ORIGINAL ARTICLE

Prevalence and Risk Factors of Hypertension, Overweight and Obesity among School Children in Madurai, Tamil Nadu: A Cross Sectional Study

Trupti Bodhare[1], Samir Bele[1], Hareini Murugvel[2], J. Vijay Anto[1]*

[1]Department of Community Medicine, Velammal Medical College Hospital & Research Institute, Madurai-625009 (Tamil Nadu) India,[2]Department of Radiation Oncology, Sri Ramachandra Institute of Higher Education and Research, Porur-600116 (Tamil Nadu) India

Abstract:

Background: Most of the Non-communicable Diseases (NCDs) including obesity and hypertension originate in early life, and manifest in adulthood leading to increased morbidity and mortality. Its identification among children has remained neglected area in India. *Aim and Objectives:* To estimate the prevalence of overweight, obesity and hypertension among school children and various risk factors among them to propose sustainable intervention. *Material and Methods:* A cross-sectional study was conducted among 544 school children between the ages of 10 to 14 years in Madurai. A semi-structured questionnaire was used to evaluate the social-demographic characteristics, diet history, and other behavioral risk factors. Anthropometric measurements were recorded using standard equipment and methodology. *Results:* The mean age of the respondents was 11.81 ± 0.041 years and 343 were male and 201 were female students. A total of 49(9%) children were overweight and 5(0.91%) were obese. Stage 1 hypertension was observed among 74(13.60%) children and 15(2.75%) children were having stage 2 hypertension. Children residing in urban area (p=0.001, OR=3.065), belonging to upper socioeconomic class (p=0.001, OR=14.182) having higher systolic (p=0.054, OR=1.022), diastolic blood pressure (p=0.010, OR=1.042), and watching TV>2 hours (p=0.000, OR=4.609) were significantly associated with overweight/obesity. Higher Body Mass Index (BMI) (p=0.001, OR= 1.113), consumption of snack and junk foods (p=0. 0.011, OR =1.255) and watching TV more than 2 hours (p=0.003, OR =1.870) were significant predictors for hypertension. *Conclusion:* The high prevalence of hypertension and its association with overweight/obesity and associated risk factors warrants immediate attention. Regular screening, care of children for NCDs and early identification of its risk factors followed by health education to make them adopt healthy lifestyle is the need of the hour.

Keywords: Overweight, Obesity, Hypertension, Children, Risk Factors

Introduction:

The substantial burden of Non-Communicable Diseases (NCDs), its rising trend, associated high mortality, disability coupled with catastrophic health expenditure warrants immediate attention to design cost effective preventive strategies. Modernization of lifestyle leads to adoption of harmful practices like tobacco use, unhealthy diet, and physical inactivity, resulting in overweight/obesity, raised blood sugar, and raised blood pressure which are major determinants of NCDs [1].

It is an established fact that most of the NCDs originate in early life, progress over time, and manifest in adulthood. The complex interaction between genetics, lifestyle, and environmental factors are attributed to this outcome. Raised

blood pressure in children and adolescent would probably continue in the same track as adults leading to increased cardiovascular morbidity and mortality. Several epidemiological studies have demonstrated this association emphasizing the implementation of prevention strategies in childhood [2]. The risk of adult obesity increases manifold if the obesity is present during childhood [3-4]. Hypertension is one of the major risk factors associated with obesity among children and recent estimates showed an alarming rise in the prevalence of both the diseases [5-6].

Primordial prevention is prevention of the emergence or development of risk factors and has gained significant consideration in the recent years for the prevention of NCDs. The mainstay of primordial prevention lies in health education encouraging people to adopt healthy lifestyles and disown the harmful lifestyle practices especially among child population. Thus, the foundation of lifelong health can be built in childhood through sustained interventions and it is the most cost-effective way to delay the incidence of NCD risk factors and outcomes [7]. There is an urgent need to identify the prevalence of NCDs among children, their lifestyle practices and other risk factors in order to develop and implement a sustainable intervention. Promoting a healthy lifestyle is crucial to halt the rise in overweight/ obesity, hypertension and other NCDs in India.

The present study aimed to estimate the prevalence of hypertension and obesity among school children, its association and the role of various lifestyles and behavioral risk factors in order to educate the children for prevention of NCDs.

Materials and Methods:

A cross-sectional descriptive study was conducted among 544 school children between the age of 10 to 14 years at Velammal Vidyalaya, Madurai, Tamil Nadu selected through purposive sampling. The study was approved by Institutional Ethics Committee. The sample size was calculated based on the approximately 6% the prevalence of hypertension as reported by the study done in similar age group. Considering the level of confidence 95% with precision of 0.02 the estimated sample size was 542.

A written permission was obtained from the Principal of Velammal Vidyalaya. The purpose of the study and informed consent procedure were explained to all students in-detail and they were given informed consent form along with participant information sheet for obtaining informed consent from the parents and written consent was obtained for the children in the presence of class teacher at the time of data collection.

A semi-structured questionnaire was used which consisted of the socio-demographic characteristics, diet history, behavioral risk factors and physical activity related information.

Anthropometric measurements were recorded using standard equipment and methodology. Body Mass Index (BMI) estimation was done by measuring height in an upright position using stadiometer and weight was measured using a standard weighing scale. The waist circumference was measured as the smallest girth between the costal margin and the iliac crest and the Hip circumference as the widest girth.

Overweight and obesity were defined by using the appropriate BMI cutoff values for age and sex provided by the World Health Organization.

Blood pressure was recorded in sitting position in the right arm by auscultatory method. The first and fifth Korotkoff sounds were used for systolic and diastolic blood pressure. The child was considered to be hypertensive if the SBP and/or DBP that are greater than or equal to the 95th percentile for sex, age, and height on three occasions.

The data was entered an excel sheet and analyzed using R Programming. The results were expressed in percentages. The prevalence rates of hypertension and obesity was estimated according to the various categories like age, sex, socioeconomic status, etc. Chi-square test and t test were used appropriately to study the association of hypertension, obesity and its association with various lifestyle related risk factors. Ordinal logistic regression model was used to assess the most predominant risk factors for hypertension and obesity.

Results:

The socio-demographic, anthropometric characteristics and hemodynamic parameters of the participants are shown in Table 1. The mean age of the participant was 11.81 ± 0.041 years and 280

Table 1: Socio-demographic, Anthropometric Characteristics and Hemodynamic Parameters of the Participants

Demographic variables	Male (n=343)	Female (n=201)	Total	*p* value
Age	11.80 ± 0.05	11.81 ± 0.07	11.81 ± 0.041	0.914
Socio-economic status n (%)				
Upper lower	4 (0.7)	3 (0.6)	7 (1.3)	0.873
Lower middle	41 (7.5)	26 (4.8)	67 (12.3)	
Upper middle	124 (22.8)	66 (12.1)	190 (34.9)	
Upper	174 (32.0)	106 (19.5)	280 (51.5)	
Height	146.91 ± 0.50	147.90 ± 8.59	147.27 ± 0.387	0.215
Weight	40.64 ± 0.54	41.10 ± 0.71	40.81 ± 0.430	0.607
BMI	18.69 ± 0.19	18.69 ± 0.26	18.69 ± 0.158	0.978
Waist Circumference	68.94 ± 0.55	68.97 ± 0.68	68.95 ± 0.427	0.979
Hip	78.17 ± 0.55	77.42 ± 0.76	77.89 ± 0.443	0.414
BP-Systolic	110.31 ± 0.56	109.22 ± 0.83	109.91 ± 0.470	0.263
BP-Diastolic	71.90 ± 0.45	71.83 ± 0.53	71.87 ± 0.353	0.930

Values expressed in Mean ± SEM

(51.5%) belonged to upper socioeconomic class. The mean BMI was 18.69 ± 0.158. The mean systolic blood pressure of the participant was 109.91 ± 0.470 mmHg and mean diastolic blood pressure was 71.87 ± 0.353 mmHg. A marginal difference was observed in the context of age, height, weight, BMI, waist circumference and waist hip ratio among both the groups. Systolic and diastolic blood pressures were marginally higher among boys as compared with girls. There was no statistically significant differences observed in the context of gender and socio-demographic, anthropometric characteristics and hemodynamic parameters of the participants.

Table 2 presents the prevalence of obesity and hypertension. Of the total 544 children, 49(9%) children were overweight and 5(0.91%) were obese. Stage 1 hypertension was observed among 74(13.60%) children and 15(2.75) children were having stage 2 hypertension. Pre- hypertension was observed among 60(11.02%) of the children.

Table 3 shows the factors affecting BMI using ordinal logistic regression model. The relationship between BMI (Ordinal scale) and other factors such as gender, age, location, socio-economic status, family history of non-communicable diseases, fruits and vegetable servings per week, snacks and junk food, blood pressure, watching television and physical activity were analyzed through bivariate analysis. On the basis of bivariate analysis, we could identify some potential factors such as blood pressure, number of days of sports activity per week, location, socio-economic status and watching television for performing multivariate modeling.

Table 2: Prevalence of Obesity and Hypertension

Variables		Number of students	Percentage (%)
BMI	**Severe Thinness**	21	3.86
	Thinness	29	5.33
	Normal	440	80.88
	Overweight	49	9.00
	Obesity	5	0.91
Total		544	100
Blood Pressure	**Pre-hypertension**	60	11.02
	Normal	395	72.61
	Stage 1 HTN	74	13.60
	Stage 2 HTN	15	2.75
Total		544	100

Table 3: Factors that Affecting BMI using Ordinal Logistic Regression Model

Variables	OR	95% Confidence Level OR [LL-UL]	*p*-value
Location Urban (Reference category: Rural)	3.065	[1.556-6.031]	0.001**
Socio-economic status			
Upper	14.182	[2.915-68.993]	0.001**
Upper Middle	9.669	[1.972-47.417]	0.005**
Middle (Reference category: Lower Middle)	5.512	[1.062-28.617]	0.042*
Systolic Blood Pressure	1.022	[0.998-1.046]	0.054
Diastolic Blood Pressure	1.042	[1.01-1.076]	0.010**
Number of days of sports activity per week	1.055	[0.953-1.169]	0.297
Watch TV>2 hours (Reference category: Watch TV<=2 hours)	4.609	[2.726-7.791]	0.000**

**Significant at 0.05 level (2-tailed), **Significant at 0.01 level (2-tailed)Dependent Variable: BMI (Ordinal Scale)*
Nagelkerke R-square: 0.194

The location of the children is significant predictor for the level of BMI i.e., the odds of urban children to be high level of BMI is 3.065 times that of rural children (p=0.001). Similarly, the odds of upper class children to be high level of BMI is 14.182 times that of lower middle class children (p=0.001), the odds of upper middle class children to be high level of BMI is 9.669 times that of lower middle class children (p=0.005) and the odds of middle class children to be high level of BMI is 5.512 times that of lower middle class children (p=0.042). The blood pressure both systolic (p= 0.054)} and diastolic (p=0.01) were one of the significant predictors for higher BMI level i.e., one unit increase in systolic blood pressure, we expect 1.022 increases in the odds of being higher level of BMI. Similarly, one unit increase in diastolic blood pressure, we expect 1.042 increases in the odds of being higher level of BMI. Finally, the odds of children who watch TV more than 2 hours to be high level of BMI is 4.609 times that of children who watch TV less than 2 hours.

Table 4 shows the factors that affecting hypertension using ordinal logistic regression model. On the basis of bivariate analysis, we could identify some potential factors such as BMI, number of day's involved in sport activities per week, consumption of fruits and vegetables per week, snacks and junk food per week and watching TV for performing multivariate modeling.

Table 4: Factors that Affecting Hypertension using Ordinal Logistic Regression Model

Variables	OR	95% Confidence Level OR [LL-UL]	*p*-value
BMI	1.113	[1.055-1.173]	0.001**
Number of days of sports activity per week	0.991	[0.902-1.088]	0.846
Fruits and Vegetable serving per week	0.817	[0.505-1.322]	0.410
Snacks and junk food consumption per week	1.255	[0.450-0.126]	0.011**
Watch TV>2 hours (Reference category: Watch TV<=2 hours)	1.870	[1.232-2.835]	0.003**

**Significant at 0.05 level (2-tailed), **Significant at 0.01 level (2-tailed)Dependent Variable: Hypertension (Ordinal Scale) Nagelkerke R-square: 0.107*

BMI was found to be significant predictors (p=0.001, OR =1.113) for enhancing blood pressure level i.e., one unit increase in BMI, we expect 1.113 increases in the odds of being higher level of blood pressure. Consumption of snack and junk foods (p=0.011, OR =1.255) and watching TV more than 2 hours (p=0.003, OR =1.870) were also significant predictors for the hypertension. However, no significant association was observed between consumption of fruits and vegetables per week and number of days of sports activity per week with hypertension among children.

Discussion:

The current study aimed to estimate the burden of NCDs and its risk factors particularly in younger age group. The younger age group is critical since attitudes and behavioral patterns are formed during this period and it is crucial to identify, encourage and empower these children to make their own choice for adopting a healthy lifestyle and practices.

In our study, we observed 9% children were overweight and 0.91 were obese. A systematic review of childhood overweight and obesity in India conducted by Ranjani *et al*. reported wide variation among prevalence rate from 3 to 24.7% for overweight and obesity ranged from 1.5 to 14 % among adolescent population and a combined prevalence of 19.3 among children [8]. The variation may be attributed to various cut off points defining overweight/obesity, geographical location and socio-demographic differences. Our study contributed to the literature by reporting on the prevalence measured using WHO cut off values. Similarly, in our studied sample 11.02% were pre-hypertensive and 16.35% were hypertensive. A systematic review and meta-analysis conducted by Daniel reported a range of 2% to 20.5%, with a pooled estimate of 7.6% prevalence among adolescents in India [9]. The possible reason for differences in the estimation might be due to differences in the number of blood pressure

readings by various researchers, geographical and socio-demographic variation among the studied population. A high prevalence 21.5% was observed by Sunder *et al*. in Chennai among urban school children similar to our study [10].

We evaluated several risk factors of hypertension, overweight and obesity using multivariate regression analysis. We observed the significant statistical association between BMI and both systolic and diastolic blood pressure values. The association between overweight, obesity and hypertension is well documented in several epidemiological studies and may be mediated in part by Sympathetic Nervous System (SNS) hyperactivity and act as risk factors for later coronary disease [11]. A school-based cross-sectional study was conducted by Mohan *et al*. in Ludhiana, Punjab showed that a higher BMI was significantly associated with increasing blood pressure values and a study conducted by Kaur among school children belonging in Delhi reported that children with more body weight had increased systolic and diastolic blood pressure. The positive association was observed between overweight and elevated blood pressure in a study conducted by Mani *et al*. among adolescent school students in Vellore district of Tamil Nadu. Our findings were consistent with the findings of these studies [12-14].

In our study, the children belonging to urban areas, upper socioeconomic class were more overweight and obese. Watching TV for more than 2 hours was one of the significant risk factors associated with both overweight/obesity and hypertension. Children consuming snacks and junk food frequently showed higher prevalence of hypertension. These findings ascertain the effect of socio-economic influence and unhealthy lifestyle practices contributing to the higher prevalence of overweight/obesity and hypertension and are consistent with the finding of the other studies [13-15].

Limitations:

The cross-sectional nature of this study and self-reporting of lifestyle activities restricts in establishing a causal relation between high blood pressure, overweight/obesity and lifestyle related risk factors. The purposive sampling technique owing to constrained resources limits the generalizability of the study findings.

Conclusion:

The current study showed high prevalence of hypertension, and its association with overweight/obesity. The children of affluent class having unhealthy dietary and lifestyle practices were having more prevalence of hypertension and overweight/obesity. A scalable model of screening and care of children for NCDs is warranted which can be implemented at school level including empowering children with the knowledge and life skills to make effective and sustainable behavior changes that address the underlying causes of disease and promote healthy lifestyle.

Acknowledgement:

We would like to acknowledge the ICMR STS, New Delhi, for granting funds for this study. We are thankful to the Principal of Velammal Vidyalaya for permitting us to conduct the study and the students for their participation in the study.

References

1. World Health Organization, Noncommunicable diseases country profiles 2018. World Health Organization. https://apps.who.int/iris/handle/10665/274512. [Last accessed 14.5.2021].
2. Yang L, Magnussen CG, Yang L, Bovet P, Xi B. Elevated blood pressure in childhood or adolescence and cardiovascular outcomes in adulthood: a systematic review. *Hypertension* 2020; 75(4):948-955.
3. Simmonds M, Llewellyn A, Owen CG, Woolacott N. Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. *Obes Rev* 2016;17(2):95-107.
4. Javedan GA, Salehiniya H, Soheilipour F. Prevalence of obesity and overweight in preschool children in northwest of Tehran, Iran. *J Krishna Inst Med Sci Univ* 2016; 5(4): 58-63.
5. Orlando A, Cazzaniga E, Giussani M, Palestini P, Genovesi S. Hypertension in children: role of obesity, simple carbohydrates, and uric acid. *Front Public Health* 2018; 6:129.
6. Charan J, Buch N, Goyal JP, Kumar N, Parmar I, Shah VB. Prevalence of hypertension in school going children of Surat city, Western India. *J Cardiovasc Dis Res* 2011;2(4):228-232.
7. Chiolero A, Bovet P. Hypertension in children: from screening to primordial prevention. *Lancet Public Health* 2017;2(8): e346-e347.
8. Ranjani H, Mehreen TS, Pradeepa R, Anjana RM, Garg R, Anand K, *et al*. Epidemiology of childhood overweight & obesity in India: A systematic review. *Indian J Med Res* 2016;143(2):160.
9. Daniel RA, Haldar P, Prasad M, Kant S, Krishnan A, Gupta SK, *et al*. Prevalence of hypertension among adolescents (10-19 years) in India: A systematic review and meta-analysis of cross-sectional studies. *PloS One* 2020;15(10): e0239929.
10. Sundar JS, Adaikalam JM, Parameswari S, Valarmarthi S, Kalpana S, Shantharam D. Prevalence and determinants of hypertension among urban school children in the age group of 13- 17 years in Chennai, Tamil Nadu. *Epidemiol* 2011;3(3):130.
11. Sorof J, Daniels S. Obesity hypertension in children: a problem of epidemic proportions. *Hypertension* 2002;40(4):441-447.
12. Mohan B, Verma A, Singh K, Singh K, Sharma S, Bansal R, *et al*. Prevalence of sustained hypertension and obesity among urban and rural adolescents: a school-based, cross-sectional study in North India. *BMJ Open* 2019;9(9): e027134.
13. Kaur S, Sachdev HP, Dwivedi SN, Lakshmi R, Kapil U, Sareen N. Association of obesity with hypertension amongst school-age children belonging to lower income group and middle income group in national capital territory of Delhi. *Indian J Comm Med* 2013;38(3):175.
14. Mani G, Balaji SM. Profile of selected lifestyle disease risk factors among adolescent school students in an industrial area of Vellore District, Tamil Nadu. *J Krishna Inst Med Sci Univ* 2019; 8(4):76-88.
15. Tharkar S, Viswanathan V, Thomas O. Impact of socioeconomic status on prevalence of overweight and obesity among children and adolescents in urban India. *Open Obesity J* 2009; 1:9-14.

Author for Correspondence:
Dr. Trupti Bodhare, Department of Community Medicine, Velammal Medical College Hospital & Research Institute, Madurai-625009 Tamil Nadu
Email:drtruptib@gmail.com Cell: 9052408271

How to cite this article:
Bodhare T, Bele S, Murugvel H, Anto JV. Prevalence and Risk Factors of Hypertension, Overweight and Obesity among School Children in Madurai, Tamil Nadu: A Cross Sectional Study. *J Krishna Inst Med Sci Univ* 2021;10(3):74-81.

Submitted: *01-Mar-2021* ***Accepted:*** *29-May-2021* ***Published:*** *01-Jul-2021*