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Determinants of blood pressure control among hypertensive patients of rural areas in a South Indian State: A community based cross sectional study

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Abstract

Introduction: Optimum blood pressure (BP) control is essential to prevent complications and improve the quality of life of patients with hypertension. This study aimed to explore the determinants of BP control in patients with hypertension on treatment without any other comorbidities.

Methods: The study was conducted among 429 patients with essential hypertension aged ≥ 30 years residing in four villages of a taluk/tahsil in a South Indian state. A pre-tested semi-structured questionnaire was used to collect data on socio-demographic characteristics, diagnosis and treatment of hypertension, lifestyle factors (e.g. diet and substance use), facilitators and barriers of BP control and anthropometric measurements. BP was measured using World Health Organization standards and classified using the Joint National Committee 8 Guidelines. Descriptive statistics were measured in terms of numbers and percentages. Univariate and multivariate logistic regression analyses were used to determine the significant determinants of BP control.

Results: Approximately 64.3% of the participants had their BP under control. The participants aged 46–59 years were more likely to have uncontrolled BP than those aged ≥60 years. The participants with <80% adherence to medication (non-adherent) had a five fold higher odds of having uncontrolled BP than those with ≥80% adherence.

Conclusion: Adherence to medication was the only significant factor for BP control in the present study. Hence, adherence to medication should be addressed with interventions targeted to improve BP control in patients with hypertension.

Introduction

Hypertension is a global public health concern, as it is often presented to healthcare systems at a late stage with complications owing to its asymptomatic nature, although it can be easily detected and treated.[1] Globally, hypertension affects nearly 40% of the population aged ≥25 years and is a major risk factor for mortality and disability associated with mainly cardiovascular, cerebrovascular and renal complications.[2] An estimated 1.13 billion people worldwide are diagnosed with hypertension, and two third of them are living in low- and middle-income countries.[2]

Various factors have been attributed to the rising prevalence of hypertension, including ageing, urbanisation, inadequate physical activity, obesity, tobacco use, alcohol consumption and stress.[3,4] Although different studies have been conducted on the determinants of blood pressure (BP) control,[3,4] only few of them have exclusively studied individuals with hypertension without other comorbidities. The presence of other comorbidities such as cancer, diabetes, stroke or any other chronic medical conditions among patients with hypertension is likely to influence the treatment outcome. Hence, the present study aimed to assess BP control and its determinants among patients without any other comorbidity.

Methods

A community-based cross-sectional study was conducted from August 2017 to September 2019 among individuals with essential hypertension aged ≥30 years. The study was conducted in four villages of a taluk/tahsil in a South Indian state, which were selected via simple random sampling. The taluk/tahsil had a population of 1.17 million, and the study

population was homogeneous in terms of occupation, literacy and food habits. The major occupation was agriculture and fishing. Medical facilities are available within 5–10 km radius in the villages, and health services are provided through a wide network of public and private hospitals. Patients with essential hypertension on treatment with either exclusively allopathy, which is a modern system of medicine, or a combination of allopathy or Ayurveda, which is an Indian system of medicine, for at least 6 months were included in the study. The Ayurveda system of medicine describes that diseases are caused by an imbalance between three factors, namely vata, pitta and kapha, and treatment is given in the form of herbal medicines.[5] For the study purpose, chronic illness was defined as any illness with a duration of more than 6 months for which a patient was on treatment. Patients with secondary hypertension, those on exclusively Ayurvedic treatment, those with other comorbidities (e.g. diabetes, stroke, ischaemic heart disease, asthma, chronic kidney disease and major psychiatric illness) who visit their physician regularly for treatment, pregnant and lactating women and those with known glaucoma on treatment were excluded from the study.

The sample size was calculated using the prevalence formula for single proportions: $4pq/d^2$, where p is the prevalence of BP control among patients with hypertension; q, 1-p; and d, absolute precision. According to Rao et al.,[4] the prevalence of BP control among patients with hypertension was 37%. Substituting this prevalence in the above equation and with an absolute precision of 5%, we calculated the sample size for this study to be 373. Given a non-response rate of 15%, the total sample to be studied was 429 patients with hypertension. The required number of participants was selected as the probability proportional to the sample size among the four villages. Purposive sampling was adopted to select participants in the villages, wherein the investigator went to the centre of the village, and the nearest house was taken as the first house for the study in that village. He then moved in one particular direction and covered all houses until he achieved the sample size required for the village. In a given house, all members satisfying the inclusion criteria were considered eligible for the study.

A pre-tested semi-structured questionnaire was used to collect data after obtaining written informed consent from the participants. The questionnaire was developed and validated by subject experts and was administered by the researcher to the participants to obtain data. The questionnaire comprised details regarding socio-demographic characteristics such as age, sex, marital status, religion, educational status, occupation, type of family and socio-economic status. Socio-economic status was assessed using the modified BG Prasad Scale.[6] Details of the diagnosis and treatment of hypertension such as the duration since diagnosis, type of healthcare facility for current treatment, current treating doctor, number of tablets currently advised, number of class of antihypertensive medications consumed, financial support for buying medications and distance between healthcare facility and home were noted. Lifestyle factors such as diet and substance use, facilitators and barriers of BP control and anthropometric measurements were also recorded. Height, weight and waist and hip circumferences were measured using standard guidelines[7] and BP using standardised methods with a mercury sphygmomanometer.[7] Two readings of BP were recorded at an interval of 10 minutes. The average of two readings of systolic BP and two readings of diastolic BP was taken to determine the baseline BP of the participants. Body mass index was classified as per the World Health Organization (WHO) classification for South Asians.[8] The participants were classified as healthy or obese based on the waist and hip circumferences and waist–hip ratio according to the WHO guidelines.[9]

Current tobacco users and alcohol drinkers were defined as individuals using tobacco and consuming alcohol, respectively, within the last 1 year, and past users were defined as those who quit using tobacco and consuming alcohol ≥1 year ago.[10,11] Current and past users were considered to be 'ever users' and individuals who have never used tobacco and consumed alcohol as 'non-users'. The regular use of high-salt foods such as pickle, dried salted fish and fried foods was enquired upon, and the use of additional salt in regular diet was noted. The frequency of consumption was classified as daily, 2–5 times per week and rarely/nil. Uncontrolled BP was defined in accordance with the Joint National Committee 8 (JNC-8) guidelines for individuals aged <60 years (≥140/90 mmHg) and ≥60 years (≥150/90 mmHg).[12]

Essential hypertension (also called primary hypertension or idiopathic hypertension) is the form of hypertension that, by definition, has no identifiable cause. Adherence to antihypertensive medication was measured on the basis of self-reports and was calculated by dividing the number of tablets consumed in a given month by the number of tablets prescribed multiplied by 100.

Data were entered and analysed using the Statistical Package for the Social Sciences version 15.0 (Bangalore) for Windows. Descriptive statistics were measured in terms of numbers and percentages. The chi-square test or Fisher's exact test was used to study the association between the categorical variables. Variables with a P-value of <0.2 in the univariate analysis were included in the multivariate logistic regression analysis to identify the significant determinants of BP control. All assumptions of the multivariate logistic regression were fulfilled, and a P-value of <0.05 was considered significant.

Ethical clearance

Ethical clearance for the study was obtained from the Institutional Ethics Committee of Kasturba Medical College and Kasturba Hospital with letter number IEC 596/2017 dated 2 September 2018. The study followed the tenets of the Declaration of Helsinki, and informed written consent was obtained from all participants for voluntary participation in local language, Kannada.

Results

The study included a total of 429 participants, among whom 72% were women. The majority of the participants belonged to Hindu religion (92.8%) and were married (71.1%). Two thirds of the study population were home makers (64.1%) and belonged to the middle class as per the modified BG Prasad Scale (66.0%). Approximately 45.2% belonged to a nuclear type of family, and 68.4% had completed 1–10 years of schooling. Among the participants, 276 (64.3% [95% Confidence Interval (CI)=59.6–68.8]) had their BP under control.

In the univariate analysis, age (46–59 years), religion (Muslim), occupation (professional, skilled) and type of family (nuclear) were found to be associated with BP control. However, in the multivariate analysis, only age (46–59 years) was found to be significantly associated with BP control (**Table 1**).

Table 1. Association between the socio-demographic characteristics and blood pressure control (N=429).

Variables	Blood pressure control		P-value	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
	Uncontrolled, n (%)	Controlled, n (%)			
Age (year)					
≤45	11 (47.8)	12 (52.2)	<0.001	2.3 (0.9–5.4)	2.1 (0.8–5.5)
46–59	59 (51.3)	56 (48.7)		2.64 (1.6–4.1)	2.4 (1.4–4.1)
≥60	83 (28.5)	208 (71.5)		1	1
Sex					
Male	41 (34.2)	79 (65.8)	0.687	0.9 (0.5–1.4)	-
Female	112 (36.2)	197 (63.8)		1	
Religion*					
Hindu	136 (34.2)	262 (65.8)	0.041	1	1
Muslim	15 (57.7)	11 (42.3)		2.6 (1.1–5.8)	1.5 (0.6–3.7)
Christian	2 (40.0)	3 (60.0)		1.2 (0.2–7.7)	2.1 (0.3–13.9)
Marital status					
Married	117 (38.4)	188 (61.6)	0.067	1	-
Widowed/Widower	36 (29.0)	88 (71.0)		0.6 (0.4–1.0)	
Educational status					
Illiterate, primary schooling	55 (32.0)	117 (68.0)	0.419	0.7 (0.4–1.2)	-
Middle school	53 (38.7)	84 (61.3)		1.0 (0.6–1.7)	
High school, pre-university college, graduate and above	45 (37.5)	75 (62.5)		1	

Table 1. Continued

Variables	Blood pressure control		P-value	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
	Uncontrolled, n (%)	Controlled, n (%)			
Occupational status					
Professional, skilled	15 (57.7)	11 (42.3)	0.029	2.3 (1.0–5.4)	1.7 (0.7–4.1)
Semiskilled, unskilled	19 (35.8)	34 (64.2)		0.9 (0.5–1.8)	0.7 (0.3–1.4)
Retired, unemployed	19 (25.3)	56 (74.7)		0.5 (0.3–1.0)	1
Home maker	100 (36.4)	175 (63.6)		1	0.7 (0.3–1.3)
Type of family					
Nuclear	78 (40.2)	116 (59.8)	0.030	1.7 (1.1–2.7)	1.5 (0.9–2.6)
Three generation	31 (40.8)	45 (59.2)		1.8 (1.0–3.2)	1
Joint	44 (27.7)	115 (72.3)		1	1.8 (0.9–3.4)
Socio-economic status (modified BG Prasad Scale)					
Upper class	48 (37.2)	81 (62.8)	0.784	1	-
Middle class	53 (36.6)	92 (63.4)		0.9 (0.6–1.5)	
Lower class	52 (33.5)	103 (66.5)		0.8 (0.5–1.3)	

*Fisher's exact test

The association between diet, substance use and anthropometric measurements is shown in Table 2. In the logistic regression analysis, none of the lifestyle factors and anthropometric measurements were found to be associated with BP control (**Table 2**).

Table 2. Association of diet, substance use and anthropometric measurements with BP control.

Variables	Uncontrolled BP, n (%)	Controlled BP, n (%)	P-value	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Salt restriction (n=425)					
Yes	109 (37.6)	181 (62.4)	0.521	1	-
No	34 (34.0)	66 (66.0)		0.8 (0.5–1.3)	
Dry salted fish consumption (n=429)*					
Daily, 2–5 times/week	2 (50.0)	2 (50.0)	0.619	1	-
Nil/rarely	151 (35.5)	274 (64.5)		0.5 (0.1–3.9)	
Additional salt use in cooked food (n=429)					
Daily, 2–5 times/week	6 (35.3)	11 (64.7)	0.974	0.9 (0.3–2.7)	-
Nil/rarely	147 (35.7)	265 (64.3)		1	
Pickle consumption (n=429)					
Daily, 2–5 times/week	11 (29.7)	26 (70.3)	0.430	0.7 (0.3–1.5)	-
Nil/rarely	142 (36.2)	250 (63.8)		1	
Junk food consumption (n=429)*					
Daily, 2–5 times/week	1 (20.0)	4 (80.0)	0.659	2.2 (0.2–20.1)	-
Nil/rarely	152 (35.8)	272 (64.2)		1	
Smoking (n=429)					
Ever smoked	6 (31.6)	13 (68.4)	0.704	0.8 (0.3–2.2)	-
Never smoked	147 (35.9)	263 (64.1)		1	
Smokeless tobacco use (snuff) (n=429)					
Ever used snuff	20 (40.0)	30 (60.0)	0.496	1.2 (0.6–2.2)	-
Never used snuff	133 (35.1)	246 (64.9)		1	
Smokeless chewable tobacco use (n=429)					
Ever used chewable tobacco	23 (33.8)	45 (66.2)	0.730	0.9 (0.5–1.5)	-
Never used chewable tobacco	130 (36.0)	231 (64.0)		1	
Alcohol consumption (n=429)					
Ever consumed alcohol	12 (35.3)	22 (64.7)	0.963	0.9 (0.4–2.0)	-
Never consumed alcohol	141 (35.7)	254 (64.3)		1	
Waist circumference (n=429)					
Normal	53 (31.4)	116 (68.6)	0.134	1	1
Obese	100 (38.5)	160 (61.5)		1.3 (0.9–2.0)	1.1 (0.6–1.9)
Waist–hip ratio (n=429)*					
Normal	3 (30.0)	7 (70.0)	1.000	1	-
Obese	150 (35.8)	269 (64.2)		1.3 (0.3–5.1)	
Body mass index (n=429)					
Normal/underweight	74 (35.5)	147 (66.5)	0.101	1	1
Overweight	59 (42.4)	80 (57.6)		1.4 (0.9–2.2)	1.0 (0.6–0.8)
Obese	20 (29.0)	49 (71.0)		0.8 (0.4–1.4)	0.5 (0.2–1.0)

*Fisher's exact test

With respect to the disease- and treatment-related factors and BP control, the multivariate analysis showed that only adherence to medication was significantly associated with BP control after adjustments for all covariates (Table 3).

Table 3. Association of the disease- and treatment-related factors with BP control (N=429).

Variables	Uncontrolled BP, n (%)	Controlled BP, n (%)	P-value	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Duration since diagnosis					
<5 years	60 (32.8)	123 (67.2)	0.283	1	
≥5 years	93 (37.8)	153 (62.2)		1.2 (0.8–1.8)	
Type of healthcare facility for current treatment					
Government	11 (40.7)	16 (59.3)	0.569	1	-
Private	142 (35.3)	260 (64.7)		0.7 (0.3–1.7)	
Current treating doctor					
Allopathic specialist with a post-graduate degree	84 (31.9)	179 (68.1)	0.126	1	1
Allopathic physician with a basic medical degree	35 (42.2)	48 (57.8)		0.68 (0.4–1.1)	1.5 (0.8–2.7)
Ayurvedic practitioner	34 (41.0)	49 (59.0)		1.0 (0.5–1.9)	1.1 (0.6–1.9)
Number of tablets currently advised					
1	138 (37.5)	230 (62.5)	0.051	1.8 (0.9–3.4)	1.5 (0.8–3.0)
≥2	15 (24.6)	46 (75.4)		1	1
Number of class of antihypertensive medication					
1	105 (37.5)	175 (62.5)	0.277	1.2 (0.8–1.9)	-
≥2	48 (32.2)	101 (67.8)		1	
Adherence*					
<80%	8 (72.7)	3 (27.3)	0.020	5.0 (1.3–19.2)	6.0 (1.4–25.0)
≥80%	145 (34.7)	273 (65.3)		1	1
Financial support for buying medications					
Free medication	29 (25.0)	87 (75.0)	0.005	1	1
Paid/both	124 (39.6)	189 (60.4)		1.9 (1.2–3.1)	1.73 (0.9–3.1)
Distance between healthcare facility and home					
≤5 km	120 (35.7)	216 (64.3)	0.967	1	-
>5 km	33 (35.5)	60 (64.5)		0.9 (0.6–1.6)	
Family history of hypertension					
Yes	80 (38.6)	127 (61.4)	0.446	1	-
No	41 (33.6)	81 (66.4)		0.8 (0.5–1.2)	
Unknown	32 (32.0)	68 (68.0)		0.7 (0.4–1.2)	

*Fisher's exact test

Discussion

Patients with hypertension with comorbidities such as cancer, diabetes, stroke or any other chronic medical conditions are likely to access medical care because of multiple coexisting illnesses. The presence of an underlying morbidity can impact the clinical outcomes. Hence, we included only patients with hypertension without other comorbidities herein, which is the strength of the present study. We observed that 64.3% of the participants had their BP under control; this proportion is higher than that in many other studies. In the present study, the majority (93.7%) of the participants were receiving treatment from private healthcare centres, and three fourths had access to a healthcare facility within 5 km from their dwelling place.

A similar study conducted in an urban area of Puducherry, India,[13] among adults aged 18–69 years reported that only 19% of patients with hypertension had their BP under control, and the majority of patients (61%) were receiving treatment from a private clinic. A study conducted in a disadvantaged rural population aged ≥18 years in India reported BP control among 23% of patients with hypertension and that accessibility to healthcare services in terms of distance had a significant impact on BP control.[14] The systematic review and meta-analysis conducted by Raghupathy et al. among adults aged ≥18 years revealed that only one tenth and one fifth of rural and urban Indian populations with hypertension had their BP under control, which indicates poor BP control in both urban and rural areas.[15]

Various studies conducted in different parts of India among adults aged 25–64 years have reported BP control among 9%–30.6% of patients with hypertension.[16,17] The reason for the high proportion of patients (64.3%) with BP control in our study may be attributed to the fact that we included only patients with hypertension without other comorbidities compared with other studies wherein people with other comorbidities were included, which may have had a bearing on BP control.

In our study, the participants aged 46–59 years were more likely to have uncontrolled BP than those aged ≥60 years. This finding could be attributed to the relaxed BP goals in adults aged ≥60 years according to the JNC-8 guidelines in addition to the inclusion of participants without other comorbidities. This datum conforms to the findings of the study conducted among adults aged ≥18 years in a disadvantaged rural population in India[14] and the study performed by Teshome et al.[18] in Ethiopia. Teshome et al. reported that individuals aged >65 years had a great likelihood of having controlled BP and that negligence owing to a busy lifestyle among younger people may be the reason for the lesser control of BP among them. In contrast to the abovementioned findings, the studies conducted by Asgedom et al.[19] in Ethiopia among adults aged ≥18 years and Al-Qahtani[20] in Saudi Arabia among adults aged ≥18 years showed that an age of ≥65 years was significantly associated with uncontrolled BP; this finding may be attributed to the fact that the older people in these studies had several comorbidities, such as diabetes, which might have contributed to uncontrolled BP among them.

In the present study, sex was not found to be significantly associated with optimal BP control. However, the study by Animut et al.[21] conducted among adults aged ≥18 years in Ethiopia and Olomu et al.[22] in Michigan found that female sex was associated with good control of BP.

Our participants with <80% adherence to medication (non-adherent) were found to have a fivefold higher odds of having uncontrolled BP than those with ≥80% adherence. This finding agrees well with that of studies conducted in other parts of the world, including the studies conducted among adults aged ≥18 years in Ethiopia by Teshome et al.,[18] Animut et al.[21] and Fekadu et al.[23] and in the USA and Portugal by Hill et al.[24] and Morgado et al.,[25] respectively: Patients who were well adherent to their medications were likely to have good control of their BP.

Dietary practices did not have any bearing on BP control in our study. However, the study conducted by Ferrara et al.[26] among middle-aged individuals (40–60 years) suggested that lowering salt intake, consuming diet rich in vegetables and having poor intake of saturated fats will result in better control of BP in patients with hypertension. In our study, we did not find any association between the anthropometric measurements and BP control. Contrary to our findings, Animut et al.[21] found that overweight and obesity were inversely related to BP control, which may be attributed to the reason stated in the study that obesity induces a chronic volume overload as a result of increased requirements to circulate blood through large and relatively low-resistance adipose tissue.

Owing to the cross-sectional nature of the present study, plausible causality cannot be established, which is a limitation of the study. Further, the pharmacological aspects of BP control with various classes of antihypertensive medications and the various streams of medicine (modern and traditional) were not evaluated in this study, which may also be other limitations of the study.

Conclusion

The present results depict that better adherence to medication results in better BP control. Counselling of patients with emphasis on the importance of adherence to medication should be conducted during routine patient interaction with healthcare providers. It is important to clarify the benefits of adherence and demystify myths and the fear of side effects of medications, which is a crucial factor for adherence.

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Author contributions

Ajo Paul (AP), Sanjay Kini B (SKB), Ashwini Kumar (AK), Sneha D Mallya (SDM)

AP and SKB contributed equally as first authors.
Idea of the study: AP, SKB, AK, SDM
Designing study methodology: AP, SKB, AK, SDM

Data collection: AP, SKB
Statistical analysis: AP, SKB, AK, SDM
Writing the paper: AP, SKB, AK, SDM
Proof reading: AP, SKB, AK, SDM
Final approval: AP, SKB, AK, SDM

Ethical approval

Ethical clearance for the study was obtained from the Institutional Ethics Committee of Kasturba Medical College and Kasturba Hospital with letter number IEC 596/2017 dated 2 September 2018.

Conflicts of interest

None declared.

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None.

Data sharing statement

The data of the study are available from the corresponding author and can be provided on request.

How does this paper make a difference in general practice?

- Adherence to medication is a key factor that general practitioners should constantly monitor during each consultation visit of patients.
- This can be achieved by directly asking patients regarding their adherence to medication, checking for empty packets of tablets, cross-questioning patient relatives, counselling patients with regard to concerns of any side effects of medication and demystifying myths about taking medications, including medications affecting the kidneys and liver, which are commonly prevalent in the Indian population.

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