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RESEARCH

Predictors of prevalence of overweight and obesity in children

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ABSTRACT

Introduction: The world health report in 2002 demonstrated a rise in prevalence in noncommunicable diseases in developing countries such as India. The prevalence of becoming overweight among children has markedly increased over the past 20 years. Body mass index is the most widely used parameter to define obesity. This study was conducted with the aim to find the association in children of higher socioeconomic status who are battling overweight or obesity as a problem and studying in private schools in West Delhi. **Materials and Methods:** This was an observational cross-sectional study conducted in two private schools in Delhi, India, during school hours from July 2013 to June 2014. Students of age group 10–18 years studying in Class VI to XIIth were included in this study. Children with a history of chronic illness were excluded from the study. **Results:** This study enrolled a total of 1250 students. This was a cross-sectional study conducted in two private schools in Delhi, India. Seven hundred and fifteen (57.2%) were males and 535 (42.8%) were females. A maximum number of students (254, 20.3%) were in the category of 11-year age group. In all categories of age groups, male children were more than female children except in 17–18-year age group. Prevalence of overweight children was 11.8% and obese children was 7.5%. Overweight children were maximum in 11-year age group (20.1%) and minimum in 17-year age group (5.3%). While prevalence of obesity was maximum in 18-year age group (15%) and minimum in 15 years of age group (3.2%). Incidence of overweight was more in males (56.5%) than females (43.5%). Obesity was also more in male children than female children. **Conclusion:** This study demonstrated a higher prevalence among overweight (11.8%) children compared to children who are obese (7.5%). Junk food consumption, dietary habits, sedentary lifestyle of using technology as entertainment, and easy modes of transport to school are perhaps the contributors to give rise to the higher prevalence of health issues in these children. The results of this study can be applicable to similar future studies. Health education regarding prevention of obesity and its risk factors leading to mortality should be included in the curriculum in all schools. Regular health awareness program for parents and children should be conducted from time to time to assess healthier lifestyle motivation among city living population.

Key words: Body mass index, childhood obesity, overweight

Introduction

An escalating epidemiology in obesity has put human population in many developing countries at risk of contracting noncommunicable diseases (NCDs) [1]. Since then, further rise of statistics highlighted the steady rise in the prevalence of obesity and creating a pandemic. More surprising is to see this pandemic targeting some of the children of poorest nations, especially children living in urban middle to high-class society. Global mortality from NCDs is expected to be 49.7 million by 2020 [2].

A total of 5% of the population in India is overweight with increasing trends. According to a study conducted by Ramachandran et al. in India, 17.8% boys and 18.8% girls were found to be overweight among adolescent (12–19 years) age group [3]. Body mass index (BMI) is defined as the body mass divided by the square of the body height and is universally expressed in units of kg/m^2, resulting from mass in kilograms and height in meters. BMI is the most widely used parameter to define obesity. Children whose BMI is at or more than 85th percentile are overweight. Children whose BMI is at or greater than the 95th percentile are obese [4].

Around 22 million children are estimated to be overweight worldwide. In the analysis carried out by world health report 2002, approximately 58% of diabetes, 21% of ischemic heart disease, and 8.42% of certain cancers globally are attributable to a BMI above 21 kg/m^2 [5].

There are only a few studies examining the influence of overweight and obesity among children living within higher socioeconomic status in urban area. Therefore, this was a study aiming to find the proportion of overweight and

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obesity and their association in children belonging to higher socioeconomic status studying in private schools in West Delhi.

Materials and Methods

This was an observational cross-sectional study conducted in private schools during school hours from July 2013 to June 2014 in Delhi, India. Students of age group 10–18 years studying in Class VI to XIIth in selected private schools of Delhi were included in our study. Children with a history of suffering from any chronic disease were excluded from the study.

Sampling size and procedure

A total of 1250 children were included in the present study. A list of private schools in Delhi was gathered from District Education Department, and then with the help of simple random sampling method, two schools were selected for this study. Investigator explained the purpose of the study and took permission for examination of students from school authorities. Informed consent form was obtained from parents. Some information such as name, age, sex, religion, and cast were recorded from school record. Information such as height, weight, and blood pressure was recorded on a predesigned pro forma at the time of examination. Pro forma was prevalidated. It is taken from Child Development Centre, Thiruvananthapuram, Teenage Screening Questionnaire, Trivandrum-2013 (TSQ-T-2013). A predesigned questionnaire prepared in English was used to gather information about dietary habits, physical activities, and family history of high blood pressure, myocardial infarction, stroke, and diabetes. We have not studied the correlation of onset of puberty in obese or overweight child; hence, Tanner staging was not planned as there was some resistance from school authority for such examination.

Method of study

Students were asked to sit in a room, and the procedure of blood pressure, height, and weight measurement was explained to allay anxiety and fear. Age was recorded from school record and rounded off in completed years. Weight was measured without shoes to nearest ½ kg, using portable weight machine previously calibrated with digital weighing machine. Children were in their regular uniform. Height of each child was measured by stadiometer in upright position without shoes. Nearest to 1 cm reading was considered for measurement [5]. Children who have never taken egg and meat were considered vegetarian. Children who had egg and meat diet were considered nonvegetarian. History of frequent intake of junk food or fast foods such as Maggie noodles, pizza, burger, pav bhaji, samosa, canned food items, and deep fried such as tikka was taken into consideration.

Overweight and obesity defined

BMI gives ideal measurements for identifying children in overweight or obesity category. BMI equals a person's weight (mass) in kilograms divided by the square of the person's height in meters (BMI = WEIGHT/HEIGHT^2). In our study, children with BMI ≥85th percentile or *z* score ≥1.04 were considered overweight and BMI ≥95th percentile or *z* score ≥+1.64 were considered obese. We used CDC 2000 chart for corresponding percentile and *z* score for BMI for age, height for age, and height for weight as seen in Table 1 [6].

Statistical analysis

All data were entered on excel sheet and analyzed using XLStat software. Quantitative data summarized in the form of mean ± standard deviation and the difference in mean was analyzed with the help of *Z*-test. Nonqualitative data in the form of proportion and difference in proportion were analyzed using Chi-square test. The level of significance and α error was 95% and 5%, respectively, for statistical analysis.

Observation and Results

Distribution of children according to age and gender

Out of 1250 students, 715 (57%) were males and 535 (42%) were females. A maximum number of students were in 11-year age group (254, 20%). In all other age groups, male children were more than female children except in 17- and 18-year age group.

Male students with overweight and obesity

Out of 715 male children, 11.6% (83) were overweight and 8.7% (62) were obese. Eighty-three students who were overweight, it was found that 17.8% (28) were in 11-year age group, 7.8% (8) were in 12-year age group, 10.8% (9) were in 13-year age group, 11.8% (9) were in 14-year age group, 14.7% (16) were in 15-year age group, 8.6% (8) were in 16-year age group, 5.3% (3) were in 17-year age group, and 5.3% (1) were in 18-year age group. Here, 15-year age group was found to be the maximum number of male students with overweight issue [Graph 1].

While 62 male students were obese, 11.5% (18) were in 11-year age group, 12.6% (13) were in 12-year age group, 6% (5) were in 13-years age group, 9.2% (7) were in 14-year age group, 4.6% (5) were in 15-year age group, 7.5% (7) were in 16-year age group, 4% (3) were in 17-year age group, and 21.1% (4) were in 18-year age group which was maximum in male population. This was found to be statistically significant ($P = 0.027$).

Female students with overweight and obesity

Out of 535 female children, 12% (64) were overweight and 6% (32) were obese. Sixty-four female students who were overweight, 23.7% (23) were in 11-year age group which was maximum in all female groups. Nearly 7.1% (5) were in 12-year age group, 7.9% (5) were in 13-year age group, 21.3% (10) were in 14-year age group, 10.5% (8) were in

15-year age group, 5.9% (5) were in 16-year age group, 5.3% (4) were in 17-year age group, and 19% (4) were in 18-year age group [Graph 1].

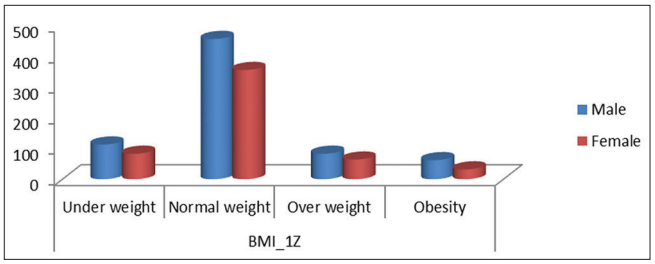
While in obese group of 32 students, 12.4% (12) were in 11-year age group which was maximum in all female groups. Nearly 11.4% (8) were in 12-year age group, 1.6% (1) were in 13-year age group, 2.1% (1) were in 14-year age group, 1.3% (1) were in 15-years age group, 4.7% (4) were in 16-year age group, 3.9% (3) were in 17-year age group, and 9.5% (4) were in 18-year age group. This was found to be statistically significant ($P = 0.001$).

Out of total 1250 children, 11.8% (147) were overweight. It was maximum in 11 years of age group (51; 20.1%) and minimum in the 17 years of age group (8; 5.3%). While out of total 1250 children, 7.5% (94) were obese. Obesity was found maximum in 18-year age group (6; 15%) and minimum in 15 years of age group (6; 3.2%). These data were found to be statistically significant ($P = 0.001$).

Table 1: Body mass index classification of children and adolescents

BMI percentile for age	Weight status	Corresponding Z-score
<5th percentile	Underweight	<−1.64
5th-84th percentile	Normal weight	≥−1.64-<1.04
85th-94th percentile	Overweight	≥+1.04-<+1.64
>95th percentile	Obesity	≥+1.64

BMI: Body mass index



Graph 1: Body mass index and sex distribution

Table 2: Distribution of children according to body mass index in different age groups

	Age	BMI					
		Underweight	Normal weight	Overweight	Obese	Total	*P*
Total children (1250)	11						0.001
	Count	20	153	51	30	254	
	Percentage within age	7.9	60.2	20.1	11.8	100.0	
	12						
	Count	26	113	13	21	173	
	Percentage within age	15.0	65.3	7.5	12.1	100.0	
	13						
	Count	25	101	14	6	146	
	Percentage within age	17.1	69.2	9.6	4.1	100.0	
	14						
	Count	15	81	19	8	123	
	Percentage within age	12.2	65.9	15.4	6.5	100.0	
	15						
	Count	31	124	24	6	185	
	Percentage within age	16.8	67.0	13.0	3.2	100.0	
	16						
	Count	37	117	13	11	178	
	Percentage within age	20.8	65.7	7.3	6.2	100.0	
	17						
	Count	29	108	8	6	151	
	Percentage within age	19.2	71.5	5.3	4.0	100.0	
	18						
	Count	13	16	5	6	40	
	Percentage within age	32.5	40.0	12.5	15.0	100.0	
Total	Count	196	813	147	94	1250	
	Percentage within age	15.7	65.0	11.8	7.5	100.0	

BMI: Body mass index

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Distribution of children and their correlation of body mass index risk factors

Body mass index with family history risk factors

Our study demonstrated a total of 147 (11.8%) children were overweight in 83 (56.5%) male students and 64 students (43.5%) were female as seen in Table 1. Out of total 94 (7.5%) obese children, 62 (66%) were males and 32 (34%) were female students as seen in Table 2. However, there was no statistical significance ($P = 0.345$).

In our study of 147 overweight children, 45 (30.6%) had positive family history of obesity/diabetes mellitus (DM)/hypertension (HTN)/stroke risk factors. In 95 obese children, 37 (39.4%) had positive family history of the same risk factors. An association of statistical significance ($P = 0.009$) was found between BMI and their corresponding positive family history of obesity/DM/HTN/stroke risk factors [Table 3].

Body mass index and dietary habits

In our study of 147 overweight children, 87 (59.2%) use to take junk/fast food 1–2 times/week (Y1 group). Out of 94 obese children, 52 (55.3%) use to take junk food 1–2 times/week (Y1 group). Those who were taking junk food 2–4 times/week (Y2 group), 51 (43.7%) students out of total 147 were overweight and 25 (26.6%) students out of 94 were obese. This was found to be statistically significant ($P = 0.001$).

Ninety-seven (66%) were vegetarian as compared to fifty (34%) students who were nonvegetarian. Out of 94 obese children, 44 (46.8%) were vegetarian as compared to 50 (53.2%) were nonvegetarian. An association of statistical significance ($P = 0.003$) was found between BMI and their corresponding dietary habits.

Table 3: Distribution of children according to body mass index and sex

BMI_1Z	Sex		Total	*P*
	Male	Female		
Underweight				0.345
Count	113	83	196	
Percentage within BMI	57.7	42.3	100.0	
Normal weight				
Count	457	356	813	
Percentage within BMI	56.2	43.8	100.0	
Overweight				
Count	83	64	147	
Percentage within BMI	56.5	43.5	100.0	
Obesity				
Count	62	32	94	
Percentage within BMI	66.0	34.0	100.0	
Total				
Count	715	535	1250	
Percentage within BMI	57.2	42.8	100.0	

BMI: Body mass index

Body mass index and extra salt intake

Only 6 (4.1%) out of total 147 overweight children take extra salt with their food, whereas 14 (14.9%) out of 94 obese children consumed extra salt. An association of statistical significance ($P = 0.010$) was found between BMI and their intake of extra salt intake.

Body Mass index and sedentary lifestyle physical inactivity

Number of hours watching TV

In our study of 147 overweight children, 104 (70.7%) watches TV 1–2 h/day. Among 94 obese children, 65 (69.1%) students spent their time watching TV 1–2 h/day. An association of statistical significance ($P = 0.001$) was found between BMI and their corresponding duration of time watching TV.

Outdoor activities participation

In our study, out of total 147 overweight children, 125 (85.0%) spend 1–2 h in outdoor activity, whereas only 6 (4.1%) children spend >2 h in outdoor activities. Out of total 94 obese children, 68 (72.3%) spend 1–2 h in outdoor activities and 14 (14.9%) children spend >2 h in outdoor activities. An association of statistical significance ($P = 0.001$) was found between BMI and their corresponding duration of time spent on outdoor physical activity.

Mode of transport to school

In our study of 147 overweight children, 123 (83.7%) students used vehicle to commute to school. Out of 94 obese children, 81 (86.2%) students use vehicle. An association of statistical significance ($P = 0.001$) was found between BMI and their corresponding mode of transport.

Body Mass index and type of family living conditions

Eighty-one (55.1%) out of 147 overweight children lived in single/nuclear family. Fifty-nine (62.8%) out of 94 obese children lived in single family. This was statistically not significant ($P = 0.251$).

Discussion

This study was done in two private schools of Delhi, India, from July 2013 to June 2014 to assess the prevalence of overweight and obesity in 11–18 years aged children. A total of 1250 children were included in our study. Out of 1250 students, 715 (57.2%) were males and 535 (42.8%) were females. A maximum number of students was in 11-year age group, i.e. 20.3% (254). In all age groups, male overweight children were more than female children (56.5% [83] vs. 43.5% [64]) except in 17 and 18-year age group. A number of obesity was seen more predominately in males (62; 66%) overall.

In our study, prevalence of overweight and obesity was seen in 11.8% and 7.5% of children, respectively. Family history of risk factors such as DM, HTN and stroke, dietary habits including junk food consumption, physical inactivity such as a number of hours watching TV, time spent doing outdoor activity, and ease of transport to school all had a definite influence on BMI and obesity.

In a study conducted by Ramachandran et al. [3] on Southern Indian children, the prevalence of overweight (BMI >25) was found to be 17.8% in boys and 15.8% in girls, whereas obesity (>30 kg/m^2) was higher in boys (3.6%) and rare in girls (2.9%). Ramachandran et al. point out that obesity is rarely overall observed in Asian children. This could be due to the general socioeconomic state between a developing county fighting in general with poverty versus a well-developed country with higher nutrition and use of preservatives within the food market distribution. Regardless, it is found that diabetes had a strong association with a person's BMI either due to the inheritance of genetics or acquaintance of buildup of resistance to insulin as obesity arises [7,8].

Studies conducted by Anand and Tandon and Verma et al. [8,9] can be used to compare our findings as it measured the prevalence of obesity in school children in Northern India. Such studies instead found obesity in children had a higher correlation with HTN. However, such studies cannot be fully compared with ours as we focused on children aged 11–18 and their age group of the study was from 5 to 15 years. Furthermore, we could not find a statistical significance between intakes of extra salt in children with overweight or obesity issue to conclude further on its impact of strong correlation with HTN.

Focusing on similar studies conducted in children worldwide, it is noted that prevalence of children with overweight has a strong correlation with decreased physical activity [10,11]. This is also a strong finding in our study, in which only 4.1% of children were being active >2 h on outdoor activities. Statistical significance was found between BMI and hours of watching TV (P = 0.001). In those who used vehicle as modes of transport to school, 86.2% (81) were obese with a close comparison to 83.7% (123) children being overweight.

Moussa et al. and Musaiger et al. studies observed risk factors in obese children to be strongly associated with family history present with obesity and DM [12]. This too was evident in our findings, in which we found a strong statistical significance in association between BMI and family history of obesity/DM/HTN/stroke risk factors (P = 0.009).

We found more overweight children in vegetarian group because most of vegetarian children from North India take lots of ghee/butter/milk product within their daily food intake. Most nonvegetarian dietary habits of children were eating high protein diet of chicken and egg and rarely mutton. Moreover, children in our study group are from private schools with economically sound background and prone to take more junk food more than 2–4/times a week in 43.7% (51) in overweight children and 26.6% (25) in those who were battling with obesity.

Our study did not find any statistical significance in the prevalence of overweight and obesity in children staying in single or nuclear family. Our limitations in this study could have been due to lack of further data on the influence of status and family impact in living conditions and how such situations impact a child's lifestyle and environmental habits. This is something further studies on similar research can perhaps work on to demonstrate any correlation and its prevalence in children with obesity and overweight issues.

Conclusion

This study found a high prevalence of overweight and obesity in young adolescents who are living in well socioeconomic strata of urban developing country. Statistical significance of dietary consumption of junk food, physical inactivity, and family history of DM/HTN and stroke all had a definite influence on obesity and overweight in children who are at greater risk.

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Author's Contributions

Vinita Verma contributed abstract and observations, Dhan Raj Bagri contributed conclusions, Vinod Kumar Sharma Contributed material and methods, Rita contributed statisics and Fariah Asha Haque contributed discussion.

Competing Interests

The authors declare that they have no competing interests.

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