Research Article

An epidemiological evaluation of risk factors for hypertension among a hilly rural population of India: a matched case–control study

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Abstract

Background: High blood pressure is a health risk factor that is considered one of the highest causes of morbidity, one of the main leading causes for cardiovascular disease, and social global burden, in addition to the high-cost burden to the global health service providers. Blood pressure is affected by external and internal variables. Internal variables such as age, gender, and heredity cannot be changed. External variables such as exercise, reduced stress, and healthy diet can significantly improve blood pressure. Regular exercise can reduce blood pressure and help manage weight and stress. External factors gone unmanaged can cause hypertension that can lead to death.

Objective: To assess the risk factor for hypertension among the hilly rural population of India.

Materials and Methods: A community based case–control study conducted to investigate the risk factor for hypertension among the hilly rural population. In our study, we selected 12 villages, 6 from Nainital and 6 from Almora district of Uttarakhand state of India. In the 12 randomly selected villages of a hilly region of Uttarakhand state, 853 subjects of more than 18 years were screened for hypertension according to JNC 7 criteria; 119 cases and their age and sex-matched controls (1:1) were selected from August 1, 2014 to October 31, 2014. Cases and controls were interviewed with the help of appropriate schedule to elicit information pertaining to sociodemographic characteristics, behavioral parameters, and disease-related parameters. Anthropometric measurements and 24-h dietary recall method were used to assess the nutritional status.

Results: Statistically significant elevated odds ratio was noted for alcohol, smoking, obesity, and salt quantity in food in those in the study population. Statistically significant odds ratio was noted for physical activity, vegetable intake, and fruits intake in both sexes.

Conclusion: Physical activity, vegetable intake, and fruits intake seem to be a preventive factor for hypertension. Diabetes and dietary habit were not statistically associated with hypertension in both sexes.

KEY WORDS: Hypertension, hilly rural population, matched case control study

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Introduction

Hypertension, or high blood pressure as it is typically known, is sometimes called the silent killer because a person could have it for years without even knowing it. It can be a very dangerous illness if not treated right away and properly. Uncontrolled high blood pressure, hypertension, is one of the leading causes of disability or death due to stroke, heart attack, heart failure, and kidney failure. Headaches, blurred

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vision, nosebleeds, or dizziness may occur, but these symptoms are not specific to high blood pressure.

Worldwide, raised blood pressure is estimated to cause 7.5 million deaths, about 12.8% of the total of all deaths.[1] Across the WHO regions, the prevalence of raised blood pressure was highest in Africa, where it was 46% for both sexes combined. Both men and women have high rates of raised blood pressure in the African region, with prevalence rates over 40%. The lowest prevalence of raised blood pressure was in the WHO region of the Americas, 35% for both sexes.[2,3] Men in this region had higher prevalence than women (39% for men and 32% for women). In all WHO regions, men have slightly higher prevalence of raised blood pressure than women. This difference was only statistically significant in the Americas and Europe.[1]

According to IDSP report of Uttarakhand, overall 32% respondents were normal, 49% were in the category of pre-hypertension, 14% in stage I hypertension, and only 5% were in stage II hypertension. Among males, 22% were normal, 54% were in the category of pre-hypertension, 18% were in stage I hypertension, and only 6% were in stage II hypertension. For females, 43% were normal, 43% pre-hypertension, 10% stage I hypertension, and 4% stage II hypertension. The composition appears to be the same in urban and rural areas.[4]

In the present study, we focus on hilly rural population of Uttarakhand state of India. The focus of the analyses is the assessment of the risk factors for hypertension in hilly rural area.

Materials and Methods

Study Area

This study was undertaken in hilly rural region of Nainital and Almora district of Uttarakhand State.

Study Participants

Study subject are Local residents of selected village of Nainital and Almora district of Uttarakhand state.

Inclusion Criteria for Cases and Controls

Freshly diagnosed hypertensive cases according to JNC-7 criteria were included. Age and sex matched community control were selected from the same village. Age matching was done following the frequency for frequency matching within 5 years. Cases and controls were selected in the ratio 1:1.

Ethical Approval

The study was approved by the Ethics Committees of Government Medical College, Haldwani, Nainital, Uttarakhand. Written informed consent in the local language was obtained prior to enrolment.

Sample Size

Sample size calculated by n-master software, considered doing matched case–control study (1:1 matching). Assuming that proportion of exposed controls is 50% and that level of significance 5% with power 90% in order to detect a two-fold increased risk. Minimum number of required discordant pairs is 110.

Sampling Technique

This study was undertaken in hilly region of Nainital and Almora district. A case–control design was adopted for this study in a community setup. In the first stage, 12 census blocks (i.e., Hilly Rural Census Block) were selected from the census blocks of Nainital and Almora district. In the second stage, one village was selected from each census block by simple random sampling. In selected villages, subjects of >18 years of age were screened for hypertension. Those who were found to be hypertensive were included as cases in the study. For identification of matched controls, screening of individuals of same sex and in the age range of 10 years was carried out and among those found nonhypertensive, one randomly selected subject was included as control. This screening of individuals was continued till 10 cases and controls were selected from the same village.

Questionnaire and Tools for Measurement

Cases and controls were interviewed with the help of predesigned and pretested schedule to elicit information pertaining to sociodemographic characteristics (viz., religion, caste, type and size of family, educational level, and marital as well as socioeconomic status), behavioral parameters (i.e., addiction), and disease-related parameters (obesity, diabetes).

Subjects were seated, and resting comfortably, blood pressure was measured by electronic sphygmomanometers. In all, blood pressure of 853 subjects were measured with electronic sphygmomanometers as per criteria suggested by JNC-7.[11] As blood pressure readings in many individuals are highly variable, the diagnosis of hypertension was made only after elevation was noted only after three readings.

Their weight was recorded using Libra weighing scale without using footwear and with minimal clothing. Accuracy of weighing scale was checked from time to time against known weight. Height of study subjects was recorded with the help of steel anthropometric rod with parallel bars. Body mass index (BMI) of each study subject was computed by their weight (in kilograms) divided by the square of their height (in meters). Dietary intake of cases and controls were assessed by 24-h recall oral questionnaire method. Some other definitions used in the study are given below.

Smoker

A person who smokes at least a bidi or a cigarette or any other form for at least 6 months from the study period.

Alcoholic

A person who takes at least 30 mL alcohol per day for at least 6 months from the study period.

Vegetarian

Defined as a person who derives his food from fruits, vegetables, wheat, rice, pulses, milk, and milk products.

Mixed Diet

A person who consumes egg and meat in addition to vegetarian diet.

Physical Activity

The physical activity level (PAL) is defined for a non-pregnant, non-lactating adult as that person's total energy expenditure (TEE) in a 24-h period, divided by his or her basal metabolic rate (BMR).Physically inactive person is defined as whose PAL is less than 1.70.

Statistical Analysis

Data were analyzed with the help of a PC using SPSS package. Statistical association of different parameters in cases and controls were tested by using χ^2. Significant risk factors were examined through conditional logistic regression (CLR) analysis. CLR is primarily used in case–control or retrospective studies where a study participant with a particular condition or treatment (i.e., case) is matched to a study participant without that condition or treatment (i.e., control).[13] The procedure is used to test the probability of having a particular condition or treatment while controlling for other covariates. Crude as well as adjusted odds ratio was computed for different risk parameters. Confidence Interval (CI) was computed by Woolf method.

Results

Cases and controls had similar age and sex composition. They did not differ significantly in terms of religion, caste, type and size of family, and marital status.

Table 1 shows that most of study subjects, that is 81.6%, belonged to the age group of 31–60 years; maximum proportion of study subjects, that is 32.8%, belonged to the age group of 51–60 years, followed by 24.4% in the age group of 41–50 years. Overall, 55.5% study subjects were males, followed by 44.4% females. Controls were matched for age and sex.

Table 1: Distribution of subjects according to age and gender

Variable		Case	Controls
Age group (in completed years)	18–30	5 (4.2%)	5 (4.2%)
	31–40	19 (24.4%)	19 (24.4%)
	41–50	29 (24.4%)	29 (24.4%)
	51–60	39 (32.8%)	39 (32.8%)
	61–70	14 (11.8%)	14 (11.8%)
	71–80	11 (9.2%)	11 (9.2%)
	80+	2 (1.7%)	2 (1.7%)
	Total	119 (100%)	119 (100%)
Gender	Male	66 (55.5%)	66 (55.5%)
	Female	53 (44.5%)	53 (44.5%)
	Total	119 (100%)	119 (100%)

Obese individuals have higher odds of 9.71 times than persons with normal BMI in hypertensive cases. The physical activity is protective and the odd has decreased to 0.54 times in hypertensive cases. The person being diabetic has increased the odd to 1.54 times in the cases than in the controls. The odd of mix diet is 1.43 times more than vegetarian diet in hypertensive cases than the controls. Increased salt level in food has increased the odd to 3.49 times in cases than that in the controls. Alcohol consumption is associated with increased odd of 2.80 times than nonalcoholic in hypertensive cases with daily intake of alcohol having highest odds of 4.13 times than nonalcoholic. The 52% (n = 62) hypertensive cases were using tobacco with 39% (n = 47) using tobacco in smoking form and only 8% (n = 10) were taking tobacco daily. The association of tobacco use with hypertension was showing higher odds of 1.92 times with 2.41 times in smoking of tobacco and 2.22 times in persons having daily intake of tobacco. On the other side, daily fruit and vegetable intake has decreased the odd to 0.21 and 0.19, respectively, in hypertensive cases. The significant risk factors for hypertension are tobacco use, alcohol use, increased salt level in food, physical activity, and higher BMI.

On carrying out the multivariable analysis, when other variables which have been found significant risk factor in univariate analysis, namely obesity, alcohol, tobacco use, increased salt level in food, has been adjusted. The adjusted odds for increased salt level in food is 3.127 times, for alcohol consumption it is 2.01 times, for tobacco use it is 1.55 times, for persons with physical activity it is 0.52 times, for obesity it is 6.42 times.

Discussion

Hypertension is a major health problem in India and other developing countries. The prevalence of hypertension has increased during the last decade.[5].Our study was conducted in a hilly rural area of Uttarakhand; we don't have similar studies, to compare the results of our study. In our study, 32.8% belonged to the age group of 51–60 years, followed by 24.4% in the 41–50 years age group, in which overall 55.5% study subjects were males, followed by 44.4% females.

Age distribution of subjects showed that majority (57.2%) were from the age group of 40–60 years, which by itself is one of the important risk factors for many noncommunicable diseases including hypertension. Late 50s is the age of retirement, which collectively causes stress, mental tension, and low physical activity resulting in gradual deviation of blood pressure from normalcy and ultimately reaching to hypertension (>140/90 mm Hg).

In our study, overweight and obesity are major risk factors for hypertension. The risk for hypertension increases with

Table 2: Effects of factors associated with hypertension

Characteristic and category	Case (119)	Control (119)	Crude OR (95% CI)	*P* value
BMI				
Normal	31 (26%)	68 (57%)	1	
Underweight	15 (12%)	26 (21%)	1.26 (0.58–2.71)	0.54
Overweight	42 (35%)	18 (15%)	5.11 (2.55–10.27)	0.0001
Obese	31 (26%)	7 (6%)	9.71 (3.84–24.46)	0.0001
Physical Activity				
No	90 (75%)	75 (63%)	1	0.036
Yes	29 (24%)	44 (37%)	0.54 (0.31–0.96)	
Diabetes				
No	110 (92%)	113 (95%)	1	0.426
Yes	9 (8%)	6 (5%)	1.54 (0.53–4.47)	
Dietary habits				
Vegetarian	31 (26%)	40 (33%)	1	0.203
Mix (veg & nonveg)	88 (74%)	79 (64%)	1.43 (0.82–2.51)	
Increased salt level in food				
No	39 (32%)	75 (63%)	1	
Yes	80 (67%)	44 (37%)	3.49 (2.05–5.96)	0.0001
Fruits intake				
Occasional	95 (79%)	55 (46%)	1	0.0001
Daily	24 (21%)	64 (54%)	0.21 (0.12–0.38)	
Vegetable intake				
Occasional	53 (45%)	16 (13%)	1	0.0001
Daily	66 (55%)	103 (86%)	0.19 (0.10–0.36)	
Alcohol				
No	46 (38%)	76 (64%)	1	0.0001
Yes	73 (62%)	43 (36%)	2.80 (1.65–4.74)	
Frequency (Alc)				
NO	46 (38%)	76 (64%)	1	
Occasional	48 (40%)	33 (27%)	2.40 (1.35–4.27)	0.0028
Daily	25 (21%)	10 (8%)	4.13 (1.81–9.37)	0.0007
Tobacco use				
No	57 (47%)	76 (64%)	1	0.0013
Yes	62 (52%)	43 (36%)	1.92 (1.41–3.23)	
Tobacco type				
No	57 (48%)	76 (64%)	1	
Chew	15 (12%)	17 (14%)	1.17 (0.54–2.55)	0.680
Smoking	47 (39%)	26 (21%)	2.41 (1.33–4.34)	0.0034
Frequency (Tab)				
NO	57 (48%)	76 (63%)	1	
Occasional	52 (43%)	31 (26%)	1.80 (1.01–3.21)	0.044
Daily	10 (8%)	12 (10%)	2.22 (1.00–4.91)	0.048

the increase in BMI. Similar findings were reported by Goel et al.,[18] Malhotra et al.[17] Agarawal,[19] Deshmukh,[20] and Shrivastava.[21] Many studies that showed the relationship between physical inactivity and hypertension were conducted in India. In our study, a statistically significant association between hypertension and leisure time physical inactivity ($P = 0.036$) was found, which is in agreement with previous study.[24–26] Excess salt intake significantly affects blood pressure. Too much sodium in your diet can cause your body to retain fluid, which increases blood pressure. Similar association between salt intake and hypertension was observed by Agarwal[16] and Mishra.[9] In our study, it is also found that alcohol consumption is significantly associated with hypertension. Among the study population, 21% had the habit of regular alcohol consumption, out of which most of them had hypertension. The odds ratio between alcoholics and nonalcoholics was as high as 4.13. It means that alcohol consumers had four times higher risk of hypertension in comparison to the nonalcoholics. Similar association was also observed by Todkar,[23] Agarawal,[19] and Hazarika.[22] Many epidemiological

Table 3: Multivariable analysis: conditional logistic regression model for risk factor

Characteristic and category	Unadjusted OR	*P* value	Adjusted OR	*P* value (LRT)
BMI				
Normal	1		1	
Underweight	1.26 (0.58–2.71)	0.54	1.01 (0.29–3.92)	0.0001
Overweight	5.11 (2.55–10.27)	0.0001	4.70 (1.30–16.09)	
Obese	9.71 (3.84–24.46)	0.0001	6.42 (2.05–20.5)	
Physical activity				
No	1	0.036	1	0.080
Yes	0.54 (0.31–0.96)		0.52 (0.25–1.08)	
Increased salt level in food				
No	1	0.0001	1	0.001
Yes	3.49 (2.05–5.96)		3.127 (1.56–6.25)	
Fruits intake				
Occasional	1	0.0001	1	0.0001
Daily	0.21 (0.12–0.38)		0.16 (0.076–0.34)	
Vegetable intake				
Occasional	1	0.0001	1	0.0001
Daily	0.19 (0.10–0.36)		0.21 (0.09–0.49)	
Alcohol				
No	1	0.0001	1	0.0021
Yes	2.80 (1.65–4.74)		2.01 (1.31–5.88)	
Frequency (Alc)				
NO	1		1	
Occasional	2.40 (1.35–4.27)	0.0028	2.18 (1.07–4.61)	0.0015
Daily	4.13 (1.81–9.37)	0.0007	3.01 (1.11–7.42)	
Tobacco use				
No	1	0.0013	1	0.041
Yes	1.92 (1.41–3.23)		1.55 (1.04–4.18)	
Tobacco type				
No	1		1	
Chew	1.17 (0.54–2.55)	0.680	1.02 (0.41–2.15)	0.854
Smoking	2.41 (1.33–4.34)	0.0034	2.08 (1.51–6.28)	
Frequency (Tab)				
NO	1		1	
Occasional	1.80 (1.01–3.21)	0.044	1.21 (0.86–3.82)	
Daily	2.22 (1.00–4.91)	0.048	1.86 (1.03–6.55)	0.032

studies from different parts of India have shown a significant correlation of smoking or tobacco use with hypertension prevalence. In our study, smoking was significantly associated with the incident of hypertension. This association has been supported by Suwarna.[6]

This article was carefully prepared; matching approaches permit the study to be replicated in different areas or over time with the production of comparable findings. In the present study, we focus on hilly rural population only; as we do not have similar studies, it is a main strength of our study. Although the research has reached its aims, there were some limitations and shortcomings. First of all, the research was conducted in the districts only. It would be better if it was conducted in all hilly districts of Uttarakhand. In addition, it is unavoidable that in this study, certain degree of subjectivity can be found.

Hilly rural population is experiencing an increase in the prevalence of many risk factors for hypertension and is in urgent need of intervention to reduce the prevalence of these risk factors and to deal with the hypertension to which they contribute.

Conclusion

In the present study, several risk factors were identified, which were significantly associated with the risk of having hypertension as mentioned in earlier studies. Findings suggest that increased BMI, excess salt intake, alcohol, physical inactivity, and smoking are the biggest risk factors for hypertension, which by using simple treatments and life style changes like weight reduction, cessation of cigarette smoking and proper

exercise alters have a greater potential for hypertension prevention. There is need for encouraging health services including health education through mass media targeting various risk factors and promotion of regular physical exercise and also themselves being an example in avoiding the risk factors for hypertension, such as consumption of fatty food, alcohol, and smoking.

References

1. World Health Organization. *Raised Blood Pressure Report*. Available at: http://www.who.int/gho/ncd/risk_factors/blood_pressure_prevalence_text/en/ (last accessed on December 10, 2015).
2. World Health Organization. *Global Status Report on Non Communicable Diseases 2010*. Geneva: World Health Organization, 2011.
3. World Health Organization. *Global Health Observatory Data Repository* [online database]. Geneva, World Health Organization, 2008. Available at: http://apps.who.int/gho/data/view.main (last accessed on February 11, 2013).
4. Integrated Disease Surveillance Project, Non-Communicable Disease Risk Factors Survey Report, ICMR, MOHFW 2007-08. Available at: http://www.icmr.nic.in/final/IDSP-NCD%20Reports/Uttarakhand.pdf (last accessed on December 10, 2015).
5. Padmavati S. A meta-analysis—National Heart Institute, New Delhi. Ind Heart J 2002;54:99–102.
6. WHO. *India Country Profiles*. Available at: http://www.who.int/nmh/countries/ind_en.pdf?ua=1 (last accessed on April 24, 2014).
7. Suwarna, M. An epidemiological study of hypertension and its risk factors in rural population of Bangalore rural district. Al Ameen J Med Sci 2012;5(3):264–70 (last accessed on December 10, 2015).
8. Gupta PC, Gupta R. Hypertension prevalence and blood pressure trends among 99,589 subjects in Mumbai. Abstract. Indian Heart J 1999;51: 691 (last accessed on December 10, 2015).
9. Mishra CP, Kumar S. ,risk factors of hypertension in a rural area of Varanasi. *Indian J Prev Soc Med 2011*;42(1): ISSN- 0301–1216.
10. Yaseen YO., hypertension and family history in missan: a case-control study. MJBU 2006;24(1&2).
11. U.S. Department of Health and Human Services. *The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure*, NIH Publication No. 03-5233 December 2003. Available at: https://www.nhlbi.nih.gov/files/docs/guidelines/express.pdf
12. Satyanarayan K, Vankata Raman Y, Rao MS, Anuradha A, Narasinga Rao BS. Quantitative assessment of physical activity and energy expenditure pattern among rural working woman. Update Growth 1987;197–205.
13. Thomson WD. Statistical analysis of case control study. Epidemiol Rev.1994;16(1):33–49.
14. Gupta SP, Siwach SN, Noda VK. Epidemiology of hypertension. Ind HJ 1977; 29: 53–62.
15. Word R. Familial aggregation and genetic epidemiology of blood pressure. In: *Hypertension: Patho-physiology, Diagnosis and Management*, Laragh JH, Bernner BM (Ed.). Raven press, 1990: 81–100.
16. Agarwal A, Yunus M, Khan A, J A. A clinico-epidemiological study of hypertension in rural population of Jawan block, Distt Aligarh (UP), India. Indian J Public Health 1994;114(1):17-9. D
17. Malhotra P, Kumari S, Kumar R, Jain S, Sharma B. Prevalence and determinants of hypertension in an unindustrialized rural population of North India. J Hum Hypertens 1999;13(7):467–72.
18. Goel N, Kaur P. Dr. P.C. Sen Memorial Award—1994. Role of various risk factors in the epidemiology of hypertension in rural community of Varanasi district. Indian J Public Health 1996;40(3):71–6.
19. Agarawal VK, Bhalwar R, Basannar DR, et al. Prevalence and Determinants of Hypertension in a Rural Community. MJAFI 2008; 64(1).
20. Deshmukh PR, Gupta SS, Bharambe MS, Maliye C, Kaur S, Garg BS, et al. Prevalence of hypertension, its correlates and levels of awareness in rural Wardha, Central India. J Health Population Dev Countries 2005;1–12.
21. Shrivastava RN, Sharma R. Verma BL: An epidemiological study of arterial pressure in an Indian rural population; Ind. J. Pub. Health: 1980; 24(1); 3-9.D
22. Hazarika NC BD, Narain K, Kalita HC, Mahanta J. Hypertension and its risk factors in tea garden workers of Assam. Natl Med J India 2002;15(2):63–8.
23. Midha T, Idris MZ, Saran RK, Srivastava AK, Singh SK. A study on the association between hypertensive status and anthropometric correlates in the adult population of Lucknow district, India. Indian J Prev Soc Med 2009;40(1&2):49–54.
24. Williams R, Bhopal R, Hunt K. Coronary risk in a British Punjabi population: comparative profile of non-biochemical factors. Int J Epidemiol 1994;23:28–37.
25. Lip GY, Luscombe C, McCarry M, Malik I, Beevers G. Ethnic differences in public health awareness, health perceptions and physical exercise: implications for heart disease prevention. Ethn Health 1996;1:47–53.
26. Hughes K, Lun KC, Yeo PP. Cardiovascular diseases in Chinese, Malays, and Indians in Singapore. I. Differences in mortality. J Epidemiol Community Health 1990;44:24–8.

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