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COMPARISON OF BLOOD PRESSURE BETWEEN ADOLESCENT LIVING IN HILLY AND NON-HILLY AREAS

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ABSTRACT

High blood pressure (BP) is a silent killer and the most common risk factor for cardiovascular diseases (CVD), chronic kidney diseases and stroke. A cross sectional comparative study was conducted on school and college going adolescent group (Class 9-12) of both hilly and non-hilly area. A total of 594 students (297 from hilly and 297 from non-hilly area), whose age was in the range of 14-18 years and had consented to be a respondents were included in the study. Bandarban was considered as hilly part of study place and Rajshahi as non-hilly. Data was collected by face to face interview through a semi-structured questionnaire consisting information relating to socio-demographic characteristics and physical activity status of respondents which was adopted from International Physical Activity Questionnaire-Short Form. The sample included 54.4% girls, and the mean age of the respondents was 16.12 ± 1.04 years. The groups were statistically similar in terms of gender composition but dissimilar in terms of age, religion, education status, salt preserved fish consumption, smoking habit, physical activity and BMI. The male respondents from hilly area had significantly higher systolic pressure, diastolic pressure, mean arterial pressure and pulse pressure compared to that for respondents from non-hilly area. In case of females, the respondents from hilly area had significantly higher systolic pressure, diastolic pressure, mean arterial pressure and pulse pressure compared to that for respondents from non-hilly area. If blood pressure screening programs and counselling on blood pressure control is introduced, it may be beneficial to the population in hilly areas.

KEYWORDS: Blood Pressure, Adolescent, Hilly and Non-hilly area.

INTRODUCTION

High blood pressure (BP) is a silent killer and the most common risk factor for cardiovascular diseases (CVD), chronic kidney diseases and stroke.[1-5] More than a quarter of the world adult population is currently hypertensive and this figure is projected to rise to 30%, by 2025.[2,5] CVDs are the leading cause of death and disability worldwide with about 80% of the deaths occurring in developing countries.[3,4] Furthermore, the onset of hypertension and CVD occurs at a relatively younger age in Asians and consequently the age at which people die of CVD is considerably younger than in developed countries, leading to widespread social and economic hardship.[6] Hypertension is a major public health problem in both the developed and developing countries and the leading cause of morbidity and mortality globally.[7] The risk factors for hypertension, which can largely be prevented through simple health promotion and preventive measures, are mostly known.[6-8] Adolescence, usually defined as the period between 10 and 19 years of age, is the phase of transition from a "child" into an "adult".[9-13] Adolescents constitute an important social and demographic group in all over the world.[9] In WHO South-East Asia Region almost one fifth or 18.8% (362.2 million individuals) of the total regional population is adolescent.[9,10] Of this, 13–17 year olds comprise 181 million or nearly one tenth (9.4%) of total regional population.[14] Bangladesh consists of 21% adolescent.[15] There are 29.5 million adolescents in Bangladesh, among them 14.4 million girls and 15.1 million boys, together representing nearly one-fifth of the country's total population of 144 million.[16] Blood pressure (BP) increases acutely in proportion to altitude.

Study shows 2% increase in prevalence of hypertension for every 100 m increase in altitude.[17] Exposure to hypoxia at high altitude is increasingly being recognized as a risk factor for hypertension.[18] In this study, we aimed to evaluate the blood pressure of adolescent with similar demographic characteristics, but living at different altitudes.

MATERIALS AND METHODS

A cross sectional comparative study was conducted on school and college going adolescent group (Class 9-12) of both hilly and non-hilly area. A total of 594 students (297 from hilly and 297 from non-hilly area), whose age was in the range of 14-18 years and had consented to be a respondents were included in the study. Bandarban was considered as hilly[19] part of study place and Rajshahi[20] as non-hilly. Data was collected by face to face interview through a semi-structured questionnaire consisting information relating to socio-demographic characteristics and physical activity status of respondents which was adopted from International Physical Activity Questionnaire-Short Form.[21] A checklist was used to evaluate blood pressure, height and weight and they were measured by using an automated digital blood pressure machine, metal measuring tape and digital weight measuring machine, respectively. At a time 10 students were taken to a room and were allowed to sit for 10 minutes. Meanwhile, in order to make them relaxed the purpose and procedure of the study was explained to them. The respondents were instructed to avoid caffeine, exercise and smoking for at least 30 min before measurement and ask to empty their bladder if there was an urge and avoided talking during blood pressure measurement was properly maintained.[22] Appropriate size cuff as per arm circumference was used to measure blood pressure. The cuff was placed 2-3 cm above the antecubital fossa with rubber bag centralized over brachial artery. Blood pressure was measured in the seated position with the right arm supported at heart level. Blood pressure was taken three times with 5 minutes' interval.[23]

RESULTS

In this cross-sectional comparative study, the number of girl respondents were 57.6% and 51.2% in hilly and non-hilly areas, respectively. Both hilly and non-hilly areas, highest proportion (33.7% and 36.7%) of the respondents were aged 16 years. Higher number of younger respondents from hilly area had been included compared to respondents from non-hilly area. About 12.8% and 18.5% of respondents in hilly and non-hilly areas respectively had family history of hypertension in spite of good physical activity.

Socio-demographic characteristics, smoking behaviours and eating habits are stated in **table 1**.

Mean of systolic blood pressure of male respondents from hilly and non-hilly areas were 123.52 ± 10.19 and 116.20 ± 8.18 mmHg respectively and in female respondents were 120.20 ± 10.10 and 114.07 ± 7.49 mmHg. There is a significant difference in mean of systolic blood pressure in both male and female respondents between hilly and non-hilly areas (t= 6.449; df= 239.169, p≤0.0001 and t= 6.237; df= 311.304, p= .000). After adjustment for the effect of age, gender, smoking history, family history of hypertension, salt preserved fish consumption, extra table salt consumption during meal, BMI and physical activity the difference of means of systolic blood pressure of respondents between hilly and non-hilly area was 5.480 mmHg (95%CI, 3.662-7.299 mmHg and the difference was statistically significant (t=5.919, p=.000). Therefore, systolic pressure of individuals from hilly area could be 3.662-7.299 mmHg higher than that in respondents from non-hilly areas **(Table 2).**

Mean of diastolic blood pressure of male respondents from hilly and non-hilly areas were 71.88 (± 7.18) and 68.89± (7.48) mmHg and in female 72.23 ± (7.78) and 70.57 ± (6.79) respectively. There is significant difference in mean of diastolic blood pressure in male and female respondents between hilly and non-hilly areas (t= 6.237; df= 311.304, p= .000 and t= 2.029; df= 321, p= .043).After adjustment for the effect of age, gender, smoking history, family history of hypertension, salt preserved fish consumption, extra table salt consumption during meal, BMI and physical activity the difference of means of diastolic blood pressure of respondents between hilly and non-hilly area was 1.556 (95%CI, .067-3.045) mmHg and the difference was statistically significant (t=2.053,p=.041). Therefore, diastolic pressure of individuals from hilly area could be .067-3.045 mmHg higher than that in respondents from non-hilly areas **(Table 2).** Details of mean of pulse pressure and mean of mean arterial pressure are showed in **table 2**.

Table 1: Socio-demographic characteristics, smoking behaviours and eating habits of respondents.			
Traits	**Hilly (%)**	**Non-hilly (%)**	**p Value**
Gender			
Male	42.4	48.8	0.118
Female	57.6	51.2	
Age			
14	7.7	3.0	
15	28.3	18.2	
16	33.7	36.	<0.0001
17	25.3	27.9	
18	5.1	14.1	
Religion			
Muslim	27.6	96.3	
Hindu	6.4	3.7	
Buddhist	36.7	0.0	0.000
Christian	16.2	0.0	
Krama	13.1	0.0	
Level of education			
Class 9	18.2	24.2	
Class 10	43.1	26.9	0.000
Class 11	22.9	22.2	
Class 12	15.8	26.6	
Familial history of hypertension			
Father	6.4	6.7	0.868
Mother	9.1	10.1	0.676
Paternal Grandparents	0.7	3.4	0.020
Maternal Grandparents	1.0	1.0	1.000
Behaviour Characteristics			
Consumption of extra table salt with meal	37.7	31.3	0.101
Consumption of salt preserved fish	80.8	22.6	0.000
Use of tobacco	8.8	19.2	0.000
Category of physical activity			
Low	22.6	14.1	
Moderate	54.9	75.8	0.000
High	22.6	10.1	
BMI status			
Under weight	25.9	55.6	
Normal weight	70.0	40.4	0.000
Over weight	3.4	3.7	
Obese class I	0.7	0.3	

Table 2: Means of different measures of blood pressure of respondents.				
	Blood Pressure	**Hilly (%)**	**Non-hilly (%)**	**p Value**
Male	SBP	123.52 ± 10.19	116.20 ± 8.18	<0.0001
	DBP	71.88 ± 7.18	68.89 ± 7.48	0.000
	PP	51.63 ± 7.86	47.31 ± 8.65	0.000
	MAP	89.09 ± 7.44	84.66 ± 6.55	0.000
Female	SBP	120.20 ± 10.10	114.07 ± 7.49	0.000
	DBP	72.23 ± 7.78	70.57 ± 6.79	0.043
	PP	47.97 ± 7.61	43.50 ± 6.88	0.000
	MAP	88.22 ± 7.84	85.07 ± 6.24	0.000

SBP= Systolic Blood Pressure, **DBP=** Diastolic Blood Pressure, **PP=** Pulse Pressure**, MAP=** Mean Arterial Pressure

DISCUSSIONS

The high blood pressure observed among adolescent living at hilly area may be due to greater effects of altitude on body weight and height, blood viscosity, and cardiac output than on peripheral vasodilatation. Another explanation is insufficient vascular adaptive changes at this age group since high altitude did not result in hypertension in adults.[24]

A few studies in this regard reveal contradictory views on difference of blood pressure of people living in high and low altitude areas. It is generally believed that both systolic blood pressure (SBP) and diastolic blood pressure (DBP) are lower in the high than in the low-altitude populations.[25] Initial exposure to high altitude leads to increase in BP which is attributed largely to increased autonomic or sympathetic activity. SBP and DBP gradually decline, after years of residence at high altitude, even falling below those observed at sea level.[26] Compared with residents living at sea level, Andean residents at high altitude have lower resting BP, especially SBP. Furthermore, high altitude residents who migrate to sea level show gradual elevations in BP levels.[27] Studies on US Whites born at low altitude living at high altitude showed that the degree of decline in systemic BP is a function of length of time at residence at high altitude.[28] The long-term residents and natives of high altitude Andes show reduced BP, lower rates of hypertension, and lower cardiac anomalies. This observation is also observed in some other high-altitude populations like Sherpa's, natives of Tien Shan and the Pamir and the people in the Ambers region in Ethiopia.[28] The cause of decline in BP at high altitude has been attributed to relaxation of vascular smooth muscle, an increase in collateral circulation, increased vascularization, higher red blood cell level and haemoglobin level, hypocaloric stress and diseases like respiratory tract ailments.[28-30] Some studies on the natives of Andes, native Americans of Chile, natives of Mongolia and an agricultural population of India did not find any effect of altitude on BP.[31] However, a few studies on high altitude natives of Ethiopia, high altitude natives of Saudi Arabia, Tibetans of Lhasa and high altitude cold zone cattle-breeders of Mongolians showed just the opposite relationship, that is, high-altitude residents showing higher BP.[32] Another study on Tibetans from a refugee settlement in India at low altitude report lower BP values.[17] Studies on other high-altitude Himalayan populations like Sherpa, who trace their ancestry to Tibet reported lower blood pressure at high altitude and a much smaller age-related increase in blood pressure. But a recent study on Sherpa in the modernizing Nepal showed elevated BP for both the altitudes.[18]

LIMITATIONS

In this present study, for each group only one area was selected purposively. So the conclusion from this study may not necessarily represent the all hilly and non-hilly areas in Bangladesh. Fast food and alcohol consumption was not measured in this study. As physical activity was assessed using IPAQ (short) questionnaire, there could have been some recall bias when respondents tried to recall their 7-day activities in responses to questions asked. Whatever bias that might have occurred are likely to have taken place in a similar fashion in both the groups so biases if any had occurred are most likely to have been nullified when comparison was done.

CONCLUSION

Systolic blood pressure, diastolic blood pressure, mean arterial pressure and pulse pressure were significant higher in respondents from hilly area compared to that for respondents from non-hilly area. Even after adjustment of age, gender, smoking habit, family history of hypertension, extra salt consumption during meal, salt preserved fish consumption, BMI and physical activity the measures of blood pressure were still significantly higher in respondents from hilly area compared to that for respondents from non-hilly area. Hence the altitude at which an individual resides most likely influences their blood pressure.

DECLARATIONS

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Conflict of interest: No competing interests relevant to this study to disclose for all authors. Full forms submitted and on file for all authors.

Ethical approval: All the procedures were conducted following the ethical guidelines of institution's ethical committee (Institutional Review Board) at National Institute of Preventive and Social Medicine (NIPSOM). The ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards will be followed wherever applicable. Before initiation of data collection, a brief introduction on the aims and objectives of the study were presented to the school and college authority. They were informed about their full right to participate or refuse to participate in the study.

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