Hypertension and its Determinants Among School Going Adolescents: A Cross Sectional Study in Nepal

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ABSTRACT

Introduction: Hypertension is a chronic life threatening non-communicable disease. It increases the risk for cardiovascular diseases even leading to premature death. Almost half of the adults with hypertension had elevated blood pressure during childhood. With globalisation and lifestyle changes, adolescents are exposed to various risk factors. However, diagnosis in this population is difficult due to absence of symptoms. Thus, regular blood pressure screening is essential in these groups. This study aimed to find out the prevalence of hypertension and its determinants among the school going adolescents of Kathmandu, Nepal.

Methods: This was a descriptive cross sectional study which included five private secondary schools of Kathmandu, Nepal. The adolescent students studying in classes VIII, IX and X were the study subjects. Two stage cluster random sampling technique was used to select 356 participants. Data collection was done by doing anthropometric measurements, blood pressure measurement and through self administered questionnaire.

Results: The study depicted that the prevalence of elevated blood pressure was 12.4%, stage 1 hypertension 32.3% and stage 2 hypertension 9.8%. Similarly, 13.8% were overweight and 1.4% were obese. Bivariate analysis depicted significant association of prevalence of hypertension with gender, religion and obesity ($p < 0.05$). The multivariate analysis shows that the significant predictors of elevated blood pressure and/or hypertension were gender and obesity. Males were six times more likely to have elevated blood pressure (AOR = 6.058, CI = 2.571 - 14.274) and 2.8 times more likely to be hypertensive (AOR = 2.838, CI = 1.688 - 4.773) compared to females. Similarly, compared to obese/ overweight students, thin and normally built ones have less likelihood of having elevated blood pressure and hypertension.

Conclusions: Hypertension has been prevalent among adolescents, due to various behavioural risk factors. This is really challenging and of public health significance. Regular screening of adolescents is essential for early detection and management of hypertension.

Key Words: adolescents; determinants; hypertension; risk factors

INTRODUCTION

The 2017 American Academy of Paediatrics (AAP) Guidelines for Childhood Hypertension (HTN) has revised HTN into three categories, that are, elevated blood pressure (BP), Stage 1 and 2 HTN.[1] HTN is one of the most common life threatening non-communicable diseases. With the rise in urbanization, there is increase in sedentary lifestyles, tobacco smoking, lack of physical activity, unhealthy diet intake, harmful use of alcohol etc., which are the risk factors of HTN.[2] Globally, it affects about one billion adults and is associated with more than nine million deaths annually.[3] It increases the risk for cardiovascular diseases including stroke, coronary artery disease, heart failure and peripheral vascular disease.[4]

Childhood HTN is an established predictor of adult HTN, and it is underestimated problem in developing countries. An increasing number of healthy children and adolescents across the world are being diagnosed with HTN.[5] The recent data on United States (US) children shows that prevalence of pre-hypertension was estimated to be 14% and 6% in boys and girls respectively and the prevalence of HTN was estimated to be 3-4% in many studies.[6–8] HTN in children and adolescents is becoming a major concern, not only because of its rising prevalence, but also because of evidence suggesting that HTN tracks from childhood to adulthood. Almost half of adults with HTN had elevated blood pressure values during childhood.[9] Similarly, adolescents are also exposed to various risk factors, mainly intake of junk food, processed food, reduced physical activity, alcohol and tobacco consumption etc.[10] Not only these factors, barring treatment, control, low awareness of HTN are also seen to be one of the main causes for having these kind of diseases. Accurate identification of HTN at the earliest possible age would, therefore, reduce the chance of developing end-organ damage and its attendant morbidity and mortality. Regular screening of the adolescents is required in order to prevent the emergence of complications later in life.[11]

There are numerous studies conducted among the adult population, but few studies are found among the adolescents. Thus, the aim of the study was to assess the prevalence and determinants of HTN among the school going adolescents in Kathmandu, Nepal.

METHODS

This was a school based cross sectional study conducted among the students of grades VIII, IX and X of different private schools of Kathmandu, Nepal. Two stage cluster random sampling technique was applied for selection of the samples. Firstly, the list of all private secondary schools located in Kathmandu and the total number of students in each school was obtained from District Education Office, Kathmandu. Then random selection of five schools was done through lottery method. From each selected school (cluster), one section each from grades VIII, IX and X was randomly selected. All the students of the selected sections were taken as the samples. Sample size was calculated based on prevalence of 12%,[12] level of significance 0.05, allowable error 5%, design effect two and non-response rate 10%. Thus, the total calculated sample size came to be 356. The students who were absent during the data collection period were excluded from the study.

Information on demographic characteristics and risk behaviours were collected through self administered semi-structured questionnaire, which was prepared based on Global School-based Student Health Survey (GSHS),[13] rigorous literature review and consultation with experts. Ethical clearance for the study was obtained from Institutional Review Board (IRB) of Tribhuwan University, Institute of Medicine. Written informed consent was taken from the parents/guardians and the study participants. All the procedures followed were in accordance with the ethical standards of Helsinki Declaration. Systolic and diastolic BP was measured by trained persons using automated digital sphygmomanometer after five minutes rest, with arm at the level of the chest. Three measurements were done at five minutes interval and the average reading was recorded. Height was measured using scale to the nearest 0.1 cm and weight was measured with the students on bare foot and school uniform using bathroom weighing scale to the nearest 0.1 kg. BP, height and weight were measured following standard protocols of Centres

for Disease Control and Prevention (CDC) 2000.[14] Basal Metabolic Index (BMI) was calculated from measured weight and height. The nutritional status were categorised based on World Health Organisation (WHO) score.[15]

Frequencies, percentage, mean and standard deviation were calculated from the data. Chi-square test and Fisher's exact test were performed to measure the association of different variables with prevalence of HTN. Multiple logistic regression model was used for multivariate analysis in order to identify the predictors.

RESULTS

Among the selected students, six parents did not give consent and 13 students were absent during data collection, thus, in total, 19 students, were missed. Finally 356 students participated in the study.

Based on the study findings, the average age of the participants was 14.76 ± 1.09 years and about half were males. Most of them were Brahmin/Chhetri (54.2%) and belonged to nuclear family (73%) (Table 1). The prevalence of elevated BP was 12.4%, stage 1 HTN 32.3% and stage 2 HTN 9.8% (Figure 1). Similarly, 13.8% were overweight and 1.4% obese (Figure 2).

Gender and religion were found to be significantly associated with HTN. The prevalence of HTN significantly increases among males and Hindus ($p < 0.05$) (Table 2). However, HTN was not significantly associated with smoking and drinking habit and physical activity. The percent of elevated BP and hypertension is significantly increased among overweight/obese compared to normal and thin participants ($p < 0.05$) (Table 3).

Table 4 shows the multivariate analysis of hypertension with different independent variables that were significant at 90% CI ($p < 0.1$) in bivariate analysis. Males are found to be six times more likely to have elevated blood pressure (AOR = 6.505, CI = 2.823 - 14.989) and 2.7 times more likely to be hypertensive (AOR = 2.778, CI = 1.675 - 4.609) compared to females. Similarly, compared to obese/overweight respondents, thin and normally built ones have less likelihood of having elevated blood pressure and hypertension.

DISCUSSION

Table 1. Socio-demographic characteristics of the respondents

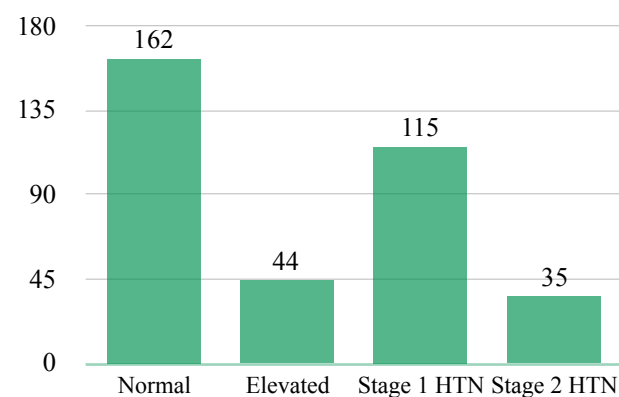| Socio-demographic characteristics	Number (n=356)	Percent
Age (in years)		
12-14	145	40.7
15-17	211	59.3
Sex		
Male	191	53.7
Female	165	46.3
Religion		
Hindu	313	87.9
Buddhist	26	7.3
Muslim	7	2.0
Christian	7	2.0
Others	3	0.9
Ethnicity		
Brahmin/Chhetri	193	54.2
Janajati	125	35.1
Dalit	6	1.7
Madhesi	22	6.2
Others	10	2.8
Type of family		
Nuclear	260	73.0
Joint	96	26.9

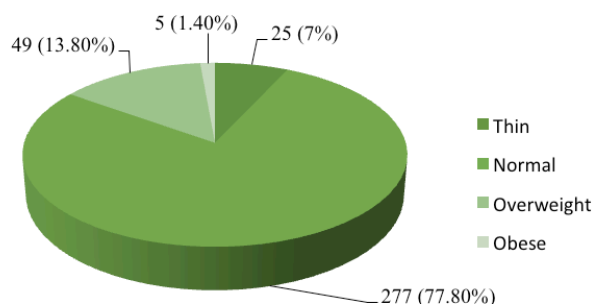**Figure 1.** Prevalence of Hypertension

Figure 2. Prevalence of Obesity

Hypertension has been one of the burning problems identified in the society having significant implications on adolescent health in coming days. So, its early identification and intervention helps in reducing mortality and morbidity among adolescents and young adults. This study included 356 students of age 12 to 17 years from different private schools of Kathmandu, among which 191 (53.7%) were males and 165 (46.3%) were females studying in Grade VIII, IX and X. The students mainly belonged to Hindu (87.9%) by religion, Brahmin/Chhetri (54.2%) by ethnicity and nuclear family (73%).

The mean systolic and diastolic BP was 119.13 ± 12.98 and 76.02 ± 8.98 mm of Hg respectively. The prevalence of elevated BP was 12.4%, Stage 1 HTN 32.3% and Stage 2 HTN were 9.8%, whereas, in the study conducted by Bell et al, the percentage of elevated BP was 19.6% and Stage 1 and Stage 2 HTN were 8.9% and 2.7% respectively.[16] Similarly, the study conducted by Ujunwa FA et al. showed that 17.3% had prehypertension, 67.8% Stage 1 and 32.2% Stage 2 hypertension.[17] However, as the present study referred to updated definition according to 2017 AAP guidelines for childhood HTN,[1] unlike major other studies which have cited 2014 definition,[18] it was difficult to compare directly with those studies.

Looking at the obesity, those with normal weight were 77.8%, followed by overweight (13.8%), obese being least in number, that was 1.4%. The mean BMI calculated was 19.88 ± 3.03 kg/m². While consistent result was seen in a study conducted in Nepal by Piryani et al., prevalence of

Table 2. Association of Hypertension with Socio-Demographic Variables

Variables		Elevated	Hyper-tensive	p value
Age (in years)				
12 - 14	68 (46.9%)	19 (13.1%)	58 40.0%)	0.787
15 - 17	94 (44.5%)	25 (11.8%)	92 (43.6%)	
Gender				
Male	62 (32.5%)	35 (18.3%)	94 (49.2%)	<0.001*
Female	100 (60.6%)	9 (5.5%)	56 (33.9%)	
Religion				
Hindu	142 (45.4%)	36 (11.5%)	135 (43.1%)	0.008*
Buddhist	16 (61.5%)	1 (3.8%)	9 (34.6%)	
Others	4 (23.5%)	7 (41.2%)	6 (35.3%)	

p value significant at 0.05

overweight was 12.2% (95% CI 8.9 to 15.5) and the mean BMI was 20.5 kg/m².[19] This may be because the cultural pattern and the exposure to the environment seems to be similar.

It was found that BP increases with age in the study conducted in Enugu, South East Nigeria.[17] However, the association was not statistically significant in the present study. Among hypertensives, 49.2% were boys and 33.9% were girls where the percent of males was found significantly high. The findings were similar to the study conducted by Mousa et al.,[20] while contrast with the study conducted by Bala S et al.[12] and Ujunwa FA et al.[17] Similarly, in this study, Hindu had significantly high prevalence of HTN compared to and other religion (p < 0.05). This finding might be due to higher percentage of Hindus compared to Buddhists and other religions in the study sample.

Table 3. Association of Hypertension with Lifestyle Factors

Variables	Normal	Elevated	Hypertensive	p value
Smoking past 30 days				
Yes	7 (33.3%)	3 (14.3%)	11 (52.4%)	0.436
No	155 (46.3%)	41 (12.2%)	139 (41.5%)	
Drink alcohol past 30 days				
Yes	24 (49.0%)	4 (8.2%)	21 (42.9%)	0.664
Normal	138 (45.0%)	40 (13.0%)	129 (42.0%)	
Physical activity done				
< 4 days/week	88 (44.2%)	23 (11.6%)	88 (44.2%)	0.649
≥ 4 days/week	74 (47.1%)	21 (13.4%)	62 (39.5%)	
Walking/riding bicycle				
< 4 days/week	61 (48.0%)	17 (13.4%)	49 (38.6%)	0.596
≥ 4 days/week	101 (44.1%)	27 (11.8%)	101 (44.1%)	
Intake of soft drinks				
< 1 time/day	119 (45.6%)	34 (13.0%)	108 (41.4%)	0.784
≥ 1 time/day	43 (45.3%)	10 (10.5%)	42 (44.2%)	
Frequency of eating from restaurant				
< 4 days/week	112 (44.6%)	34 (13.5%)	105 (41.8%)	0.567
≥ 4 days/week	50 (47.6%)	10 (9.5%)	45 (42.9%)	
Junk food consumption				
< 4 days/week	63 (39.9%)	26 (16.5%)	69 (43.7%)	0.05
≥ 4 days/week	99 (50.0%)	18 (9.1%)	81 (40.9%)	
Frequency of meat intake				
< 4 days/week	135 (45.0%)	39 (13.0%)	126 (42.0%)	0.719
≥ 4 days/week	19 (50.0%)	3 (7.9%)	16 (42.1%)	
Extra salt intake				
Yes	9 (33.3%)	1 (3.7%)	17 (63.0%)	0.071
No	153 (46.5%)	43 (13.1%)	133 (40.4%)	
BMI				
Thin	17 (68.0%)	2 (8.0%)	6 (24.0%)	<0.001*
Normal	135 (48.7%)	33 (11.9%)	109 (39.4%)	
Overweight/obese	10 (18.5%)	9 (16.7%)	35 (64.8%)	

p value significant at 0.001

Obesity and overweight are one of the risk factors of HTN. In obese children, activation of the sympathetic nervous system shifts the arterial pressure control mechanism of diuresis and natriuresis to higher BP levels. This might be the possible reason illuminating the association.[21] In this study, BMI was significantly associated with HTN where 64.8% with obesity/overweight had HTN ($p < 0.05$). This finding is similar to other studies.[17,22,23] However, no statistically significant association was seen in study by Bala S et al.[12] Similarly, there was no correlation between high BP and overweight in a study done by Chirag BA et al.[22] After controlling all other variables, gender and BMI were found to be the strong predictors of elevated BP and HTN. Males are six times more

Table 4. Multivariate analysis for association of hypertension with different variables

Category of hypertension	Study variables	Crude OR	Adjusted OR	95% CI	p value
Elevated	Sex				
	Male	6.272	6.505	2.823 - 14.989	< 0.001*
	Female	Ref			
	Obesity				
	Thin	0.131	0.107	0.017 - 0.669	0.017
	Normal	0.272	0.246	0.087 - 0.701	0.009*
	Overweight/Obese	Ref			
Hypertensive	Sex				
	Male	2.707	2.778	1.675 - 4.609	< 0.001*
	Female	Ref			
	Religion				
	Hindu	0.634	1.516	0.688 - 3.341	0.302
	Buddhist and others	Ref			
	Obesity				
	Thin	0.101	0.064	0.018 - 0.224	< 0.001*
	Normal	0.231	0.217	0.098 - 0.478	< 0.001*
	Overweight/Obese	Ref			

p value significant at 0.001

likely to have elevated BP (AOR = 6.058, CI = 2.571 - 14.274) and 2.8 times more likely to have HTN (AOR = 2.838, CI = 1.688 - 4.773) compared to females. This might be due to increased BMI among males and increased tendency to eat fast food. A study done in two cities of Egypt showed that sex (OR = 0.551, CI = 0.417 - 0.729) had increased estimated risk of HTN and females had lesser odds of having risk of HTN.[20]

Similarly, in the present study, compared to obese/overweight respondents, thin and normally built ones have less likelihood of having elevated BP and HTN. This shows that with increasing obesity/overweight, there is increased chance of having elevated BP and HTN. The findings were consistent with the study by Mousa et al., in which BMI (OR = 1.468, CI = 1.256- 1.715) is one of the best predictors of HTN.[20] Similarly, another study done in North Indian City found that obesity significantly increased the odds of both HTN as well as pre hypertension.[24]

This is a multi-institutional study with a representative sample. Thus, the findings might be generalised in other similar settings. However, as the study was conducted in the capital of the country, this might not represent the entire population. Another limitation of the study might be, being a cross-sectional study, no causal relationship could be established. The information on behaviours/lifestyles like smoking and alcohol use, physical activity, dietary habit etc was entirely based on self reporting. This might pose question on reliability of the information. Similarly, assessment of food habits was based on the respondents' memory which may be subject to recall bias.

CONCLUSIONS

Our study revealed that the prevalence of elevated BP was 12.4%, Stage 1 HTN 32.3% and Stage 2 HTN 9.8%. The significant predictors of HTN were found to be gender and obesity. Obesity and overweight among children and adolescents has been prevalent in the urban areas these days as

adolescents substitute their lunch and dinner by junk foods and drinks, omitting breakfast, sedentary lifestyle etc, which directly leads to increase in hypertension. As the roots of essential HTN extend into adulthood, routine screening of BP should be emphasised during adolescence. Students spend most of their time in school environment. So, school has to focus on promoting positive health behaviour. Strategies should be adopted for addressing the healthy foods in the school premises as well as outside through behavioural skill training and making sports as a part of compulsory physical education activities. This study helps to identify the prevalence and associated determinants of HTN during adolescence which are amendable for prevention of complications in adulthood. This can lead to reduction in mortality and morbidity of the population as a whole.

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