





RESEARCH ARTICLE

Role of family support and self-care practices in blood pressure control in individuals with hypertension: results from a cross-sectional study in Kollam District, Kerala [version 1; peer review: 2 approved]

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Abstract

Background: Despite the availability of effective drugs, blood pressure (BP) control rate is sub-optimal in individuals with hypertension in low- and middle-income countries (LMICs). The role of self-care in the management of BP is less studied in LMIC settings.

Methods: We conducted a community-based, cross-sectional study in individuals with hypertension in Kollam district, Kerala. A multistage cluster sampling method was used for the selection of study participants. We measured self-care by using an adapted Hypertension Self-Care Activity Level Effects (H-SCALE) scale. Descriptive statistics were used to summarise the data and logistic regression analysis was conducted to identify factors associated with BP control.

Results: In total, 690 individuals with hypertension (women=60%) and a mean age of 57±8 years participated in the study. More than half (54%) of the participants were adherent to anti-hypertensive medications. However, the adherence rate was much lower for the dietary approach to stop hypertension (DASH) diet (12.8%), recommended level of physical activity (24%) and weight management (11.4%). Overall BP control was achieved in two of five individuals (38.4%, 95% CI: 34.7-42.0%). Among self-care activities, adherence to medications (AOR: 1.8, 95% CI: 1.3-2.5), DASH diet (AOR: 1.5, 95% CI: 1.0-2.4), and non-smoking status (AOR: 3.3, 95% CI: 1.7-6.4) were associated with control of BP. Additionally, good family support to self-care (AOR: 1.9, 95% CI: 1.1-3.1) was associated with better control of BP.

Conclusion: In individuals with hypertension, the BP control rate is achieved in two of five individuals. Adoption of self-care activities are sub-optimal. Both family support and adherence to self-care activities are associated with BP control. Family based interventions to improve

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report



report

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Any reports and responses or comments on the article can be found at the end of the article.

adherence to self-care activities could have a significant public health impact in achieving better population-level BP control rates in Kerala, India.

Keywords

Hypertension, blood pressure control, self-care, family support, India



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Introduction

Globally, hypertension is a major cause of premature death and disability. Two of five adult individuals worldwide have raised blood pressure (BP)¹. Annually, more than 10 million deaths and 200 million disability adjusted life years (DALYs) are attributable to elevated BP². Hypertension is undoubtedly a major risk factor for stroke, heart failure, coronary heart disease and chronic kidney disease. More than half of the deaths due to cardiovascular disease (CVD) are linked to complications from hypertension³. Hypertension is also a major public health problem in India, affecting almost one in three adult individuals⁴. Additionally, high BP is attributable to more than 1.5 million deaths and 38 million DALYs in India⁵.

Optimal BP control is essential to prevent the premature deaths and related disability attributable to hypertension. For example, a reduction of more than a third in the risk of stroke and a reduction of a quarter in the risk of myocardial infarction and heart failure are associated with optimal BP control in individuals with hypertension⁶. However, BP control rates are abysmal in low- and middle-income countries (LMICs) even with the availability of effective drugs for management of hypertension⁷. The disproportionately higher number of deaths from elevated BP in LMICs as compared to high-income regions is largely attributable to sub-optimal control of BP.

Hypertension is prevalent in two of five adult individuals in the state of Kerala, India⁸. Despite the availability of a relatively strong public health system⁹, BP control rate is poor in Kerala. For example, the BP control rate at the population level in adults over 18 years was less than 15% in a recent state-wide representative survey conducted in Kerala⁸. In order to achieve optimal BP control, it is desirable to identify the major road blocks and target them with comprehensive health system approaches.

Comprehensive management of hypertension requires both pharmacological and lifestyle modification. Self-care has been recognised as an important determinant for achieving optimal BP control at the individual level. According to the World Health Organisation (WHO), self-care is defined as “the ability of individuals, families and communities to promote health, prevent disease, maintain health and to cope with illness and disability with or without the support of a healthcare provider”¹⁰. Further, hypertension guidelines advise self-care activities such as self-monitoring of BP, reduction of dietary sodium intake, increase in physical activity, limiting alcohol intake, adoption of a dietary approach to stop hypertension (DASH) diet plan, weight management and abstinence from tobacco as lifestyle modification strategies to achieve optimal BP control¹¹. However, research in the areas of self-care practices and BP control are limited in LMICs. We aimed to assess hypertension self-care practices and its impact on BP control among adult individuals with hypertension in Kerala.

Methods

Ethical statement

The Institutional Ethics Committee of Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, Kerala

reviewed and approved the conduct of the study in Kerala (SCT/IEC/1450/NOVEMBER-2019). Written informed consent was obtained from all the study participants before administering the interview schedule. The participants had the freedom to refuse participation at the outset or during any stage of the study. There was no anticipated risk for participants by their involvement in the study. None of the selected participants refused participation.

Study design

We conducted a community based cross-sectional survey in Kollam District, Kerala, India.

Study setting

The study was conducted in five of eleven randomly selected ‘*block panchayats*’ (panchayats are the lowest level of the three-tier local self-governance model in Kerala) of Kollam district, Kerala, India and the data collection took place between December 2019 to February 2020. The population size of Kollam district is 2.64 million, based on the 2011 census¹².

Study population

Individuals in the age group of 30–70 years, diagnosed with hypertension for at least six months and started on at least one antihypertensive drug as part of initial management were eligible to be part of the study. Individuals who could not communicate and were unable to provide informed consent were excluded from the study. A multistage cluster sampling method was used to identify eligible participants for the cross-sectional survey conducted in Kollam district, Kerala. The primary sampling unit was ‘*block panchayats*’. Initially, five of eleven ‘*block panchayats*’ were randomly selected from Kollam District, Kerala using computer-generated random numbers. In the second stage of sampling, two primary health centres (PHCs: caters to a population of approximately 25,000–40,000) were identified by simple random sampling procedure from each ‘*block panchayat*’. Additionally from each primary health centre, we randomly identified three sub-centres (sub-centres cater to a population of approximately 5,000 individuals) for the study using computer-generated random numbers. We obtained the listing of all individuals with hypertension in the selected sub-centres based on the population-based screening records held by the Accredited Social Health Activists (ASHA) in the respective areas. From the chosen sub-centres, we randomly selected 23 individuals with hypertension using computer-generated random numbers from the population-based listing of all individuals with diagnosed hypertension. Participants were approached in person at their residence by the researcher (SC) with the help of a local community health worker (ASHA). Participants were provided with an information sheet (see *Extended data*¹³) in Malayalam language, which contains details about research aims, objectives, and information regarding study questionnaires.

Sample size

A sample size of 690 individuals with hypertension yields more than 80% power to estimate reliably a range of prevalence of self-care activities and BP control rate from 10% to 50%^{8,14} with an absolute precision of 2.5% (assuming an alpha error of 0.05 and a design effect of 1.5).

Study variables and data collection

The researcher (SC) collected the data in person by visiting each study participant at their residence. We collected information regarding sociodemographic factors, health-seeking behaviour, details related to comorbidities, family support and self-care practices. Self-care activities were captured using the adapted version of Hypertension Self-care Activity Levels Effects (H-SCALE) developed by Jan Warren-Fellow and Seymour¹⁵. The H-SCALE was modified to suit the cultural practices prevalent in Kerala. Questions related to intake of certain types of fruits and vegetables were modified and replaced with culturally relevant food items. A panel of experts with expertise in public health, epidemiology and clinical cardiology reviewed the face validity and content validity of the modified version of the questionnaire (see *Extended data*¹⁶). The modified tool was translated into the local language (Malayalam, see *Extended data*¹⁷), and piloted in five individuals with hypertension who were selected from Trivandrum district in Kerala. The piloting involved testing the wordings, possible responses, and clarity of instructions. The tool was finalised after an expert review of the responses received to each item of the scale in the piloting phase. Only minor changes to the wording of some of the items were introduced to improve clarity of the questions. We measured BP and heart rate of the study participants using a digital sphygmomanometer (OMRON HEM-7121). BP was measured after the individual was seated comfortably in an upright position with their arm rested and using an appropriate cuff-size. The BP was measured from the left arm as per the WHO guidelines. After obtaining the first reading, the cuff was deflated fully and the next measurement was conducted after three minutes. The measurement was repeated for the third time by following the same procedure. The mean of the consecutive three readings was obtained and recorded as the BP of the individual.

Definitions

Medication adherence: We used a three-item scale to measure how many days the person took the medication in a week at the recommended dosage and at the recommended time. The scores for each item were summed (range 0–21). A score of 21 was considered as good adherence.

Adherence to the DASH diet: We used an 11-item scale to assess the intake of healthy foods associated with the nutritional composition of the DASH diet. The scores for each item were summed. The possible range of scores for the DASH-Q scale was 0 to 77. A score of <32 was considered as low diet quality; a score between 33 and 51 was considered as medium quality, and scores of 52 or greater were considered as good adherence.

Physical activity engagement: A two-item scale measured the number of days of physical activity of at least 30 minutes for each participant. The scores on both items were summed (range 0–14). A score of eight or above was considered as good adherence to physical activity.

Smoking: The scores in a two-item scale were summed (range 0–14). Respondents who scored zero were considered as adherent to non-smoking.

Weight management: A 10-item scale measured weight management activities in the last month. The sum of the scores on all items ranged from 10–50. Individuals who scored above 40 were considered as adherent to weight management practices.

Alcohol use: Individuals who did not drink alcohol at all were considered as alcohol abstinent.

Family support: A 16-item scale measured the influence of family members on diet and other health behaviour. The average score on all items ranged from 0.94–2.56. We categorised family support into minimal, mild, moderate and strong based on quartiles of the observed score. A score of <1.37, 1.38–1.56, 1.57–1.68, and 1.69 or greater were considered as minimal, mild, moderate and strong support, respectively.

BP control: BP control was defined as a mean BP \leq 140/90 mmHg in all individuals based on the average of three readings.

Data analysis

We performed all data analysis in SPSS Version 25. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as means with standard deviations. We performed multivariate logistic regression analysis to identify independent factors associated with BP control. All variables found to be statistically associated with BP control in the bivariate analyses at a higher p-value threshold of 0.1 were considered in the multivariate model.

Results

General characteristics of the study population

In total, 690 individuals (response rate = 100%) participated in the study. The age of participants ranged from 31 to 70 years with a mean age of 57 ± 8 years (Table 1). More than half of the participants (59.7%) were women. More than one-quarter (29%) of participants had primary or less than primary level of education. One in 10 women (10.7%) were living alone, while this was true for 3% of men. Below poverty level (BPL) ration cards were held by 44% of participants. Individual-level data for each participant are available as *Underlying data*¹⁸.

BP related characteristics of the study population

The mean age of diagnosis of hypertension was 50 ± 9 years (Table 2). Nearly three of five participants (59%) measured their BP at least once in a month. However, three-quarters (74.8%) of individuals were not aware of their last BP values. More than half (54%) were seeking treatment from public facilities. Similarly, more than half of the study participants (52.5%) visited a physician or health worker at least on a monthly basis. Only 10.8% and 7.3% of men and women were monitoring BP at home, respectively.

Hypertension in isolation was present in 30% of the study population. Diabetes (39.1%) and dyslipidemia (32.2%) were the major comorbid conditions. The proportion of study participants with hypertension and one or two or more co-morbidities were 39% and 31.2%, respectively.

Self-care practices

The overall prevalence of medication adherence among study participants was 54.8% (Table 2). The medication

Table 1. General characteristics of the study population.

Characteristics	Men N=278	Women N=412	p-value
Age, mean (SD)	57.40 (\pm 8.91)	56.93 (8.73)	0.489
Age group, n (%)			0.520
31 - 40	16 (5.8)	23 (5.6)	
41-50	41 (14.7)	78 (18.9)	
51-60	109 (39.2)	147 (35.7)	
61-70	112 (40.3)	164 (39.8)	
Marital status, n (%)			0.0001
Married	249 (89.6)	267 (64.8)	
Single /divorced	29 (10.4)	145 (35.2)	
Education, n (%)			0.360
Primary	74 (26.6)	127 (30.8)	
Secondary	146 (52.5)	213 (51.7)	
Higher secondary	58 (20.9)	72 (17.5)	
Occupation, n (%)			0.001
Self/formal employment	89 (32.0)	50 (12.1)	
Unemployed	37 (13.3)	27 (6.6)	
Retired	45 (16.2)	32 (7.8)	
Homemakers	0	262 (63.6)	
Daily wages	107 (38.5)	41 (10.0)	
Living alone, n (%)			0.001
Yes	9 (3.2)	44 (10.7)	
No	269 (96.8)	368 (89.3)	
Income categories, n (%)			0.262
Below poverty line	114 (41.0)	188 (45.6)	
Above poverty line	164 (59.0)	224 (54.4)	

adherence was higher in men (60.4%) as compared to women (51%). Adherence to the DASH diet was very poor in both men (14.4%) and women (11.7%). Overall, 24% of participants were engaged in the recommended level of physical activity. Adherence to the recommended level of physical activity was very low in women (15.8%) as compared to men (36%). Nearly one-third (32.7%) of men were smokers. Alcohol use was prevalent in 13.3% of men. Overall, 11.4% of the individuals were adherent to weight management practices (Table 2).

Family support in self-care

More than half (53.2 %) of men and 62.1% of women reported minimal to mild family support to self-care activities. Similarly, 47.6% and 37.7% of men and women reported moderate to strong family support to self-care activities related to hypertension management, respectively (Table 2).

Factors associated with BP control

The proportion of individuals with controlled BP increased with the improvement in family support from minimal (26.6%) to strong support (48.8%). Similarly, the mean systolic BP was lowest in individuals with strong family support to self-care activities (140.10 \pm 2.82 mmHg) as compared to individuals with minimal family support (149.05 \pm 3.35mmHg) (Figure 1).

Age group, gender, educational level or occupation did not show any association with control of BP in the bivariate analysis (Table 3). Similarly, duration of hypertension, home BP monitoring and frequency of BP monitoring were not associated with BP control. Only a quarter of patients living alone (24.5%) achieved BP control as compared to 40% in patients living with other family members ($p = 0.04$). Individuals seeking care from both private and public facilities were less likely to achieve BP control as compared to individuals seeking care from either private or public facilities. BP control rate improved with family support, adherence to medications and DASH diet. BP control rate was also better in those who were adherent to non-smoking practices as compared to smokers (Table 3).

In the multivariate model (Table 4), participants who were adherent to medication were approximately 1.5 times more likely to have controlled BP than non-adherent individuals ($P = 0.009$, OR = 1.5, 95% CI = 1.1-2.2). Individuals who were adherent to the DASH diet were 1.6 times more likely to have controlled BP as compared to the non-adherent group ($P = 0.043$, OR = 1.6, 95% CI = 1.0-2.6). Similarly, adherence to non-smoking improved the odds of BP control by almost three times ($P = 0.001$, OR = 3.1, 95% CI = 1.6-6.3).

Discussion

BP control is an important treatment goal for prevention of cardiovascular disease and related complications in individuals with hypertension. Self-care practices are sub-optimal and they are strongly associated with BP control in individuals with hypertension in Kerala. Additionally, family support enhances adherence to self-care practices related to BP management.

The overall BP control rate in our study population is higher than the data reported in previous studies from Kerala. For example, a large cross-sectional survey conducted in Kerala observed that BP control is only achieved in less than 15% of individuals with hypertension⁸. As a standard practice in community-based surveys on hypertension prevalence, the above cited study included all individuals with elevated BP above the hypertension threshold of 140/90 mmHg in the 'uncontrolled BP' category. Hence, even the individuals with a first time diagnosis of hypertension based on a single visit BP measurement are labelled as 'uncontrolled hypertension'. However, we have included those who were diagnosed with hypertension for at least six months, started on at least one antihypertensive drug as part of initial management, and had a BP above the hypertension threshold in the 'uncontrolled BP'

Table 2. Blood pressure, health seeking pattern and adherence to self-care components.

Characteristics	Men	Women	p-value
Age at diagnosis, mean (SD)	50.50 (9.5)	50.62 (9.3)	0.871
Duration of hypertension, mean (SD)	6.90 (6.6)	6.31 (6.3)	0.237
Systolic BP (mmHg), mean (SD)	142.55 (20.7)	144.59 (19.4)	0.186
Diastolic BP (mmHg), mean (SD)	87.55 (11.5)	86.90 (11.3)	0.465
Health care facility, n (%)			0.840
Public	150 (54.0)	228 (55.3)	
Private	84 (30.2)	116 (28.2)	
Both	44 (15.8)	68 (16.5)	
Visit to a physician/health worker, n (%)			0.433
Weekly/monthly	146 (52.5)	198 (48.1)	
Twice/once in a year	53 (19.1)	79 (19.2)	
Rarely	79 (28.4)	135 (32.8)	
Home BP monitoring, n (%)			0.142
Yes	30 (10.8)	30 (7.3)	
No	248 (89.2)	382 (92.7)	
Awareness of last BP value, n (%)			0.432
Yes	75 (27.0)	99 (24.0)	
No	203 (73.0)	313 (76.0)	
Frequency of BP monitoring, n (%)			0.220
Monthly	175 (62.9)	232 (56.3)	
Twice/once in a year	37 (13.3)	65 (15.7)	
When symptoms occur/rarely	66 (23.7)	115 (28.0)	
Perceived BP control status, n (%)			0.143
Yes	115 (41.4)	195 (47.3)	
No	163 (58.6)	217 (52.7)	
Family support in self-care, n (%)			0.065
Minimal	66 (23.7)	118 (28.6)	
Mild	82 (29.5)	138 (33.5)	
Moderate	55 (19.8)	78 (18.9)	
Strong	75 (27.0)	78 (18.9)	
Self-care practices, n (%)			
Medication adherence	168 (60.4)	210 (51.0)	0.018
DASH diet adherence	40 (14.4)	48 (11.7)	0.347
Physical activity adherence	100 (36.0)	65 (15.8)	<0.001
Weight management adherence	44 (15.8)	37 (9.0)	0.009
Alcohol abstinence	241 (86.7)	412 (100.0)	<0.001
Non-smoking	215 (77.3)	412 (100.0)	<0.001

BP, blood pressure; SD, standard deviation; DASH, dietary approach to stop hypertension.

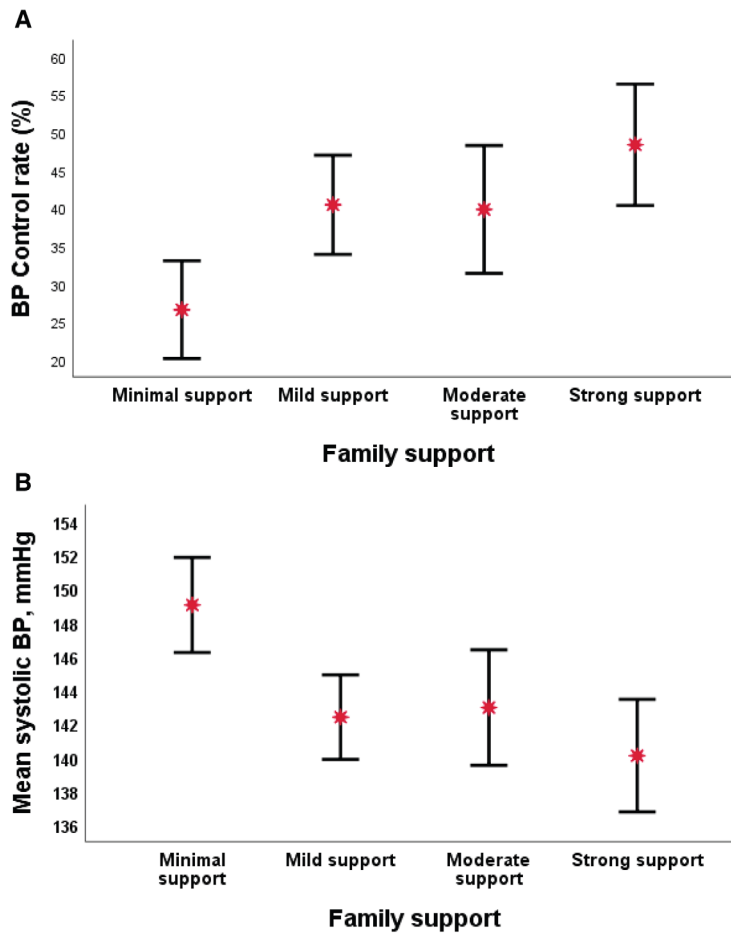


Figure 1. Panel **A**) Family support and blood pressure (BP) control rate. Panel **B**) Family support and mean systolic BP.

Table 3. Factors associated with blood pressure control.

Variable	Controlled n = 265	Uncontrolled n = 425	p-value
Age group, n (%)			0.429
31 - 40	18 (46.2)	21 (53.8)	
41 - 50	42 (35.3)	77 (64.7)	
51 - 60	105 (41.0)	151 (59.0)	
61 - 70	100 (36.2)	176 (63.8)	
Gender, n (%)			0.283
Men	114 (41.0)	164 (59.0)	
Women	151 (36.7)	261 (63.3)	
Education level, n (%)			0.730
Up to primary	78 (38.8)	123 (61.2)	
Secondary	141 (39.3)	218 (60.7)	
Higher secondary and above	46 (35.4)	84 (64.6)	

Variable	Controlled n = 265	Uncontrolled n = 425	p-value
Occupation, n (%)			0.962
Formal/self-employment	56 (40.3)	83 (59.7)	
Unemployed	25 (39.1)	39 (60.9)	
Retired	27 (35.1)	50 (64.9)	
Homemaker	101 (38.5)	161 (61.5)	
Daily wages	56 (37.8)	92 (62.2)	
Living alone, n (%)			0.044
Yes	13 (24.5)	40 (75.5)	
No	252 (39.6)	385 (60.4)	
Health care facility, n (%)			0.006
Public	154 (40.7)	224 (59.3)	
Private	83 (41.5)	117 (58.5)	
both	28 (25.0)	84 (75.0)	
Duration of hypertension, n (%)			0.245
<5 years	136 (37.9)	223 (62.1)	
5-10 years	74 (35.6)	134 (64.4)	
<10 years	55 (44.7)	68 (55.3)	
Home BP monitoring, n (%)			0.337
Yes	27 (45.0)	33 (55.0)	
No	238 (37.8)	392 (62.2)	
Frequency of BP monitoring, n (%)			0.922
Monthly	155 (38.1)	252 (61.9)	
Twice/once in a year	41 (40.2)	61 (59.8)	
When symptoms occur/rarely	69 (38.1)	112 (61.9)	
Family support, n (%)			0.001
Minimal	49 (26.6)	135 (73.4)	
Mild	89 (40.5)	131 (59.5)	
Moderate	53 (39.8)	80 (60.2)	
Strong	74 (48.4)	79 (51.6)	
Medication adherence, n (%)			<0.001
Adherent	169 (44.7)	209 (55.3)	
Non-adherent	96 (30.8)	216 (69.2)	
DASH diet adherence, n (%)			0.071
Adherent	42 (47.7)	46 (52.3)	
Non-adherent	223 (37.0)	379 (63.0)	
Physical activity adherence, n (%)			0.261
Adherent	70 (42.4)	95 (57.6)	
Non-adherent	195 (37.1)	330 (62.9)	
Weight management adherence, n (%)			0.924
Adherent	32 (39.5)	49 (60.5)	
Non-adherent	233 (38.3)	376 (61.7)	
Alcohol abstinence, n (%)			0.552
Adherent	253 (38.7)	400 (61.3)	
Non-adherent	12 (32.4)	25 (67.6)	
Non-smoking adherence, n (%)			0.001
Adherent	253 (40.4)	374 (59.6)	
Non-adherent	12 (19.0)	51 (81.0)	

BP, blood pressure; DASH, dietary approach to stop hypertension.

Table 4. Strength of association of self-care and control of blood pressure.

Variable	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Living alone				
Yes	Reference		Reference	
No	2.0 (1.1-3.9)	0.034	1.7 (0.8-3.5)	0.116
Family support				
Minimal	Reference		Reference	
Mild	1.9 (1.2-2.9)	0.004	1.4 (0.9-2.2)	0.124
Moderate	1.8 (1.1-2.9)	0.013	1.3 (0.8-2.8)	0.218
Strong	2.6 (1.6-4.0)	<0.001	1.9 (1.1-3.1)	0.013
Health care facility				
Public	Reference		Reference	
Private	1.0 (0.7-1.5)	0.860	0.9 (0.6-1.3)	0.648
Both	0.5 (0.3-0.8)	0.003	0.5 (0.3-0.8)	0.005
Adherence to home BP monitoring				
No	Reference		*	
Yes	1.3 (0.8-2.3)	0.273		
Medication adherence				
Adherent	1.8 (1.3-2.5)	<0.001	1.5 (1.1-2.2)	0.009
Non-adherent	Reference		Reference	
DASH diet adherence				
Adherent	1.5 (1.0-2.4)	0.056	1.6 (1.0-2.6)	0.043
Non-adherent	Reference		Reference	
Physical activity adherence				
Adherent	1.2 (0.9-1.8)	0.224	*	
Non-adherent	Reference			
Weight management adherence				
Adherent	1.1 (0.7-1.7)	0.828	*	
Non-adherent	Reference			
Non-smoking adherence				
Adherent	3.3 (1.7-6.4)	<0.001	3.1 (1.6-6.3)	0.001
Non-adherent	Reference		Reference	
Alcohol abstinence				
Adherent	1.3 (0.7-2.7)	0.444	*	
Non-adherent	Reference			

BP, blood pressure; OR, odds ratio; CI, confidence interval; DASH, dietary approach to stop hypertension.

* Not included in multivariate analysis

category in our study. Therefore, the control rate observed in our study is among individuals who were formally diagnosed and treated for hypertension. Unlike other facility-based surveys, our results are based on a representative community-based sample of individuals with diagnosed hypertension.

Self-care practice was less than optimal in our study population. Despite the prescription of treatment and the follow-up by ASHA workers, only 55% were adherent to the medications. Additionally, adherence to DASH diet components were only observed in less than 15% of the study population. Our study demonstrates that self-care practices are very important in achieving optimal control of BP. We show that those who were

adherent to drugs, the DASH diet and non-smoking achieved better BP control than the non-adherent group. Consistent findings on adherence to medication and BP control are reported in other studies¹⁹⁻²¹.

BP control in individuals with hypertension often requires adherence to self-care activities beyond medications. However, self-care activities related to diet and smoking are often ignored. Clinical trial evidence suggests that a low sodium DASH diet improves the control of BP and reduces cardiovascular risk in individuals with hypertension¹¹. In the PREMIER trial, the DASH diet and other lifestyle practices together reduced BP and cardiovascular events²². Despite the known benefits of a low

sodium DASH diet, adherence to DASH diet components were abysmally poor in our study. Community-based strategies to improve adherence to DASH diet components²³ and policy initiatives promoting low sodium salt²⁴ may improve the BP control rate at the population level. Prescribing mandatory targets for the food industry, front of pack labelling, food procurement policies and taxation are some additional policy initiatives to reduce population level salt consumption²⁵.

We show that smoking status is independently associated with BP control. Consistent findings are reported in the national health survey in England²⁶. Available evidence also shows that nicotine in cigarettes acts as an adrenergic agonist and mediates release of catecholamines, which affects BP levels and heart rate²⁷. Alcohol abstinence is also an important self-care practice that plays a significant role in the control of BP. In our study, alcohol use was not associated with BP control. However, the amount of alcohol consumption should be taken into consideration while exploring the association with BP control. In the INTERSALT study, a significant reduction in BP was observed in people who had limited their alcohol consumption²⁸. The potentially causal relationship between alcohol abstinence and BP reduction in the INTERSALT study provides further evidence to recommend alcohol reduction to control BP in hypertensive individuals.

Family support of self-care activities is a key factor associated with BP control in our study. Better family support acts through improvements in the adherence to self-care activities and thereby improves BP control. The positive association between BP control and perceived family support emphasizes the need for health care providers to assess the available family support when managing individuals with hypertension. Further, it calls for innovative family-based models such as the Programme of Lifestyle Intervention in Families (PROLIFIC study) in managing BP²⁹. The PROLIFIC model vouches for a family centred strategy for lifestyle changes and self-care for cardiovascular risk reduction. In a family centred approach, the proposed lifestyle changes and self-care strategies are more achievable and sustainable for the individuals and their family members³⁰.

Strengths and limitations

The study sample was representative of the population of Kollam District in Kerala. To the best of our knowledge, the impact of self-care activities on BP control is not studied in detail in community settings in India. Due to the self-reported nature of adherence pattern, the study is prone to recall and response bias. The associations observed in our study may not infer causality due to the cross-sectional nature of the study.

Conclusion

Overall, BP control is achieved in two of five participants with diagnosed hypertension and on treatment in Kerala at the community level. Further, compliance to self-care practices are less than optimal in the study population. Optimal adherence to self-care strategies is important in improving BP

control rate in individual with hypertension. Family support is key to improving adherence to self-care practices and thereby facilitates individuals with hypertension to achieve improved BP control. Interventions to improve family support for self-care activities could have a significant public health impact in achieving better population-level BP control rates in Kerala, India.

Data availability

Underlying data

Figshare: Role of family support and self-care practices in blood pressure control in individuals with hypertension; results from a cross sectional study in Kollam District, Kerala. <https://doi.org/10.6084/m9.figshare.12616325.v1>¹⁸.

This project contains the following underlying data:

- Dataset.csv (raw individual level data for each participant)
- Codes used in dataset.docx

Extended data

Figshare: Role of family support and self-care practices in blood pressure control in individuals with hypertension; results from a cross sectional study in Kollam District, Kerala. <https://doi.org/10.6084/m9.figshare.12616214.v4>¹⁶.

This project contains the following extended data:

- Interview schedule English version.pdf

Figshare: Role of family support and self-care practices in blood pressure control in individuals with hypertension; results from a cross sectional study in Kollam District, Kerala. <https://doi.org/10.6084/m9.figshare.12662042.v2>¹⁷.

This project contains the following extended data:

- Interview schedule malayalam version.pdf

Figshare: Role of family support and self-care practices in blood pressure control in individuals with hypertension; results from a cross sectional study in Kollam District, Kerala. <https://doi.org/10.6084/m9.figshare.12662357.v1>¹³.

This project contains the following extended data:

- Participant information sheet english version.pdf
- Participant information sheet malayalam version 2.pdf

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0).

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Timothy Walker 

School of Medicine and Public Health, University of Newcastle, Newcastle, Australia

This is a well conducted and clearly described cross-sectional study assessing blood pressure control practices among a cluster-derived sampling of adult hypertensive patients in Kerala, India, and correlating this with blood pressure control at a single time point.

The sampling methodology is very clearly described. 100% participation is remarkable, and may reflect additional cultural or other factors at play.

The H-SCALE tool used was put through a rigorous translation, piloting and validation process prior to its use in the study. Results are clearly presented and well laid out. Generally it is clear what was found, and the authors present a sensible discussion of their results in light of the available literature.

A few minor suggestions for improvement follow below:

1. The p-values in Table 1 are not clearly described or annotated to make clear which statistical test was applied, or what question was to be answered by this test. It is generally preferable if a table can stand alone without further explanation, and an explanatory note should be added to Table 1 to aid interpretation.
2. The statistical methods used could be laid out more clearly. It is unclear which tests were used to arrive at the stated p-values in the Tables, and no check for normal distribution of data appears to have been undertaken prior to use of parametric tests. Overall the statistics are inadequately described to allow replication of results.
3. Using a single set of three blood pressure measurements to define a concept as complex as blood pressure control is obviously methodologically fraught. While this may well have been the most practical method available, this limitation should have been discussed, particularly given it related to the primary outcome.

Thanks for the opportunity to review this interesting study.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Gastroenterology, Internal Medicine, Global Health, Medical Education.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 13 November 2020

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Yogesh Kalkonde 

Society for Education, Action and Research in Community Health, Gadchiroli, India

In this manuscript the authors evaluated the role of family support and self-care on blood pressure control in Kollam district of India. The study found that blood pressure control was poor (40%) and certain self-care activities and good family support were associated with improved blood pressure control. These findings support evaluation of self-care and family-support interventions to improve control of hypertension which is a leading risk factor for death and disability globally. There is very little information on self-care and family support for hypertension control in community settings in India so this study is important.

It is a well conducted study. The authors could get a response rate of 100% which is really hard to achieve in field studies.

I have some suggestions which are listed below.

Title

- The title needs to reflect that the study was conducted in India. Abstract

The abstract is concise.

- The authors should define BP control in the abstract by specifying the cut offs e.g. <140/90.

Introduction

The introduction is well written, explains the rationale for conducting this study and provides the objectives of the study.

- The statement 'disproportionately higher number of deaths from elevated BP in LMICs...attributable to suboptimal control of BP' needs a reference.
- The statement 'self-care has been recognized as an important determinant...at the individual level' also needs a reference.

Methods

The methods section is clearly written.

- It would be beneficial for the readers if the authors can provide the rationale for conducting this study in the Kollam district of Kerala.
- The authors state that they drew 23 individuals with hypertension randomly from the population-based listing of all individuals with diagnosed hypertension. However, the source of this list is unclear. Was this list prepared during the population-based screening of hypertension under the national programme for prevention and control of chronic diseases? Was the list obtained from the primary health centres?
- The authors state that self-care activities were captured using H-SCALE tool. The authors have attached the tool in the supplement but it will be beneficial for the readers to describe in brief what the key components of this tool are in the methods section.
- In defining medications adherence, adherence to DASH diet, physical activity engagement, weight management, family support the authors provide certain cut-offs to classify these activities as good or mild, moderate and strong. What was the rationale for selecting these thresholds? It will be good to state this in the methods.

Results

- In Table 2, the authors should provide data on percentage of men and women with controlled BP in addition to providing mean systolic and diastolic BP.
- In Table 3, the categories in the duration of hypertension are listed as <5 years, 5-10 years and <10 years. The last category should be >10 years.
- The authors may want to change the title of Table 4 to 'strength of association of components of self-care and control of blood pressure'.
- In Tables 3 and 4, the terms non-smoking adherence and alcohol abstinence should be replaced with simpler terms such as current smoking and current alcohol use. Understanding non-smoking non-adherence can become challenging.
- The authors use weight management adherence as one of the parameters to assess self-

care but have not provided an information on obesity among the participants. It will be useful to provide this information.

Discussion

The authors have discussed the interpretation of their findings, the strengths and the limitations of their study. However, some additional discussion will be useful.

- Physical activity and weight management are important measures to improve blood pressure control. However, these factors were not associated with blood pressure control in this study. The authors may want to discuss briefly why this might be the case.
- While discussing no association between alcohol use and BP control the authors argue that this could be related to the amount of alcohol consumed but a more plausible reason in this study could be that a very few participants were using alcohol - 86.7% men and 100% women participants were alcohol abstinent. Therefore, finding an association between blood pressure control and alcohol use could be hard.
- Presence of other diseases e.g. diabetes, coronary artery disease and stroke among patients with hypertension might modify self-care and control. As the data on these comorbidities are not presented, this should be discussed as a limitation of the study.

Overall it is an excellent study which meets the standard of the journal and will advance this area of research further in India.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health, non-communicable diseases, epidemiology.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.
