

Short Communication

Prevalence of overweight and obesity amongst school children in Delhi, India

Supreet Kaur MD¹, HPS Sachdev MD², SN Dwivedi PhD³, R Lakshmy PhD⁴,
Umesh Kapil MD⁵

¹Department of Human Nutrition, All India Institute of Medical Sciences, New Delhi, India

²Senior Consultant Pediatrics and Clinical Epidemiology, Sitaram Bharti Institute of Science and Research, New Delhi, India

³Department of Biostatistics, All India Institute of Medical Sciences, New Delhi, India

⁴Department of Cardiac-Biochemistry, All India Institute of Medical Sciences, New Delhi, India

⁵Department of Human Nutrition, All India Institute of Medical Sciences, New Delhi, India

Obesity has emerged as an epidemic worldwide. The present study was conducted to assess the prevalence of overweight and obesity amongst children in the age group of 5-18 years belonging to low, middle and high income group in National Capital Territory NCT of Delhi. A total of 16,595 children (LIG 5087, MIG 5134 and HIG 6368) were covered in the present study. Overweight and obesity were assessed using Body Mass Index (BMI) and Triceps Skin Fold Thickness (TSFT) utilizing age and sex specific cut off points. Considering the BMI cut off points, the prevalence of obesity and overweight in Low Income Group (LIG) school children was 0.1 and 2.7 percent respectively, amongst Middle Income Group (MIG) school children it was 0.6 and 6.5 percent and in High Income Group (HIG) school children was 6.8 and 15.3 percent respectively ($p < 0.001$). With regard to the TSFT criteria, the prevalence of obesity and overweight in LIG school children was 1.2 and 2.4 percent, amongst MIG school children it was 2.5 and 4.9 percent and in children belonging to HIG schools was 9.3 and 13.1 percent respectively ($p < 0.001$). The present study documented that the prevalence of overweight and obesity was higher in the HIG children as compared to the MIG and the LIG for all age groups, highlighting the possible role of change in the dietary pattern and physical activities with increase in income levels.

Key Words: obesity, body mass index, triceps skin fold thickness, school children, socio economic status

INTRODUCTION

Obesity is one of the most prevalent nutritional disease of children and adolescents in many developed and developing countries.¹ The World Health Organisation (WHO) has declared overweight as one of the top ten health risks in the world and one of the top five in developed nations.² Existing WHO standards and data from 79 developing countries including a number of industrialized countries suggest that about 22 million children five years old are overweight worldwide.³ Once considered a problem of affluence, obesity is fast growing in many developing countries also.⁴ Even in countries like India, which are typically known for high prevalence of under nutrition, a significant proportion of overweight and obese children now coexist with those who are under nourished.⁵ Increasing relative weight trends in populations have caused much concern among health care providers. Limited studies have been conducted on the prevalence of overweight (OW) and obesity (OB) in the children belonging different socio economic groups in the **National Capital Territory** (NCT) of Delhi hence the present study was conducted.

MATERIALS AND METHODS

Study area

A cross-sectional study was conducted in the National Capital Territory of Delhi. All the schools in the National Capital Territory of Delhi were enlisted. The probability proportionate to size (PPS) sampling methodology was utilized for selection of 90 schools. In each of the socio economic groups i.e., Lower Income Group (LIG), Middle Income Group (MIG) and High Income Group (HIG), 30 clusters were selected. All the Government and Municipal Corporation of Delhi schools were considered to be in the category of LIG, all Kendriya Vidyalayas were in the category of MIG and similarly all private schools that are charging tuition fees above Rs.1000 were in the category of HIG.

Sample size

Corresponding Author: Dr. Umesh Kapil, Department of Human Nutrition, All India Institute of Medical Sciences, New Delhi-110029, India

Tel: 91-1126593383, 91-11-26195105, 91-11-26862633; Fax: 91-11-26862663

Email: umeshkapil@yahoo.com

Manuscript received 26 September 2007. Initial review completed 22 August 2008. Revision accepted 27 November 2008.

The sample size of 5,000 was taken in each socio economic group. The sample size calculation was calculated keeping in the prevalence of OB as 7% as reported by an earlier study in Delhi.⁶ The 95% confidence level and 10% relative precision were considered. A total of 16,595 children (LIG 5087, MIG 5140 and HIG 6368) were covered in the present study.

Collection of data

A pre-tested, semi structured questionnaire was administered to each subject to elicit information on socio-demographic profile, physical activity pattern, dietary intake and anthropometric measurements. Each child's assessment of height, weight, and triceps skin fold thickness (TSFT) measurements were conducted. Anthropometric measurements of weight and height were recorded utilizing the standard equipments and methodology. Weight was recorded using SECA electronic weighing scale, to nearest 100 g. Height was recorded using the anthropometric height board to the nearest 0.1 cm. Triceps skin fold thickness was measured using Harpendens skin fold calipers. The midpoint of the back of the upper left arm between the tip of oleocranon and acromion process was determined with the arm flexed at 90 degree,

then with the arm hanging freely a fold of skin and subcutaneous fat was grasped firmly with the thumb and fore finger and pulled away from the underlying muscular tissue. Measurements were recorded within 2 seconds of applying force. Three reading of height, weight and triceps skin fold thickness were taken and the mean of the last two readings was considered as final.

Assessment of physical activity of children above the age of 10 years in all three socio economic groups was undertaken. List of common physical activities performed by children during their leisure time was provided to each child. The activities were namely jogging, running, playing outdoor games (involve running), yoga, physical exercise and others like swimming, dancing etc. MET (metabolic equivalents) value of each of the activity was known.⁷ The child was asked to mention the number of hours spent on each activity and energy expenditure for leisure time activity was then calculated.

Assessment of obesity

International Obesity Task Force (IOTF) classification was utilized for the estimation of overweight and obese subjects. Overweight (OW) was defined as children with BMI value between 85th to 95th percentile for a specific

Table 1. Distribution of the study subjects as overweight and obese as per body mass index criteria (IOTF classification) in different socio-economic groups

Income Group and Age Group (yrs)	Males			Females			Total			p value
	n	OW	OBS	n	OW	OBS	n	OW	OBS	
< 6										p<0.001*
LIG	65	1(1.5)	-	147	-	-	212	1(0.5)	-	
MIG	119	7(5.9)	1(0.8)	112	4(3.6)	-	231	11(4.8)	1(0.4)	
HIG	38	2(5.3)	-	29	3(10.3)	1(3.4)	67	5(7.4)	1(1.5)	
6 - <9										p<0.001*
LIG	348	3(0.8)	1(0.3)	635	9(1.4)	-	983	12(1.2)	1(0.1)	
MIG	608	34(5.6)	2(0.3)	542	33(6.1)	3(0.6)	1150	67(5.8)	5(0.4)	
HIG	717	84(11.7)	48(6.7)	701	56(8.0)	48(6.8)	1418	140(9.9)	96(6.8)	
9 - <12										p<0.001*
LIG	483	18(3.7)	1(0.2)	687	15(2.2)	-	1170	33(2.8)	1(0.1)	
MIG	649	40(6.1)	1(0.2)	595	41(6.9)	1(0.2)	1244	81(6.5)	1(0.1)	
HIG	993	171(17.2)	39(3.9)	983	161(16.4)	54(5.5)	1976	332(16.8)	93(4.7)	
12 - <15										p<0.001*
LIG	802	14(1.7)	-	614	26(4.2)	1(0.2)	1416	40(2.8)	1(0.1)	
MIG	843	48(5.7)	8(0.9)	712	49(6.9)	4(0.6)	1555	97(6.2)	12(0.8)	
HIG	1018	159(15.6)	81(7.9)	849	175(20.6)	68(20.6)	1867	334(17.6)	149(8.0)	
15 - < 18										p<0.001*
LIG	662	20(3.0)	1(0.1)	598	33(5.5)	2(0.3)	1260	53(4.2)	3(0.2)	
MIG	510	43(8.4)	6(1.2)	417	35(8.4)	6(1.4)	927	78(8.4)	12(1.3)	
HIG	523	69(13.2)	48(9.2)	507	96(18.9)	48(9.5)	1030	165(16.0)	96(9.3)	
18 and above										p<0.001*
LIG	26	-	-	20	1(5.0)	-	46	1(2.1)	-	
MIG	21	1(4.8)	-	12	-	-	33	-	-	
HIG	9	1(11.1)	-	1	-	-	10	-	-	
Total										p<0.001*
LIG	2386	56(2.3)	3(0.1)	2701	84(3.1)	3(0.1)	5087	140(2.7)	6(0.1)	
MIG	2750	173(6.3)	18(0.6)	2390	162(6.8)	14(0.6)	5140	335(6.5)	32(0.6)	
HIG	3298	486(14.7)	216(6.5)	3070	491(16.0)	219(7.1)	6368	977(15.3)	435(6.8)	

Figures in Parenthesis Indicates Percentages

* Significant at 95% level of confidence

age and sex. Similarly obesity (OB) was defined as children with a BMI value above 95th percentile for a specific age and sex.⁸

Prevalence of OW and OB was also assessed by triceps skin fold thickness values. The Must et al Classification⁹ was used for the same. The values between 85th to 95th percentile for specific age and sex was considered OW and values above 95th percentile for age and sex was considered as OB.⁹

The study protocol was approved by ethical committee of All India Institute of Medical Sciences (AIIMS), New Delhi. A prior consent for the study was taken from the school administration and from the parents. At the time of the initiating the study the parents of each participant were informed about the study protocol and written consent was obtained to their child's participation.

Pearson correlation analysis was undertaken to estimate the *p* value for the difference in prevalence of overweight and obesity in different socioeconomic groups.

RESULTS

A total of 16,595 school children LIG (n=5087), MIG (n=5140) and HIG (n=6368) in the age group of 5-18 years were included in the study. With regard to dietary habits, 42% children from LIG schools, 40% children from MIG schools and 44% children from HIG schools were vegetarian.

Data on consumption of energy dense fast food showed that about 12.0% of children from HIG schools consumed fast food more than four times in a week when compared with LIG (7.2%) and MIG (9.8%) school children.

The age wise prevalence of overweight and obesity according to BMI calculations is depicted in Table 1. According to this the prevalence of OB and OW in LIG school children was 0.1 and 2.7 percent respectively, amongst MIG school children it was 0.6 and 6.5 percent and in HIG school children was 6.8 and 15.3 percent respectively (*p*<0.001).

The age wise prevalence of overweight and obesity ac-

Table 2. Distribution of the study subjects as overweight and obese as per triceps skin fold thickness (TSFT): (NHANES) criteria in different socio-economic groups

Income Group and Age Group (yrs)	Males			Females			Total			<i>p</i> value
	n	OW	OBS	n	OW	OBS	n	OW	OBS	
< 6										<i>p</i> <0.001*
LIG	65	-	-	147	-	-	212	-	-	
MIG	119	3(2.5)	4(3.4)	112	1(0.9)	2(1.8)	231	4(1.7)	6(2.6)	
HIG	38	1(2.6)	1(2.6)	29	3(10.3)	6(20.7)	67	4(6.0)	7(10.4)	
6 - <9										<i>p</i> <0.001*
LIG	348	3(0.9)	2(0.6)	635	3(0.5)	6(0.9)	983	6(0.6)	8(0.8)	
MIG	608	21(3.5)	11(1.8)	542	14(2.6)	13(2.4)	1150	35(3.0)	24(2.1)	
HIG	717	81(11.3)	64(8.9)	701	56(7.9)	44(6.3)	1418	137(9.7)	108(7.6)	
9 - <12										<i>p</i> <0.001*
LIG	483	11(2.3)	6(1.2)	687	12(1.7)	7(1.0)	1170	23(1.9)	13(1.1)	
MIG	649	26(4.0)	23(3.5)	595	25(4.2)	10(1.7)	1244	51(4.1)	33(2.7)	
HIG	993	115(11.6)	116(11.6)	983	115(11.7)	84(8.6)	1976	230(11.6)	200(10.1)	
12 - <15										<i>p</i> <0.001*
LIG	802	16(2.0)	9(1.1)	614	20(3.3)	4(0.7)	1416	36(2.5)	13(0.9)	
MIG	843	63(7.5)	27(3.2)	712	35(4.9)	6(0.8)	1555	98(6.3)	33(2.1)	
HIG	1018	166(16.3)	141(13.9)	849	123(14.5)	32(3.8)	1867	289(15.5)	173(9.3)	
15 - < 18										<i>p</i> <0.001*
LIG	662	31(4.7)	17(2.6)	598	26(4.3)	7(1.2)	1260	57(4.5)	24(1.9)	
MIG	510	36(7.1)	27(5.3)	417	26(6.2)	7(1.7)	927	62(6.7)	34(3.7)	
HIG	523	74(14.1)	76(14.5)	507	76(15.0)	31(6.1)	1030	150(14.6)	107(10.4)	
18 and above										<i>p</i> <0.001*
LIG	26	-	1(3.8)	20	1(5.0)	1(5.0)	46	1(2.2)	1(2.2)	
MIG	21	-	-	12	-	-	33	-	-	
HIG	9	-	-	1	-	-	10	-	-	
Total										<i>p</i> <0.001*
LIG	2386	61(2.5)	35(1.5)	2701	62(2.3)	25(0.9)	5087	123(2.4)	60(1.2)	
MIG	2750	149(5.4)	92(3.3)	2390	101(4.2)	38(1.6)	5140	250(4.9)	130(2.5)	
HIG	3298	437(13.4)	398(12.2)	3070	98(12.2)	197(6.5)	6368	835(13.1)	595(9.3)	

Figures in Parenthesis Indicates Percentages

● Significant at 95% level of confidence

Abbreviations: LIG = Low Income Groups; MIG = Middle Income Groups; HIG = High Income Groups; OW = Over Weight; OBS = Obesity

ording to TSFT measurement is depicted in Table 2. According to TSFT criteria the prevalence of OB and OW in LIG school children was 1.2 and 2.4 percent, amongst MIG school children it was 2.5 and 4.9 percent and in children belonging to HIG schools it was 9.3 and 13.1 percent respectively ($p < 0.001$).

Data regarding physical activity of the subjects revealed that about 88% children from HIG schools were involved in leisure time physical activities like jogging, running, playing outdoor games, doing yoga etc whereas only 75% of the children from MIG and 46% of the children from LIG were undertaking these activities. Physical activity and BMI showed a statistical negative correlation in the LIG children ($r = -0.0346$; $p < 0.001$) and MIG children ($r = -0.013$; $p < 0.001$) and HIG children ($r = -0.058$; $p < 0.001$).

DISCUSSION

The present study planned to evaluate in detail, the complete spectrum of childhood obesity (by calculating BMI and measuring triceps skin fold thickness) and compare the prevalence in different socio-economic groups.

Earlier studies from India have not documented the prevalence of obesity in children by using two anthropometric measurements namely; BMI and TSFT. In the present study socio economic status ($r = 0.096$, $p < 0.001$) was found to be directly correlated with BMI. The similar results have been reported in an earlier study conducted amongst children.¹⁰

A study from NCT of Delhi reported the prevalence of OB as 7.4%.² While another study done in school children in Punjab reported prevalence of overweight (OW) and obesity (OB) to be 11.1% and 14.2% respectively.¹¹ A study conducted in Pune documented the prevalence of OB 5.7% and OW 19.9%.¹² The results of the above stated studies are only comparable to the results from HIG school children from the present study as the studies were conducted in an affluent class of children. Data of LIG and MIG school children cannot be compared as no study is available in the literature from the country on prevalence of OB and OW in LIG and MIG category children by utilizing the IOTF's BMI classification and Must et al SKFT criteria.

In present study, the prevalence of OW and OB was greater in male subjects as compared to female subjects in all three categories. Similar results have been documented from Punjab, which reported that the prevalence of obesity as well as overweight was higher in boys as compared to girls (12.4% vs 9.9%, 15.7% vs 12.9%).¹¹

Analysis of the association between BMI and physical activity in children revealed that as the amount of physical activity increased, the BMI decreased i.e. the prevalence of overweight and obesity decreased. Similar findings have been reported earlier.¹³⁻¹⁵

The present study documented that the prevalence of OW and OB was higher in the HIG as compared to LIG and MIG for all age groups, highlighting the possible role of change in the dietary pattern and physical activities with increase in income levels.

ACKNOWLEDGEMENT

We would like to thank all the students, teachers and principals of the schools for their kind co-operation and valuable support required for the data collection. We would also like to thank staff and teachers of all the schools for the help extended during the study. We would like to thank Division of Non-Communicable Disease, Indian Council of Medical research, New Delhi for providing the financial support for conducting the study. Project Grant No. 5/4/1-2/2003-NCD-II

AUTHOR DISCLOSURES

The authors have nothing to disclose.

REFERENCES

1. WHO consultation on obesity. Special issues in the management of obesity in childhood and adolescence. In: obesity preventing and managing the global epidemic Geneva: WHO, 1998; pp 231-47.
2. WHO (World Health Organisation). 2002. The World Health Report: Reducing Risks, Promoting Healthy Life. Geneva: World Health Organisation.
3. WHO (World Health Organisation). 1998a. Obesity: Preventing and Managing the global Epidemic. Report of WHO Consultation on Obesity. WHO, Geneva.
4. WHO (World Health Organisation), International Association for the Study of Obesity (IASO) and International Obesity task Force (IOTF). 2000. The Asia-Pacific Perspective: Redefining Obesity and its treatment. Geneva: World Health Organisation.
5. Popkin BM., D Horton, S Kim, A Mahal and J Shuigao. Trends in diet nutritional status and diet related non communicable diseases in China and India: The economic costs of the nutritional transition, *Nutr Rev.* 2001;59:379-90.
6. Kapil U, Singh P, Pathak P, Dwivedi SN. Prevalence of obesity amongst affluent adolescent school children. *Indian Pediatrics.* 2001;39:449-52.
7. Anura VK, Sumathi S, Swarnarekha B. IAP National Task Force for Childhood Prevention of Adult Diseases: The effect of childhood physical activity on prevention of adult diseases. *Indian Pediatrics.* 2004;41:37-62.
8. Cole JC, Mary CB, Katherine MF, William HD. Establishing a standard definition for child overweight and obesity worldwide: international survey. *Br Med J.* 2000;20:320.
9. Must A, Gerard ED, William HD. Referencing data for obesity: 85th and 95th percentiles of body mass index and triceps skin fold thickness. *Am J Clin Nutr.* 1991;53:839-46.
10. Qamra SR, Mehta S, Deodhar SD. A mixed longitudinal study on the pattern of pubertal growth. Relationship to socio economic status and calorie intake IV. *Indian Pediatrics.* 1991;28:147-56
11. Chhatwal J, Verma M, Riar SK. Obesity among pre-adolescents of a developing country (India). *Asia Pac J Clin Nutr.* 2004;13:231-5.
12. Khadikar VV, Khadikar AA. Prevalence of Obesity in Affluent School Boys in Pune. *Indian Pediatrics.* 2004; 41: 857-8
13. Moayeri H, Bidad K, Zadhoush S, Gholami N, Anari S. Increasing prevalence of iron deficiency in overweight and obese children and adolescents (Tehran Adolescent Obesity Study). *Eur J Pediatr.* 2006 ;165:813-814.
14. Flodmark CE, Marcus C, Britton M. Interventions to prevent obesity in children and adolescents: a systematic literature review. *Int J Obes (Lond).* 2006;30:579-89
15. Kelishadi R, Pour MH, Sarraf-Zadegan N, Sadry GH, Ansari R, Alikhassy H, Bashardoust N. Obesity and associated modifiable environmental factors in Iranian adolescents: Isfahan Healthy Heart Program - Heart Health Promotion from Childhood. *Pediatr Int.* 2003;45:435-42.

Short Communication

Prevalence of overweight and obesity amongst school children in Delhi, India

Supreet Kaur MD¹, HPS Sachdev MD², SN Dwivedi PhD³, R Lakshmy PhD⁴,
Umesh Kapil MD⁵

¹Department of Human Nutrition, All India Institute of Medical Sciences, New Delhi, India

²Senior Consultant Pediatrics and Clinical Epidemiology, Sitaram Bhartia Institute of Science and Research, New Delhi, India

³Department of Biostatistics, All India Institute of Medical Sciences, New Delhi, India

⁴Department of Cardiac-Biochemistry, All India Institute of Medical Sciences, New Delhi, India

⁵Department of Human Nutrition, All India Institute of Medical Sciences, New Delhi, India

印度德里市學童的過重及肥胖盛行率

在全世界，肥胖已經是一個流行性的問題。本研究要評估印度首都-德里區內分屬低、中、高收入族群的 5-18 歲兒童，他們的過重及肥胖盛行率。總共有 16,595 個兒童（低收入組有 5087 位、中收入組 5134 位、高收入組 6368 位）納入本研究中。以年齡及性別作分層，利用 BMI 及三頭肌皮下脂肪厚度 (TSFT) 來評估過重及肥胖。根據 BMI 的切點，在低收入族群的學童肥胖及過重盛行率分別為 0.1% 及 0.7%，中收入族群的學童中，肥胖及過重盛行率分別為 0.6% 及 6.5%。而高收入族群中分別為 6.8% 及 15.3% ($p < 0.001$)。以 TSFT 為標準，在低收入族群的學童，肥胖及過重的盛行率分別為 1.2% 及 2.4%，中收入族群分別為 2.5% 及 4.9%，高收入族群分別為 9.3% 及 13.1% ($p < 0.001$)。本研究證明在所有年齡層中，與中低收入族群的學童做比較，高收入族群學童過重及肥胖的盛行率是較高的，也顯示隨著收入增加而改變的飲食型態及活動量與此可能有相關。

關鍵字：肥胖、身體質量指數、三頭肌皮脂厚度、學童、社經地位