Prevalence and Factors Associated with Overweight/ Obesity in Adolescent School Girls: A Cross-Sectional Study in Kolkata, India

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ABSTRACT: Overweight and obesity in adolescent girls are considered a leading global public health issues in recent times. There is a need to evaluate the potential socioeconomic and behavioural factors behind adolescents' overweight and obesity in different environmental settings. The present study aims to understand the prevalence of overweight and obesity among urban adolescent school girls and to determine the association between selected socioeconomic and behavioural factors and overweight/obesity. This is a cross-sectional study using a multistage stratified cluster sampling with a sample size of 1041 adolescent girls aged 10 to 18 years from schools of Kolkata, India. Overall prevalence of overweight and obesity were 18.9% and 23.7%, respectively. The prevalence of overweight and obesity was higher among those adolescent girls whose parents had completed higher education (49.5%) and had higher monthly per capita household expenditure (48.4%). Stepwise binary logistic regression analysis confirmed that the probability of being overweight/ obese tended to be in adolescents who slept less than 7 hours per day ($p<0.001$). Overweight /obesity was also higher among those children whose fathers were fatty ($p=0.002$), taken medicines three months before the survey ($p=0.008$), and watched television and mobile phones for more than 1 hour a day ($p=0.039$). Rapid change in modern lifestyles is seemingly decreasing sleep duration in adolescents with subsequent negative impact on their health.

KEY WORDS: Prevalence, Obesity, Body Mass Index, Sleep, Adolescents, India

Introduction

Obesity, a "pandemic", has potential consequences for human health (Chincholikar et al. 2016). It generally results from an imbalance between energy intake and energy expenditure. Several international and regional studies indicate that several factors are responsible for developing obesity; these include genetic, behavioural, environmental, cultural, and socioeconomic factors (Okour et al. 2019).

Adolescent obesity is growing very fast and leads to a wide range of health issues regardless of weight during adulthood. It has become increasingly important to identify the risk factors predisposing to overweight and obesity from childhood onwards (Viswambharan et al. 2020). Adolescence is a period of high physical growth and reproductive maturation that generally requires optimal macro or micronutrients or both (Egidaw and Gebremariam 2019; Kumar et al. 2021). It is also the peak time when individuals start to decide on their lifestyle, take fast food, develop sedentary behaviours, etc. (Bjorntorp 2001).

Examining the factors involving weight gain and obesity in developing countries is very sensitive because socioeconomic changes in those countries lead to the problem of managing obesity and have a significant concern about malnutrition (Bharati et al. 2008). Therefore, it is essential to determine which factors are associated most with obesity among adolescents. Chincholikar and Sohani (2016) stated that adolescents belonging to the upper socioeconomic class may be at higher risk of becoming obese than those in lower classes. Several studies found that economic difficulties, educational level,

lifestyle behaviours, low cost of energy-dense foods etc., are potential variants in determining the physical health status of adolescent girls (Pigeyre et al. 2012). Ghosh (2014), who studied adolescent girls of Kolkata, found that family monthly income, taking too many fast foods and junk foods, and spending time with computers, were factors in increasing BMI.

In adolescents, sleep is considered an essential factor for physical health. However, adolescent lifestyles often curtail sleep time. For example, adolescents need to wake up early to go to school. There are also social pressures for shortening the amount of sleep, as well as playing with mobile phones, etc. Healthy sleep depends upon the quality and regularity of sleep and proper duration. When sleep is disrupted, health risks ensue (Chaput and Dutil 2016). Reduced sleep time up-regulates appetite by reducing leptin, an increase in ghrelin, and a reduction in insulin sensitivity; these changes increase the risk for obesity (Van Cauter et al. 2008). Adolescent girls experience weight gain when there is insufficient sleep, especially if they sleep less than 6 hours per night (Berkey et al. 2008).

Therefore, this study examines the prevalence of overweight and obesity among urban adolescent school girls, and in determining the association between selected socioeconomic and behavioural factors and overweight/obesity.

Material and Methods

Study Population and area: In this cross-sectional study, data was collected from the adolescent girls aged 10–18 years from Government and Government-sponsored higher secondary schools in

Kolkata, West Bengal, India. West Bengal is India's fourth most populous state and is located in the eastern region of India. Kolkata is the capital city of West Bengal and is often known as the cultural capital of India.

Sample size and sampling: The total study sample was 1041 adolescent girls. We calculated the sample size for estimating a reported prevalence of 35.5% (Ghosh 2014) with a margin of error of 5 percentage points and 98% confidence interval, assuming a design effect of two, approximately 5% non-response rate. Therefore, approximately 1041 girls were selected using multistage stratified cluster sampling. Firstly, four sampled schools were selected out of all Bengali medium higher secondary schools in Kolkata, including Government and Government-sponsored schools. The primary differences between Government and Government-sponsored schools are the management system. Government schools are owned and controlled by the local state government in India. In contrast, government-sponsored schools have their private management system but get funds from the state government. However, in the present study these reflected small differences in the students' socio-economic status between Government and Government-sponsored schools. Then from each group, two schools were selected randomly. Equal weightage was given to all the groups, and two schools were selected from every group. Adolescent girls who were Hindu by religion, whose mother tongue was Bengali and were within the age group 10 to 18 years were selected for this study. We were given prior informed consent from the School Education Directorate, the head of the respective schools, the students'

parents, and the students. Data were collected from September 2018 to January 2020.

Data collection

Socioeconomic data: Socioeconomic data like age (date of birth), caste, education, and occupation of the parents, household size, and monthly household expenditure data were collected. The data was cross verified from school records and also from the respective parents. A schedule was formulated for the students' parents. Students filled in information from their parents. Mobile phone numbers were collected from the students and also from the schools for a future response if needed.

Anthropometric data: The height (cm) and weight (kg) of the subjects were measured according to the standard procedures (Weiner and Lourie 1981). We had used an anthropometer and a portable weighing machine for the measurements of height and weight. Before taking the measurement, each subject was asked to stand erect without footwear. Height was recorded to the nearest 0.1 cm and weight to the nearest 0.5 kg. Body mass index (BMI) was calculated by dividing weight in kilogram by square of height in meter. Calculated BMI was categorized using the BMI for Age Girls (5 to 19 years) World Health Organization percentiles guidelines (WHO 2006): normal (<5th – 85th percentile), overweight (<85th – 95th percentile), obese (>95th percentile). The individual with physical deformities was excluded from the study. Technical error of measurements (TEM) was incorporated and found within accepted limits (Ulijaszek and Kerr 1999).

Behavioural data: Physical activity (do you exercise regularly? Yes or No.), sedentary behaviour data (Do you watch television and mobile? If yes, how many hours do you spend on television and mobile in a day?), sleeping duration data (What time do you go to sleep? What time do you wake up?) were collected. We also collected health-related data such as taking medicine in the last three months before the survey and subjective perception of their each parent's body physique (obese, slim, or normal?).

Categorisation of socio-economic and demographic and also habits related characteristics: The ages of the adolescent girls were categorised into two groups, i.e. 10–13 years and 14–17 years. The family type was classified into two groups, i.e. nuclear (1–4 members) and joint (Above 4 members) families. Father's and mother's education status was combined to form a new category as parental educational status. Four quartile ranges (1st, 2nd, 3rd and 4th) were calculated to understand the household per capita monthly expenditure patterns. Sleeping duration ($\leq$ 7 hours vs > 7 hours) and watching TV and Mobile ($\leq$ 1 hour vs > 1 hour) per day were categorised by using the median values (50th percentile).

Statistical Analysis: Overall prevalence and age-specific prevalence rates of overweight and obesity were estimated. We calculated the percentages of socioeconomic, demographic, and habit-related data. We evaluated the association between overweight and obesity and other of socioeconomic, demographic, and habit-related variables through the chi-square (χ2) test. Lastly, stepwise binary logistic regression analysis (forward confidential) was performed

to get the most significant predictors of overweight and obesity in studied adolescent girls. In the stepwise binary logistic analysis, the dependent variable as overweight and obesity status among the adolescent girls was considered binary and coded as "Overweight and obese adolescent girls" = 1 and "rest of the children" = 0. In the stepwise binary logistic analysis, all significantly distributed socioeconomic, demographic, and habit-related variables in the chi-square (χ2) test were chosen as independent variables except mother education and father education variables. We selected only our new combined variable parental education status as an independent variable in the stepwise binary logistic analysis. Nagelkarke R^2 was calculated for the final step of stepwise binary logistic regression analysis to find out the amount of variation in the overweight/obesity explained by the independent variables in the model. Data were analyzed using software named IBM SPSS (Statistical Package for Social Sciences) statistics version 16.0. A *p*-value <0.05 and <0.001 were considered statistically significant.

Results

Table 1 shows the age-specific prevalence of overweight and obesity among the studied adolescent girls. The overall prevalence for overweight was 18.92%, and obesity was 23.73%. The maximum prevalence of overweight girls (29.17%) was 16 years, while obesity was 31.58% at 17 years. In general, the prevalence of overweight and obesity rose with increasing age. The combined prevalence of overweight and obesity was 42.65% among the studied adolescent girls of Kolkata (Fig. 1).

Table 1. Age specific prevalence of overweight and obesity among the studied girls

| Age (years)	Total (n)	Underweight (<5th)		Normal (5th – 85th)		Overweight (>85th)		Obese (>95th)	
		n	%	n	%	n	%	n	%
10	84	13	15.48	33	39.29	19	22.62	19	22.62
11	173	28	16.18	73	42.20	30	17.34	42	24.28
12	174	26	14.94	73	41.95	33	18.97	42	24.14
13	167	28	16.77	79	47.31	34	20.36	26	15.57
14	112	10	8.93	53	47.32	18	16.07	31	27.68
15	116	13	11.21	56	48.28	17	14.66	30	25.86
16	120	10	8.33	48	40.00	35	29.17	27	22.50
17	95	13	13.68	41	43.16	11	11.58	30	31.58
Total	1041	141	13.54	456	43.80	197	18.92	247	23.73
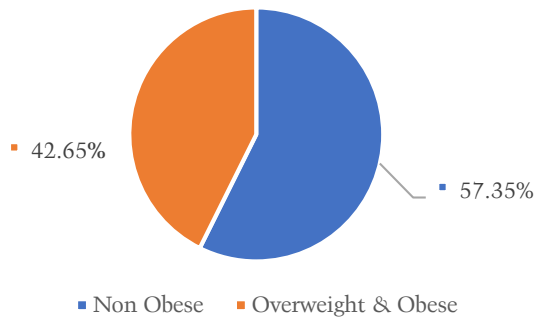
Fig.1. Overall prevalence of obesity (overweight and obese) among the studied girls.

Table 2 represents the socioeconomic and demographic and also habits-related characteristics of the studied participants. The result showed that the majority of the participants (57.4%) were within the age group of 10–13 years, studied in Government schools (52.8%), staying in nuclear families (1–4 members) (67.1%), and belonged to a general caste group (67.5%). The majority of the parents among the participants had graduated and undertaken higher education (39.0%), engaged in government or private services (40.6%), and the per capita monthly expenditure was Rs ≥ 5001 (29.6%, 4th quartiles). It also showed that 28.7% of students sleep was ≤ 7 hours per night (71.3%), did not engage in any physical exercise (81.2%), and consumed regular fast food (54.9%). Nearly 24% of girls watched television and mobile phones for more than one hour per day, and 37.4% had taken medicine three months before the survey. The perception of studied participants towards their parent's body physiques showed that 13.5% of fathers and 18.2% of mothers looked "fatty".

Table 2. Socio-economic and demographic and also habits related characteristics of the studied participants

Characteristics	Adolescent girls (n = 1041)	
	n	%
Age group (years)		
10–13	598	57.4
14–17	443	42.6
School status		
Government sponsored	491	47.2
Government	550	52.8
Family type		
Nuclear (1–4 members)	698	67.1
Joint (Above 4 members)	343	32.9
Social group		
General Caste	703	67.5
Others (SC, ST & OBC)	338	32.5
Father educational status		
Up to Higher Secondary	432	41.5
Graduation and above	609	58.5
Mother's educational status		
Up to Higher Secondary	565	54.3
Graduation and above	476	45.7
Parental educational status		
Both of them studied upto Higher Secondary	362	34.8
One of them studied graduation and above	273	26.2
Both of them studied graduation and above	406	39.0
Father occupation		
Self employed	40	3.8
Service	423	40.6
Business	395	37.9
Others	183	17.6
Household per capita monthly expenditure		
1st quartile (≤ Rs. 2250)	266	25.6
2nd quartile (Rs. 2251 – Rs. 3333)	231	22.2
3rd quartile (Rs. 3334 – Rs. 5000)	236	22.7
4th quartile (≥ Rs. 5001)	308	29.6
Sleeping duration per day		
≤ 7 hours	299	28.7
> 7 hours	742	71.3
Doing regular exercise[a]		
No	845	81.2
Yes	196	18.8
Consume regular fast-food[b]		
No	571	54.9
Yes	470	45.1
Watching TV and Mobile in a day		
≤ 1 hour	790	75.9
> 1 hour	251	24.1

$\overline{x}$	Adolescent girls (n = 1041)	
	n	%
Taking medicine 3 months prior to survey[c]		
No	652	62.6
Yes	389	37.4
Children perception on father's body physique		
Slim	134	12.9
Normal	766	76.6
Fatty	141	13.5
Children perception on mother's body physique		
Slim	101	9.7
Normal	751	72.1
Fatty	189	18.2

a = Bicycling, running and dancing, b = Drinking cold drink, cake and pastry and potato chips
c = medicines related to cold and cough, fever, thyroid, menstrual problem, etc
SC = Scheduled Caste, ST = Scheduled Tribe, OBC = Other Backward Caste

Table 3 depicts the prevalence of overweight and obesity among adolescent girls and the association with different socioeconomic and habit-related characteristics. Out of all factors, parental educational status found a significant association with overweight and obesity. The prevalence of overweight and obesity was higher among parents who both had graduated and undertaken higher education (49.5%, $p<0.001$) than other educational groups. Overweight and obesity were high-er among the participants whose fathers engaged in service (44.9%) and business sectors (45.3%), and where the distribution was significant ($p<0.05$). In household per capita monthly expenditure, the 4th quartile group had the highest prevalence of overweight and obesity (48.4%, $p<0.05$). It found that children who slept ≤ 7 hours per night had a higher prevalence of overweight and obesity (52.8%) than the ≥ 7 hours group (38.5%). Here the distribution was highly significant ($p<0.001$).

Table 3. Percentage distribution of overweight and obesity according to characteristics of students

Characteristics	Adolescent girls (n = 1041)		Chi-square values
	n	%	
Age group (years)			
10–13	245	41.0	1.624[ns]
14–17	199	44.9	
School status			
Government sponsored	210	42.8	0.005[ns]
Government	234	42.5	
Family type			
Nuclear (1–4 members)	289	41.4	1.347[ns]
Joint (Above 4 members)	155	45.2	
Social group			
General Hindu	308	43.8	1.193[ns]
Others (SC, ST & OBC)	136	40.2	

Table 3 (cont.)

Characteristics	Adolescent girls (n = 1041)		Chi-square values
	n	%	
Father educational status			
Up to Higher Secondary	158	36.6	11.150**
Graduation and above	286	47.0	
Mother's educational status			
Up to Higher Secondary	212	37.5	13.290***
Graduation and above	232	48.7	
Parental educational status			
Both of them studied upto Higher Secondary	127	35.1	16.283***
One of them studied graduation and above	116	42.5	
Both of them studied graduation and above	201	49.5	
Father occupation			
Self employed	14	35.0	
Service	190	44.9	9.488*
Business	179	45.3	
Others	61	33.3	
Household per capita monthly expenditure			
1st quartile (≤ Rs. 2250)	112	42.1	
2nd quartile (Rs. 2251 – Rs. 3333)	99	42.9	8.971*
3rd quartile (Rs. 3334 – Rs. 5000)	84	35.6	
4th quartile (≥ Rs. 5001)	149	48.4	
Sleeping duration per day			
≤ 7 hours	158	52.8	17.813***
> 7 hours	286	38.5	
Doing regular exercise[a]			
No	370	43.8	2.367[ns]
Yes	74	37.8	
Consume regular fast-food[b]			
No	234	41.0	1.443[ns]
Yes	210	44.7	
Watching TV and Mobile in a day			
≤ 1 hour	323	40.9	4.174*
> 1 hour	121	48.2	
Taking medicine 3 months prior to survey[c]			
No	257	39.4	7.461**
Yes	187	48.1	
Children perception on father's body physique			
Slim	44	32.8	12.612**
Normal	324	42.3	
Fatty	76	53.9	
Children perception on mother's body physique			
Slim	35	34.7	6.063*
Normal	316	42.1	
Fatty	93	49.2	

a = Bicycling, running and dancing, b = Drinking cold drink, cake and pastry and potato chips
c = medicines related to cold and cough, fever, thyroid, menstrual problem, etc.
*$p<0.05$; **$p<0.01$; *$p<0.001$

On the other hand, the girls who watched television and mobile phones for more than 1 hour a day had a higher prevalence of overweight and obesity (48.2%, p<0.05) than the opposite group. It further identified that girls who had taken medicines related to cold and cough, fever, thyroid, menstrual problem, etc., had higher overweight and obesity (48.1%) than those girls who had not taken medicine three months prior to the survey. When the participants were asked about their perception of the patient's body physique, it was interesting to find that overweight and obesity were higher among girls whose father looked "fatty" (53.9%) and whose mother looked "fatty" (49.2%). Both the distributions were significantly varied.

Table 4 shows the stepwise binary logistic regression (forward conditional) analysis of significant socioeconomic and other habit-related predictors on overweight and obesity among adolescent girls. In this analysis, highly significant predictors were included, which directly affected overweight and obesity. In Step 1, the first predictor found was sleeping duration which indicates the maximum significance level ($\beta=0.580$; $p<0.001$). This step observed that adolescents who slept ≤ 7 hours per night had higher likelihood of being overweight and obese (OR=1.787, 95%CI = 1.363–2.343, $p<0.001$) than ≥ 7 hours sleeping duration group. In the next step, parental education ($\beta=0.529$; p<0.001) was considered. The analysis indicates that girls who slept ≤ 7 hours per day and had parents with higher education (both of them studied graduation and above) showed a higher prevalence of overweight and obesity. In step 3, children's perception of their father's body physique ($\beta=0.797$; $p=0.002$) was detected. This step revealed that adolescents who had perceived their father's

body physique and parents were highly educated and slept ≤ 7 hours per day, had a higher risk of getting overweight and obese. The next step (Step-4) found that taking medicine three months before the survey ($\beta=0.349$; $p=0.008$) was added as a new predictor. Medicines included, menstrual related analgesics, fever, thyroid etc. In step 5, watching television and mobile phones in a day was included as a predictor. Results showed that adolescents who watched television and mobile phones for more than 1 hour per day showed a higher prevalence ($\beta=0.308$; $p=0.039$) of being overweight and obese. This analysis shows that the afore mentioned predictors had conjugated predictors on overweight and obesity among adolescent girls. In step 5, low sleeping duration (≤ 7 hours per day) was still a significant risk factor (OR=1.684, 95% CI = 1.280–2.216, $p<0.001$) for developing overweight and obesity among the studied girls. The step 5 model explained 10% (Nagelkerke R^2) of the variance of overweight and obesity in the studied adolescent girls and correctly classified approximately 59.5% of cases.

Discussion

The prevalence of overweight and obesity increases daily in Indian adolescents, specifically those living in urban areas. Socioeconomic and behavioural factors play an essential role in developing overweight and obesity risk. This study considers the overall prevalence of overweight and obesity among adolescent school girls of Kolkata. Ghosh (2014) observed that the prevalence of overweight and obesity was 35.5% among 12 to 15-year and 30.4% among 16 to 18-year-old girls in Kolkata. The present result showed that the overall prevalence is 42.65% which is relatively high and concerning.

Table 4. Step-wise binary logistic regression (forward confidential) analysis of significant socio-economic and habits related predictors on overweight and obesity among the urban adolescent girls

Step	Characteristics	B	S.E.	Wald	df	Sig.	OR	95.0% C.I. Lower	95.0% C.I. Upper
Step 1	Sleeping duration per day ≤7 hours (Ref > 7 hours)	0.580	0.138	17.623	1	0.001	1.787	1.363	2.343
	Constant	-0.467	0.075	38.250	1	0.001	0.627		
Step 2	Parental educational status			12.415	2	0.002			
	One of them studied graduation and above (Ref = Both of them studied upto Higher Secondary)	0.299	0.166	3.256	1	0.071	1.349	0.975	1.866
	Both of them studied graduation and above (Ref = Both of them studied upto Higher Secondary)	0.529	0.150	12.411	1	0.001	1.697	1.264	2.278
	Sleeping duration per day ≤7 hours (Ref > 7 hours)	0.521	0.140	13.845	1	0.001	1.684	1.280	2.216
	Constant	-0.738	0.116	40.502	1	0.001	0.478		
Step 3	Parental educational status			11.770	2	0.003			
	One of them studied graduation and above (Ref = Both of them studied upto Higher Secondary)	0.276	0.167	2.748	1	0.097	1.318	0.951	1.827
	Both of them studied graduation and above (Ref = Both of them studied upto Higher Secondary)	0.518	0.151	11.768	1	0.001	1.678	1.248	2.255
	Sleeping duration per day ≤7 hours (Ref > 7 hours)	0.496	0.141	12.362	1	0.001	1.642	1.245	2.164
	Children perception on father's body physique			10.018	2	0.007			
	Normal (Ref = slim)	0.376	0.200	3.513	1	0.061	1.456	0.983	2.157
	Fatty (Ref = slim)	0.797	0.254	9.878	1	0.002	2.219	1.350	3.648
	Constant	-1.107	0.208	28.455	1	0.001	0.330		

	B	SE	Wald	df	Sig	OR	Lower CI	Upper CI
Step 4								
Parental educational status			12.149	2	0.002			
One of them studied graduation and above (Ref = Both of them studied upto Higher Secondary)	0.286	0.167	2.917	1	0.088	1.331	0.959	1.847
Both of them studied graduation and above (Ref = Both of them studied upto Higher Secondary)	0.528	0.151	12.149	1	0.001	1.695	1.260	2.282
Sleeping duration per day ≤7 hours (Ref > 7 hours)	0.485	0.141	11.754	1	0.001	1.624	1.231	2.143
Taking medicine 3 months prior to survey (Yes, Ref = No)	0.349	0.132	6.976	1	0.008	1.418	1.094	1.837
Children perception on father's body physique			9.836	2	0.007			
Normal (Ref = slim)	0.399	0.202	3.924	1	0.048	1.491	1.004	2.214
Fatty (Ref = slim)	0.797	0.255	9.790	1	0.002	2.219	1.347	3.655
Constant	-1.261	0.217	33.662	1	0.001	0.283		
Step 5								
Parental educational status			12.303	2	0.002			
One of them studied graduation and above (Ref = Both of them studied upto Higher Secondary)	0.281	0.168	2.802	1	0.094	1.324	0.953	1.839
Both of them studied graduation and above (Ref = Both of them studied upto Higher Secondary)	0.532	0.152	12.299	1	0.001	1.703	1.265	2.283
Sleeping duration per day ≤7 hours (Ref > 7 hours)	0.501	0.142	12.432	1	0.001	1.650	1.249	2.179
Watching TV and Mobile in a day> 1 hour (Ref = ≤ 1 hour)	0.308	0.150	4.239	1	0.039	1.361	1.015	1.825
Taking medicine 3 months prior to survey (Yes, Ref = No)	0.325	0.133	5.984	1	0.014	1.384	1.067	1.797
Children perception on father's body physique			9.845	2	0.007			
Normal (Ref = slim)	0.403	0.202	3.969	1	0.046	1.496	1.007	2.223
Fatty (Ref = slim)	0.799	0.255	9.804	1	0.002	2.224	1.348	3.667
Constant	-1.335	0.221	36.389	1	0.001	0.263		

R^2 = 0.10 (Nagelkarke); Correct Percentage = 59.5, Model chi-square = 51.627 (df=7), $p < 0.001$

OR = Odd ratio, CI = Confidence interval, Ref = Reference category

The present study also investigated socioeconomic and behavioural determinants of overweight and obesity among adolescent girls. The results showed that the prevalence of obesity was higher among those who live in joint families. In supporting the finding, many studies have noted that children belonging to larger families were more likely to become overweight and obese. One reason could be that children from more prominent families receive less parental instruction regardingtheir food choices. Accordingly, smaller families may be more attentive regarding their child's dietary behaviour and physical activity patterns (Brown et al. 2004; Khader et al. 2009; Lindsay et al. 2006).

Furthermore, socioeconomic status directly influences the nutritional status of adolescents. According to Okour et al. (2019), the main factor influencing children's BMI was the parental economic status. The present findings showed that parents with the highest education graduation and above and highest household per capita monthly expenditure families reflected a higher prevalence of overweight and obesity among adolescents. The study also suggested that family economic status informed children's total calorie intake, dietary behaviour and physical activity (Khader et al. 2009). Schoolchildren raised within families of higher economic status had a more comprehensive range of food choices, including food served at restaurants. Moreover, we speculate that a higher daily children's pocket expenditure could have resulted in less strict control of children's dietary behaviour by the parents, a factor that might have led to higher consumption of calorie-dense food as noted in this study also (Ahmed et al. 2018; Zhang et al. 2018; Whitaker and Orzol 2006).

Another vital factor significantly associated with obesity among adolescents was sedentary behaviour like television and mobile watching and sleeping duration. The study suggested that obesity was higher among those who watched television and mobile and suffered from sleeplessness. Obesity was associated with television viewing in many studies, and the more the duration of television watching, the higher the prevalence of obesity (Viswambharan et al. 2020). A review by Mech et al. (2016) also found that television viewing mediated the relationship between socioeconomic status and overweight and obesity in children (Gatjens et al. 2020). Other mediation analyses also revealed that the effect of socioeconomic status on overweight and obesity assessed by BMI percentiles was partly mediated by media exposure (Morgenstern et al. 2009). Other than television watching and mobile browsing, sleeping duration directly affected the BMI of adolescents. Less sleep was associated with a more significant increase in BMI from age 14 to 18 years (Mitchell et al. 2013). This consequence provides strong evidence that sleep duration was an im portant risk factor in factoradolescent obesity. It is imperative to ensure that adolescents in the upper half of the BMI distribution at age 14 years accumulate sufficient hours of sleep throughout adolescence. It has also been proposed that less sleep increases adolescent BMI by decreasing physical activity due to fatigue and changes in hormones that regulate energy expenditure (Taheri 2010; Knutson et al. 2008). The reason could be adolescents with short sleep duration may be more likely to be awake at night and be exposed to light during the dark cycle. Such biological consequences could affect the periph-

eral clock in adipose tissue by releasing adipokines (Bass et al. 2010; Johnston et al. 2009). The secretion of several hormones, including growth hormone, prolactin, cortisol, thyrotropin, and insulin, are influenced by sleep (Copinschi 2005; Hart et al. 2011). In support of this, a cross-sectional study observed that adolescents going to bed late tend to have higher BMIs, independent of sleep duration, compared with adolescents who go to bed early (Olds et al. 2011). However, the present study found the additive impact of socioeconomic and behavioural factors in overweight and obese adolescent children. The adolescents who slept ≤ 7 hours per day, educated parents studied graduation and above, affluent families in terms of household expenditures, spend more time watching television, browsing mobile phones, taking medicines for health problems, and perceiving their fathers as being "fatty" showed a higher prevalence of overweight and obesity. Besides, adolescents with higher educated parents felt pressure in performing well at school, which could be one reason for sleeping late at night and gaining weight.

The study was limited to school-going adolescent girls in Kolkata, India. Thus, it did not represent all adolescents in the area. One should not generalize the results of all adolescent girls of West Bengal. As this was a cross-sectional study, the causal relationship between socioeconomic and behavioural factors and overweight and obesity could not be established. In-depth food habits and physical activity data were not considered in this study. Breakfast skipping data was also not taken into account, but missing breakfast had been associated with an increased tendency to have snacks and fast foods, resulting in weight gain.

Conclusion

This study concludes that socioeconomic status such as family size, father's occupation, parental education, and total family expenditure influence the increasing prevalence of overweight and obesity among adolescents. Other than these factors, television, mobile watching, and sleeping duration have become critical factors for increasing overweight and obesity in this study. Socioeconomic factors have detrimental effects in developing obesity, but behavioural factors like sleep duration may also significantly influence it. The rapid change in modern lifestyles influences adolescents from having adequate sleeping duration, negatively impacting their health. Therefore, adolescent girls should take preventive measures to reduce overweight/obesity. The government should implement competent nutrition and health promotion strategies towards adolescent girls and their respective parents/guardians to build proper dietary habits, physical activity, and sleeping habits to maintain a healthy lifestyle and reduce the risk of weight disorders..

Author Contributions

PR developed the aim of the study. PR, SC, PB designed and assisted in drafting the methodology. PR oversaw the data collection. SC did the statistical analysis. PR and SC wrote the final draft of the paper. PB and DC helped in revising the final version of the manuscript. All the authors read and agreed to the final manuscript.

Conflict of Interest

The authors have no conflict of interest to declare.

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