Original Research Article

PREVALENCE OF OVERWEIGHT AND OBESITY AMONG RURAL AND URBAN SCHOOL GOING ADOLESCENTS (10-19 YEARS) IN NORTH INDIA: A POPULATION BASED STUDY

Anmol Goyal [1,*], Nabeel Ahmed Gadi [2], Randhir Kumar [3]

1. Assistant Professor, Department of Community Medicine, Gian Sagar Medical College and Hospital, Ramnagar, Rajpura, Patiala, Punjab, India. 2. Assistant Professor, Department of Community Medicine, Universiti Sains Malaysia-kle imp, Belgavi, Karnataka, India. 3. Assistant Professor, Department of Community Medicine, SGRR Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India.

Corresponding author – **Dr. Anmol Goyal**

Email id – anmolgoyal01.ag@gmail.com

ABSTRACT

Background: Various chronic diseases of adult life are the resultant of childhood overweight and obesity. However, there are no studies available regarding the direct or indirect increase of chronic diseases related to overweight and obesity in district Ambala (Haryana), India, especially in urban areas. **Objectives** The objective of the present study is to determine the prevalence of overweight and obesity among adolescents. **Methods** A cross sectional study was conducted among 1600 school going adolescents (10-19 years) from 5th to 12th class of government and private schools in rural and urban area of district Ambala, Haryana. A self-designed, semi- structured questionnaire was used to assess the socio-demographic profile, socio-economic status, socio-environmental factors followed by anthropometric measurement of the children. **Results** The overall prevalence of overweight and obesity was found to be 18.02% and 7.98% respectively. Prevalence of overweight and obesity was 16.16% and 8.96% among males and 20.32% and 6.77% among females. Higher prevalence was also seen in urban area, private schools, nuclear family, and upper socio-economic class. **Conclusion** Overweight and obesity has multi-factorial causes and needs multi-prolonged interventions at the earliest for control and prevention.

Keywords obesity, overweight, adolescents, chronic diseases.

INTRODUCTION

Childhood overweight and obesity are the commonest health issues in recent years. Obesity and its related diseases in adults are directly dependent on age and also its severity in childhood. The overweight and obesity has become the major public health concern globally and risk factors for various metabolic disorders like hypertension, diabetes mellitus (DM) and cardiovascular diseases (CVD) **(1).** Due to overweight and obesity, every year about 3.4 million adults die **(2).** Change in lifestyles with better socio-economic status of families and increase in physical inactivity due to television, video games and computers instead of outdoor games and other social activities has led to increase in overweight and obesity. The world is home to 1.2 billion individuals aged 10–19 years **(3).** Adolescent comprises approximately 20.9% of the total Indian population **(4).** The prevalence of overweight and obesity has tremendously increased in children and adolescents in developing countries **(4).** Globally, an estimated 10% of school-aged children, between 5 to 17 years of age, are overweight or obese **(5).** In Indian subcontinent, the pooled estimates of the prevalence of overweight and obesity in children were 2% to 36% **(6).** Various studies in India have shown that the prevalence of

overweight among adolescents ranges from 10% and 30%. Prevalence of childhood obesity in rural Haryana was 7% in males and 9% in females **(7).** The words 'obese'/'obesity' have derived from French and Latin language, where 'obedere' means 'over eat' and 'obesitas' means being very fat **(8).** Obesity may be defined as unusual growth of adipose tissue due to an increase of size of fat cell or number of fat cells or both. Overweight means having excess body weight as per specific height. According to Centers of Disease Control and Prevention (CDC) classification for 2-19 years of age, overweight is defined as children body mass index (BMI) value between 85th-95th percentile for a specific age and gender **(9).** Similarly, obesity is defined as with BMI value above 95th percentile for that specific age and gender **(9).** According to World Health Organization (WHO), an adolescent is a person aged 10 to 19 years inclusive **(10).**

There are various factors for childhood overweight and obesity which includes upper socio-economic status, urbanization and gender inequality etc. Obesity is often expressed by many indicators like BMI, waist hip ratio (WHR), waist circumference and skin fold thickness **(9).** In Haryana state, no specific initiatives/ programmes or strategies have been taken so far to tackle the problem of adolescent overweight and obesity. Thus it is important to understand the factors affecting the adolescent overweight and obesity, so that incidence and prevalence can be decreased by taking specific preventive steps. With this background in mind, the present study was undertaken in rural and urban adolescent school students in Ambala (Haryana) to estimate the prevalence of childhood overweight and obesity, where only few studies have been done and not enough data is available as yet.

MATERIAL AND METHODS

A cross-sectional study was carried out among adolescents (10-19 years of age) studying from 5th to 10+2 class in government and private schools of rural and urban areas in district Ambala (Haryana) from January 2013 to May 2015. Sample collection was done by stratified random sampling technique. Literature review reveals that the prevalence of overweight and obesity in adolescents (10-18 years) from 1998 to 2013 were found to be 3% to 26% and 15 to 14.6% respectively **(6).** Thus, the sample size was calculated by presuming the prevalence of overweight and obesity to be 20% (mean of reported prevalence in India) which comes out to be 1600. Ambala district had a total number of 224 both

government and private higher secondary as well as senior secondary schools (as per the record available with the District Education Office, Ambala) in rural and urban areas of the district. In the study, only 134 government and 69 private co-educational schools were included. Keeping in view, the number of government and private schools are in 2:1 ratio, so 8 government and 4 private schools were included in the study, which were randomly selected and 1075 students from government and 525 students from private schools were allocated to cover the desired sample size of 1600 students. Guardians of 46 students did not give consent, thus a total of 1554 students were included for the study. The semi-structured questionnaire was used to assess socio-environmental factors pertaining to overweight and obesity **(11).** According to WHO, body mass index (BMI) is a ratio of weight and height (kilograms/meters^2). BMI for age cut-off in both sexes defines overweight and obesity. Normal students are those who were not overweight and obese. Waist circumference is measured at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest.

Data Analysis The analysis was performed using SPSS Version 21 software. The appropriate statistical methods (mean values, standard deviation, Chi-square test and independent t test) were applied as per requirement.

Ethic Consideration The present study did not impose any financial burden to the participants and informed and written consent from the subject and class teacher was taken before conducting the study. The study was cleared by ethic committee.
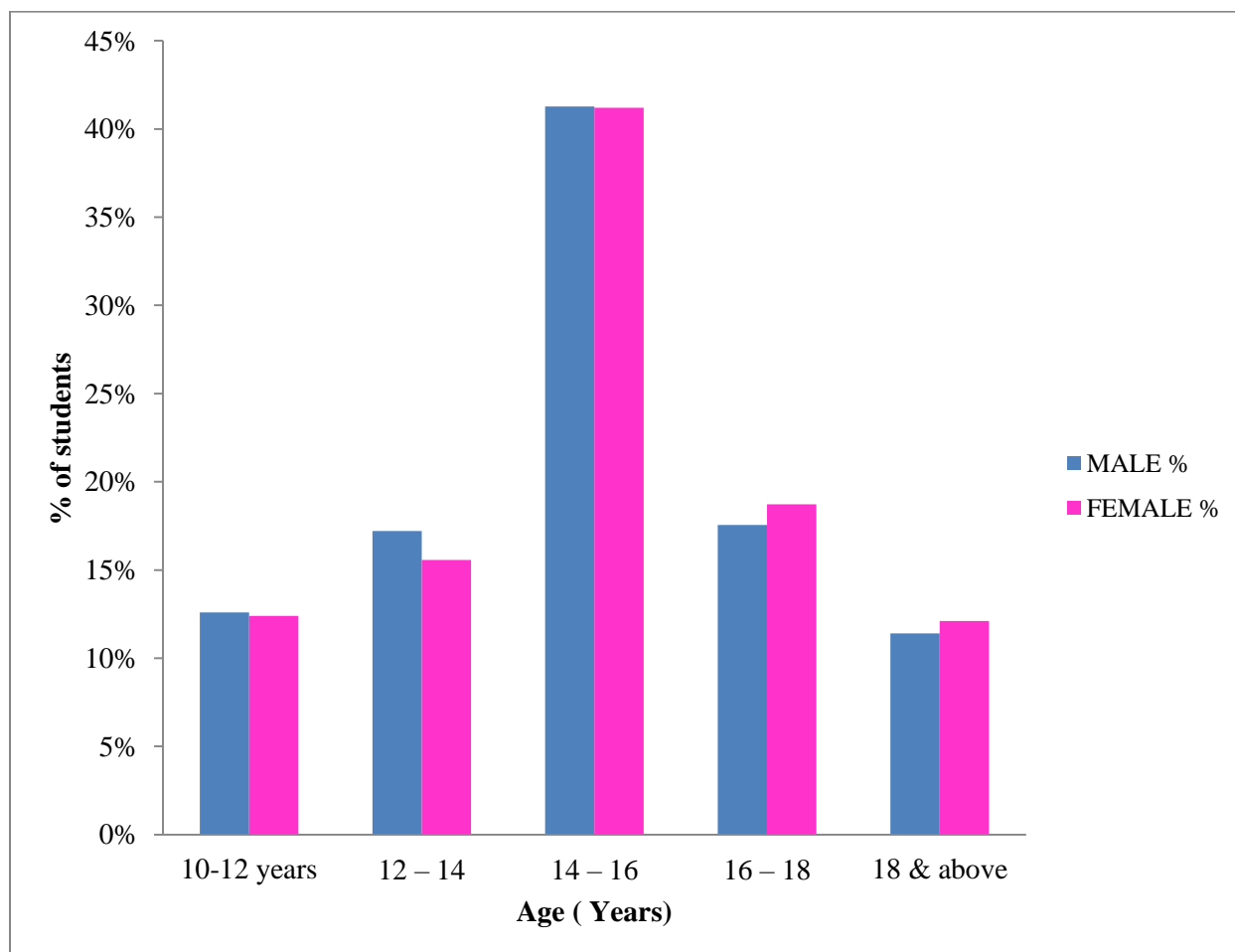
RESULTS

1. Distribution of study participants The distribution of study participants as per age and sex are shown in Figure 1. Out of 1554 total students, 860 were male and 694 were females. Majority of the students (nearly 40%) belong to age group 14-16 years followed by 16-18 years of age group having 17% - 18% of students. Mean age of males were 10.67 ± 2.47 years and 11.09 ± 2.61 years of females.

2. Socio-demographic characteristics the socio-demographic distribution of the students is shown in Table 1. Out of 1554 students, 745 students belonged to rural area whereas 809 belonged to urban area. Out of 745 rural students, 447 (60%) were males and 298 (40%) were females. Similarly, out of 809 urban students, 413 (51.05%) were males

and 396 (48.95%) were females. Therefore, the proportion of males students were more in both the localities as compared to female students. Majority of the students were Hindus (71.62%) followed by Sikhs (20.27%) and Muslims (7.14%). 57.01% students belonged to nuclear families and 42.99% to joint families. Joint families (70.33%) were more in rural area as compared to urban area (17.80%) while nuclear families (82.20%) were more in urban area as compared to rural area (29.66%) respectively. Overall, there was almost equal representation of students from all the classes (5th to 12th). Out of 1554 students, 13.84% were in class 5th, followed by 13%, 12.61%, 12.23%, 11.84% and 11.65 % in classes 9th, 11th, 6th, 10th, 12th and 7th respectively. Maximum number of students belonged to government schools (70.53%) while only (29.47%) students were from private schools. Government school students were more in the rural area (83.09%) as compared to urban area (58.96%) while private school students were more in urban area (41.04%) as compared to rural area (16.92%) respectively. For assessing socio-economic status in rural area, Uday Pareek scale and for urban area, Kuppuswamy scale was used. Majority of the students (76.64%) belonged to social classes II, III and IV whereas remaining 14.35% and 9.01% students belonged to class V and I respectively. In socio-economic classes I, II and III, majority of students were present from urban area (11.74%, 26.20% and 33.00%) as compared to rural area (6.04%, 14.76% and 26.84%). But in socio-economic classes IV and V, majority of students were present from rural area (29.53% and 22.82%) than the urban area (22.50% and 6.55%) respectively.

"Figure 1: Distribution of students as per age and gender"

"Table 1: Socio-demographic distribution of total students"

Variables	RURAL		URBAN		TOTAL	
	N	%	N	%	N	%
GENDER						
Male	447	60%	413	51.05%	860	55.34%
Female	298	40%	396	48.95%	694	44.66%
Total	745	100%	809	100%	1554	100%
RELIGION						
Hindu	541	72.62%	572	70.70%	1113	71.62%
Sikh	142	19.06%	173	21.38%	315	20.27%
Muslim	56	7.52%	55	6.80%	111	7.14%
Others	6	0.80%	9	1.12%	15	0.97%
Total	745	100%	809	100%	1554	100%
TYPE OF FAMILY						
Nuclear	221	29.66%	665	82.20%	886	57.01%
Joint	524	70.34%	144	17.80%	668	42.99%
Total	745	100%	809	100%	1554	100%
CLASS						
5th	110	14.77%	105	12.98%	215	13.84%
6th	90	12.08%	100	12.36%	190	12.23%
7th	85	11.41%	96	11.87%	181	11.65%
8th	94	12.62%	102	12.61%	196	12.61%
9th	105	14.09%	97	11.99%	202	13.00%
10th	90	12.08%	100	12.36%	190	12.23%
11th	86	11.54%	110	13.60%	196	12.61%
12th	85	11.41%	99	12.24%	184	11.84%
Total	745	100.0%	809	100.0%	1554	100.0%
SCHOOLS						
Government	619	83.09%	477	58.96%	1096	70.53%
Private	126	16.91%	332	41.04%	458	29.47%
Total	745	100.0%	809	100.0%	1554	100.0%
SOCIO-ECONOMIC STATUS						
I	45	6.04%	95	11.74%	140	9.01%
II	110	14.76%	212	26.20%	322	20.72%
III	200	26.84%	267	33.00%	467	30.05%
IV	220	29.53%	182	22.50%	402	25.87%
V	170	22.82%	53	6.55%	233	14.35%
Total	745	100.0%	809	100.0%	1554	100.0%

3. Anthropometric parameters The results of anthropometric parameters in Table 2 suggest that the mean height (cm) was found to be significant in males (139.70±15.38) and females (137.87±15.22). The difference of mean weight (kg) was observed highly significant in males (50.8±4.2) and females (48.4±3.2). However, no significant difference was seen in mean waist circumference (cm) of males (56.28±8.26) and females (55.74±8.14). Mean waist height ratio was found to be 0.40±0.04 in males and 0.39±0.03 in females respectively and difference is highly significant. It was observed that males had slightly more mean values of height (cm), waist circumference (cm) and waist height ratio as compared to females.

"Table 2: Mean anthropometric parameters among total students"

COMPONENTS	MALE			FEMALE			P value
	Mean	SD	95%CI	Mean	SD	95%CI	
Height (cm)	139.70	15.38	138.04±141.37	137.87	15.22	136.92±138.82	0.019
Weight (kg)	50.8	4.2	49.03±51.3	48.4	3.2	47.81±49.54	<0.001
Waist circumference(cm)	56.28	8.26	55.77± 56.79	55.74	8.14	54.86± 56.62	0.197
Waist height ratio	0.40	0.04	0.40± 0.41	0.39	0.03	0.39± 0.40	<0.001

4. Prevalence of overweight and obesity In Table 3, age and area-wise distribution among students as per BMI for age based on WHO classification of normal, overweight (+2SD) and obesity (+3SD) was depicted. As per age wise distribution, prevalence of overweight (19.75%) and obese (8.90%) was seen more in 16-18 years of age followed by 18 and above years, 18.13% overweight and 8.24 obese and normal weight (77.32%) in seen more among 10-12 years. But this association is found to be insignificant. Area-wise distribution among students as per BMI for Age based on WHO classification of normal, overweight (+2SD), obesity (+3SD). Out of 745 rural students, 74.10% were normal, 17.99% overweight (+2SD) and 7.91% obese (+3SD). Similarly, in 809 urban students, 73.92% were normal, 18.05% overweight (+2SD) and 8.03% obese (+3SD). Overweight (+2SD) and obesity (+3SD) was seen higher in urban area as compared to rural area. This association of area wise BMI for age among students is found to be statistical insignificant. So, the overall prevalence of overweight is 18.02% and obesity 7.98%.

"Table 3: Age and Area wise BMI for Age distribution among total students as per WHO classification"

Variables		BMI		TOTAL	P value
	NORMAL	+2SD	+3SD		
Age					
10-12 N (%)	150 (77.32%)	32 (16.49%)	12 (6.19%)	194 (100%)	
12–14 N (%)	190 (74.22%)	45 (17.58%)	21 (8.20%)	256 (100%)	0.971
14–16 N (%)	475 (74.10%)	115 (17.94%)	51 (7.96%)	641 (100%)	
16–18 N (%)	201 (71.53%)	55 (19.57%)	25 (8.90%)	281 (100%)	
18 & above N (%)	134 (73.63%)	33 (18.13%)	15 (8.24%)	182 (100%)	
Total N (%)	1150 (74.00%)	280 (18.02%)	124 (7.98%)	1554 (100%)	
Locality					
Rural	552 (74.10%)	134(17.99%)	59 (7.91%)	745 (100%)	
Urban	598 (73.92%)	146(18.05%)	65 (8.03%)	809 (100%)	0.996
Total	1150(74.00%)	280(18.02%)	124 (7.98%)	1554 (100%)	

"Table 4: Prevalence of overweight and obesity in various components"

Components	Normal	Overweight	Obesity	P value
Rural	640 (85.91%)	90 (12.08%)	15 (2.01%)	<0.001
Urban	510 (63.04%)	190 (23.49%)	109 (13.47%)	
Sex				
Male	644 (74.88%)	139 (16.16%)	77 (8.96%)	0.046
Female	506 (72.91%)	141(20.32%)	47 (6.77%)	
Type of family				
Nuclear	647 (73.02%)	160 (18.06%)	79 (8.92%)	0.281
Joint	503 (75.30%)	120 (17.96%)	45 (6.74%)	
Type of school				
Government	845 (77.10%)	175 (15.97%)	76 (6.93%)	0.001
Private	305 (66.59%)	105 (22.93%)	48 (10.48%)	
Socio-economic status				
Class I	64 (45.71%)	53 (37.86%)	23 (16.43%)	
Class II	220 (68.32%)	65 (20.19%)	37 (11.49%)	
Class III	348 (74.52%)	80 (17.13%)	39 (8.35%)	<0.001
Class IV	325 (80.85%)	60 (14.93%)	17 (4.23%)	
Class V	193 (86.55%)	22 (9.86%)	8 (3.59%)	

The results of Table 4 highlight the prevalence of overweight and obesity in different variables. The prevalence of overweight and obesity was seen higher in urban area (23.49% and 13.47%) as compared to rural area (12.08% and 2.01%) and it was highly statistically significant. Overweight and obesity was 16.16% and 8.96% in males and 20.32% and 6.77% in females. Thus, overweight was seen more in females and obesity was seen more in males. This difference in the prevalence of overweight and obesity in males and females was found to significant statistically. There was statistically insignificant slightly higher proportion of overweight and obese adolescent students seen in nuclear families (18.06% and 8.92%) as compared to joint families (17.96% and 6.74%). The proportion of adolescent overweight and obesity was significantly higher in private schools (22.93% and 10.48%) versus government schools (15.97% and 6.93%). Majority of adolescent overweight (37.86%) and obese (16.43%) belonged to class I followed by class II with 20.19% overweight and 11.49% obese and class III with overweight 17.13% and 8.35%

obese. Least proportions 24.79 % overweight and 7.82% obese children belong to class IV and V respectively. Hence, higher the socio-economic status, higher is the prevalence of overweight and obesity and this association was statistically highly significant.

DISCUSSION

The present cross-sectional study was conducted to know the prevalence of overweight and obesity among rural and urban school going adolescents (10-19 years) in district Ambala, Haryana. Out of 1600 students enrolled with inclusion and exclusion criteria, 1554 students were surveyed from class 5th to 12th standard in government and private schools in rural and urban area of district Ambala.

Anthropometric measurements In the present study, the mean height (cm) of male and female adolescents were 139.70±15.38 and 137.87±15.22 respectively. Various studies conducted in Odisha, Hyderabad and West Bengal also observed similar mean height for males and females adolescents (11-13). Contrary to our findings, Mandal et al had

observed higher mean height (154.6) among adolescents (14). This variation could be due to the characteristic of the study population selected for the study. The mean waist circumference (cm) was found to be 56.28±8.26 and 55.74±8.14 and the mean waist height ratio was 0.40±0.04 and 0.39±0.03 in male and female students respectively. Few studies also showed the same trend of mean waist circumference among adolescents, (11,15) however, other studies have reported mean waist circumference and mean waist height ratio to be lower among females (16, 17). The mean weight (kg) was found to be 50.8±4.2 and 48.4±3.2 in males and females respectively. Rajkumari et al (18) and Mandal et al (14) also reported nearly similar mean weight. On the other hand, Dhole et al (19) in Maharashtra and Maiti et al (20) in West Bengal reported lower mean weight. The possible reason for this lower mean weight could be due to characteristics of study population. BMI for age based on WHO classification was seen maximum in more than 16 years of age group among both males and females. The higher prevalence in later part of adolescence could be due to high burden of college work and academic competitiveness which decreases the participation in physical activities. Similar trend was reported by Varadappa et al (21), Goud et al (22) and Brahmbhatt et al (23). In contrast, Banjade et al (24) and Rani et al (25) reported higher prevalence in early part of adolescence in their studies. The possible reason could be that an increased adipose tissue and overall body weight in adolescents during puberty than during the post pubertal period.

Prevalence of overweight and obesity The overall prevalence of overweight and obesity among adolescent was found to be 18.02% and 7.98% respectively. Similar prevalence was reported by few studies in China and different parts of India (26, 27). Some studies have reported lower prevalence of overweight and obesity among adolescents in comparison to the present study (28, 29). This variance could be due to differences in socio-economic status and dietary behaviors of children and adolescents in their studies areas as well as differences in their genetic makeup. The prevalence of obesity (7.98%) from this study compares well with the prevalence of obesity reported in Pakistan (7.5%) and 8.1% in South Africa (30, 31). Some studies have reported a higher prevalence of overweight and obesity among adolescents (24, 32). The increase can be attributed to the changes in life style, reduced physical activity and faulty dietary

patterns in adolescents of different regions of the world. Additionally, the prevalence of overweight and obesity was seen to be higher in urban area as compared to rural area. This could be due to improved access to governance, health care, education, employment and income, in addition to increased availability of packed foods high in saturated fats and sugars and increased sedentary behaviour, all of which are more accessible to and or affordable for those individuals living in urban areas. Similar findings are also shown by few studies (33, 34). In contrast to present study, higher prevalence of overweight and obesity was seen in rural areas (4). High prevalence in rural areas could be due to the fact that the living conditions in rural areas had improved considerably. Transport facilities, medical care, food habits and family income had dramatically improved which along with easy access to city and television watching resulted in changes in life style. These eventually led to a significant increase in BMI as well as abdominal obesity. In the present study, though prevalence of overweight was seen more in females (20.32%) than males (16.16%) but obesity was more (8.96%) in males as compared to females (6.77%). So combined prevalence of overweight and obesity in males was 25.12% and 27.09% in females. Some studies had reported similar findings of higher proportion of overweight in females (35, 36) and few had mentioned nearly similar prevalence of overweight and obesity among males (27).

Globally, few studies reported the higher prevalence of overweight and obesity from the current study (12, 17) and other study observed the lower prevalence of overweight and obesity from the current study (21). The difference in results might be due to difference in age groups of study subjects and study area selected for the study and the methodology used for the survey.

The prevalence of overweight and obesity is found to be higher in nuclear families 18.06% and 8.92% respectively as compared to 17.96% and 6.74% in joint families. Higher prevalence in nuclear families is probably due to more attention of parents towards child and pampering by the parents. Similar study had reported higher significant among those adolescents residing in nuclear families than joint families (27). On the other hand, the prevalence of overweight and obesity in adolescent is significant higher in the upper socio-economic status, greater the sedentary lifestyle followed, which includes consumption of high calorie food and physical inactivity (27). The current study reported that the prevalence of adolescent overweight and obesity was

higher in private schools as compared to government schools. Similar findings had been reported by various studies **(22, 27).**

Strength and limitation

The current study has several strengths. This study used BMI as a criterion for classification which is mostly accepted to screen overweight and obesity. There is limited knowledge available on overweight as well as obesity and hence, can also serve as a reference study for future investigators. On the other hand, the limitations were inevitable as study is cross-sectional in nature and may not be strong to demonstrate direct cause and effect relationship between risk factors and outcome. During interview, there may be potential behavioral, recall bias for dietary patterns, physical activities and sedentary behaviors of the participants. Apart from these, it is believed that other unidentified confounders including genetic factors might have affected the findings of our study.

CONCLUSION

In conclusion, the findings of the study have shed light on the prevalence of overweight and obesity among adolescents in rural and urban area of district Ambala, Haryana. The prevalence of overweight and obesity was observed higher among females and males respectively and also increased with the age. Moreover, higher prevalence of overweight and obesity was also seen in urban area, nuclear families, higher socio-economic class and private schools. If primary preventive measures are not taken instantly, prevalence of overweight and obesity among adolescents in district Ambala might increase rapidly in the coming few years. Based on the findings, we suggest that necessary steps in the form of primodial prevention need to be taken at an early age by educating the school children regarding the importance of diet, physical exercise, curtailing the period of television watching in order to have good health and a healthy future. Governmental and non-governmental agencies of country should work together in encouraging young adults to adopt healthy lifestyle and to educate them regarding the adverse effects of obesity to reduce the high burden of obesity in India. We also recommend to carry out further investigations regarding the understanding of genetic factors in relation to overweight as well as the prenatal, perinatal and postnatal predictors of childhood obesity because early interventions on modifiable risk factors may decrease the rate of childhood obesity. Nutritional intervention and educational programs about obesity and associated health consequences should start early in childhood so as to prevent the increasing prevalence of childhood obesity in India.

REFERENCES

1. Park K. Park's Text book of preventive and social medicine. 22nd ed. Jabalpur, India;M/s Banarsidas Bharat Publishers. Vol. 367; 2013.

2. Prasad RV, Bazroy J, Singh Z. Prevalence of overweight and obesity among adolescent students in Pondicherry, South India. Int J Nutr Pharmacol Neurol Dis. 2016;6(2):72-5. doi: 10.4103/2231-0738.179966.

3. Gedam DDS. Childhood Obesity - challenges in the Indian Scenario. Int J Med Res Rev. 2013;1(1):1-4. doi: 10.17511/ijmrr.2013.i01.01.

4. Alok P, Malay P, Divyeshkumar V. Prevalence of overweight and obesity in adolescents of urban & rural area of Surat, Gujarat. Natl J Med Res. Jul–Sep 2012;3(2):325-29.

5. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C et al. Global, regional and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014;384(9945):766-81. doi: 10.1016/S0140-6736(14)60460-8, PMID 24880830.

6. Ranjani H, Mehreen TS, Pradeepa R, Anjana RM, Garg R, Anand K, Mohan V. Epidemiology of childhood overweight & obesity in India: A systematic review. Indian J Med Res. Feb 2016;143(2):160-74. doi: 10.4103/0971-5916.180203, PMID 27121514.

7. National Family Health Survey-4. Available from: http://rchiips.org/NFHS/pdf/NFHS4/India.pdf.

8. Sangeeta CS. Obesity assessment based on BMI in the young adults of Haryana- A state of India. Res. J Recentsci. 2013;2:304-07.

9. Singh M, Mathur S, Taneja M, Maini B. Identification of family risk factors of obesity in urban adolescents of North India. J Obes Metab Res. 2015;2(2):84-8. doi: 10.4103/2347-9906.151756.

10. World Health Organization. Adolescent health. Available from: http://www.who.int/topics/adolescent_health/en/.

11. Pati S, Swain S, Hussain MA, Chauhan AS. Prevalence and correlates of childhood obesity in suburban area of Odisha: A cross sectional study. Epidemiol Biostat Public Health J. 2014;11(3):1-6.

12. World Health Organization. Global recommendations on physical activity for health; 2011.Available from: http://www.who.int/diet physicalactivity/physical-activity-recommendations-5-17years.pdf.

13. Jahnavi A, Chandrika DBN, Sultana G, Vanita KP. Prevalence of overweight and obesity in school going children. Pharmanest Int J Adv Pharm Sci. 2011;2(4):369-77.

14. Mandal PK, Kole S, Mallik S, Manna N, Ghosh P, Dasgupta S. Behavioural factors related to overweight and obesity among adolescents: A cross-sectional study in an urban area of West Bengal, India. Sudanese J Public Health. 2012;7(1):135-38.

15. Iyer U, Elayath N, Akolkar A. Magnitude and Determinants of Overweight and Obesity in 6-12-year-old school children of Vadodara City. Curr Pediatr Res. 2011;15(2):105-09.

16. Kawatra A, Trygg N, Parhar G, Mohta A. Waist circumference and Waist height ratio percentiles for assessing childhood obesity: cross-sectional Survey in rural Indian child population. Indian J Basic Appl Med Res. 2013;3(1):246-56.

17. Al-Hazzaa HM, Musaiger AO, Abahussain NA, Al-Sobayel HI, Qahwaji DM. Prevalence of short sleep duration and its association with obesity among adolescents 15-19 year olds: A cross-sectional study from three major cities in Saudi Arabia. Ann Thorac Med. 2012;7(3):133-39. doi: 10.4103/1817-1737.98845, PMID 22924070.

18. Rajkumari B, Akoijam BS, Akoijam JS, Longjam U. Assessment of body composition and body mass index of adolescent school children in Imphal-West district, Manipur. J Med Soc. 2012;26:184-88.

19. Dhole SS, Mundada VD. Augmenting body mass index and waist–height ratio for establishing more efficient obesity percentiles among school-going children by using body mass index, waist to hip ratio and waist to height ratio. Muller J Med Sci Res. 2014;5(1):11-4. doi: 10.4103/0975-9727.128934.

20. Maiti S, De D, Ali KM, Bera TK, Ghosh D, Paul S. Overweight and obesity among early adolescent school girls in urban area of West Bengal, India: prevalence assessment using different reference standards. Int J Prev Med. 2013;4(9):1070-74. PMID 24130950.

21. Varadappa ST, Prakash PK, Gangaboraiah RajuRMN, Subbanna LY. Prevalence of obesity among college students in rural area of Bangalore. Natl J Commun Med. 2014;5(1):42-5.

22. T GG, K R. Overweight and obesity among adolescents in Bellary City Corporation. J Evol Med Dent Sci. 2014;3(7):1718-23. doi: 10.14260/jemds/2014/2048.

23. Brahmbhatt KR, Oza NU. Obesity among adolescents of Ahmedabad city, Gujarat, India- a community based cross-sectional study. Int J Biol Med Res. 2012;3(2):1554-57.

24. Banjade B, A. Naik VA, Narasannavar A. Prevalence of obesity and its risk factors among Pre-University college adolescents of Belgaum city, Karnataka. IOSR JDMS. 2014;13(4):56-60. doi: 10.9790/0853-13475660.

25. Rani MA, Sathiyasekaran BWC. Behavioural determinants for obesity: A cross-sectional study among urban adolescents in India. J Prev Med Public Health. 2013;46(4):192-200. doi: 10.3961/jpmph.2013.46.4.192, PMID 23946877.

26. Guo X, Zheng L, Li Y, Zhang X, Yu S, Yang H, Zhang X, Sun Z, Sun Y. Prevalence and risk factors of being overweight or obese among children and adolescents in northeast China. Pediatr Res. 2013;74(4):443-49. doi: 10.1038/pr.2013.116, PMID 23835653.

27. Gupta R, Rasania SK, Acharya A, Bachani D. Socio-demographic correlates of overweight and obesity among adolescents of an urban area of Delhi, India. Indian J Commun Health. 2013;25(3):238-43.

28. Kotian MS, Kumar G, Kotian SS. Prevalence and determinants of overweight/obesity among adolescent school children of south Karnataka, India. Indian J Commun Med. 2010;35(1):176-78.

29. Vohra R, Bhardwaj P, Srivastava JP, Srivastava S, Vohra A. Overweight/obesity among school-going children of Lucknow city. J Family Community Med. 2011;18(2):59-62. doi: 10.4103/2230-8229.83369, PMID 21897912.

30. Mushtaq MU, Gull S, Shahid U, Shafique MM, Abdullah HM, Shad MA, Siddiqui AM. Family-

based factors associated with overweight and obesity among Pakistani primary school children. BMC Pediatr. 2011;11:114. doi: 10.1186/1471-2431-11-114, PMID 22172239.

31. Armstrong ME, Lambert MI, Sharwood KA, Lambert EV. Obesity and overweight in South African primary school children -the Health of the Nation Study. S Afr Med J. 2006;96(5):439-44. doi: 10.1080/22201009.2006.10872144, PMID 16751921.

32. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. JAMA. 2014;311(8):806-14. doi: 10.1001/jama.2014.732, PMID 24570244.

33. Muhihi AJ, Mpembeni RN, Njelekela MA, Anaeli A, Chillo O, Kubhoja S et al. Prevalence and determinants of obesity among primary school children in Dar es Salaam, Tanzania. Arch Public Health. 2013;71(1):26. doi: 10.1186/0778-7367-71-26, PMID 24094276.

34. Mahor GR. Prevalence of obesity in young adolescents of urban Bhopal. J Biomed Pharm Res. 2013;2(3):165-67.

35. Marwaha RK, Tandon N, Singh Y, Aggarwal R, Grewal K, Mani K. A study of growth parameters and prevalence of overweight and obesity in school children from Delhi. Indian Pediatr. 2006;43(11):943-52. PMID 17151397.

36. Jain S, Pant B, Chopra H, Tiwari R. Obesity among adolescents of affluent public schools in Meerut. Indian J Public Health. 2010;54(3):158-60. doi: 10.4103/0019-557X.75740, PMID 21245587.