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Original Research Article

Distribution of Hypertension Subtypes According to Habitat: A Study in Northeast India

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ABSTRACT

Background: Quantum of day- to-day physical activity may differ between people living in plain and hilly areas due to the need to work in hilly terrains. Such differential exposure of physical activity may affect distribution of hypertension and its subtypes in the population.
Methods: Cross sectional study was conducted in Assam (plain terrain) and Mizoram (hilly terrain). Blood pressure, anthropometric and relevant socio-demographic information were recorded from 12,810 subjects of either gender, aged $\geq$ 30 years. Distribution of hypertension subtypes were analysed according to geographical location and gender. Risk factors of hypertension subtypes including isolated systolic hypertension (ISH) were calculated using multivariable logistic regression analysis.
Results: Prevalence of ISH (3.0% vs. 6.8%, p<0.001) and systolic diastolic hypertension (13.1% vs. 31.1%, p<0.001) were significantly lower in hill dwellers than that of plain dwellers. Obesity in hilly people and alcohol consumption in case of plain dwellers were significantly associated with ISH. People living in plains had a significantly higher risk (OR 2.4, 95% CI: 1.9-3.1) to develop ISH.
Conclusions: Distribution of hypertension subtypes along its risk factors differed across the geographical locations and elevated quantum of day to day physical activity seems a protective factor for the individuals among the hilly region as quantum prevalence of ISH was significantly low over the dwellers.

Keywords: Cross sectional study, Hypertension, Physical activity, ISH

INTRODUCTION

India is undergoing a rapid health transition with rising burden of hypertension and it seems to be the most common cause of morbidity and mortality through variety of hypertension associated complications including stoke and cardiovascular aberrations. [(1)] European society of hypertension categorise hypertension into different hypertension subtypes based on the increase of either systolic or diastolic or systolic-diastolic blood pressures. [(2)] Of the hypertension subtypes, isolated systolic hypertension (ISH) is a common condition in the elderly and is associated with a high risk of cardiovascular morbidity and

mortality. [3-6] A meta-analysis has shown that ISH was associated with a two- to four-fold increase in risk of all-cause mortality and cardiovascular disease morbidity. [3,7] From the results of the Framingham study, systolic blood pressure (SBP) is now considered to be an important predictor of cardiovascular events than diastolic blood pressure (DBP) in the elderly. [3,7]

Joint National Committee VII (JNC VII) recommends 30 minutes of brisk walking daily for at least five days in a week as healthy lifestyle modification behaviour for management of hypertension. [8] Physical activity is inversely related to hypertension [9] and reduces cardiovascular morbidity and mortality. [10] However, the effect of physical activity on hypertension subtypes is not clear. [11,12] In the present study we hypothesize that distribution of hypertension subtypes may be different between plain and hilly residential due to differential exposure of arduous physical activity due to the need for day-to-day livelihood related works in hilly landscape and tried to compare the prevalence and distribution of hypertension subtypes from North East India among hilly and plain terrains.

MATERIALS AND METHODS

The present study was a community based cross sectional study. Detailed methodology was described elsewhere. [13] The study was carried out in 2 states (Assam & Mizoram) of Northeast India. Subjects from Assam (indigenous Assamese community and tea garden workers [TGW]) represented individuals dwelling in the plains and those from Mizoram (situated at an altitude of 2123.1 metres) represented the hill dwelling group.

Study subjects:

Indigenous Assamese: Five out of 23 districts of Assam were selected on the basis of geographical location and ethnic distribution. Twenty five villages (5 from each selected district) covering a population of 20,857 were selected by simple random sampling. Household list was collected from the revenue department and were selected by systematic random sampling.

Tea garden workers: A tea garden of Assam was selected purposively for its ethnic homogeneity, population size and operational feasibility. Tea Garden Workers (TGW) were listed from every alternate family using systematic random sampling. All the subjects included in the study were manual workers.

Hill dwellers (Mizoram): Aizawl, the capital town of Mizoram was selected purposively for the study. For urban area, 6 clusters out of 69 villages/wards were selected using probability proportionate to the size sampling method. For rural area, a rural block was selected at random. The villages of entire block were listed and stratified according to population size and 14 villages were selected at random. Households from the selected localities were selected by systematic random sampling.

A total of 12,810 subjects (4,688 from Assam and 8,122 from Mizoram), in the age group $\geq$ 30 years were included in the present study. The study subjects from Assam represent the plain tribes whereas subjects from Mizoram represent the hill tribes

Collection of socio-demographic and clinical data:

Information regarding socio-demographic variables, smoking habit, alcohol consumption was recorded in a pre-designed and pre-tested questionnaire. Height and weight were recorded by trained person using standard methodologies. Anthropometric rod and platform balance (SECA) were used to measure height and weight respectively. Body mass index (BMI) was calculated as weight in kg divided by meter squared. Quantum of physical activity was presumed to be higher in hilly areas in comparison with plain areas.

Blood pressure was measured using a mercury sphygmomanometer following standard guidelines. [(14)] We took three readings for each participants and the average of three readings was used for analysis. Participants who smoked, took alcohol were allowed to take rest for 30 min to 1 hour before recording of BP. Hypertension was defined as per JNC VII guidelines.[15]

The study was approved by the Institutional Ethical Committee of Regional Medical Research Centre, NE Region (ICMR), Dibrugarh.

Statistical analysis

All analyses were done using the Statistical Package for Social Science (SPSS-17.0) software. Comparison of different risk variables between hill and plain dwellers were done by chi-square test for categorical variables and independent samples *t*-test for continuous variables. The level of significance was determined at $p<0.05$. Multivariable logistic regression analysis was executed in the data base to identify adjusted odds ratio and the independent predictors for hypertension subtypes. We also calculated adjusted odds ratio of plain dwellers for development of different hypertension subtypes.

RESULTS

A total of 12,810 subjects (4,688 from Assam and 8,122 from Mizoram), in the age group ≥ 30 years (range 30-85 years) were included in the present study. The study subjects from Assam represent the plain tribes whereas subjects from Mizoram represent the hill tribes.

Distributions of socio-demographic characteristics according to geographical location are depicted in Table 1. Plain dwellers were significantly younger than hilly people. Illiteracy was higher among the plain dwellers than that of hilly people.

Table 1: Socio-demographic characteristics according to geographical location

Socio-demographic characteristics	Geographical location	
	Hill dwellers * (n=8122)	Plain dwellers** (n=4688)
Age, years, mean ± SD	48.4±13.8	44.9±12.5
Male, N (%)	3775(46.5)	2140(45.6)
Educational level, illiteracy, N (%)	337(4.1)	2405(51.3)
Waist hip ratio, mean ± SD	0.87±0.2	0.86±0.1
BMI, mean ± SD	21.8±3.7	19.4±3.2
Consumption of extra salt, N (%)	6824(84.0)	2827(60.3)
Consumption of alcohol, N (%), Yes	681(8.4)	2324(49.6)
Smoking habit, N (%)		
• Non User	1908(23.5)	1859(39.7)
• Exclusive smokeless tobacco	2823(34.8)	2443(52.1)
• Exclusive smoker	1897(23.4)	282(6.0)
• Both users	1494(18.4)	104(2.2)

* Mizo subjects

** Assamese and TGW subjects;

***statistically significant (p-value < 0.05)

Table 2 reveals distribution of socio-demographic variables according to hypertension subtypes and geographical location. Distribution of blood pressure categories are depicted in the Table 3. Prevalence of ISH was significantly lower (3.0% and 6.8%) among the hill dwellers than that of plain people. Gender wise analysis revealed similar trends. Prevalence of SDH was also found to be significantly lower in hilly people than that of people living in plain areas.

Table 2: Distribution of socio-demographic characteristics according to hypertension subtypes and geographical locations

Socio-demographic characteristics	Hill dwellers* (n=8122)			Plain dwellers** (n=4688)		
	ISH	IDH	SDH	ISH	IDH	SDH
Age (Mean ± SD)	61.1±15.6	48.1±12.9	55.0±14.5	52.6±12.3	40.5±10.3	49.1±12.8
Gender, N (%)						
Female	132(3.0)	131(3.0)	510(11.7)*	177(55.7)	58(2.3)	803(31.5)
Male	110(2.9)	196(5.2)	556(14.7)	141(44.3)	60(2.8)	656(30.7)
Education						
Illiterate, N (%)	21(6.2)*	6(1.8)*	57(16.9)*	174(7.2)	73(3.0)*	843(35.1)*
Literate, N (%)	221(2.8)	321(4.1)	1009(13.0)	144(6.3)	45(2.0)	616(27.0)
BMI, mean ± SD	22.4±4.1	23.2±4.1	23.4±4.2	19.5±3.6	19.6±2.9	19.7±3.6
Extra salt, N (%), Yes	209(3.1)	271(4.0)	913(13.4)	188(6.7)	80(2.8)	991(35.1)*
Alcohol, N (%) Yes	9(1.3)*	43(6.3)*	101(14.8)	172(7.4)	78(3.4)*	838(36.1)*
Tobacco habit, N (%)						
• Non User	72(3.8)	91(4.8)*	320(16.8)*	112(6.0)	31(1.7)	476(25.6)*
• Exclusive smokeless tobacco	71(2.5)	93(3.3)	331(11.7)	182(7.4)	17(3.2)	839(34.3)
• Exclusive smoker	54(2.8)	93(4.9)	217(11.4)	17(6.0)	3(1.1)	101(35.8)
• Both users	45(3.0)	50(3.3)	198(13.3)	7(6.7)	7(6.7)	43(41.3)

* Mizo subjects, ** Assamese and TGW subjects, ISH I: solated systolic hypertension, IDH: Isolated diastolic hypertension, SDH: Systolic diastolic hypertension

Table 3 Distribution of blood pressure categories according to population groups

	Communities	Normotensive N (%)	Hypertension subtypes			P value*
			ISH N(%)	IDH N (%)	SDH N (%)	
Overall	Hill dwellers	6487(79.9)	242(3.0)	327(4.0)	1066(13.1)	
	Plain dwellers	2793(59.6)	318(6.8)	118(2.5)	1459(31.1)	<0.001
Male	Hill dwellers	2913(77.2)	110(2.9)	196(5.2)	556(14.7)	<0.001
	Plain dwellers	1283(60.0)	141(6.6)	60(2.8)	656(30.7)	
Female	Hill dwellers	3574(82.2)	132(3.0)	131(3.0)	510(11.7)	
	Plain dwellers	1510(59.3)	177(6.9)	58(2.3)	803(31.5)	<0.001

ISH: Isolated systolic hypertension, IDH: Isolated diastolic hypertension, SDH: Systolic diastolic hypertension

* Statistically significant (p-value < 0.05)

Table 4 Adjusted odds ratio of subtypes of hypertension in the study groups estimated by multi variable logistic regression analysis

Variables	Adjusted odds ratio(95% CI)					
	Hill dwellers			Plain dwellers		
	ISH	IDH	SDH	ISH	IDH	SDH
Age group, yrs						
Up to 50	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
>50	5.9(4.2-8.2)*	1.2(0.9-1.5)	2.9(2.6-3.4)*	3.5(2.7-4.4)*	0.5(0.3-0.7)	2.4(2.1-2.7)*
Gender						
Female	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Male	0.9(0.7-1.2)	1.6(1.2-2.0)*	1.2(1.0-1.4)*	0.8(0.6-1.0)	1.1(0.7-1.7)	0.8(0.7-0.9)
Education						
Illiterate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Literate	0.7(0.4-1.1)	2.1(0.9-4.7)	0.8(0.6-1.1)	1.1(0.9-1.4)	0.7(0.4-1.0)	0.8(0.7-0.9)*
BMI, mean ± sd						
Normal	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Overweight	1.2(0.9-1.7)	2.1(1.6-2.7)*	2.4(2.0-2.8)*	1.2(0.7-2.1)	0.9(0.3-2.4)	2.9(2.2-3.9)*
Obese	2.3(1.3-4.1)*	2.9(1.8-4.7)*	3.5(2.5-4.7)*	2.4(0.9-6.5)	1.5(0.2-10.9)	3.6(1.8-7.5)*
Underweight	0.8(0.6-1.2)	0.9(0.7-1.3)	0.7(0.5-0.8)	1.0(0.8-1.3)	0.6(0.4-0.9)	0.8(0.7-0.9)
Extra salt, N (%)						
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	1.3(0.9-1.9)	0.9(0.7-1.3)	1.2(1.0-1.5)*	0.9(0.7-1.1)	1.1(0.8-1.7)	1.5(1.3-1.7)*
Alcohol, N (%)						
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	1.1(0.6-2.3)	0.6(0.4-0.9)	0.5(0.4-0.7)	1.4(1.1-1.8)*	1.4(0.9-2.2)	1.4(1.2-1.7)*
Tobacco habit, N (%)						
• Non User	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
• Exclusive smokeless tobacco	0.8(0.6-1.2)	0.8(0.6-1.0)	0.8(0.7-0.9)	1.2(0.9-1.5)	1.6(0.9-2.6)*	1.4(1.2-1.6)*
• Exclusive smoker	0.8(0.5-1.1)	0.9(0.7-1.3)	0.6(0.5-0.8)	0.8(0.4-1.3)	0.6(0.2-2.2)	1.4(1.0-1.9)*
• Both users	1.0(0.7-1.6)	0.6(0.4-0.9)	0.8(0.7-0.9)	1.1(0.5-2.4)	2.9(1.2-7.2)*	1.7(1.1-2.7)*

* Adjusted for age, gender, educational status, BMI, consumption of extra salt, alcohol consumption and habit of tobacco use

BMI: Body mass index, ISH: Isolated systolic hypertension, IDH I: solated diastolic hypertension, SDH: Systolic diastolic hypertension

Table 4 shows adjusted odds ratios and independent predictors for different hypertension subtypes in hill vs. plain dwellers. The group of predicting variables were different for each hypertension subtypes and according to geographical locations. Older age and obesity are found to be at significant risk for ISH in case of hill dwellers whereas older age and consumption of alcohol are found to be significant risk factors for ISH among plain dwellers. Plain dwellers in comparison with hilly people were at higher risk (OR 2.4, 95% CI: 1.9-3.1) to develop ISH (Table 5).

Table 5 Multivariable logistic regression analysis to show association between geographical location and hypertension subtypes

Variables	Adjusted odds ratio * (95% CI)		
	ISH	IDH	SDH
Hill dwellers	Ref.	Ref.	Ref.
Plain dwellers	2.4 (1.9-3.1)**	0.5 (0.4-0.7)	3.2 (2.8-3.7)

* Adjusted for age, gender, educational status, BMI, consumption of extra salt, alcohol consumption and habit of tobacco use
** Statistically significant
ISH: Isolated systolic hypertension; IDH: Isolated diastolic hypertension; SDH: Systolic diastolic hypertension

DISCUSSION

Hypertension subtypes, specifically, ISH is an important predictor of death from coronary heart disease and stroke [16,17] with 2.2-fold rise in risk of myocardial infarction. [18] The burden of ISH among the hypertensive patients is increasing over the past 20 years. [19,20] Prevalence of ISH was significantly lower in hilly people in comparison with people living in plain areas (3% vs. 6.8%, p<0.001). *ISH in the study population (hill and plain dwellers) was lower in comparison with an earlier study conducted in Shimla that revealed 7.78% of ISH among the study participants.* [21] *Prevalence among the participants from plain areas were found to be* higher than reported by Chou (6.1%), Garland (6.3%) and comparable with the findings by Curb et al. (6.8%). [18,22,23] For all these studies ISH among the hill dwellers was significantly lower.

Multivariable logistic regression analysis carried out in our dataset revealed a number of risk factors that are independently associated ISH and other hypertension subtypes. Older age (>50 years) was a risk factor for ISH in the subjects living in plain as well as hilly terrains. Association of older age and ISH is in conformity with the earlier community based study conducted in Taiwan. [18] Obesity and consumption of alcohol is other risk factors associated with ISH. Our finding is substantiated by earlier studies. [24]

Hypertension treatment guidelines now aim at reducing SBP for its predominant role in cardiovascular morbidity and mortality. Significant benefit after pharmacological treatment has been demonstrated in three large trials. [25-27] *T*hese trials revealed beneficial effects of lowering SBP on cardiovascular events in subjects with ISH. However, the effectiveness of antihypertensive drug therapy may be limited by the detrimental effects of further reductions in diastolic pressure [28] which may promote myocardial ischemia. [29] In addition to pharmacological intervention, Joint National Committee – VII [15] recommends thirty minutes of brisk walking daily for five days in a week as healthy lifestyle behaviour for prevention and treatment of hypertension. The beneficial effects of exercise for normotensive and hypertensive subjects have been proved in a number of studies. [27-30] *However, effect of such exercise or* ***physical activity on specific type of hypertension is not clear.***

A community-based study carried out by Yang-Ming Crusade in 1987-1988 in Pu-Li Town, Taiwan has clearly identified poor physical activity as a significant risk factor for ISH. [18] The quantum of physical activity in the two population groups (hill

vs. plain) differed significantly because of the need to work in hill vs. plain terrains. In the multivariable analysis, after adjustment for a number of variables (Table 5), living in plain areas was found to be an independent predictor for development of ISH. Therefore, significantly lower prevalence of ISH among the hilly dwellers may be related to the background high level of physical activity encountered by the hilly people that might provide protective mechanism in the control of blood pressure including ISH. Although the present study design is unable to comment certainly about the preventive role of day to day physical activity on ISH, positive effect of exercise or physical activity on hypertension is evident in many studies. [27-30]

The findings of the present study must be viewed in respect to the limitations of the present study. Due to the cross sectional design of the study, blood pressure of the study participants was recorded in a point of time. The level of physical activity in the study population was assessed qualitatively. Some amount of recall bias during collection of information like alcohol consumption, smoking habits, chewing tobacco was inevitable. We did not investigate biochemical parameters. Therefore, influence of biochemical parameters on our finding was not clear.

In spite of these limitations, our study bears significant impact in revealing differential prevalence of ISH in two population groups categorised by their habitat. This may attract the attention of the researcher to initiate studies to explore the possible role of physical activity on a clinically important hypertension subtypes i.e. ISH.

CONCLUSION

Prevalence of ISH was significantly low among hill dwellers than the plain dwellers due to continuous exposure to physical activity.Alcohol consumption in case of subjects from Assam and obesity in case of subjects from Mizoram was significantly associated with ISH. It also reveals that older age was a common risk factor of ISH for both these population groups. Prevalence of ISH and SDH and its associated risk factor in plain areas were high due to less exposure to physical activity.

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