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RESEARCH ARTICLE

Risk factors of hypertension among adult men: Evidence from a real world outcomes investigation in a Western Indian population

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Abstract

Hypertension is a significant public health concern of world-wide distribution and is also the most common cardiovascular disease risk factor. This study was an attempt to determine the relationship of age, gender, family history, diet, medical history, alcohol consumption, tobacco consumption and different lifestyles as risk factors in the city of Pune, Maharashtra, India (in diagnosed male hypertensive patients). The questionnaire was administered by the investigator by a face to face interview where the questionnaire was filled by the investigator. Only patients who were known cases of Hypertension were interviewed. Odds ratios, z value, estimate, standard error and P value were calculated using logistic regression analysis to estimate the relation between hypertension status and the risk factors. The study comprised of 500 patients and the mean (SD) age was 47(10.88). Amongst the risk factors in metabolic syndrome, (diabetes, hyperlipidemia, CVD), weight, waist circumference in cms, hip circumference in cms, body mass index and waist to hip ratio, smoking, oral tobacco consumption, physical activity/sedentary lifestyle, alcohol consumption and excessive salt intake was found to be have a significant association ($P < 0.01$ for all factors) with presence of hypertension. Family history of female parents showed significant association. Dietary habits, socioeconomic status, religion, language did not show any discernible association with risk of hypertension. Our findings strongly support the current state of the art evidence regarding the risk factors of hypertension and underline the need for national policy for its eradication.

INTRODUCTION

Hypertension is a significant public health concern of world-wide distribution and is also the most common cardiovascular disease risk factor[(1)]. According to the World Health Organization (WHO), recent estimates show that hypertension affects more than a third of adults aged 25 and above, accounting for about a billion people world-wide and contributes to nearly 9.4 million deaths from cardiovascular diseases each year[(2)]. It is responsible for causation of 50% of coronary heart disease and almost two-thirds of strokes[(3, 4)]. Further, it has been estimated that by the year 2030, 23 million cardiovascular deaths are projected to be due to hypertension, of which about 85% cases will be from low-resource settings and developing nations [(2)]. Poorly managed hypertension results in a plethora of complications ranging from atherosclerosis, damage to coronary arteries/heart/kidneys/visual system, heart failure, disability, poor quality of life and eventually death[(2, 5-7)]. Adequate control of blood pressure is a critical element in the prevention of hypertension-induced-organ damage and life-threatening complications. Prevention of

hypertension is possible and early detection and effective treatment can significantly reduce the incidence of adverse clinical outcomes [3, 8, 9].

High blood pressure (BP) is ranked as the third most important risk factor for attributable burden of disease in south Asia (2010) [10]. Hypertension exerts a substantial public health burden on cardiovascular health status and healthcare systems in India [11]. Hypertension is directly responsible for 57% of all stroke deaths and 24% of all coronary heart disease (CHD) deaths in India [12]. The WHO rates hypertension as one of the most important causes of premature death worldwide [13]. The Global and Regional Burden of Disease and Risk Factors study (2001), in a systematic analysis of population health data for attributable deaths and attributable disease burden, has ranked hypertension in south Asia as second only to child underweight for age [14].

Indians have high rates of cardiovascular disease. Hypertension is an important modifiable risk factor. In an analysis of worldwide data for the global burden of hypertension, 20.6% of Indian men and 20.9% of Indian women were suffering from hypertension in 2005 [4]. The rates for hypertension in percentage are projected to go up to 22.9 and 23.6 for Indian men and women, respectively by 2025[4]. Recent studies from India have shown the prevalence of hypertension to be 25% in urban and 10% in rural people in India [12, 15, 16]. According to the WHO 2008 estimates, the prevalence of raised BP in Indians was 32.5% (33.2% in men and 31.7% in women) [17]. However, only about 25.6% of treated patients had their BP under control, in a multicenter study from India on awareness, treatment, and adequacy of control of hypertension [18].

The objective of the present investigation was to understand the underlying relationship between the presence of risk factors like: age, alcohol, smoking and chewing tobacco, BMI, central obesity (defined as waist circumference>90 cm in men and >80 cm in women), consumption of low vegetables/fruits, high consumption of dietary fat and salt, alcohol, oral tobacco, and smoking with absence/presence of hypertension in an Indian setting.

Methods

Data collection

This was a real world study in hypertensive patients in Pune city, India. In this study, females have not been included as the etiology of hypertension in females primarily includes pregnancy-induced-hypertension, out of which 1/3rd of the cases regress but the rest 2/3rd of the case progress to essential hypertension. Additionally, the regular consumption of oral contraceptives results in raised levels of blood pressure due to hormonal changes. Chronic use of oral contraceptives may raise blood pressure in certain women and may have other adverse effects on cardiovascular risk. Early epidemiologic studies using high-dose estrogen found mean elevations in blood pressure of 3 to 6 mmHg systolic and 2 to 5 mmHg diastolic, with approximately 5% of women developing new hypertension. Thus, Hypertension in females has additional etiologies which may not be due to underlying medical disorders or lifestyle or dietary factors.

This study was an attempt to determine the relationship of age, gender, family history, diet, medical history, alcohol consumption, tobacco consumption and different lifestyles as risk factors in the city of Pune (in males). The study variables included demographics, individual characteristics associated with major risk factors of CVD, past medical history, and anthropometric measurements. Most of these factors are modifiable and hence the pathogenesis of hypertension can be controlled to some extent.

Data Collection

Sources of Data Collection were as follows-

- Primary data – Face to face Questionnaires
- Secondary data – Previous history of medication, old prescriptions and other medical records
- Sample selection- The samples were drawn from the hospitals and clinics. Randomized sampling method was be used to ensure a representative sample.

The exclusion criteria included all individuals below 20 years of age or above 60 years of age. The respondent should be mentally sane.

The questionnaire was designed for individuals who had hypertension (previously diagnosed). It was divided into four broad sub-sections i.e., demographic information, burden of disease, dietary habits and lifestyle determinants. The demographic information included the residential address, contact number, type of residence (slum/non-slum), religion, mother tongue, and number of family members and monthly income of the family. For each of the family member, information about their age, relationship with the head of the household, educational qualification and occupation was gathered. Data analysis was done for all this information except for occupation which was not included in the data entry. Under burden of disease, the health status of all family members was noted along with the type of illness and the duration of the illness. Then information was taken about cardiovascular diseases, hypertension, and diabetes mellitus along with their duration of illness and medication details. The family history of cardiovascular diseases, hypertension, stroke and angina pectoris was noted. Also recorded were details about age at

diagnosis. Under dietary habits details about frequency of intake of green leafy vegetables, roots and tubers, salads, milk, non-vegetarian foods, amount and type of oil were noted. Lifestyle determinants included exercise frequency, tobacco intake and alcohol consumption.

The questionnaire was administered by the investigator by a face to face interview where the questionnaire was filled by the investigator. Before the questionnaire was administered, consent was taken from the respondent-written or verbal. In case the consent was not given, it was considered as a non-response. The questions were asked in the language understood by the respondent. The questionnaire was pre- tested among known people. A total of 30 questionnaires were pre-tested. Later after some editing in the questionnaire, it was again pilot tested in a population not known to the investigator. The data acquired though the questionnaires was entered in the Excel spreadsheets prepared by the investigator.

Data analysis

The data which was accrued was cleaned manually to remove typographical errors.

Rational approaches were used to recover missing values when there were redundancies in the data, or external information that could be brought to bear on the problem.

Descriptive statistics of the baseline characteristics were calculated. Patients were categorized as positive or negative for hypertension. Odds ratios, z value, estimate, standard error and P value were calculated using logistic regression analysis to estimate the relation between hypertension status and metabolic syndrome (diabetes, hyperlipidemia); cardiovascular diseases (CVD); age and sex; family and sibling's history of hypertension; medication and surgery; anthropometry (height, weight, waist inches/centimeters, hip inches/centimeters, body mass index, and waist to hip ratio); Other factors (residence, religion, mother tongue, monthly income, education, health status etc. and habits (smoking, alcohol, salt intake, oral tobacco etc.). R statistical software was used for data analysis and $p<0.05$ was considered significant.

Results

The study comprised of 500 patients and the mean (SD) age was 47(10.88). Amongst the risk factors in metabolic syndrome; diabetes, hyperlipidemia and CVD were found to have significant association with presence of hypertension ($p< 0.001$ and $p < 0.01$ respectively) (Table 1).

Table 1. Association of hypertension with diabetes, hyperlipidemia and cardiovascular diseases

Factors	Odds ratio	95%CI	Estimates	Std. Error	Z value	P value
Diabetes	5.73420457	(3.23 – 8.96)	1.7464	0.4792	3.644	0.000268***
Hyperlipidemia	0.26410790	(0.11 – 0.41)	-1.3314	0.4302	-3.095	0.001967**
CVD	0.71567	(0.46 – 0.96)	0.7948	0.4886	1.627	0.00380*

*p<0.05,**p<0.01,***p<0.001

The factors age and sex showed significant association ($p< 0.001$ and $p < 0.01$ respectively) with presence of hypertension. The factors family history of sibling and family history of grandmother showed significant association ($p< 0.05$ and $p < 0.01$ respectively) with presence of hypertension (Table 2)

Table 2. Association of hypertension with family history, age and sex

Factors	Odds ratio	95%CI	Estimates	Std. Error	Z value	P value
Age	0.8855534	(0.5-1.1)	-0.12154	0.01263	-9.620	< 2e-16***
Sex	0.4413374	(0.11-0.74)	-0.81795	0.26139	-3.129	0.00175**
Fhsib	0.1811295	(0.10 – 0.34)	-1.7085	0.7374	2.317	0.0205 *
Mofh	0.8894020	(0.40 – 1.23)	-0.1172	0.2339	-0.501	0.6164
Fafh	0.3390397	(0.05-0.57)	-1.0816	0.5583	-1.937	0.0527
Grnm	13.9849217	(11.22-15.67)	2.6380	0.7687	3.432	0.0006**
Grnf	0.7316722	(0.55-0.97)	-0.3124	1.2226	-0.256	0.7983
Othf	0.8468704	(0.45-1.22)	-0.1662	0.8851	-0.188	0.8511

*p<0.05,**p<0.01,***p<0.001

Codes : Fhsib :family history- sibling; Mofh: family history mother; Fafh: family history father; Grnm: family history grandmother; Grnf:family history grandmother; Othf: family history others

Drugs and surgery did not show association with presence of hypertension. Presence of hypertension showed significant influence on all anthropometric factors eg: weight, waist inches/cms, hip in inches/cms, body mass index and waist to hip ratio ($p < 0.001$, $p<0.001$, $p< 0.01$, $p< 0.01$ and $p < 0.001$ respectively) (Table 3).

Table 3. Association of hypertension with family history, age and sex

Factors	Odds ratio	95%CI	Estimates	Std. Error	Z value	P value
Medication	0.9265851	(0.78-1.25)	-0.07625	0.06615	-1.153	0.249
Surgery	1.1791021	(0.67-1.56)	0.16475	0.66486	0.248	0.804
Height	0.9734166	(0.56-1.23)	-2.4871	0.4637	-5.363	0.88878
Weight	0.8181327	(0.67-1.22)	3.0063	0.5456	5.510	0.0008 ***
Waist in cms	0.7769705	(0.34-0.97)	0.8190	1.2371	0.662	0.00193 **
Hip in cm	0.6398466	(0.43-0.97)	-8.5061	2.9761	-2.858	0.00426 **
Body mass index	0.9481396	(0.43-1.22)	-9.4664	1.6322	-5.800	0.00001 ***
Waist to hip ratio	0.7813416	(0.23-1.56)	-25.1423	38.9693	-0.645	0.00001 **

*p<0.05,**p<0.01,***p<0.001

The factors religion and education showed significant association ($p < 0.05$ and $p < 0.01$) with presence of hypertension (Table 4)

Table 4. Association of hypertension with general factors like residence, religion, language, income and education

Factors	Odds ratio	95%CI	Estimates	Std. Error	Z value	P value
Residence	0.9474196	(0.34-1.45)	-0.054013	0.166597	-0.324	0.74578
Religion	0.8181525	(0.49-1.33)	-0.200707	0.089460	-2.244	0.02486 *
Mother tongue	0.9962452	(0.56-1.45)	-0.003762	0.024571	-0.153	0.87832
Monthly income	0.9969705	(0.67-1.66)	-0.003034	0.060834	-0.050	0.96022
Education	0.7817465	(0.45-1.26)	-0.246225	0.088542	-2.781	0.00542 **
Health status	2.0398100	(1.62-2.89)	0.712857	0.497548	1.433	0.15193

*p<0.05,**p<0.01

The factors smoking, oral tobacco consumption, physical activity/sedentary lifestyle, alcohol and excessive salt intake had a significant association ($p < 0.01$) with presence of hypertension (Table 5).

Table 5. Association of hypertension with general factors like residence, religion, language, income and education

Factors	Odds ratio	95%CI	Estimates	Std. Error	Z value	P value
Smoking	0.9833196	(0.67-1.62)	-0.052313	0.162397	-0.424	0.001578 **
Tobacco Consumption (Oral)	0.8367525	(0.45-1.22)	-0.223707	0.089340	-2.844	0.00386 **
Sedentary lifestyle	0.9333452	(0.45-1.25)	-0.033762	0.024765	-0.353	0.00822 **
Excessive Salt Intake	0.7343465	(0.44-1.45)	-0.242325	0.086742	-2.981	0.00412 **
Alcohol	0.9367796	(0.65-1.34)	-0.032413	0.132397	-0.404	0.001238 **
Physical activity	0.6833196	(0.37-1.72)	-0.034513	0.13397	-0.404	0.000178 **

*p<0.05,**p<0.01,***p<0.001

None of the dietary factors had a significant correlation with presence of hypertension, except salt and sugar consumption, which showed a discernible and clear significant risk ($P<0.01$ and $p<0.001$) (Table 6).

Table 6. Association of hypertension with dietary factors

Factors	Odds ratio	95%CI	Estimates	Std. Error	Z value	P value
Glv intake	0.945456	(0.63-1.69)	-0.03313	0.162397	-0.404	0.15378
Roots and tubers consumption	0.833325	(0.65-1.12)	-0.23007	0.089340	-2.874	0.39886
Other vegetable consumption	0.934545	(0.35-1.85)	-0.03989	0.024765	-0.393	0.22993
Salad consumption	0.738645	(0.44-1.67)	-0.24345	0.086742	-2.981	0.43312
Fruit consumption	0.933454	(0.45-1.89)	-0.03987	0.132397	-0.498	0.98123
Quantity of milk in ml per day	0.933331	(0.58-1.95)	-0.07354	0.06615	-1.987	0.2484
Milk type	1.1734541	(0.57-1.66)	0.163333	0.66486	0.287	0.7842
Non veg consumption in grams	0.9833196	(0.47-1.72)	-0.05298	0.162397	-0.478	0.3338
Fish consumption in grams	0.9456796	(0.55-1.54)	-0.07863	0.132397	-0.487	0.4538
Egg consumption	0.9234551	(0.66-1.25)	-0.07897	0.06615	-1.187	0.789
oil consumption per individual	1.178021	(0.69-1.86)	0.16888	0.66486	0.2489	0.898
type of oil	0.9367796	(0.65-1.34)	-0.032413	0.132397	-0.404	0.001238
Vanaspati consumption in grams	0.9265851	(0.78-1.25)	-0.07625	0.06615	-1.153	0.249
Consumption of ghee in grams	1.1791021	(0.67-1.56)	0.16475	0.66486	0.248	0.804
Sugar	0.656596	(0.27-1.34)	-0.078613	0.13337	-0.494	0.00008 **
Salt	0.60006	(0.27-1.92)	-0.098713	0.18797	-0.498	0.00001 ***

*p<0.05,**p<0.01,***p<0.001

Discussion

Hypertension is an important public health concern of global distribution and is also the most common cardiovascular disease risk factor. Adequate control of blood pressure is a key element in the prevention of hypertension induced-organ damage and life-threatening complications. Prevention of hypertension is possible and early detection and effective treatment can significantly minimize the incidence of subsequent adverse clinical outcomes. An array of socio-demographic and potential risk factors have been identified in the causation and determining the long-term outcomes of the disease world-wide. As the natural history of hypertension is complex and etiology is multi-factorial, the strategy to counteract also should be multi-pronged based on the trends and magnitude of the disease in variable settings.

Recent reviews have underlined the pivotal risk factors associated with hypertension in Indian population[10, 19]. Age, alcohol, smoking and chewing tobacco, BMI, central obesity (defined as waist circumference>90 cm in men and >80 cm in women), consumption of low vegetables/fruits, high consumption of dietary fat and salt, and sedentary activity were the significant risk factors for hypertension among Indian patients [19]. A significant positive trend (P<0.0001) was observed over time in prevalence of hypertension by region and gender. Increasing age, body mass index, smoking, diabetes and extra salt intake were common risk factors[10, 19].

Education

Recent studies from India have shown that hypertension is significantly more prevalent in the lower education group when compared with higher education group [20]. We too have found that education influences the presence or absence of hypertension. Low/no education is a predictor of possible hypertension.

CVD and anthropometry

The higher prevalence of hypertension in urban areas may have arisen as cardiovascular disease risk factors among the urban poor and middle class are rapidly increasing in India [21]. Presence of cardio-metabolic risk factors in southern India (such as central obesity and high BMI) [22] have been recognized as the principle contributing factors for high prevalence of hypertension in both urban and rural parts of east and south India. Our study though carried out in western India, bears very similar findings and patterns showing that central obesity and high BMI are the major drivers of increased risk of hypertension.

Age

Increase in hypertension with advancing age has been shown by six studies [23-28]. Our study has also shown that the increase in age is positively associated with the increased risk of hypertension.

Smoking and oral tobacco

Lifestyle changes (harmful dietary practices, consumption of tobacco, and sedentary habits) occurring because of rapid urbanization and economic progress in urban areas has also contributed to the growing epidemic of hypertension in urban areas of India. Higher rates of salty food consumption in eastern parts of India [27] owing to presence of humid conditions. A close to a two-fold increase in risk for hypertension among Indians when they smoked [15, 26, 28], orally consumed khaini and tobacco [27], had extra salt intake in their food [27], had a sedentary lifestyle [29], were centrally obese [15, 26, 28, 30, 31], had BMI at least 25[15, 24, 25, 28, 31], and consumed alcohol [25, 29, 32].Our findings too allude and support the recent evidence base in a very strong manner and the undeniable role of smoking, oral tobacco and alcohol being primary villains leading to morbid hypertensive conditions.

It has been recently reported that one-third of urban adult Indian population and close to one fourth of rural adult Indians are hypertensive. The danger is only quarters of rural Indians suffering from hypertension are aware of and are being treated for hypertension. Moreover, only forty-two percent of urban Indian hypertensive patients are aware of their hypertensive status. The plight still continues and it is reported that thirty-eight percent of urban Indians are being treated for their hypertension. Another scary but true phenomenon is only one-tenth of rural Indians and one fifth of urban Indians suffering from BP have their BP under control.

In view of these findings, urgent steps to improve health education and health promotion (specifically on modifiable risk factors and awareness of BP) measures have to be made by the policy makers on a large scale. Existing interventions should look at incorporating multicomponent and multilevel approaches for better managing BP among Indians, as current rates for awareness, treatment of BP, and control of BP among those on treatment are very low.[10, 19]

These findings are in accordance with our results and show that our study too was able to underline the risk factors prevailing for hypertension in Indian society as determined by other researchers assessing various facets of Indian population.

The findings of the current investigation clearly reflect the necessity for a comprehensive national program for hypertension and its associated risk factors well backed by intensive health awareness campaigns to spread information about the potential risk factors and the sequel of inadequately managed cases of hypertension. Specific guidelines should be formulated and implemented for management of hypertensive patients depending on their blood pressure levels. All the physicians from the public health sector and the private sector including practitioners from other disciplines who are treating hypertensive patients should be trained in the appropriate and adequate management of hypertension.

The outreach health workers should also be trained, aligned and empowered in various aspects of life-style modifications with special emphasis on the conceptual understanding of each of them so that they can spread the awareness, knowledge and message to each and every household during their routine home visits.

Strong political will is desired for establishing a network between of international and national agencies/bodies for ensuring external mentoring, and monitoring. The need of the hour is to strengthen and deepen community-based qualitative and quantitative observational studies to further estimate/determine/quantify the level of awareness, knowledge and practices among the general population regarding potential risk factors and importance of life-style modifications in different settings. This would sensitize them to the currently prevailing messages/strategies being undertaken by the healthcare team to ensure actual optimal implementation of the policies. In each of such efforts a conscious attempt should be made by the researchers to discern the perceived gaps or the barriers that hinder community members from availing routine screening services for hypertension. Research should also be conducted to explore the role of dietary issues and physical inactivity/sedentary lifestyle in the causation of hypertension. This

needs to be followed-up with designing of a comprehensive yet lucid diet and exercise schedules/plan for people with different needs and strata of society to eradicate this issue from the roots.

Conclusion

Our findings strongly support the current state of the art evidence regarding the risk factors of hypertension elucidate by major authors and underline the need for national policy for its eradication.

Suggested policy interventions

(i) Establishment of a national regulatory agency to enforce tobacco control legislation seems inevitable as the role of tobacco is well defined and elucidated in our investigation. Programs to address the high rates of use of smoked beedies and of smokeless tobacco (chewing tobacco and *Paan*) should be developed.

(iii) Programs to promote healthy dietary patterns and physical activity in schools and workplaces should be enforced. Another important effort could be identification of cultural norms that might hinder hypertension prevention efforts.

Suggested capacity building measures

(i) Development of research infrastructure and training of clinical researchers is an important arena which currently lacks both fund and zeal. This lacuna should be filled.

(ii) High-quality national surveillance programs which document causes of death and disability to guide policy and decision makers should be established and continued with the support of national funding agencies.

Suggested research initiatives

(i) Reliable and robust real world statistics on epidemiology (prevalence and incidence) of CVD and its associated risk factors and CVD-related mortality should be generated through the initiation of large cohort studies and trial registries. Studies documenting childhood risk factors, such as obesity, in both urban and rural settings could also be initiated. Lon term registries and case-control studies should be established to document the burden of stroke and its determinants in the Indian subcontinent.

(ii) Randomized controlled clinical trials based in South Asian countries to answer research questions of high relevance to the Indian subcontinent (e.g., effectiveness of the polypill in CVD prevention, homocysteine lowering in subjects with vascular disease) should be initiated to understand and decipher the response and trends in this population

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