CORRELATION OF BODY MASS INDEX WITH BLOOD PRESSURE IN SCHOOL GOING CHILDREN AGED 6 TO 14 YEARS IN RAMDHUNI MUNICIPALITY OF EASTERN NEPAL

Nabal Kishor Ray[1], Hem Sagar Rimal[2], Rajnish Mishra[3], Shailendra Kumar Yadav[4], Shivani Singh[4]*

Affiliation

1. *Lecturer, Birat Medical College and Teaching Hospital, Nepal*
2. *Professor, Birat Medical College and Teaching Hospital, Nepal*
3. *Consultant, Manipal College of Medical Science, Nepal*
4. *Medical officer, Manipal college of medical sciences, Nepal*

ARTICLE INFO

Received : 29 June, 2023

Accepted : 05 July, 2023

Published : 10 November, 2023

ORA 358

DOI: https://doi.org/10.3126/bjhs.v8i2.59860

Corresponding Author

Dr. Nabal Kishor Ray

Lecturer

Birat Medical College & Teaching Hospital, Nepal

Email: nabalray7@gmail.com

ORCID : https://orcid.org/0000-0002-1238-9469

Citation

Correlation of Body Mass index with Blood Pressure in School Going Children aged 6 to 14 Years in Ramdhuni Municipality of Eastern Nepal. Nabal Kishor Ray, Hem Sagar Rimal, Rajnish Mishra, Shailendra Kumar Yadav, Shivani Singh BJHS 2023;8(2)21. 2057 -2061.

ABSTRACT

Introduction

Children of school age groups in developing countries are facing the problem of overweight and obesity. Childhood obesity continues as obesity in adulthood. The chance of high blood pressure (BP) in overweight and obese children is more than healthy weight children.

However, in Nepal, data on the relationship between hypertension and obesity, and disease burden in children at the national level are limited. To overcome these diseases and to develop effective prevention strategies, knowing the prevalence of the disease is a priority. Thus, this study aims to determine the prevalence and the relationship between overweight/obesity with BP in school going children aged 6-14 years, living in Ramdhuni municipality of eastern Nepal.

Objective

To find prevalence and the association of BMI with blood pressure in school going children aged 6 to 14 years in Ramdhuni municipality of eastern Nepal.

Methodology

This was a school based cross-sectional prospective study conducted at various schools in Ramdhuni municipality from February -March 2022. A total of 490 apparently healthy students of age group 6-14 years of both boys and girls were enrolled. Measurement of height and weight was done by standard procedure. The data was entered into Microsoft offices excel and analyzed using a statistical package for social sciences (SPSS 20.0).

Result

In this present study, data of 490 students aged between 6 and 14 years were evaluated. Of them, 77.8% (n=381) were normal weight, 10.6% (n=52) were overweight and 5.9% (n=29) were obese. The prevalence of hypertension and prehypertension was 0.8% (n=4) and 0.6% (n=3), respectively. The body mass index was statistically significant as an explanatory variable of hypertension for both genders.

Conclusion

This study concludes that overweight and obese children are at a significantly higher risk for hypertension than are normal weight children. Blood pressure measurement should be routine and frequent in children, especially overweight and obese children.

KEYWORD

BMI, Blood pressure, Overweight, Obesity.

INTRODUCTION

Body mass index is positively and independently associated with morbidity and mortality from hypertension, cardiovascular disease, type II diabetes mellitus, and other chronic diseases.[1] There is evidence that hypertension in adults starts in childhood.[2,3] Children whose blood pressure and body weight are high for their age are more likely to develop hypertension in the future .[4]

In recent years, the prevalence of hypertension in children and adolescents is increasing. Various studies have reported that the prevalence of overweight among adolescents varies from 10% to 30%.[5] Differences in the lifestyle, dietary pattern, and physical activities are the principal contributors of overweight and obesity, responsible for variation in prevalence within the country.[5]

Nearly 50%- 80% of obese children continue as obese in adulthood.[6] The prevalence of hypertension (HTN) varies from 3.8% to 24.8% in youth with overweight and obesity.[7] Children with obesity and HTN may be accompanied by additional cardio metabolic risk factors such as dyslipidemia and disordered glucose metabolism[8,9] which may contribute their effects on BP or may represent comorbid conditions arising from the same adverse lifestyle behaviors.[10,11] Some researchers suggested that the presence of multiple risk factors along with obesity and HTN increases the cardiovascular (CV) risk to a greater extent than by the individual risk factor alone .[12]

Studies conducted with large samples in several countries have demonstrated that high blood pressure is an important determinant for obesity in children.[13, 14] However, in Nepal, data on the relationship between hypertension and obesity, and disease burden in children at the national level are limited. To overcome these diseases and to develop effective prevention strategies, knowing the prevalence of the disease is a priority.

Thus this study was aimed to determine the prevalence and the relationship between obesity and hypertension in school going children aged 6-14 years, living in Ramdhuni municipality of Eastern Nepal.

METHODOLOGY

This was a school based cross-sectional prospective study conducted at various schools in Ramdhuni municipality from February - March 2022. After getting ethical clearance from the BMCTH IRC (Ref: IRC-PA-162/2078-79), a total of 490 apparently healthy students of age group 6-14 years of both boys and girls were enrolled. Three primary schools were selected with a simple randomized method. All students were from English medium schools. Screening was done by face to face interview and general examination to select the students.

Those suffering from any systemic disease were excluded from the study. Data collection days were determined and data collectors (volunteer's health staff and medical students) were trained. After taking the consent from the concerned school Principal, measurement of height and weight of enrolled students were taken by standard procedure. BMI was calculated by dividing weight (kg) by the square of the body height (m2), which was expressed in units of kg/m^2.

BMI percentile value based on their age and gender was determined. Those BMI percentiles less than 5th percentile was considered as underweight, from 5th percentile to less than the 85th percentile as normal weight, from the 85th to less than 95th percentile as overweight and equal to or greater than the 95th percentile was considered as obese.[15] BP measurement was done by an auscultatory method.

Resting blood pressure measurements was performed manually using a mercury sphygmomanometer with a cuff appropriate to their age. Measurements were performed in the sitting position after at least a 10-minute rest.

According to age and height, systolic or diastolic blood pressures in the >/=95th percentile was considered as hypertension, between the >/=90th percentile and the <95th percentile as prehypertension, and lower than the 90th percentile as normal.[16] The data was entered into Microsoft offices excel and analyzed using statistical package for social sciences (SPSS 22.0).

RESULT

In this present study, data of 490 students aged between 6 and 14 years were evaluated. Of the students, 54.48% (n=267) were male. The mean age of the girls and boys were 10.25±1.92 and 10.30±2.11, respectively. The students' mean BMI value was 17.06±2.82, mean systolic blood pressure value was 102.07±10.01 mmHg and mean diastolic blood pressure value was 63.08±9.25 mmHg (Table 1). Of them, 77.8% (n=381) were normal weight, 10.6% (n=52) were overweight and 5.9% (n=29) were obese (Table 2) .The prevalence of hypertension and prehypertension was 0.8% (n=4) and 0.6% (n=3), respectively (Table 3).

The distribution of BMI and blood pressure values of the participants for age and gender is shown in (Table 4). An increase was determined in the BMI and diastolic blood pressure mean values with age in both genders (p<0.001). For the 6-year-old boy students, the BMI and diastolic blood pressure mean values were 15.5±2.08 kg/m2 and 57.86 ± 6.99 mmHg respectively. These values increased to 18.69± 2.63 kg/m2 and 63.70±9.37 mmHg for the 14-year-old boy students. The values were 14.82±0.92 kg/m2 and 55±5.48 mmHg for the 6-year-old girl students, and 19.38±2.72 kg/m2 and 63.08±4.80 mmHg for the 14-year-old girl students. The comparison of girls and boys BMI (16.82±2.71 vs. 17.26±2.90), systolic (101.73±10.45 vs. 102.36±11.11) and diastolic blood pressure (62.42±9.08 vs. 63.63±9.37) mean values revealed no significant difference (P>0.05).

The results of regression analysis indicating the factors affecting the blood pressure values of the boys and girls are shown in (Table 5). In the girls, BMI and age accounted for 10% and 4.1% of the variance for the systolic blood pressure and diastolic blood pressure respectively. These rates were 10.1% and 11.2% for the boys. BMI was identified as the variable directly affecting both the systolic blood pressure and the diastolic blood pressure for the two genders (p<0.001)

Table 1. Mean distribution of age, height, weight, BMI, SBP and DBP according to gender

Variables	Female (n=223)		Male (n=267)		p values	Total (n=490)			
	Mean	SD	Mean	SD		Mean	SD	Minimum	Maximum
Age in years	10.25	1.92	10.30	2.11	0.808	10.28	2.02	6.00	14.00
Height (Meter)	1.330	0.117	1.331	0.136	0.949	1.331	0.127	0.970	1.690
Weight (Kg)	30.35	8.72	31.32	10.02	0.255	30.88	9.46	13.70	70.00
BMI	16.82	2.71	17.26	2.90	0.081	17.06	2.82	10.01	29.62
SBP	101.73	10.45	102.36	11.11	0.519	102.07	10.81	60.00	140.00
DBP	62.42	9.08	63.63	9.37	0.149	63.08	9.25	40.00	80.00

Table 2: BMI distribution

Interpretation of BMI	No of students	Percentage
Underweight	28	5.7
Normal weight	381	77.8
Overweight	52	10.6
Obese	29	5.9
Total	**490**	**100**

Table 3: Blood pressure distribution

Status	No of students	Percentage
Normal	483	98.6
Prehypertension	3	0.6
Hypertension	4	0.8
Total	490	100.0

Table 4: Body mass index (BMI) and systolic and diastolic blood pressure according to age and gender.

Boys	N	BMI		SBP		DBP	
		Mean	SD	Mean	SD	Mean	SD
6	14	15.50	2.08	94.29	11.58	57.86	6.99
7	17	16.62	1.83	100.59	10.88	61.76	10.74
8	23	16.03	1.48	96.52	9.82	59.57	8.78
9	33	16.21	2.54	102.73	10.69	61.82	9.83
10	54	17.12	2.79	103.52	10.67	63.15	8.20
11	50	17.34	2.78	107.00	8.86	68.60	9.26
12	31	18.13	3.07	100.00	13.42	65.16	9.96
13	27	19.13	3.92	103.33	11.44	63.70	7.42
14	18	18.69	2.63	103.33	9.70	63.33	9.70
Total	267	17.26	2.90	102.36	11.11	63.63	9.37
F=		4.585		3.387		3.581	
p=		<0.001		0.001		0.001	
		BMI		SBP		DBP	
Girls	N	Mean	SD	Mean	SD	Mean	SD
6	6	14.82	0.92	88.33	9.83	55.00	5.48
7	15	15.73	2.51	96.00	10.56	58.67	9.16
8	17	15.48	1.37	99.41	9.66	59.41	8.99
9	36	15.41	1.56	100.56	9.24	60.28	6.96
10	51	16.90	2.93	103.63	11.88	64.31	11.00
11	42	16.88	2.00	103.10	9.24	65.24	9.17
12	28	17.87	3.38	101.79	10.20	62.50	9.28
13	15	18.99	2.62	105.33	8.34	62.67	5.94
14	13	19.38	2.72	104.62	9.67	63.08	4.80
Total	223	16.82	2.71	101.73	10.45	62.42	9.08
F=		6.825		2.768		2.189	
p=		<0.001		0.005		0.029	

Table 5. Association of overweight and obesity with hypertension.

Variables	HTN Present	HTN Absent	OR	P Value
Overweight and obesity present	3	78	15.69	0.015
Overweight and obesity absent	1	408		

Table 6: Multiple regression analysis of blood pressure results.

Dependent Variable	Gender	Independent variables	R^2 (Adj)	β	t	p value
Systolic	Female	Age and BMI	0.100	78.002	16.81	<0.001
		Age		0.745	1.949	0.053
		BMI		0.957	3.532	0.001
	Male	Age and BMI	0.101	78.85	17.993	<0.001
		Age		0.353	1.089	0.277
		BMI		1.151	4.878	<0.001
Diastolic	Female	Age and BMI	0.041	48.474	11.652	<0.001
		Age		0.559	1.632	0.104
		BMI		0.488	2.011	0.046
	Male	Age and BMI	0.112	42.507	11.565	<0.001
		Age		0.391	1.44	0.151
		BMI		0.99	5.003	<0.001

DISCUSSION

This study was a school-based study and planned to include the students of different English medium schools in Ramdhuni municipality of Eastern Nepal. This study suggested that 52 (10.6%) students were overweight and 29 (5.9%) were obese which is almost similar in comparison to the study by Jain et al. in 2016 in India shown their study 12.5 % overweight and 5.6% obese.[17] This result is lower in comparison to the study on school children in 2000 by Kapil et al. in Delhi, India where the overall prevalence of obesity was 7.4 %.[18] In this study, overweight and obesity are more in boys than girls, and similar result was found by Goyal et al. in 2010.[19]

This study reported that overweight and obese subjects both in boys and girls experience more BP (both SBP and DBP) in comparison to healthy weight individuals. The findings of this study was similar with the data in standard guideline of updated 4th report for screening and management of high BP in children and adolescents.[7]

This study suggested that there was a positive correlation between BMI with SBP and DBP in both genders. Our report is agreed with Also et al., they reported a significant correlation between BMI with SBP and DBP in both sex in primary school children of Nigeria.[20] Significant positive correlation between BMI and BP (both SBP and DBP) has also been suggested by other studies by Taksande et al. and Raj et al. [21,22] Analysis the data with implementation of odds ratio (Table 5), our study suggested that overweight and obesity were associated with HTN. Berkey et al. in their study suggested that greater BMI in adolescence is associated with elevated BP.[23] Sorof and Daniels confirmed that obesity has become an increasingly important medical problem in children and adolescents. They suggested that

obese children are at a 3-fold higher risk for development of HTN than nonobese children.[24]This study reported that the hypertensive students were in the overweight and obese category. In obesity, there is abnormal renal tubular dysfunction in which tubular reabsorption of sodium is increased which is responsible for the expansion of extracellular fluid volume, blood volume and hence BP. Also in obesity, there is activation of the sympathetic nervous system, renin-angiotensin-aldosterone system. Thus, all these mechanisms contribute to high BP in overweight and obese participants.[25]

The results of the regression analysis showed that high BMI is an important predictor for the risk of hypertension in children. In both sexes, both diastolic and systolic blood pressure increased as BMI increased.

The results obtained from this present study are applicable only to the students surveyed and thus they cannot be generalized to other school children.

CONCLUSION

This study concludes that overweight and obese children are at a significantly higher risk for hypertension than are normal weight children. Blood pressure measurement should be routine and frequent in children, especially overweight and obese children. To protect children against cardiovascular disease risks in adulthood, it is important to diagnose their problems at an early stage and to implement preventive interventions.

RECOMMENDATION

Such studies could be done in multiple Centers so that conclusion can be generalized. Number of the study subject could be increased to increase the power of the study.

LIMITATION OF THE STUDY

Our study included only three schools. For the evaluation of prevalence, a larger group of students is more appropriate. Socioeconomic status of the parents is lacking here which is a contributing factor of overweight and obesity. Dietary habit of the students may be considered for overweight and obesity. Further study may be done considering all these aspects for a better output.

ACKNOWLEDGEMENT

I wish to express my sincere gratitude to the faculties of the Department of Pediatrics for their continuous support throughout the study period. My special thanks go to all the children and teachers who participated in the study.

CONFLICT OF INTEREST

None

REFERENCES

1. F. X. Pi-Sunyer. “Medical hazards of obesity.” Annals of Internal Medicine. 1993; 119 (7): 655–60. https://doi.org/10.7326/0003-4819-119-7_Part_2-199310011-00006
2. Lurbe E, Redon J. Ambulatory blood pressure monitoring in children and adolescents: the future. J Hypertens 2000; 18 (10): 1351-4. DOI: 10.1097/00004872-200018100-00001
3. Rosner B, Prineas RJ, Loggie JMH, Daniels SR. Blood pressure nomograms for children and adolescents, by height, sex and age, in the United States. J Pediatr 1993; 123: 871- 886. https://doi.org/10.1016/S0022-3476(05)80382-8.
4. He Q, Ding ZY, Fong DY, Karlberg J. Blood Pressure is associated with body mass index in both normal and obese children. Hypertension 2000; 36: 165-170. https://doi.org/10.1161/01.HYP.36.2.165
5. Kotian MS, Kumar SG, Kotian SS. Prevalence and determinants of overweight and obesity among adolescent school children of South Karnataka, India. Indian J Community Med 2010; 35:176-8. DOI: 10.4103/0970-0218.62587
6. Styne DM. Childhood and adolescent obesity. Prevalence and significance. Pediatr Clin North Am 2001; 48:823-54. DOI: 10.1016/s0031-3955(05)70344-8
7. Flynn JT, Kaelber DC, Baker-Smith CM, Blowey D, Carroll AE, Daniels SR, et al. Clinical practice guideline for screening and management of high blood pressure in children and adolescents. Pediatrics 2017; 140. DOI: 10.1542/peds.2017-1904
8. Yip J, Facchini FS, Reaven GM. Resistance to insulin-mediated glucose disposal as a predictor of cardiovascular disease. J Clin Endocrinol Metab 1998; 83:2773-6. DOI: 10.1210/jcem.83.8.5005
9. Kashyap SR, Defronzo RA. The insulin resistance syndrome: Physiological considerations. Diab Vasc Dis Res 2007; 4:13-9. DOI: 10.3132/dvdr.2007.001
10. Zhang T, Zhang H, Li S, Li Y, Liu Y, Fernandez C, et al. Impact of adiposity on incident hypertension is modified by insulin resistance in adults: Longitudinal observation from the Bogalusa Heart Study. Hypertension 2016; 67:56-62. DOI: 10.1161/ HYPERTENSIONAHA. 115.06509
11. Lurbe E, Torro I, Aguilar F, Alvarez J, Alcon J, Pascual JM, et al. Added impact of obesity and insulin resistance in nocturnal blood pressure elevation in children and adolescents. Hypertension 2008; 51:635-41. DOI: 10.1161/HYPERTENSIONAHA.107.099234
12. Chinali M, de Simone G, Roman MJ, Best LG, Lee ET, Russell M, et al. Cardiac markers of pre-clinical disease in adolescents with the metabolic syndrome: The strong heart study. J Am Coll Cardiol 2008; 52:932-8. DOI: 10.1016/j.jacc.2008.04.013
13. Lu X, Shi P, Luo CY, et al. Prevalence of hypertension in overweight and obese children from a large school-based population in Shanghai, China. BMC Public Health 2013; 13: 24. https://doi.org/10.1186/1471-2458-13-2414. Dong B, Ma J, Wang HJ, Wang ZQ. The association of overweight and obesity with blood pressure among Chinese children and adolescents. Biomed Environ Sci 2013; 26 (6): 437-444. DOI: 10.3967/0895-3988.2013.06.004
15. Centers for Disease Control and Prevention. BMI for Children and Teens; 2009b. Available from: http://www.cdc.gov/ healthy weight/assessing/bmi/childrens_bmi/about_childrens_bmi. html. [Last retrieved on 2009 Aug 10].
16. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatr 2004; 114(2): 555-576. doi: 10.1542/peds.2004-2345.
17. Jain A, Jain A, Pankaj JP, Sharma BN, Paliwal A. The study of obesity among children aged 5-18 years in Jaipur, Rajasthan. Muller J Med Sci Res 2016; 7:125-30. DOI: 10.4103/0975-9727.185013.

18. Kapil U, Singh P, Pathak P, Dwivedi SN, Bhasin S. Prevalence of obesity amongst affluent adolescent school children in Delhi. Indian Pediatr 2002; 39:449-52. PMID: 12037275.
19. 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; 58:151-8. PMID: 20848812
20. Also U, Asani M, Ibrahim M. Prevalence of elevated blood pressure among primary school children in Kano Metropolis, Nigeria. Niger J Cardiol 2016; 13:57-61. DOI: 10.4103/0189-7969.165167.
21. Taksande A, Chaturvedi P, Vilhekar K, Jain M. Distribution of blood pressure in school going children in rural area of Wardha District, Maharashtra, India. Ann Pediatr Card 2008;1:101-6. doi: 10.4103/0974-2069.43874 .
22. Raj M, Sundaram KR, Paul M, Deepa AS, Kumar RK. Obesity in Indian children: Time trends and relationship with hypertension. Natl Med J India 2007; 20:288-93. PMID: 18335794
23. Berkey CS, Gardner J, Colditz GA. Blood pressure in adolescence and early adulthood related to obesity and birth size. Obes Res 1998; 6:187-95. DOI: 10.1002/j.1550-8528.1998.tb00336.x.
24. Sorof J, Daniels S. Obesity hypertension in children: A problem of epidemic proportions. Hypertension 2002; 40:441-7. DOI: 10.1161/01.hyp.0000032940.33466.12
25. Nanawarel NL, Gavkare AM, Surdi AD. Study of Correlation of Body Mass Index (BMI) with blood pressure in school going children and adolescents. Int J Recent Trends Sci Technol 2011; 1:20-6.