25 kg/m^2 at 19 years), obesity: >+2 SD (equivalent to BMI 30 kg/m^2 at 19 years), and underweight: <−2 SD.

Assessment of socioeconomic status

Modified B. G. Prasad socioeconomic scale 2017 was used for the assessment of the socioeconomic status.[13]

Statistical analysis

Statistical analysis was done with the software Epi Info (version 6.0, Centre for Disease Control, Atlanta, USA). The descriptive data were presented in the forms of frequency and percentages. Multinomial logistic regression analysis was done in stepwise manner to ascertain the various predictors of underweight, overweight, and obesity among adolescent females, and *P* value less than 0.05 was considered as significant.

Ethical clearance

Ethical clearance for the study was granted by the Institutional Ethics Committee of Hind Institute of Medical Sciences, Barabanki, Uttar Pradesh. Prior permission was obtained from the district education officers and principals of the selected schools for conducting the study.

Results

A total of 2400 school-going adolescents were enrolled in the study. About 21.0% were early adolescents (10–13 years) while 1100 (45.8%) were mid-adolescents (14–16 years) and 797 (33.2%) were late-adolescent (17–19 years) age group. Majority of them belonged to Hindu religion (73.9%) followed by 26.1% who were non-Hindu (i.e., Muslims and Christians). About 44.3% belonged to other backward castes (OBCs) followed by 37.4% in general and 18.3% in scheduled caste/scheduled tribe category. More than 80% of the school-going adolescent girls who participated in the study belonged to lower middle or below socioeconomic status. About one-third (37.5%) were from rural residence. About two-third of the students in study population were from government schools/government aided schools and 36.7% from private schools. The fathers of 42.8% of the students were educated up to primary school. Majority of the mothers were housewives (78.1%). The proportion of underweight, overweight, and obese students were 47.0%, 5.9%, and 2.7%, respectively, that is, about 55.6% of the school-going adolescent girls were suffering from the double burden of malnutrition. The mid and late adolescents were the most affected age group. About 68.9% of underweight, 85.8% of overweight, and 93.8% of obese adolescents belong to this age group. Also, about 40.9% of the adolescents in age group of 14–19 years were underweight for age. Among all the underweight for age adolescents, 76.3% belonged to Hindu religion. However, the proportion of Hindu or non-Hindu adolescents affected with undernutrition almost equal (48.5% and 42.7%, respectively). About 63.3% of underweight students and 51.8% of overweight belonged to OBC/SC/ST category while 62.5% of the obese were from general category. The proportion of overweight and obese students who belonged to nuclear family were 56.0% and 73.4%, respectively. A major proportion of overweight and obese individuals were from middle or upper socioeconomic status (70.9% and 79.7%, respectively) while 88.8% of underweight adolescent girls were from lower socioeconomic strata (lower middle and below). About 59.6% of overweight and 67.2% of the obese belonged to urban background while 68.4% of the underweight adolescent girls were from rural background. About 62.1% of the underweight adolescents were studying in government or aided schools. Fathers and mothers of 89.4% and 73.4% of the overweight and 87.5% and 81.3% of obese adolescents were educated to middle school and above, while of all underweight adolescents, 71.3% of the mothers were educated up to primary. The fathers of 85.1% of the overweight and 75.0% of the obese adolescents were in service or engaged in some business or professional employment. Mothers of 81.3% of the underweight adolescent girls were housewives and were not engaged in any other sort of education. About 61.0% of the overweight and 84.4% of the obese adolescent girls use to go via school bus or some other passive mode of transportation [Table 1].

The girls in mid and late adolescent age group were significantly less susceptible for underweight for age (OR 0.28; 95% CI 0.22–0.36; $P = 0.00$) as compared to early adolescents. The school-going adolescent girls who belong to non-Hindu religion were about 4 times more susceptible toward overweight (OR 4.52; 95% CI 2.39–8.54; $P = 0.00$) and had 12 times more chances to get obese (OR 12.35; 95% CI 4.70–32.47; $P = 0.00$) as compared to Hindu girls. The adolescent females in general category were found to be significantly less susceptible to get overweight (OR 0.53; 95% CI 0.28–0.99; $P = 0.04$) as compared to those who belong to OBC/SC/ST category. The probability of being overweight was found about 2 times higher among adolescent females who belong to nuclear family (OR 2.30; 95% CI 1.35–3.92; $P = 0.00$). The girls who belonged to middle and upper socioeconomic strata were about 35 times more susceptible toward obesity (OR 35.12; 95% CI 13.33–92.49; $P = 0.00$) and 12 times toward overweight (OR 12.46; 95% CI 13.33–92.49; $P = 0.00$) as compared to those in lower income groups. Also, the probability of overweight and obesity was about 3 times (OR 3.13; 95% CI 1.76–5.55; $P = 0.00$) and 10 times (OR 9.66; 95% CI 4.00–23.35; $P = 0.00$) higher among adolescents who resides in urban areas as compared to rural one. Those with father education middle school and above were about 3 times (OR 2.94; 95% CI 1.38–6.25; $P = 0.00$) more likely to get overweight and had 5 times (OR 5.18; 95% CI 1.61–16.63; $P = 0.00$) more predisposition to get obese as compared to the adolescents with father's education maximum up

Table 1: Biosocial and behavioral correlates of double burden malnutrition among school-going adolescent girls

Variables	Normal (*n*=1068)	Underweight (*n*=1127)	Overweight (*n*=141)	Obese (*n*=64)
Age category (years)				
Mid and late adolescents (14-19) (*n*=1897)	940 (88.8) (49.6)	776 (68.9) (40.9)	121 (85.8) (6.4)	60 (93.8) (3.2)
Early adolescents (10-13) (*n*=503)	128 (12.0) (25.4)	351 (31.1) (69.8)	20 (14.2) (4.0)	4 (6.3) (0.8)
Religion				
Non-Hindu (*n*=626)	258 (24.2) (41.2)	267 (23.7) (42.7)	61 (43.3) (9.7)	40 (62.5) (6.4)
Hindu (*n*=1774)	810 (75.8) (45.7)	860 (76.3) (48.5)	80 (56.7) (4.5)	24 (37.5) (1.4)
Category				
General (*n*=897)	375 (35.1) (41.8)	414 (36.7) (46.2)	68 (48.2) (7.6)	40 (62.5) (4.5)
Other backward castes/Scheduled caste/Scheduled tribe (*n*=1503)	693 (64.9) (46.1)	713 (63.3) (47.4)	73 (51.8) (4.9)	24 (37.5) (1.6)
Type of family				
Nuclear (*n*=1101)	457 (42.8) (41.5)	518 (46.0) (47.0)	79 (56.0) (7.2)	47 (73.4) (4.3)
Joint (*n*=1299)	611 (57.2) (47.0)	609 (54.0) (46.9)	62 (44.0) (4.8)	17 (26.6) (1.3)
Socioeconomic class[#]				
Upper, upper middle, and middle (*n*=389)	112 (10.5) (28.8)	126 (11.2) (32.4)	110 (70.9) (25.7)	51 (79.7) (13.1)
Lower middle/Lower (*n*=2011)	956 (89.5) (47.5)	1001 (88.8) (49.8)	41 (29.1) (2.0)	13 (20.3) (0.6)
Residence				
Urban (*n*=900)	417 (39.0) (46.3)	356 (31.6) (39.6)	84 (59.6) (9.3)	43 (67.2) (4.8)
Rural (*n*=1500)	651 (61.0) (43.4)	771 (68.4) (51.4)	57 (40.4) (3.8)	21 (32.8) (1.4)
Type of school				
Private (*n*=880)	347 (32.5) (39.4)	427 (37.9) (48.5)	75 (53.2) (8.5)	31 (48.4) (3.5)
Government/Government-aided (*n*=1520)	721 (67.5) (47.4)	700 (62.1) (46.1)	66 (46.8) (4.3)	33 (51.6) (2.2)
Father education				
Middle school and above (*n*=1371)	577 (54.0) (42.1)	612 (54.3) (44.6)	126 (89.4) (9.2)	56 (87.5) (4.1)
Up to primary (*n*=1029)	491 (46.0) (47.7)	515 (45.7) (50.0)	15 (10.6) (1.5)	8 (12.5) (0.8)
Mother education				
Middle school and above (*n*=767)	288 (27.0) (37.5)	324 (28.7) (42.2)	103 (73.0) (13.4)	52 (81.3) (6.8)
Up to primary (*n*=1633)	780 (73.0) (47.8)	803 (71.3) (49.2)	38 (27.0) (2.3)	12 (18.8) (0.7)
Father occupation				
Professional/Service/Business (*n*=805)	337 (31.6) (41.9)	300 (26.6) (37.3)	120 (85.1) (14.9)	48 (75.0) (6.0)
Unemployed/Labor/Farmer (*n*=1595)	731 (68.4) (45.8)	827 (73.4) (51.8)	21 (14.9) (1.3)	16 (25.0) (1.0)
Mother occupation				
Engaged in any sort of occupation (*n*=524)	164 (15.4) (31.3)	211 (18.7) (40.3)	101 (71.6) (19.3)	48 (75.0) (9.2)
Unemployed (*n*=1876)	904 (84.6) (48.2)	916 (81.3) (48.8)	40 (28.4) (2.1)	16 (25.0) (0.9)
Mode of travel to school				

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Table 1: Biosocial and behavioral correlates of double burden malnutrition among school-going adolescent girls

Variables	Normal (*n*=1068)	Underweight (*n*=1127)	Overweight (*n*=141)	Obese (*n*=64)
School bus/Other transport (*n*=372)	135 (12.6)	97 (8.6)	86 (61.0)	54 (84.4)
	(36.3)	(26.1)	(23.1)	(14.5)
Walking/Bicycle (*n*=2028)	933 (87.40)	1030 (91.4)	55 (39.0)	10 (15.6)
	(46.0)	(50.8)	(2.7)	(0.5)
Outdoor physical activity (>2 h/day)				
Absent (*n*=781)	312 (29.2)	352 (31.2)	90 (63.8)	27 (42.2)
	(39.9)	(45.1)	(11.5)	(3.5)
Present (*n*=1619)	756 (70.8)	775 (68.8)	51 (36.2)	37 (57.8)
	(46.7)	(47.9)	(3.2)	(2.3)
Frequent carbonated soft drink intake (>3 times a week)				
Yes (*n*=1837)	831 (77.8)	830 (73.6)	123 (87.2)	53 (82.8)
	(45.2)	(45.2)	(6.7)	(2.9)
No (*n*=563)	237 (22.2)	297 (26.4)	18 (12.8)	11 (17.2)
	(42.1)	(52.8)	(3.2)	(2.0)
Frequent intake locally available sold out street food items (more than 5 times a week)				
Yes (*n*=2203)	949 (88.9)	1072 (95.1)	133 (94.3)	49 (76.6)
	(43.1)	(48.7)	(6.0)	(2.2)
No (*n*=197)	119 (11.1)	55 (4.9)	8 (5.7)	15 (23.4)
	(60.4)	(27.9)	(4.1)	(7.6)

[#]Modified B. G. Prasad socioeconomic scale 2017

to primary. On the other hand, those girls with mother's education middle school and above were about 4 times (OR 4.49; 95% CI 1.67–12.04; $P = 0.00$) more preponderate to get obese. The girls whose fathers were professionals or in service or businessmen were less preponderate to get underweight (OR 0.66; 95% CI 0.53–0.82; $P = 0.00$) and were more than 4 times (OR 4.49; 95% CI 1.67–12.04; $P = 0.00$) susceptible to get obese. The probability of being overweight and obesity was 21 times (OR 21.21; 95% CI 11.88–37.86; $P = 0.00$) and 47 times (OR 47.40; 95% CI 19.52–115.12; $P = 0.00$) higher among adolescent females whose mothers were engaged in any sort of occupation. The school-going adolescent girls who use to go school via bus or some other passive vehicles as mode of travel to school had 3 times more chances (OR 3.52; 95% CI 1.96–6.29; $P = 0.00$) to get overweight and 12 times higher probability (OR 12.67; 95% CI 5.11–31.42; $P = 0.00$) to get obese. Also, the adolescent females who use to spend more than 2-h time in outdoor physical activity and games had reduced chances to get overweight (OR 0.36; 95% CI 0.21–0.60; $P = 0.00$). Also, frequent intake of carbonated drinks was found to be directly associated with increased BMI. The adolescent girls who use to drink carbonated drink were about two and have times more preponderate to get overweight (OR 2.68; 95% CI 1.31–5.47; $P = 0.00$).

The adolescent females who reported frequent intake of locally available indigenous street food (majority of them usually eat locally available sold out street items salted cucumbers, roasted peanuts, bhelpuri, panipuri, aaloo/chick pea tikki, roasted and salted Bengal grams, etc.) had about 2 times more chances to be underweight for age (OR 2.25; 95% CI 1.58–3.19; $P = 0.00$) while consumption of these typically locally available low fat-containing street items as snacks was found to reduce the probability to get obese (OR 0.07; 95% CI 0.02–0.22; $P = 0.00$) [Table 2].

Discussion

The present study revealed that about 55.6% of the adolescent females were suffering from double burden of malnutrition (47.0% underweight, 5.9% overweight, and 2.7% obese). However, in a recent similar study, Gupta *et al.*, in North India, reported comparatively lower prevalence (47.0%) with proportion of underweight and overweight/obese adolescent females 30.3% and 10.4%, respectively.[8] When analyzed separately, the proportion of underweight were found higher (47.0%) in present study, while the proportion of overweight and obese adolescent females were comparatively lower. In another study conducted at 10 different sites in India, the proportion of underweight and overweight adolescents were reported 27.1% and 8.5%, respectively.[14] Also in another study conducted by Singh *et al.*, in Manipur, the proportion of underweight and overweight adolescents were found to be 28.3% and 5.1%, respectively.[15] Apart from that when compared to studies conducted in different countries, both the proportion of underweight and overweight revealed in present study were quite higher.[16,17] However, the prevalence of obesity and overweight were somehow quite comparable to the findings of previous studies conducted in other parts of India.[18,19] Also in a study conducted by Vohra *et al.*, in adjoining district of the present study settings, about 3.1% and 1.2% of the school-going adolescents were found to be affected by overweight and obesity.[11] This huge variation in prevalence could be probably explained by the fact that different methods, tools, and criteria (i.e., WHO BMI standards, Khadilkar's BMI cutoff, International Obesity Task Force cutoff) have been used for the assessment purpose.[12,20,21] Also, the difference in baseline characteristics of the study population in different study settings that used to vary from region to region and nation to nation might also have important intervening role.

Table 2: Multinominal logistic regression for the factors associated with underweight and obesity among school-going adolescent girls

Variables	Underweight (*n*=1127)	Overweight (*n*=141)	Obese (*n*=64)
Age category (years)			
Mid and late adolescents (14-19)	0.2 (0.22-0.36)*	0.8 (0.39-1.76)	2.9 (0.70-12.03)
Early adolescents (10-13)		Reference	
Religion			
Non-Hindu	1.0 (0.80-1.26)	4.5 (2.39-8.54)*	12.3 (4.70-32.47)*
Hindu		Reference	
Category			
General	0.9 (0.78-1.16)	0.5 (0.28-0.99)*	0.9 (0.35-2.31)
Other backward castes/Scheduled caste/ Scheduled tribe		Reference	
Type of family			
Nuclear (*n*=1101)	1.0 (0.83-1.19)	2.3 (1.35-3.92)*	5.6 (2.51-12.49)
Joint (*n*=1299)		Reference	
Socioeconomic class*			
Upper, upper middle, and middle (*n*=389)	1.3 (0.95-1.84)	12.4 (6.79-22.85)*	35.1 (13.33-92.49)*
Lower middle/Lower (*n*=2011)		Reference	
Residence			
Urban	0.82 (0.66-1.02)	3.1 (1.76-5.55)*	9.6 (4.00-23.35)*
Rural		Reference	
Type of school			
Private	1.2 (0.98-1.48)	1.9 (1.08-3.40)*	1.1 (0.50-2.55)
Government/Government-aided		Reference	
Father education			
Middle school and above	1.0 (0.85-1.25)	2.9 (1.38-6.25)*	5.1 (1.61-16.63)*
Up to primary		Reference	
Mother education			
Middle school and above	1.2 (1.00-1.56)	1.5 (0.89-2.71)	4.4 (1.67-12.04)*
Up to primary		Reference	
Father occupation			
Professional/Service/Business	0.6 (0.53-0.82)*	3.5 (1.89-6.79)*	1.0 (0.40-2.04)
Unemployed/Labor/Farmer		Reference	
Mother occupation			
Engaged in any sort of occupation	1.1 (0.90-1.46)	21.2 (11.88-37.86)*	47.4 (19.52-115.12)*
Unemployed		Reference	
Mode of travel to school			
School bus/Other transport	0.6 (0.49-0.95)*	3.5 (1.96-6.29)*	12.6 (5.11-31.42)*
Walking/Bicycle		Reference	
Outdoor physical activity (>2 h/day)			
Present	0.9 (0.81-1.20)	0.3 (0.21-0.60)*	0.9 (0.44-2.09)
Absent		Reference	
Frequent carbonated soft drink intake (more than 3 times a week)			
Yes	0.65 (0.53-0.81)*	2.6 (1.31-5.47)*	1.8 (0.69-5.11)
No		Reference	
Frequent intake locally available sold out street food items (more than 5 times a week)			
Yes	2.2 (1.58-3.19)*	0.6 (0.24-1.55)	0.0 (0.02-0.22)*
No		Reference	

*Statistically significant $P<0.05$; #modified B. G. Prasad socioeconomic scale 2017

In the present study, the females in mid and late adolescent age groups were less likely to get underweight as compared to early adolescents. This indirectly reflects the ability of elder age groups to eat according to needs and their more accessibility toward intake of food as and when required thereby leading to better nutritional status. However, no such association with respect to age group has been reported in previous Indian studies.[8,11,18,19,22] More or less, there are numerous multifaced causes of undernutrition as well as overnutrition which are often interlinked with each other and play intervening role in between. In the present study, adolescent who belonged to non-Hindu religion was more predisposed for overweight and obesity as compared to Hindu girls. However, no

such findings had been reported in any previous studies.[8,22] Also, females who belonged to general category were less likely to get overweight. This biosocial predisposition could be explained by the different dietary and lifestyle pattern of the individuals and families in typical Indian settings that use to vary with religion and caste. When data were analyzed in relation to socioeconomic status, those who belonged to economically affluent groups were about 12 times more likely to get overweight and had 30 times more preponderance to get obese. Earlier Indian studies also reported similar findings.[11,23-27] Also, adolescent residing in urban areas had relatively greater probability to get overweight/obese. This finding could be explained by the fact that family belonging to higher socioeconomic strata has fairly more ability and access to choose and consume modern food items as per their wish. Also, in coherence with the finding of positive association between socioeconomic status and the likelihood of being overweight or obese, the probability of increased abnormal BMI for age was found to be higher among adolescents whose parents (both mother and father) belonged to relatively higher earning group and were engaged in some sort of occupation. This is further strengthened by the fact that adolescents who study in private schools were at 2 times higher risk to get overweight. In India generally, families who belong to higher socioeconomic strata use to enroll their children in private convent schools while the nonaffluent group usually prefer government one due to economic concerns. Also, those living in urban areas have relatively higher consumption rate and frequency to use the processed food available nowadays in market, thereby predisposing the adolescents to gain abnormal weight. Higher parental education (both father and mother) was found to be one of the factors leading to more probability of adolescent to get overweight/obese.[11,23,28] In spite of having comparatively more knowledge about known facts with respect to hazards of being overweight, this indirectly reveals suboptimal concern of the parents about the importance of nutrition and its impact on health. It was also revealed in the present study that adolescents who use to spend more than 2 h in outdoor physical activities were less likely (about one-third) to get overweight. Also, those adolescent females who used to prefer school bus or other passive mode of transport to school (thereby leading to decreases physical activity) had higher probability to get overweight or obese. The findings are in coherence with the results of previous studies.[11,19,25] Frequent intake of high sugar carbonated drinks increases the chances to get overweight due to additional intake of high calories through these soft drinks. Since the study was conducted in urban and rural schools of Barabanki district of Uttar Pradesh, exposure of the adolescent to classical junk foods of metropolitan cities with high trans-fatty-acid content was comparatively less. In paradox to that, students reported the consumption of local available items such as salted cucumber, peanuts, bhelpuri, roasted Bengal grams, aaloo tikki, and panipuri as their common preferred street food. In the present study, frequent consumption of these locally available street foods were found to be directly associated with increased chances of underweight on one side and on another facet, it reduces the risk to get overweight. But still it's a matter of concern, because although being relatively nonhazardous as compared to classical junk foods, consumption of these food items was found to have profound effect in normal dietary pattern, thereby having impact in reducing BMI by reducing both quantity and frequency of normal nutritious household food items from the diet of adolescents.

However, the findings of the study should be interrelated in lights of limitations. The study was conducted in schools and was focused primarily on adolescent girls; therefore, the results could not be implicated to community settings and generalized to both the genders. However, the strength lies in the fact that a huge sample size was enrolled during study which provides more conclusive findings.

Conclusions

The finding of the study revealed that double burden of malnutrition (both underweight and overweight/obesity) is quite prevalent among adolescent girls. Since these adolescent females are the emcee of upcoming future generation, their health is of utmost importance. The various factors that are revealed in the present study could further be targeted in routine health-care settings through counseling and guidance clinic under the direct supervision of primary-care physicians. In primary health-care settings apart from providing curative services, direct involvement of medical professionals and primary-care physicians in implementation of opportunity strategies like adolescent's behavioral change toward inculcation of healthy lifestyle, their counseling for optimal physical activities, and augmentation of knowledge regarding importance of proper balanced diet will be the most cost-effective way to deal with the problem. Also, among higher socioeconomic group who use to prefer private medical professionals for health seeking and where the proportion of obese children is comparatively more, these physicians could play a significant role through concurrent counseling of parents and their children to bring out desired behavioral change substantially so as to prevent forthcoming complications associated with overnutrition.

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Conflicts of interest

There are no conflicts of interest.

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