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Research Article

Prevalence of obesity and hypertension in school going children aged 12 to 16 years-A cross sectional study

Dr Rachita Chatterjee[1], Dr Aditi Agrawal[2], Dr Minal Kemkar[3*]
[1]Assistant Professor, Department of Paediatrics, Baba Raghav Das Medical College, Gorakhpur, Uttar Pradesh, India.
[2]Associate Professor, Department of Paediatrics, Baba Raghav Das Medical College, Gorakhpur, Uttar Pradesh, India.
[3*]Assistant Professor, Department of Paediatrics, Baba Raghav Das Medical College, Gorakhpur, Uttar Pradesh, India.
Email: drkemkar@yahoo.co.in
Corresponding Author: Dr Minal Kemkar
Assistant Professor, Department of Paediatrics, Baba Raghav Das Medical College, Gorakhpur, Uttar Pradesh, India.
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ABSTRACT
Aim: To study the prevalence of obesity and hypertension in school going children aged 12 to 16 years.
Materials and methods: This cross-sectional study was conducted among 200 school-going adolescents aged 12–16 years. Participants were enrolled after obtaining informed consent from parents/guardians. Adolescents with genetic syndromes or chronic systemic illnesses were excluded. Demographic details, anthropometric measurements (height, weight, waist and hip circumference), and blood pressure were recorded using standardized protocols. Body mass index (BMI), waist-hip ratio, and waist circumference were assessed using Indian Academy of Pediatrics (IAP)-modified WHO growth charts and age- and sex-specific Indian reference standards. The association between obesity and hypertension was evaluated using appropriate statistical analysis.
Results: Among the 200 adolescents, 104 (52.0%) were males and 96 (48.0%) were females. Most participants were non-vegetarians (88.0%), consumed junk food (90.0%), were non-obese (82.0%), and had normal weight (78.0%). Hypertension was present in 32 (16.0%) participants, while 12 (6.0%) were pre-hypertensive. Hypertension was more common among males, overweight, and obese participants. However, no significant association was observed between hypertension and sex, dietary pattern, socioeconomic status, junk food consumption, or overweight status ($p>0.05$). Obesity showed a significant association with hypertension ($p=0.021$), with hypertensive cases being more frequent among obese participants (33.3%) than non-obese participants (4.9%).
Conclusion: These findings highlight the need for early screening, lifestyle modifications, and school-based interventions to prevent obesity and reduce the risk of hypertension and its long-term cardiovascular complications in adolescents.

Keywords: Body Mass Index, Adolescents, Childhood Obesity, Hypertension, Obesity.

INTRODUCTION

Increased arterial blood pressure is a major risk factor for cardiovascular, cerebrovascular & renal disease. Indeed high blood pressure or hypertension may be considered as a major cause of morbidity & mortality in many populations. The insidious & steady history of hypertension in adults indicates that essential hypertension in adults is a result of process, that starts early in childhood and adolescent life, but probably goes unnoticed.[1]

Most of the studies of blood pressure carried out in different population have shown a rise of blood pressure with age and obesity.[2] Prevalence of hypertension in children have shown an upward trend from a low <1% to a high of 16.2% in different studies of recent times.[3,4] Investigation of blood pressure in children can contribute not only to the knowledge of etiology of the condition, but also have an important advantage that they may lead to the prevention of high blood pressure before its harmful sequel can occur.[5] Obesity is one of the most important parameter consistently shown to be associated with hypertension. Recently there have been frequent reports of increased prevalence of overweight & obesity in childhood.[6,7,8] Early

childhood obesity is associated with increased risk of subsequent morbidity whether or not obesity persists into adulthood. The rapid increase in the prevalence of overweight and obesity and its potential effect on morbidity & mortality in childhood & adulthood, emphasizes the importance of identifying critical periods for prevention of overweight in the vulnerable population and of understanding the factors that causes excess weight gain.

Childhood Blood pressure (BP) is a strong indicator of adult blood pressure, so, early intervention is important. There is paucity of data on prevalence and determinants of Obesity and HTN among adolescents. Early detection of Hypertension and obesity during childhood and adolescence is important to identify those who are at increased risk of primary hypertension as adults, and who might benefit from earlier intervention and follow-up. Therefore, we designed a present study to predict the prevalence of obesity and hypertension in school going children aged 12 to 16 years.

MATERIALS AND METHOD

After obtaining clearance from institutional ethical committee, a cross-sectional study was conducted in private aided school in urban part of eastern Uttar Pradesh. 200 adolescent school-going girls and boys were enrolled for the study.

Study Population

Inclusion Criteria

- Adolescent school-going girls and boys aged 12 to 16 years.
- Prior informed consent obtained from the participants or their guardians were included.

Exclusion Criteria

- Adolescents with known genetic or syndromic abnormalities, adolescents with chronic systemic medical illnesses related to cardiac, renal, neurologic, etc.
- Adolescents or their guardians who refused consent were excluded.

METHODOLOGY

A standardized proforma collected participants' information, including demographic details and anthropometric measures. Vitals and blood pressure examinations were conducted and meticulously recorded as part of the data collection process. Height measurements were taken using a standardized stadiometer placed on a level surface. Participants removed shoes, socks, and hair ornaments and stood with their feet slightly apart on the baseboard. The back of the head, shoulder blades, buttocks, calves, and heels touched the vertical board. Trunk balance, straight legs, and flat feet were ensured. The head was aligned parallel to the baseboard, and the headboard was gently pressed on top, compressing the hair. The height was recorded in centimeters, rounded to the nearest 0.1 cm.

The weight measurements were taken using standardized electronic weighing scales. Participants were instructed to stand in the middle of the scale with their feet slightly apart, ensuring the display showed 0.0. They were then asked to remain still until their weight appeared on the display. Weight measurements were recorded to the nearest 0.1 kg. The recorded height and weight data were plotted on the Indian Academy of Pediatrics (IAP)-modified WHO growth charts, and the corresponding percentiles were noted.

The waist circumference (WC) was measured using stretch-resistant tape. The measurements were taken at the end of several consecutive natural breaths. The tape was positioned parallel to the floor, at a midpoint between the top of the iliac crest and the lower margin of the last palpable rib in the mid-axillary line. Hip circumference was also measured using stretch-resistant tape. The tape was wrapped around the participant at the largest circumference of the buttocks. It should be snug but not constricting. The measurement was taken parallel to the floor. During both measurements, the participant stood upright with arms relaxed at the sides, feet evenly spread apart, and body weight evenly distributed. WC was compared to age- and gender specific reference curves based on the Indian population. A WC above the 90th centile indicated an increased risk for metabolic and cardiovascular morbidities.

The waist-hip ratio was calculated by dividing waist circumference (cm) by hip circumference (cm). A waisthip ratio of >0.5 predicts cardiovascular disease in adults. The same is true for adolescents as well. With the correct cuff size, blood pressure was measured in the right arm for consistency of practice. Prior permission was obtained from school authorities and parents through informed consent.

Statistical Analysis

All the data from the research subjects were entered into a Microsoft Excel spreadsheet

(Microsoft® Corp., Redmond, WA). Statistical Package for the Social Sciences (SPSS, IBM Corp., Armonk, NY) was used to analyze the data. Categorical variables were represented as percentages and numbers. The chi-square test was used to compare categorical variables across study groups. A P-value of 0.05 was considered statistically significant.

RESULTS

Among the 200 study participants, 104 (52.0%) were males and 96 (48.0%) were females, indicating an almost equal sex distribution. The majority were non-vegetarians (176, 88.0%), consumed junk food (180, 90.0%), were non-obese (164, 82.0%), and had normal weight (156, 78.0%). Hypertension was present in 32 (16.0%) participants, while 168 (84.0%) were normotensive. Additionally, 12 (6.0%) participants were identified as pre-hypertensive. Regarding socioeconomic status, 108 (54.0%) participants belonged to the lower-middle socioeconomic class and 92 (46.0%) to the upper-middle socioeconomic class. Overall, the study population demonstrated a high prevalence of junk food consumption, with 16.0% of participants having hypertension (Table 1).

The study findings showed that out of 200 patients, 32 (16.0%) were hypertensive and 168 (84.0%) were normotensive. Hypertension was more prevalent among males, non-vegetarians, participants consuming junk food, overweight individuals, and obese individuals. However, only obesity showed a statistically significant association with hypertension ($p = 0.028$), with 44.4% of obese participants being hypertensive compared with 9.8% of non-obese participants. No significant associations were observed between hypertension and sex, dietary pattern, socioeconomic status, junk food consumption, or overweight status ($p > 0.05$) (Table 2).

In the present study, 156 (78.0%) were not overweight and 44 (22.0%) were overweight. Hypertension was more common among overweight participants (18.2%) than non-overweight participants (7.7%). However, this association was not statistically significant ($p = 0.384$). (Table 3)

Among the 200 participants, 164 (82.0%) were non-obese and 36 (18.0%) were obese. Hypertension was significantly more common among obese participants (33.3%) than non-obese participants (4.9%), demonstrating a significant association between obesity and hypertension ($p = 0.021$) (Table 4).

Table 1: Demographic Data of the Study

Study Variable	Frequency (n=200)	Percentage
Sex		
Male	104	52.0%
Female	96	48.0%
Diet		
Non-vegetarian	176	88.0%
Vegetarian	24	12.0%
Junk Food Consumption		
No	20	10.0%
Yes	180	90.0%
Obesity		
No	164	82.0%
Yes	36	18.0%
Overweight		
No	156	78.0%
Yes	44	22.0%
Hypertension (HTN)		
No	168	84.0%
Yes	32	16.0%
Pre-Hypertension (Pre-HT)		
No	188	94.0%
Yes	12	6.0%

Socioeconomic Status		
Lower middle	108	54.0%
Upper middle	92	46.0%

Table 2: Comparison of Parameters of Hypertension

Study Variables	**HTN: No**		**HTN: Yes**		**P-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
Sex					0.421
Female (n=96)	84	87.5%	12	12.5%	
Male (n=104)	84	80.8%	20	19.2%	
Diet					0.683
Non-vegetarian (n=176)	148	84.1%	28	15.9%	
Vegetarian (n=24)	20	83.3%	4	16.7%	
Socioeconomic Status					0.792
Lower middle (n=108)	92	85.2%	16	14.8%	
Upper middle (n=92)	76	82.6%	16	17.4%	
Junk Food Consumption					0.615
No (n=20)	16	80.0%	4	20.0%	
Yes (n=180)	152	84.4%	28	15.6%	
Overweight					0.287
No (n=156)	136	87.2%	20	12.8%	
Yes (n=44)	32	72.7%	12	27.3%	
Obesity					0.028
No (n=164)	148	90.2%	16	9.8%	
Yes (n=36)	20	55.6%	16	44.4%	

Table 3: Comparison of Overweight with Hypertension

Study Variable	**HTN No**		**HTN Yes**		**P-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
Overweight					**0.384**
No (n=156)	144	92.3%	12	7.7%	
Yes (n=44)	36	81.8%	8	18.2%	

Table 4: Comparison of Obesity with Hypertension

Study Variable	**HTN No**		**HTN Yes**		**P-value**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
Obesity					**0.021**

No (n=164)	156	95.1%	8	4.9%	
Yes (n=36)	24	66.7%	12	33.3%	

DISCUSSION

Childhood obesity is a grave health issue that impacts the well-being of children and adolescents. This concern is particularly distressing as it sets children on a trajectory toward health conditions previously associated mainly with adults, such as diabetes, hypertension, and hyperlipidemia. Furthermore, childhood obesity can contribute to negative consequences like low self-esteem and depression. First, when considering sex, the current study found a significant association between sex and HTN. A higher percentage of males (19.2%) had HTN than females (12.5%). This finding suggests that males may be more susceptible to developing HTN than females in the studied population. Several studies have shown that men younger than 65 consistently have higher hypertension levels than women of the same age group.[9]

The prevalence of HTN was similar among non-vegetarians (15.9%) and vegetarians (16.7%). While the association was not statistically significant, it is worth noting that the percentage of individuals with HTN was slightly higher among vegetarians. On the contrary, vegetarian dietary patterns have been associated with reductions in risk for several chronic diseases, such as hypertension and high blood pressure.[10,11] The current study found that socioeconomic status was not significantly associated with HTN. However, evidence suggests that individuals with lower socioeconomic status are more likely to engage in unhealthy behaviors, which can contribute to the development of hypertension.[12]

In the present study, the prevalence of hypertension (HTN) was found to be slightly higher among individuals who consumed junk food (20%) compared to those who did not (15.6%), although this difference was statistically insignificant. These findings align with a study conducted by Zhang et al. in Southwest China, which demonstrated that higher adherence to the vegetable-grain pattern and lower adherence to the junk food pattern significantly reduced the incidence of hypertension among the population.[13]

The association between obesity and hypertension is well-established, as evidenced by various studies conducted on children and adults across different genders.[14] In the current study, a significant relationship was observed between obesity and hypertension. Among individuals with obesity, a higher percentage (33.3%) had hypertension than those without obesity (4.9%). These findings are consistent with previous research. For example, the Framingham Offspring Study reported that a significant proportion of new cases of essential hypertension in both men and women were attributable to excess body fat (78% in men and 65% in women).[15] Moreover, even a modest weight gain of 5% was associated with a 20-30% increase in the incidence of hypertension. In a separate Nurses' Health Study involving a large cohort of 82,882 adult women followed over 14 years, body mass index (BMI) emerged as the strongest risk factor for developing hypertension. Obese women had nearly five times the incidence of hypertension compared to those with a BMI below 23.0 kg/m2.[16] These findings underscore the importance of addressing obesity as a significant risk factor for hypertension. The association between excess body fat and hypertension highlights the need for effective strategies for weight management, healthy lifestyle modifications, and public health interventions to combat the rising prevalence of obesity-related hypertension. As per the WHO data on childhood malnutrition, obesity is increasing in developing countries and has started plateauing in developed countries.[17] Further, in the WHO statement on regional and country-wise data on obesity and overweight, India’s major nutritional problem is mentioned in the underweight category. In the general population, underweight may be the major problem, but the obesity and overweight rate is soaring and, if not given enough attention, may become a major health issue with other comorbid conditions much earlier than expected. As per the Government of India's National Family Health Survey 5 (NFHS 5), 36% of children under the age of five are stunted; 19% are wasted; 32% are underweight; and 3% are overweight.[18] India had the highest prevalence of moderate and severe underweight throughout these four decades (24.4% of girls and 39.3% of boys were moderately or severely underweight in 1975, and 22.7% and 30.7% in 2016). In 2016, 97 million of the world’s moderately or severely

underweight children and adolescents lived in India.**Error! Bookmark not defined.**

The study showed a strong correlation between central obesity and hypertension. Though the abnormal blood pressure was measured by different people and finally confirmed, it could not be measured on a different day in a different setting. The other reasons for hypertension need to be ruled out, which was not possible as there was no access to past medical records. The study population is more representative of urban children as the rural population could not be included due to practical difficulties.

CONCLUSION

Obesity, particularly central obesity, is an important risk factor for hypertension and cardiovascular disease. In the present study, hypertension was more common among males and showed a significant association with obesity. These findings highlight the need for early screening, lifestyle modifications, and school-based interventions to prevent obesity and reduce the risk of hypertension and its long-term cardiovascular complications in adolescents.

REFERENCES

1. Bagudai S, Nanda P, Kodidala SR. Prevalence of obesity & hypertension in adolescent school going children of Berhampur, Odisha, India. Int J Physiother Res 2014;2(6):777-80
2. WHO preventing chronic disease: a vital investment. World Global Report. Genera: World Health organization:2005
3. Gupta AK, Ahmad AJ. Normal blood pressures and the evaluation of sustained blood pressure elevation in childhood. Indian Pediatrics. 2019;27(1):33-42.
4. Sachdev Y. Normal blood pressure & hypertension in Indian children Indian pediatric 2021;21:41-48.
5. Verma M, Chhatwal J, George SM. Obesity and hypertension in children. Indian Pediatr. 2004;31(9):1065-9.
6. Chhatwal J, Verma M, Rial SK. Obesity among preadolescent and adolescents of a developing country (India). Asia Pac J. Clin Nutr 2014;13:231-5.
7. 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 pediatrics. 2016;43(11):943.
8. Khadikar VV, Khadikar AV. Prevalence of obesity in affluent school boys in pune. Indian pediatr 2004; 41:857-8.
9. Everett B, Zajacova A. Gender differences in hypertension and hypertension awareness among young adults. Biodemography and social biology. 2015;61(1):1-7.
10. Appleby PN, Davey GK, Key TJ. Hypertension and blood pressure among meat eaters, fish eaters, vegetarians and vegans in EPIC–Oxford. Public health nutrition. 2022;5(5):645-54.
11. Pettersen BJ, Anousheh R, Fan J, Jaceldo-Siegl K, Fraser GE. Vegetarian diets and blood pressure among white subjects: results from the Adventist Health Study-2 (AHS-2). Public health nutrition. 2012;15(10):1909-16.
12. Hujova Z, Rostakova K: Several anthropometric predictors of cardiovascular disease in central Slovakian adults: socioeconomic and educational differences. Bratisl Lek Listy. 2013, 114:31-5.
13. Zhang Y, Wang Y, Chen Y, Zhou J, Xu L, Xu K, et al. Associations of dietary patterns and risk of hypertension in Southwest China: a prospective cohort study. International journal of environmental research and public health. 2021;18(23):12378.
14. Faulkner JL, Belin de Chantemèle EJ. Sex differences in mechanisms of hypertension associated with obesity. Hypertension. 2018;71(1):15-21.
15. Vasan RS, Larson MG, Leip EP, Kannel WB, Levy D. Assessment of frequency of progression to hypertension in non-hypertensive participants in the Framingham Heart Study: a cohort study. The Lancet. 2021;358(9294):1682-6.
16. Forman JP, Stampfer MJ, Curhan GC. Diet and lifestyle risk factors associated with incident hypertension in women. Jama. 2019;302(4):401-11.
17. Malnutrition. (2023). Accessed: August 1, 2023: https://www.who.int/news-room/factsheets/detail/malnutrition.
18. National family health survey (NFHS-5), 2019-21. (2023). Accessed: August 1, 2023: https://main.mohfw.gov.in/sites/default/files/NFHS-5_Phase-II_0.pdf