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UNCOVERING OBESITY TRENDS IN ADOLESCENT SCHOOL GOING CHILDREN

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ABSTRACT

Background: Childhood obesity is one of the most serious public health challenges of 21st century. The problem is global and is steadily affecting many low and middle income countries, particularly in urban settings. The prevalence has increased at an alarming rate. Globally, prevalence of obesity and overweight has gone high from 8% to 23% in 2022.This study was conducted to know the prevalence of obesity among school going adolescent children in the city. **Objectives:** Primary objective - to identify the prevalence of obesity in adolescent school going children. Secondary objective – 1. To identify the gender wise distribution of obesity 2. To compare the prevalence of obesity among private and government school children 3. To compare the prevalence of central obesity using different indicators.

Materials and Methods: This cross sectional study was carried out in selected public and private schools of the city from January 2023 to august 2023. Written consent from school principal and parents were taken before enrolling their children in the study. Anthropometric measurements like weight, height, waist circumference, hip circumference were taken as per standard method. Standard WHO Age and sex appropriate BMI charts (using Z score) were used for plotting and analysis of data. Centile charts on waist circumference by Khadilkar were used as reference. Waist hip ratio (WHR) and waist height ratio (WHtR) were calculated from the above- mentioned measurements. A WHR ratio cut off of >0.85 in girls and >0.9 in boys were taken as obesity. A WHtR cut off of >0.5 was taken as obesity.

Results: Total 603 adolescent school going children of 11 to 14 years of age were assessed. Among them 228 were girls and 375 were boys. 257 students were from private school and 346 students were from government school. Overall prevalence of obesity was 3.32% (20) in the study. It was more in boys than girls. (Chi-square: 0.536, p value: 0.4642, p value not significant). Prevalence of overweight was 9.95% (60) in study population, more in girls than boys.(p value not significant). Prevalence of central obesity as per waist circumference was 3.81% (23) in our study. It was more in boys compared to girls. (Chi-square 27.015, p value 0.0001, p value significant). Central obesity as per waist hip ratio was 16.42% (99). More girls were obese with this criteria than boys. (Chi-square 14.083, p value 0.0002, p value significant). Prevalence of central obesity as per waist height ratio was 9.29% (56). Boys were more obese using this criteria than girls. (Chi-square: 0.799, p value: 0.3714, p value not significant). Overall prevalence of obesity was more in private school children than government school children (Chi square 1.29, p value not significant). Overweight was also more in private school children (p value not significant). Prevalence of central obesity as per waist circumference and waist height ratio was more in private school going adolescent (p value significant).

While central obesity as per waist hip ratio was more in government school children (p value significant).
Conclusion: There was no significant difference in the prevalence of obesity (BMI), overweight among boys and girls. Central obesity was high in boys using waist circumference. While girls were more centrally obese using waist hip ratio. Central obesity was high in government school children using waist hip ratio. While students from private school showed high prevalence of central obesity using waist circumference and waist height ratio.
Keywords: Adolescent, obesity, BMI, waist indicators.

INTRODUCTION

Obesity and overweight amongst children was considered primarily as disease of developed countries with high per capita income. However, developing countries also show increase prevalence because of rapid change in food habits and life style. India has a paradox of being considered a fast weight gaining nation and is also struggling with malnutrition. As per WHO report 2022, over 390 million children and adolescent were overweight. Among them 160 million are living with obesity.[1] The prevalence of obesity among 5-19 years age group, has been increased significantly from 1.9% in 1990 to 8.8% in 2024.[2] There are many long-term consequence of childhood obesity as its persistence into adulthood along with its health risks. Obesity is more likely to persist if it starts in adolescence.[3,4] Females are more likely to be obese as compared to males, owing to inherent hormonal differences. Access to high calories cold drinks, packaged non-nutritive food, more outside eating, increase screen time are main risk factors for obesity in adolescents. Additional risk factors include low physical activity, social and cultural factors as well as lower birth order and lower number of siblings.[5,6] There is no single element causing this epidemic. But obesity is due to complex interactions between biological, developmental, behavioural, genetic, and environmental factors.[19] The role of epigenetics and the gut micro biome, as well as intrauterine and intergenerational effects, have recently emerged as contributing factors to the obesity epidemic.[5-6] Other factors including small for gestational age (SGA) status at birth, formula rather than breast feeding in infancy, and early introduction of protein in infant's dietary intake have been reportedly associated with weight gain that can persist later in life.[6-8] World health organization (WHO) has defined obesity as " abnormal or excessive fat accumulation that may impair health."[9] It can be measured by various anthropometric measurements and body fat estimation by dual energy X ray absorptiometry. Measurements include BMI, skin fold thickness, conicity index, waist indices, neck and wrist circumference. BMI is widely used tool to measure obesity but it does not consider the fat distribution in the body. It is proven that central obesity is more hazardous than generalized obesity.[10] Prevalence of central obesity is high in Indian children as compared to other ethnic group.[11]

As per WHO, waist hip ratio (WHR) has been suggested superior to BMI for prediction of cardiovascular risk in adolescents and adults.[12] Some studies have suggested waist circumference as a simplest clinical tool for obesity in children. Indian cut offs are lower than other ethnic groups. The rising prevalence of childhood obesity poses a significant public health challenge by increasing the burden of chronic non-communicable diseases.[13,14] Obesity increases the risk of developing early puberty in children,[15] menstrual irregularities in adolescent girls,[13,16] sleep disorders such as obstructive sleep apnea (OSA),[13,17] cardiovascular risk factors that include Pre diabetes, Type 2 Diabetes, High Cholesterol levels, Hypertension, NAFLD and Metabolic syndrome.[4,13] Additionally, obese children and adolescents can suffer from psychological issues such as depression, anxiety, poor self-esteem, body image and peer relationships, and eating disorders.[18,19] Early identification of at risk children may help in prevention of obesity and related complications. Screening with BMI is time consuming in busy OPDs.[20] But use of waist circumference or WHR or WHtR can be used easily by non-professionals and health workers also.[21-29] This study was conducted to know the prevalence of obesity in school going adolescent children and to compare the efficacy of waist indices with BMI as a tool to diagnose obesity in children.

Aims & Objectives

Primary Objective: To identify the prevalence of obesity in adolescent school going children.

Secondary Objectives:

1. To compare the prevalence of obesity among girls and boys
2. To compare the prevalence of obesity among private and government school children
3. To compare the prevalence of central obesity using different indicators.

MATERIALS AND METHODS

It was Cross sectional observational study conducted from January 2023 to August 2023. It was conducted in selected private and public schools of the city. Adolescent children of selected schools as per criteria were enrolled. Students from both types of schools were selected in almost equal number. As per timings of schools, students of class 6 to 8 were available at school at the time of visit. In private

school, class 9 students were also available so they were also included in study. While in government schools, 9th standard students were in different shift, so not included in the study. Class 10 to 12 were busy with studies. So they were exempted from the study.

Inclusion Criteria: Adolescent school going children of age group 11 to 14 years whose parents have
given informed consent and those who were available were included in the study.

Exclusion Criteria

1. Unable to get consent
2. Pre-existing chronic medical illness like diabetes, Thalassemia, Sickle cell disease, chronic cardiac illnesses, malignancies etc. or any other chronic illness.
3. Adolescent with intellectual disability who cannot communicate
4. Students with hereditary genetic disorder
5. Students absent on the day of visit

Sampling Method: A separate list of government and private schools of particular area was made. Both types of schools were selected by random sampling method.

3.1 Sample size: sample size was decided by using following formula. n =4pq/L2 where n = sample size p = prevalence of overweight (20% according to WHO report 2024) q = 100-p (80%) L = allowable error (which we have taken 15% of p) According to this formula sample size was 426. But as per availability of children, we enrolled 603 students in the study.

It was conducted in selected government and private schools which fall under particular urban health center. Ethical approval for the study was taken prior to study from institutional ethical committee. The director of health and family welfare department was also informed about the study objectives and method. Primary written approval of principal of the school was taken prior to school visit. Purpose of the study was explained to the principal, teachers and other supportive staff from the school. Formal informed consent was taken from parents and students both. Preformed structured proforma was explained to the teachers and students. It was filled by investigator. On the day of examination, Body weight was measured with the subject standing motionless on the weighing scale (ex life electric weighing scale) with the weight distributed equally on each leg. Height was measured (to the nearest 0.5 cm) with the subject standing in an erect position against a vertical scale of stadiometer and with the head positioned so that the top of external auditory meatus was level with the inferior margin of the bony orbit. BMI was calculated using the formulae weight in kg/height in m2. Standard WHO Age and sex appropriate BMI charts (using Z score) were used for plotting and analysis of data. As per BMI charts, overweight was confirmed when BMI for age fell between 1 SD to 2 SD above the mean. Obesity was confirmed when BMI for age more than 2 SD above the mean.[20] Waist circumference was measured using non stretchable tape in standing posture with arms at the sides and feet positioned close together, at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest at the end of normal expiration (just above the umbilicus). Measurements were taken with the tape held snugly, but not constricting, and at a level parallel to the floor. Centile charts on waist circumference by Khadilkar et al were used as reference.[21] A cut off value of 70th centile was taken as an indicator of central obesity. Hip circumference (HC) was measured around the widest portion of the buttocks with the tape parallel to the floor. Waist hip (WHR) and waist height ratios (WHtR) were calculated from the above- mentioned measurements. A WHR ratio of >0.85 in girls and >0.9 in boys was taken as obesity.[27,28] A WHtR of >0.5 was taken as obesity. General examination of all the adolescents was carried out in good natural light. Other demographic details were filled in preformed proforma and results were obtained. Problems were identified if any and children were referred to nearby government health facility for further work up and treatment. Exact age of the child was established from birth certificate/ school identification card. Data was analyzed using appropriate descriptive statistical tests. For qualitative data proportion, quantitative data mean and standard deviation. MS Excel, Epi info and SPSS software was used to analyses data.

RESULTS

Table 1: Prevalence of Obesity as per different indicators (gender wise)

	BMI		WAIST CIRCUMFERENCE		WAIST-HIP RATIO		WAIST-HEIGHT RATIO	
	N	%	N	%	N	%	N	%
BOYS	14	2.32	22	3.65	45	7.46	39	6.47
GIRLS	6	0.996	1	0.97	54	8.95	17	2.82
TOTAL	20	3.32	23	3.81	99	16.42	56	9.29

Table 2: Prevalence of obesity as per WHO BMI classification (School wise)

AGE	GOVERNMENT		PRIVATE		TOTAL	
	N	%	N	%	n	%
11	5	3.8	3	6.52	8	4.52
12	1	0.93	4	8	5	3.16

13	3	2.8	1	1.92	4	2.51
14	-	-	3	2.75	3	2.75
TOTAL	9	2.6	11	4.2	20	3.32% of total participants

Table 3: Prevalence of overweight as per WHO BMI classification (School wise)

AGE	GOVERNMENT		PRIVATE		TOTAL	
	N	%	N	%	N	%
11	12	9.1	5	10.87	17	9.60
12	6	5.56	6	12	12	7.59
13	11	10.28	5	9.61	16	10.06
14	-	-	15	13.76	15	13.76
TOTAL	29	8.38	31	12.06	60	9.95% of total participants

Table 4: Prevalence of Obesity as per different indicators (school wise)

	BMI		WAIST CIRCUMFERENCE		WAIST-HIP RATIO		AIST-HEIGHT RATIO	
	N	%	N	%	N	%	n	%
PRIVATE	11	4.2	17	6.61	27	10.50	29	11.28
GOVERNMENT	9	2.6	6	1.73	72	20.8	27	7.8
TOTAL	20	3.32	23	3.81	99	16.42	56	9.29

Study revealed that overall prevalence of obesity was 3.32% (20) and it was more in boys (3.73%) than girls(2.63%).(Chi-square : 0.536 , p value: 0.4642, p value not significant). Prevalence of overweight was 9.95%, more in girls (10.8%) compared to boys (9.86%).(p value not significant) Overall Prevalence of central obesity as per waist circumference was 3.81%(23),more in boys (5.87%) compared to girls(0.44%),Chi-square 27.015, p value 0.0001) (p value significant).Prevalence of central obesity as per waist hip ratio was 16.42%, more girls (23.68%) were obese with this criteria than boys (12%),(Chi-square 14.083, p value : 0.0002) (p value significant). Prevalence of central obesity as per waist height ratio was 9.29% (56), Boys(10.4%) were more obese using this criteria than girls(7.46%),(Chi-square : 0.799, p value : 0.3714) (p value not significant)

Prevalence of obesity was more in children from private school 4.2% compare to government school 2.6%. (p value not significant) Prevalence of overweight was more in children from private school (12.06%) compare to government school 8.38%.%.(p value not significant) Prevalence of central obesity is high in private school (6.61%) children as per waist circumference compare to government (1.73 %) school children. (p value significant). While central obesity is more among government school children as per waist hip ratio (20.8%), (p value significant). With waist height ratio (11.28%), (p value significant) private school children are more obese.

DISCUSSION

National family health survey-5 which was conducted in 2019-2021 which had given many alarming reports. Obesity in 5 -19 years old children was 8.4% and overweight was 12.4%. In our study, prevalence of obesity and overweight both was below the national average. We have compared different tools to diagnose obesity in our study. Which shows that more children were obese using waist hip ratio than any other method. Waist height ratio, waist circumference and BMI follows waist hip ratio. BMI considers weight and height. So BMI may fail sometimes to detect central obesity. Waist circumference and other tools using it have single cut off to detect obesity which makes them easy tool to use.

Similar study was conducted in Chennai in 2013 with 18955 children both from public and private school. In Jagdeshan et al, they have used BMI with national cut off using Khadilkar charts. Study suggests higher incidence of obesity in private school children and more in girls.[32]

Another study Selvaraj at al was conducted in south India to know nutritional status of adolescent children. WHO BMI cut off was used to define obesity in this study. Study results were almost similar to our study showing obesity and overweight prevalence 10.9% and 6% respectively.[31]

In Krishnan DK et Al, waist indices were compared with BMI to identify obesity in adolescent children. prevelence of obesity was high with all indices than our study. But more children were obese using BMI and WHR than WC and WHtR.[29]

CONCLUSION

Study concludes that, there was no significant difference in the prevalence of obesity (BMI), overweight, among boys and girls. Central obesity was high in boys using waist circumference. While girls were more centrally obese using waist hip ratio. Central obesity was high government school children using waist hip ratio. While students from private school showed high prevalence of central obesity using waist circumference and waist height

ratio. All waist indices are well correlated with BMI.

Prevalence of obesity is alarmingly high. Central obesity is more prevalent in Indian children nowadays. Central obesity indicators are statistically correlated well with BMI and can be used as screening tool. Central obesity increases risk of coronary artery diseases, diabetes and hypertension. life style modifications like exercise, dietary changes, health awareness can improve health of children as a whole.

Limitations of the study

This was cross sectional study and was completed in limited period because of time constrain. So sample size was very small. To get better idea of prevalence of under nutrition, obesity and stunting large number of sample size is essential. To know more about mal nutrition, other demographic details like parents education, type of household, socio economic status, dietary history, screen time, daily physical exercise/activity etc should be considered.

REFERENCES

1. Jacob JJ. Tackling the Rising Tide: Understanding the Prevalence of Childhood Obesity in India. Indian Journal of Endocrinology and Metabolism [Internet]. 2024 Apr 1 [cited 2024 May 17];28(2):101. Available from: https://journals.lww.com/indjem/fulltext/2024/03000/tackling_the_rising_tide__understanding_the.1.aspx
2. World Health Organization. Obesity and overweight [Internet]. World Health Organization. WHO; 2024. Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
3. Gurnani M, Birken C, Hamilton J. Childhood Obesity. Pediatric Clinics of North America. 2015 Aug;62(4):821–40.
4. Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, Bhadoria. AS. Childhood obesity: causes and consequences. J Family Med Prim Care. (2015) 4:187–92.10.4103/2249-4863.154628 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
5. Rinninella E, Raoul P, Cintoni M, Fransceschi F, Miggiano GAD, Gasbarrini A, et al.. What is the healthy gut microbiota composition? a changing ecosystem across age, environment, diet, and diseases. Microorganisms. (2019) 7:14. 10.3390/microorganisms7010014 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
6. Indrio F, Martini S, Francavilla R, Corvaglia L, Cristofori F, Mastrolia SA, et al.. Epigenetic matters: the link between early nutrition, microbiome, and long-term health development. Front Pediatr. (2017) 5:178. 10.3389/fped.2017.00178 [PMC free article] [PubMed]
Marcovecchio ML, Gorman S, Watson LPE, Dunger DB, Beardsall
7. K. Catch-up growth in children born small for gestational age related to body composition and metabolic risk at six years of age in the UK. Horm Res Paediatr. (2020) 93:119–27. 10.1159/000508974 [PubMed]
[CrossRef] [Google Scholar]
8. Koletzko B, Fishbein M, Lee WS, Moreno L, Mouane N, Mouzaki M, et al.. Prevention of childhood obesity: a position paper of the global federation of international societies of paediatric gastroenterology, hepatology nutrition (FISPGHAN). J Pediatr Gastroenterol Nutr. (2020) 70:702–10. 10.1097/MPG.0000000000002708 [PubMed]
[CrossRef] [Google Scholar]
9. Ranjani H, Mehreen TS, Pradeepa R, Anjana RM, Garg R, Anand K et al. Epidemiology of childhood overweight and obesity in India: A systematic review. Indian J Med Res. 2016;143(2):160-74.
10. Sommer I, Teufer B, Szelag M, Nussbaumer-Streit B, Titscher V, Klerings I et al. The performance of anthropometric tools to determine obesity: a systematic review and meta-analysis. Sci Rep. 2020;10(1):1-12.
11. Khadilkar A, Ekbote V, Chiplonkar S, Khadilkar V, Kajale N, Kulkarni S et al. Waist Circumference Percentiles in 2-18-Year-Old Indian Children. J Pediatr. 2014;164(6):1358-62.
12. Geneva: World Health Organization; 2008. World Health Organization (WHO). Waist Circumference and Waist-Hip Ratio. Report of WHO Expert Consultation. Available at https://www.who.int/publications/i/item/9789241501491. Accessed 14 November 2020.
13. Sung RY, Yu CC, Choi KC, McManus A, Li AM, Xu SL et al. Waist circumference and body mass index in Chinese children: cutoff values for predicting cardiovascular risk factors. Int J Obesity. 2007;31:550-58.
14. Taylor RW, Jones IE, Williams SM, Goulding A. Evaluation of waist circumference, waist-to-hip ratio, and the conicity index as screening tools for high trunk fat mass, as measured by dual-energy Xray absorptiometry, in children aged 3-19 y. Am J Clin Nutr. 2000;72(2):490-5.
15. De Leonibus C, Marcovecchio ML, Chiarelli F. Update on statural growth and pubertal development in obese children. Pediatr Rep. (2012) 4:e35. 10.4081/pr.2012.e35 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
16. Witchel SF, Burghard AC, Tao RH, Oberfield SE. The diagnosis and treatment of PCOS in adolescents. Curr Opin Pediatr. (2019) 31:562–9. 10.1097/MOP.0000000000000778 [PubMed] [CrossRef] [Google Scholar]
17. Marcus CL, Brooks LJ, Draper KA, Gozal D, Halbower AC, Jones J, et al. Diagnosis and management of childhood obstructive sleep apnea syndrome. Pediatrics. (2012) 130:e714–55. 10.1542/peds.2012-1672 [PubMed] [CrossRef] [Google Scholar]
18. Rankin J, Matthews L, Cobley S, Han A, Sanders R, Wiltshire HD, et al.. Psychological consequences of childhood obesity: psychiatric comorbidity and prevention. Adolesc Health Med Ther. (2016) 7:125–46. 10.2147/AHMT.S101631 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
19. Topçu S, Orhon FS, Tayfun M, Uçaktürk SA, Demirel F. Anxiety, depression, and self-esteem levels in obese children: a case-control study. J Pediatr Endocrinol Metabol. (2016) 29:357–61. 10.1515/jpem- 2015-0254 [PubMed] [CrossRef] [Google Scholar]
20. Ranjani H, Mehreen TS, Pradeepa R, et al. Epidemiology of childhood overweight & obesity in India: a systematic review. Indian J Med Res. 2016; 143(2): 160–174.
21. WHO. World Health Organization growth reference data for 5-19 years. 2007. https://www.who.int/groWHtRef/en/. Accessed February 6, 2020.
22. WHO. Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation, 8–11 December 2008. Geneva: World Health Organization; 2011.
23. Deepa M, Farooq S, Deepa R, Manjula D, Mohan V. Prevalence and significance of generalized and central body obesity in an urban Asian Indian population in Chennai, India (CURES: 47). Eur J Clin Nutr. 2007; 63: 259–267.
24. Ross R, Neeland I, Yamashita S, et al. Waist circumference as a vital sign in clinical practice: a Consensus statement from the IAS and ICCR working group on visceral obesity. Nat Rev Endocrinol. 2020; 16(3): 177–189.
25. Mushtaq M, Gull S, Abdullah H, Shahid U, Shad M, Akram J. Waist circumference, waist-hip ratio and waist height ratio percentiles and central obesity among Pakistani children aged five to twelve years. BMC Pediatr. 2011; 11: 105.
26. Poh B, Jannah A, Chong L, Ruztia A, Ismail M, McCarthy D. Waist circumference percentile curves for Malaysian children and adolescents aged 6.0–16.9 years. Int J Pediatr Obes. 2011; 6: 229–235.
27. Nawarycz O, Krzyzaniak A, Stawińska-Witoszyńska B, et al. Percentile distributions of waist circumference for 7–19

year-old Polish children and adolescents. Obes Rev. 2010; 11(4): 281–288.
28. Ashwell M. Waist to height ratio and the AshwellR shape chart could predict the health risks of obesity in adults and children in all ethnic groups. Nutr Food Sci. 2005; 35: 359–364.
29. Divya Krishnan K.1*, Shyna K. P.2, Urmila K. V.3, Anand K. V.4 A study on correlation of waist indices with body mass index among school children in North Kerala Krishnan DK et al. Int J Contemp Pediatr. 2021 Jan;8(1):20-25 International DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20205428
30. https://pubmed.ncbi.nlm.nih.gov/24655536/#:~:text=2014%20Jun%3B164,5 Waist circumference percentiles in 2-18 year old Indian children Anuradha Khadilkar 1, Veena Ekbote 2, Shashi Chiplonkar 2, Vaman Khadilkar 2, Neha Kajale 2, Surabhi Kulkarni 2, Lavanya Parthasarathy 2, Archana Arya 3, Anjan Bhattacharya 4, Sanwar Agarwal 5
31. Vinoth Selvaraj1*, Shanthi Sangareddi2, Lakshmi Velmurugan2, Umakanthan Muniyappan3, Fatima Shirly Anitha1 Nutritional status of adolescent school children in a semi-urban area based on anthropometry DOI: http://dx.doi.org/10.18203/2349- 3291.ijcp20161028 2022 Jun 15:10:877073.
32. 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 Pediatrics [Internet]. 2014 Jul [cited 2019 Aug 23];51(7):544–9. Available from: https://www.indianpediatrics.net/july2014/544.pdf.