

Prevalence and Factors Associated with Overweight and Obesity among School Children in Kashmir Valley: A Community Based Cross-Sectional Study

Javaid Ahmad Bhat¹, Shariq Rashid Masoodi², Moomin Hussain Bhat³, Peerzada Ovais Ahmad⁴, Raiz Ahmad Misgar⁵, Mir Iftikhar Bashir⁶, Arshad Iqbal Wani⁷

¹ Government Medical College, Srinagar, Jammu & Kashmir

^{2,3,4,5,6,7} Department of Endocrinology, Sher-i-Kashmir Institute of Medical Sciences, Srinagar, J&K

ABSTRACT

Objective: To estimate the prevalence and factors associated with overweight and obesity among children aged 5-15 in Kashmir valley.

Material and Methods: A total of 9,576 students, both male and female, under age group 5-15 years were studied all over the valley, with boys comprising 56.6% (5416) and girls 43.4% (4160) of the study group. It was a community based prospective study. The study was conducted by adapting multistage sampling procedures. Prevalence of overweight and obesity in these schoolchildren was studied according to using CDC and IOTF sex-specific BMI-for-age reference criteria.

Results: The prevalence of overweight by IOTF criteria was 24.7%, while obesity was 11.5%. As per CDC Criteria, the prevalence of underweight, normal weight, overweight and obesity was 7.0%, 70.7%, 11.7% and 10.6% in boys, and 5.9%, 71.8%, 12.5% and 9.7% in girls, respectively. By IOTF Criteria, the prevalence of normal weight, overweight, and obesity was 65.4%, 23.9%, and 10.5% in boys and 61.6%, 25.6%, and 12.7% in girls. Factors significantly associated with obesity on logistic regression were age more than ten years (OR 1.44; P<0.001) and female gender (OR 1.29; P<0.001). Urban status had no statistical significance with obesity (OR 1.08; P>0.3)

Conclusion: The high prevalence of overweight obesity in school-going children with no significant difference in the obesity prevalence between boys and girls demands urgent measures to avoid pandemics of non-communicable diseases among the Kashmiri population in future.

Keywords: Childhood obesity, Overweight, Prevalence, CDC criteria, IOTF criteria

JMS: 2021; 24(3):11-17 DOI: <https://doi.org/10.33883/jms.v24i3.1141>

INTRODUCTION

Obesity refers to the accumulation of abnormal or excessive fat in a person that may interfere with maintaining an optimal state of health¹. Declared as a global pandemic, an increase in the prevalence of obesity is emerging as a significant concern, especially in children and adolescents^{2,3}, thus creating an enormous socio-economic and public health burden, especially in poorer countries. Childhood obesity affects both developed and developing countries of all socio-economic groups, irrespective of age, sex or ethnicity. It has been increasing in parallel with adult obesity⁴. The national representative data on childhood obesity in developing countries is scarce, with very few reports on the prevalence of obesity among children despite

the findings that 50-80% of obese children will continue as obese adults⁵ and be at risk for non-communicable diseases (NCD) like diabetes, hypertension and cardiovascular disease in early adulthood^{6,7} and many more obesity-related conditions. India is a fast-growing economy undergoing major epidemiological, nutritional and demographic transitions. These transitions tend to promote obesity in all age groups. In India also, obesity is emerging as an important health problem, paradoxically co-existing with

Access this article online



Website:
www.jmsskims.org

DOI:
<https://doi.org/10.33883/jms.v24i3.1141>

Correspondence:

Dr. Shariq Rashid Masoodi, DM
Professor, Department of Endocrinology, SKIMS Srinagar, J&K
Phone No: 09419013289
Email: shariq.masoodi@skims.ac.in,
shariq.masoodi@gmail.com

How to cite this article: Bhat J, Bhat M, Masoodi S, Ahmad P, Bashir M, Wani A, Misgar R. Prevalence and factors associated with overweight and obesity among school children in Kashmir valley: a community based cross-sectional study. JMS 2021; 24 (3) 11-17

Received: 2021-08-07 Accepted: 2021-08-19



This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

significant undernutrition prevailing in different sections of the population⁸. Studies have shown that the prevalence of overweight among adolescents varies between 10% and 30%(913).

Despite this mounting epidemic of overweight and obesity globally and related morbidity and mortality, there is limited data on childhood obesity in India and very scarce data in the Valley of Kashmir. The lack of significant data on the prevalence of overweight and obesity in Kashmir Valley prompted this study.

Study design and sample size

METHODS

The study of the prevalence of overweight and obesity and related factors was conducted in the school children of Kashmir Valley. Both male and female students in the age group of 5-15 years were included in our study. Nine thousand five hundred seventy-six students were studied all over the valley, with boys comprising 56.6% (5416) and 43.4% (4160) of the study group.

Study design

This epidemiological design was an observational, descriptive, cross-sectional and population-based study with a cohort of school children and adolescents. The study was conducted by adapting multistage sampling procedures. The prevalence of overweight and obesity in these school children was studied according to different recommended criteria based on BMI (CDC/IOTF).

Selection of study population

The valley was stratified according to already well-defined districts (administrative units) at the first stage. In the second stage, a frame of tehsils (administrative subunit) from each district was made from which a sample of twenty tehsils was drawn on a random basis, ensuring at least two tehsils per district. A total of 210 randomly selected villages spread all over the valley were taken for this study. Finally, a list of schools from the randomly drawn villages was prepared, and a selection of schools was drawn by simple randomization. All students in the age group of 5-15 years from these randomly selected schools were selected for the survey. While finalizing, efforts were made to keep the number of included students from each district proportionate to the district's population as per the last census[WU1]. In areas where the number of children in the selected school was fewer or only boys or girls were

available, more than one school (one primary and one secondary, or one boys' school and one girls' school) were chosen at random[WU2].

The list of schools and their specifications was obtained from the Directorate of School Education Kashmir. The number of districts and tehsils from each district was obtained from the latest records of the office of the Divisional Commissioner of Kashmir Valley.

Clinical survey of overweight and obesity

The study was conducted in private and government schools in randomized areas of Kashmir Valley. The selected schools were visited during school hours. Children in the age group of 5-15 years were examined after taking necessary consent from the heads of the respective schools and the students. The age of the students was recorded from the school register and was rounded off to the nearest whole number. All ethical procedures were followed. Anthropometric measurements were taken to calculate BMI and central obesity (WHR). The instruments used in the study areas

1. An electronic weighing machine.
2. Height measuring scale (Stadiometer).
3. Measuring tape (Non-elastic).
4. Scale.

Anthropometric measurements

Weight was measured in the upright position to the nearest 0.1 kg using a calibrated electronic balance. Height was measured without shoes to the nearest 0.1 cm using a calibrated stadiometer. Waist circumference (WC) was measured to the nearest 0.1 cm horizontally at the narrowest point between the lower end of the rib cage and iliac crest. Hip circumference was measured to the nearest 0.1 cm at the greatest horizontal circumference below the iliac crest at the level of the greater trochanter. Body mass index (BMI) was defined as the ratio of body weight to body height squared, expressed as kg/m².

BMI (Quetelet index) = Weight (Kg.) / Height² (m)

The criteria for establishing weight norms in children are slightly more complex. This is due to significant differences in the amount of body fat between boys and girls and for specific age groups. We used different criteria's based on BMI to estimate the prevalence of overweight and obesity in our studied population. IOTF criterion was used to classify

our study group into normal, overweight and obese as per the cut off points for BMI based on gender and age. Center for Disease Control (CDC-2006) criteria, based on the percentiles of BMI for all age groups (i.e., percentile derived for each age group and sex and the reference values for BMI percentile were adapted from May 2000 growth charts based on a combination of data sources.) was used to assess the prevalence of overweight ($\geq 85^{\text{th}} < 95^{\text{th}}$ percentile) and obesity ($\geq 95^{\text{th}}$ percentile) in boys and girls according to Weight Percentile criteria (defined and calculated using the May 2000 growth charts based on a combination of data sources).

RESULTS

The total number of school children in the age group of 5-15 years studied for the prevalence of overweight and obesity was 9,576, drawn from a total of 210 randomly selected villages from all Districts, spread all over the valley. A total of 5416 (57%) boys and 4160 (43%) girls participated in the study. The age and sex distribution of the study subjects is shown in Table 1. The prevalence of overweight and obesity was assessed using the Center for Disease Control and Prevention (CDC 2000) and International Obesity Task Force (IOTF) standards.

The prevalence of overweight and obesity, as per the International Obesity Task Force (IOTF) criteria, was 24.7% and 11.5 %, respectively (Table 2). Among the studied cohort, 24% of boys and 25.6% of girls were overweight, whereas 10.5% of boys and 12.8% of girls were found to be obese. Thus the prevalence of overweight and obesity was seen more in girls as compared to boys as per the IOTF criteria. According to CDC classification prevalence of underweight was 6.5 % (Boys=7% & Girls=5.9%), prevalence of Overweight was 12.1% (Boys=11.7% & Girls 12.5%) and prevalence of obesity was 10.2% (Boys=10.6% & Girls 9.7%) respectively. Prevalence of underweight was more in boys (7%) compared to girls (5.9%), and overweight was seen more in girls (12.5%) than boys (11.7%). However, the prevalence of obesity was seen more in boys (10.6%) than in girls (9.7%). The total prevalence of overweight obese based on CDC criteria was 22.3%, with equal prevalence seen in both boys and girls. Table 2

The studied population was further divided into age groups 5-10 years (Children) and 11-15 years (Adolescence) to

look for the trend and pattern of overweight and obesity. Prevalence of Overweight and obesity was significantly higher (29.8 % and 13.2%) in the age group of 11-15 years than (19.4% and 9.8%) in the age group of 5-10 years which was statistically significant ($p=0.000$). It was seen more in the case of girls compared to boys. Table 3

Factors associated with obesity on logistic regression were age more than ten years (which was statistically significant with OR 1.44; $P<0.001$) and female gender (OR 1.29; $P<0.001$); urban status had no statistically significant association with obesity (OR 1.08; $P>0.3$). Table 4

DISCUSSION

Obesity is emerging as an important health problem in both developed and developing countries¹⁴⁻¹⁷, paradoxically co-existing with significant undernutrition prevailing in different sections of the population⁸ in India. A study by Bharati et al¹³ indicated that the country is facing an epidemic of obesity not only in adults but also among children. In India, different studies have reported a prevalence of obesity in the range of 2.9%¹⁴, 14.3%¹⁸⁻²⁰ and overweight in the range of 1.5%¹⁸⁻²¹. These studies were conducted at different times, using different standards with other cut-off points to assess the prevalence of obesity and overweight.

The present study was conducted to check the prevalence of overweight and obesity in schoolchildren aged 5-15 years in Kashmir Valley. Using Centre for disease control (CDC) criteria²², we found that the prevalence of overweight-obesity was 22.3%, with no significant difference between boys and girls. However, using IOTF criteria²³, the study revealed a prevalence of overweight in 24.7% (24% of boys and 25.6% of girls) and obesity in 11.5% (10.5% of boys and 12.5% of girls). The prevalence of obesity was significantly higher in the age group of 11-15 years than in the age group of 5-10 years and was seen more in girls than in boys, which again was statistically significant.

We reported a prevalence of overweight of 24.7% (IOTF Criteria), which is comparable to the results reported by other studies²⁴⁻²⁶. Misra et al.²⁴, in their study involving 38296 children aged 8 to 18 years, reported an overweight prevalence of 21.1%. Chatterjee et al.²⁵ demonstrated the overweight prevalence of 29% in 4000 children aged 4 to 17 years. Similarly, Sharma et al.²⁶ 2007 reported an overweight prevalence of 22% in a study involving children

Table 1: Age and Sex distribution of the study population

Age (years)	N	Boys		Girls	
		No.	Percent	No.	Percent
5+	563	294	52.2%	269	47.8%
6+	703	380	54.0%	323	46.0%
7+	725	383	52.8%	342	47.2%
8+	912	449	49.3%	463	50.7%
9+	1005	486	48.4%	519	51.6%
10+	835	440	52.7%	395	47.3%
11+	783	445	56.8%	338	43.2%
12+	1025	560	54.6%	465	45.4%
13+	1138	652	57.3%	486	42.7%
14+	1138	784	68.9%	354	31.1%
15+	749	543	72.5%	206	27.5%
Total	9576	5416	56.6%	4160	43.4%

$$\chi^2=212, df=10; P=0.000.$$

Table 2: Prevalence of Normal weight, Overweight and Obesity in the study population.

		Boys		Girls		Total	
		n	%	n	%	n	%
CDC CLASSIFICATION	Normal BMI	3547	65.5	2563	61.61	6110	63.8
	Overweight BMI	1298	24.0	1066	25.6	2364	24.6
	Obese BMI	571	10.5	531	12.7	1102	11.5
	Underweight (<5 th percentile)	377	6.9	246	5.91	623	6.5
	95% CI		4.6-10.4		5.8-13.4		5.0-9.1
	Normal (5 th -<85 th percentile)	3829	70.6	2988	71.8	6817	71.1
	95% CI		69.2-72.1		70.1-73.4		70.1-72.3
	Overweight (≥85 th percentile)	635	11.7	522	12.5	1157	12.0
	Obese (≥95 th percentile)	575	10.6	404	9.7	979	10.2
	Overweight-Obese (≥85 th percentile)	1210	22.3	926	22.2	2136	22.3
	95% CI		-		21.0 – 23.6		21.5 – 23.2

IOTF; International Obesity Task Force, CDC; Center for Disease Control (CDC -2006) criteria, BMI criteria ($\chi^2=18.2$; $df=2$, $P=0.000$) and by Weight Percentile criteria ($\chi^2=4.396$, $df=10$; $P=0.000$.)

Table 3: Distribution of population according to different categories based on age and gender.

Age group	N	BMI Class			significance
		Normal BMI	Over-weight BMI	Obese BMI	
Boys					$\chi^2(df_2)=54$ $P=0.000$
5-10y	2432	70.5%	19.5%	10.0%	
11-15y	2984	61.4%	27.6%	11.0%	
Girls					$\chi^2(df_2)=198$ $P=0.000$
5-10y	2311	71.1%	19.3%	9.6%	
11-15y	1849	49.8%	33.5%	16.8%	
Overall					$\chi^2(df_2)=201$ $P=0.000$
5-10y	4743	70.8%	19.4%	9.8%	
11-15y	4833	57.0%	29.8%	13.2%	

Table 4: Factors affecting obese status on Logistic regression

Variable	B	S.E.	Wald	Df	P value	Odds ratio (Exp.[B])
Age > 10y	0.364	.065	31.116	1	0.000	1.44
Girl child	0.251	.065	14.954	1	0.000	1.29
Urban status	0.077	.078	.983	1	0.321	1.08
Constant	-2.981	.151	390.291	1	0.000	0.051

Variable(s) entered: Age>10, Female gender, Habitat.

aged 4-17 years from Delhi.

Our findings of obesity prevalence of 11.5% (IOTF criteria) and 10.5 % (CDC criteria) are comparable to the findings by Chhatwal et al.²⁹, Jain et al. (18), and Kaur et al.³⁰, who reported obesity prevalence of 11%, 10% and 9.3% respectively among studied children[WU3]. However, our results of obesity were higher than those reported by Marwaha et al.³¹ and Ramachandran et al.³², who demonstrated that among studied children, the prevalence of obesity was 5.6% in boys, 5.7% in girls and 3.6% boys and 2.7% girls respectively[WU4].

Our results demonstrate that a good proportion (22%) of Kashmiri schoolchildren are overweight or obese (IOTF criteria), as was demonstrated in a study among children and adolescents in Chennai by Jagadesan et al.³³. Overall, the prevalence of children with BMIs greater than the 85th percentile was 24.7%, and the corresponding prevalence with BMIs greater than the 95th percentile was 10.50%. Keeping in view that Asians have higher subcutaneous and intra-abdominal fat mass than white Caucasians at comparable BMI, we find this prevalence of overweight quite alarming.

The association of obesity with age in our study is not surprising. It is now well known that obesity has a direct correlation with age. However, a higher prevalence of obesity in girls, similar to other studies^{33,34}, is an interesting observation. This could be because our girl children do not participate in outdoor sports activities because of various cultural and social reasons and prevailing conditions. In addition, the influence of gender and adolescence on obesity can also be attributed to hormonal changes at puberty and the development of secondary sexual characteristics resulting in fat accumulation and redistribution³⁵.

In 1990, a national survey on the weight status of 9464 American Indian school children (ages 5-18 years) living on or near reservations[WU5]³⁶ revealed overall, 39% of American Indian children were overweight (BMIs above the 85th percentile using NHANES II reference data), a prevalence very similar to the current survey. These and other studies³⁷ confirm that being overweight is an important public health problem for both genders and all school-age groups^{37,38}.

Limitations of our study need to be considered. While this

study population is large, it is unknown whether school attendance or willingness to participate is random with respect to the weight status of children. Our definition of overweight-obesity is based on CDC criteria of considering overweight-obese when the bodyweight of the child is 85th percentile or above in the CDC chart. There are many other definitions of overweight and/or obesity, and there is no consensus on using a particular definition so far. Therefore, it is quite possible that our results will be different if we use other criteria. Also, it makes it difficult to compare our data with that of others as an additional criterion has been used in the different studies.

We conclude that overweight-obesity is a mounting public health problem in Kashmir Valley in school children and young adults aged 20-40 years, as has been shown in a study conducted by the Department of Endocrinology at Sher-i-Kashmir Institute of Medical Sciences Srinagar³⁹. Overweight-obesity prevalence among young Kashmiri school children aged 5-15 years is 22.3%. This may explain the growing prevalence of pre-diabetes, particularly impaired fasting hyperglycemia (IFG), recently observed in young Kashmiri adults³⁹.

There is a necessity to develop an action plan and a health strategy for controlling overweight and obesity and its consequences among the Kashmiri population right from school level before it becomes an epidemic like observed in the West and some Indian metro cities.

SUMMARY & CONCLUSIONS

Summary

This study was conducted on Kashmiri schoolchildren aged 5 to 15 years for the prevalence of overweight and obesity. A total of 9576 subjects from 210 randomly selected villages spread all over the valley were studied. The total numbers of boys surveyed were 5416 (57%), and girls were 4160 (43%)

CONCLUSIONS

1. Mean ($\pm$ SD) BMI of boys was 16.9 $\pm$ 3.2, 17.0 $\pm$ 3.2, 16.2 $\pm$ 2.8, 17.6 $\pm$ 3.2, 17.5 $\pm$ 3.4, 16.9 $\pm$ 3.4, 16.9 $\pm$ 2.8, 17.6 $\pm$ 2.9, 18.5 $\pm$ 3.3, 18.3 $\pm$ 2.8, and 18.1 $\pm$ 2.6 for ages 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 respectively.
2. Mean ($\pm$ SD) BMI of girls was 16.6 $\pm$ 3.4, 16.9 $\pm$ 3.1, 16.4 $\pm$ 2.8, 17.0 $\pm$ 2.9, 17.0 $\pm$ 3.6, 17.4 $\pm$ 3.6, 17.4 $\pm$ 3.2, 17.9 $\pm$ 3.0, 19.2 $\pm$ 3.3, 19.3 $\pm$ 3.0, and 19.8 $\pm$ 3.2 for ages 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 respectively.

3. 24% were overweight in boys, and 10.5% obese. Whereas in girls, 25.4% were overweight and 12.8% were Obese. Overall, the prevalence of overweight by BMI as per the IOTF criteria was 24.7%, while obesity was 11.5%.
4. As per CDC based cut off Criteria, the prevalence of underweight, normal weight, overweight, and obesity was 7.0%, 70.3%, 11.7% and 10.6% in boys, and 5.9%, 71.8%, 12.5% and 9.7%, respectively.
5. Overall, 22.3% of boys and girls were either overweight or obese, with a similar prevalence of overweight-obesity in the two genders.
6. Factors significantly associated with obesity on logistic regression were age more than ten years (OR 1.44; $P<0.001$) and female gender (OR 1.29; $P<0.001$); urban status had no statistically significant with obesity (OR 1.08; $P>0.3$).

Conflict of Interest: None

Funding: None

Written informed consent : Taken

REFERENCES

1. James WPT. The epidemiology of obesity: the size of the problem. *J Intern Med*. 2008 Apr 1;263(4):33652.
2. Weiss R, Dziura J, Burgert TS, Tamborlane WV, Taksali SE, Yeckel CW, et al. Obesity and the Metabolic Syndrome in Children and Adolescents. *N Engl J Med*. 2004 Jun 3;350(23):236274.
3. Ludwig DS, Gortmaker SL. Programming obesity in childhood. *The Lancet*. 2004 Jul 17;364(9430):2267.
4. Wong JP, Ho SY, Lai MK, Leung GM, Stewart SM, Lam TH. Overweight, obesity, weight-related concerns and behaviours in Hong Kong Chinese children and adolescents. *Acta Paediatr*. 2005;94(5):595601.
5. Styne DM. CHILDHOOD AND ADOLESCENT OBESITY: Prevalence and Significance. *Pediatr Clin North Am*. 2001 Aug 1;48(4):82354.
6. Chakraborty P, Dey S, Pal R, Kar S, Zaman FA, Pal S. Obesity in Kolkata children: Magnitude in relationship to hypertension. *J Nat Sci Biol Med*. 2011;2(1):1016.
7. Shah B, Anand K, Joshi P, Mahanta J, Mohan V, Thankappan K. Report of the Surveillance of Risk Factors of Non-communicable Diseases (STEPS 1 and 2) From Five Centers in India WHO IndiaICMR initiative. New Delhi: <http://www.whoindia.org/LinkFiles/NCD Surveillance NCDRFSurveillanceReportPdf.2004>;
8. Ramachandran A. Diabetes & obesity-the Indian angle. *Indian J Med Res*. 2004;120(5):437.
9. Kotian MS, S GK, Kotian SS. Prevalence and Determinants of Overweight and Obesity Among Adolescent School Children of South Karnataka, India. *Indian J Community Med Off Publ Indian Assoc Prev Soc Med*. 2010 Jan;35(1):1768.
10. Stigler MH, Arora M, Dhavan P, Shrivastav R, Reddy KS, Perry CL. Weight-related concerns and weight-control behaviors among overweight adolescents in Delhi, India: A cross-sectional study. *Int J Behav Nutr Phys Act*. 2011 Feb 7;8(1):9.
11. Gupta DK, Shah P, Misra A, Bharadwaj S, Gulati S, Gupta N, et al. Secular Trends in Prevalence of Overweight and Obesity from 2006 to 2009 in Urban Asian Indian Adolescents Aged 14-17 Years. *PLoS ONE* [Internet]. 2011 Feb 23 [cited 2019 Jun 15];6(2). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3044166/>
12. Raj M, Sundaram KR, Paul M, Sudhakar A, Kumar RK. Dynamics of growth and weight transitions in a pediatric cohort from India. *Nutr J*. 2009 Nov 23;8(1):55.
13. Bharati DR, Deshmukh PR, Garg BS. Correlates of overweight & obesity among school going children of Wardha city, Central India. *Indian J Med Res*. 2008 Jun;127(6):53943.
14. Wang Y, Monteiro C, Popkin BM. Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. *Am J Clin Nutr*. 2002 Jun 1;75(6):9717.
15. Kain J, Uauy R, Vio F, Albala C. Trends in overweight and obesity prevalence in Chilean children: comparison of three definitions. *Eur J Clin Nutr*. 2002 Mar;56(3):200.
16. Lobstein T, Frelut M-L. Prevalence of overweight among children in Europe. *Obes Rev*. 2003;4(4):195200.
17. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and Trends in Overweight Among US Children and Adolescents, 1999-2000. *JAMA*. 2002 Oct 9;288(14):172832.

18. 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.
19. Kumaravel V, Shriraam V, Anitharani M, Mahadevan S, Balamurugan AN, Sathiyasekaran BWC. Are the current Indian growth charts really representative? Analysis of anthropometric assessment of school children in a South Indian district. *Indian J Endocrinol Metab*. 2014;18(1):56.
20. Goyal RK, Shah VN, Saboo BD, Phatak SR, Shah NN, Gohel MC, et al. Prevalence of overweight and obesity in Indian adolescent school going children: its relationship with socioeconomic status and associated lifestyle factors. *J Assoc Physicians India*. 2010;58:151158.
21. 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.
22. Using the BMI-for-Age Growth Charts. Available from: <http://www.cdc.gov/nccdphp/dnpa/growthcharts/training/modules/module1/text/module1print.pdf>, accessed on November 22, 2013.
23. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000 May 6;320(7244):1240.
24. Misra A, Shah P, Goel K, Hazra DK, Gupta R, Seth P, et al. The high burden of obesity and abdominal obesity in urban Indian schoolchildren: a multicentric study of 38,296 children. *Ann Nutr Metab*. 2011;58(3):203211.
25. Chatterjee P. India sees parallel rise in malnutrition and obesity. *Lancet*. 2002;360(9349):1948.
26. Sharma A, Sharma K, Mathur KP. Growth pattern and prevalence of obesity in affluent schoolchildren of Delhi. *Public Health Nutr*. 2007;10(5):485491.
27. Kapil U, Singh P, Pathak P, Dwivedi SN, Bhasin S. Prevalence of obesity amongst affluent adolescent school children in Delhi. *Indian Pediatr*. 2002;39(5):44952.
28. Alok P, Malay P, Divyeshkumar V. Prevalence of overweight and obesity in adolescents of urban and rural area of Surat, Gujarat. *Natl J Med Res*. 2012;2:3259.
29. Chhatwal J, Verma M, Riar SK. Obesity among pre-adolescent and adolescents of a developing country (India). *Asia Pac J Clin Nutr*. 2004;13(3).
30. Kaur S, Sachdev HPS, Dwivedi SN, Lakshmy R, Kapil U. Prevalence of overweight and obesity amongst school children in Delhi, India. *Asia Pac J Clin Nutr*. 2008;17(4):592596.
31. 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.
32. Ramachandran A, Snehalatha C, Vinitha R, Thayyil M, Sathish Kumar CK, Sheeba L, et al. Prevalence of overweight in urban Indian adolescent school children. *Diabetes Res Clin Pract*. 2002 Sep 1;57(3):18590.
33. Jagadesan S, Harish R, Miranda P, Unnikrishnan R, Anjana RM, Mohan V. Prevalence of overweight and obesity among school children and adolescents in Chennai. *Indian Pediatr*. 2014;51(7):544549.
34. Tharkar S, Viswanathan V. Impact of socioeconomic status on prevalence of overweight and obesity among children and adolescents in urban India. *Open Obes J*. 2009;1:914.
35. Solorzano CMB, McCartney CR. Obesity and the pubertal transition in girls and boys. *Reproduction*. 2010 Sep 1;140(3):399410.
36. Jackson MY. Height, weight, and body mass index of American Indian schoolchildren, 1990-1991. *J Am Diet Assoc*. 1993;93(10):11361140.
37. Broussard BA, Johnson A, Himes JH, Story M, Fichtner R, Hauck F, et al. Prevalence of obesity in American Indians and Alaska natives. *Am J Clin Nutr*. 1991;53(6):1535S1542S.
38. Story M, Strauss KF, Zephier E, Broussard BA. Nutritional concerns in American Indian and Alaska Native children: transitions and future directions. *J Am Diet Assoc*. 1998;98(2):170176.
39. Zargar AH, Wani AA, Laway BA, Masoodi SR, Wani AI, Bashir MI, et al. Prevalence of diabetes mellitus and other abnormalities of glucose tolerance in young adults aged 20-40 years in North India (Kashmir Valley). *Diabetes Res Clin Pract*. 2008 Nov 1;82(2):27681.