

## Original Research Article

# Prevalence and risk factors of uncontrolled hypertension in the urban population of Kerala

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## ABSTRACT

**Background:** Hypertension is leading risk factor for cardiovascular diseases and stroke, and leads to 12.8% of all deaths in the world. Uncontrolled hypertension doubles the risk of cardiovascular disease among the adults with hypertension. Globally 65% of the treated hypertensive have uncontrolled hypertension and in Kerala about three fourth of the treated hypertensive have poor blood pressure control. The burden of uncontrolled hypertension is suggestive of preventable deaths and cardiovascular events.

**Methods:** A cross-sectional study was conducted among 1210 residents of Kochi Corporation of Kerala aged 18 years and above during the period of Sept. 2014 to Sept. 2016. Pre-tested, semi-structured questionnaire was used to collect data on socio-demographic factors such as age, sex, occupation, socio-economic status, education and marital status. Behavioural factors such smoking, alcohol intake, physical activity and dietary factors were collected. Data was analysed by using statistical package for social sciences software version 20.0.

**Results:** The prevalence of uncontrolled hypertension was 13.14% among the study population. Majority of the uncontrolled hypertensive were females (67.3%) and belonged to the age group 45 years and above (92.5%). The independent predictive factors of uncontrolled hypertension were additional salt intake (aOR 3.62; 95% CI 1.36-9.66), health education by a doctor (aOR 3.58; 95% CI 1.48-8.64), poor adherence to medication (aOR 4.45; 95% CI 1.23-16.03) and patients having no other co-morbidity (aOR 3.24; 95% CI 1.36-7.72).

**Conclusions:** The burden of uncontrolled hypertension was high in this urban setting. A comprehensive measure involving doctors and healthcare workers have to be adopted to achieve optimum blood pressure among the hypertensive.

**Keywords:** Adherence to medication, Cardiovascular diseases, Complications of hypertension, Uncontrolled hypertension

## INTRODUCTION

Hypertension is the leading risk factor of cardiovascular diseases and stroke, and leads to 12.8% of all deaths in

the world.<sup>1</sup> It is an important public-health challenge worldwide affecting more than a quarter of the world's adult population. According to the WHO, currently around 37% of the population residing in the South East Asian Region is hypertensive. Overall prevalence of

hypertension in India, among the age group 15-64 years, is around 35.2% with a higher prevalence among the male gender.<sup>2,3</sup> Studies in Kerala have reported above 30% prevalence of elevated blood pressure with a higher prevalence reported among the urban residents.<sup>4-6</sup>

Uncontrolled hypertension doubles the risk of cardiovascular diseases among the adults. However, studies have reported that, adequate hypertension treatment and control can reduce the incidence of first and recurrent heart attacks and strokes, heart failure, and chronic kidney disease, and can save lives.<sup>7</sup> Worldwide; more than 7 million deaths can be prevented annually by adequate blood pressure control. About 50% of the treated hypertensive individuals, in India, have uncontrolled hypertension.<sup>8</sup>

Globally around 65% of the treated hypertensive individuals have uncontrolled hypertension. The prevalence of uncontrolled hypertension among the treated hypertensive population in the developed and developing countries are 64.2% and 68.2% respectively.<sup>9</sup> In India, national data on uncontrolled hypertension is not available, multiple studies conducted in the North (10.5%), South (8%), East (18.1%) and West (13.6%) reported sub optimal blood pressure control.<sup>10</sup> In Kerala, only a quarter of the treated hypertensive patients have controlled hypertension.<sup>11</sup> There is difference in prevalence of uncontrolled hypertension between the states and within the states in India due to the diverse profile of socioeconomic growth, demographic change, health care policies and life style practices.

The burden of uncontrolled hypertension is suggestive of the preventable deaths and cardiovascular events. As there is a gap in knowledge regarding the burden and factors leading to poor control of blood pressure, we conducted this study aimed at finding the magnitude of uncontrolled hypertension and to study the factors associated with it.

## METHODS

### *Study design and sample size*

This cross sectional community based study was conducted in Kochi Corporation in the southernmost part of India, Kerala. Kochi Corporation has 74 divisions with a population of 6, 01,574 with a female to male sex ratio of 1027 and average literacy rate of 97.36%. The study was conducted during September 2014 to September 2016. The study population included adults aged 18 years and above, who were residents of Kochi Corporation. Patients with severe conditions and pregnant women were excluded from the study.

The sample size was calculated with a prevalence of 14.9% reported in an urban population in Trivandrum. The sample size was estimated to be 550 with 95% confidence and 20% allowable error using the formula

$(Z\alpha)^2 pq/d^2$ .<sup>5</sup> Since the study adopted cluster sampling, the obtained sample was multiplied by design effect. Assuming an Intra cluster correlation (ICC) of 0.02 and cluster size of 40 the design effect is calculated to be 2. We assumed a non-response rate of 10% and calculated the final sample size as 1210. Using probability proportional to size technique, 30 divisions out of the 74 divisions in Kochi Corporation was selected and 40 houses from each cluster were visited.

Each house was visited starting from the centre point of every cluster. At the centre point, one of the direction to which houses were visited was selected by lottery method. From the first house, every house on the same side was visited. From the end of every side or row of houses visited the first right direction was chosen to continue data collection. Those houses found locked at the time of the visit were excluded after revisiting on three consecutive days and the next house was chosen for data collection. One of the adult members of every house was randomly selected using lottery method as study participants.

### *Data collection*

After obtaining informed consent, pre-tested, semi-structured questionnaire adopted from WHO STEPS, IDSP Kerala Survey 2007 and Four items Morisky Medication Adherence Scale, was administered to the person directly or through an in-formant, the head of the family by the Principle Investigator, who is a trained medical professional.<sup>2,8</sup> Written informed consent printed in Malayalam or English was obtained from the respondents prior to the interview. The study was ethically approved by Institutional Ethical Committee. Four items Morisky Medication Adherence Scale has reported sensitivity of 88% and specificity of 44% in measuring the adherence to antihypertensive medication. This scale consists of four questions with each question weighing one mark.<sup>2,8</sup>

BP was measured in the sitting position, after a resting period of 5 minutes, with the feet on the floor and arm supported at the heart level using a calibrated mercury sphygmomanometer. If the subjects had caffeine, smoking or exercise, BP was measured after 30 minutes. Systolic BP was the point at which the first of two or more Korotkoff sound was heard, and the disappearance of Korot-koff sound was used to define diastolic BP. Two other BP measurements were taken on each participant within 30 minutes and the mean value of the recorded BP was considered as the BP of the participant.

Anthropometric factors such as height of the eligible individual participant were taken in centimetre by using Constant tension tape and weight was measured in kilogram using a portable analogue weighting scale. Socio-economic status was assessed using Kuppuswamy classification for 2014 and demographic factors such as age, sex, occupation, education and marital status was

recorded. Behavioural factors such smoking, alcohol intake, physical activity and dietary factors were collected using STEPS Questions.<sup>8</sup>

### According to Joint National Committee Report<sup>11</sup>

Hypertension is defined as a systolic BP of at least 140mmHg and/or diastolic BP of at least 90mmHg and/or self-reported current use of BP lowering medication. Known case of hypertension or known hypertensive is defined as a self-reported prior diagnosis of hypertension by a doctor or nurse. Treated hypertension is defined as self-reported current use of antihypertensive medication. Uncontrolled hypertension is defined as having systolic BP of more than equal to 140mmHg and/or diastolic BP more than equal to 90mmHg, in the context of taking pharmacological treatment.

### Statistical analysis

The values obtained were tabulated on a Microsoft excel sheet and the analysis was done on Statistical Package for Social Sciences (SPSS) software version 20.0 Percentage prevalence rate of hypertension, treated hypertension and uncontrolled hypertension was calculated. To test the statistical significance between various factors and uncontrolled hypertension, Chi-square test was done. Logistic regression analysis was done for finding the independent risk factors of uncontrolled hypertension.

## RESULTS

A total of 1210 adults belonging to the age group 18 years and above were included in this study. Around equal number of participants were there in the age group below and above 45 years with a higher proportion being females (57.44%). Majority (77.76%) of the participants were married at the time of the study.

Figure 1 shows the prevalence of hypertension among the participants. The overall prevalence of hypertension was 40.8% (95% CI 39.4-42.2) among which the prevalence of uncontrolled hypertension among the participants was 13.14% (95% CI 12.2-14.1). About 1% (12) of the

participants aged 60 and above did not qualify as uncontrolled hypertensive under JNC VIII. A notable proportion (22%) of the individuals was not aware of their hypertension. Majority of the hypertensive participants in this study had a stage I systolic (62.8%) and diastolic (35%) hypertension. Among the study participants with uncontrolled hypertension a higher proportion of them had stage II systolic (51.6%) and diastolic (34.6%) hypertension.

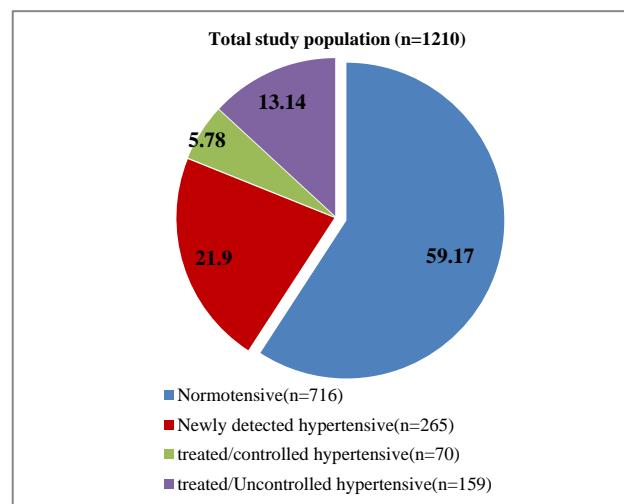


Figure 1: Pie-chart showing the distribution of hypertension in the study population.

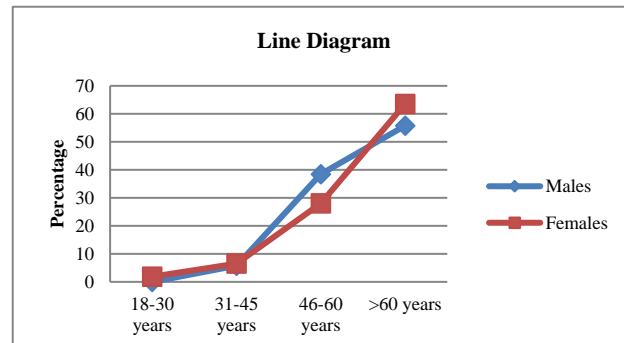


Figure 2: Age and Sex wise distribution of uncontrolled hypertension (n=159).

Table 1: Association of socio-demographic and economic factors with uncontrolled and controlled hypertension.

Socio-demographic variables	Treated hypertension (n=229)		OR (95%CI)#
	Uncontrolled (%) (n=159)	Controlled (%) (n=70)	
Age (years)			
<50	20 (58.8)	14 (41.2)	1
>51	139 (71.3)	56 (28.7)	1.73 (0.821-3.67)
Sex			
Female	107 (74.3)	37 (25.7)	1.8 (1.03-3.25)
Male	52 (61.2)	33 (38.8)	1
Marriage			
Staying with spouse	60 (77.9)	17 (22.1)	1.8 (1.0-3.5)

Continued.

Socio-demographic variables	Treated hypertension (n=229)		OR (95%CI)#
	Uncontrolled (n=159)	Controlled (n=70)	
Without spouse	99 (65.1)	53 (34.9)	1
<b>Religion</b>			
Hindu	58 (65.2)	31 (34.8)	1
Christian	63 (72.4)	24 (27.6)	1.40 (0.73-2.6)
Muslim	38 (71.7)	15 (28.3)	1.35 (0.64-2.83)
<b>Education</b>			
Graduates & Professionals	24 (63.2)	14 (36.8)	1
+2 & 10	55 (65.5)	29 (34.5)	1.10 (0.49-2.45)
Secondary & Primary	64 (71.9)	25 (28.1)	1.5 (0.66-3.34)
Illiterate	16 (88.9)	2 (11.1)	4.6 (0.93-23.37)
<b>Occupation</b>			
Working	36 (56.3)	28 (43.8)	1
Not working	123 (74.5)	42 (25.5)	2.27 (1.24-4.17)
<b>Socio-economic status</b>			
Upper	5 (71.4)	2 (28.6)	1.18 (0.21-6.39)
Upper middle	49 (73.1)	18 (26.9)	1.28 (0.65-2.52)
Lower middle	76 (67.9)	36 (32.1)	1
Upper lower & lower	29 (67.4)	14 (32.6)	1 (0.46-2.07)

(\*p value <0.05 is significant #Odds ratio with 95% Confidence Interval).

**Table 2: Association of dietary factors, physical activity, alcohol consumption and smoking with uncontrolled and controlled hypertension.**

Variables	Treated hypertension (n=229)		OR(95%CI)#
	Uncontrolled (%) (n=159)	Controlled (%) (n=70)	
<b>No. of days of intake of fruits/week</b>			
0 days	25 (80.6)	6 (19.4)	1.29 (0.44-3.79)
1-4 days	89 (64)	50 (36)	0.55 (0.27-1.10)
>4 days	45 (76.3)	14 (23.7)	1
<b>No. of servings of fruit taken per day (n=198)#</b>			
>3 servings	4 (80)	1 (20)	1
1-3	130 (67.4)	63 (32.6)	0.51 (0.05-4.71)
<b>No. of days of intake of vegetables/week</b>			
≤3 days	36 (78.3)	10 (21.7)	1.75 (0.81-3.77)
>3 days	123 (67.2)	60 (32.8)	1
<b>No. of servings of vegetables taken per day</b>			
<5	137 (69.2)	61 (30.8)	0.92 (0.40-2.11)
≥5	022 (71)	09 (29.0)	1
<b>Intake of additional salt</b>			
Yes	53 (81.5)	12 (18.5)	2.41 (1.19-4.88)
No	106 (64.6)	58 (35.4)	1
<b>Physical Activity</b>			
Vigorous	10 (76.9)	3 (23.1)	1.6 (0.42-6.07)
Moderate	116 (67.4)	56 (32.6)	1
No Physical Activity	33 (75)	11 (25)	1.44 (0.68-3.07))
<b>Walking/ Cycling</b>			
Yes	93 (68.4)	43 (31.6)	1
No	66 (71)	27 (29)	1.13 (0.63-2.00)
<b>Body Mass Index (BMI)</b>			
Underweight	7 (58.3)	5 (41.7)	0.50 (0.14-1.80)

Continued.

Variables	Treated hypertension (n=229)		OR(95%CI)#
	Uncontrolled (%) (n=159)	Controlled (%) (n=70)	
Normal	50 (73.5)	18 (26.5)	1
Overweight	27 (61.4)	17 (38.6)	0.57 (0.25-1.28)
Obese	75 (71.4)	30 (28.6)	0.90 (0.45-1.78)
<b>No. of people who drinks alcohol</b>			
Yes	21 (61.8)	13 (38.2)	0.66 (0.31-1.42)
No	138 (70.8)	57 (29.2)	1
<b>No. of people ever smoked</b>			
Yes	17 (53.1)	15 (46.9)	1
No	142 (72.1)	55 (27.9)	2.27 (1.06-4.87)

(\*p value <0.05 is significant #Odds ratio with 95% Confidence Interval; # Servings of fruit is not analysed for those who don't eat fruits).

Figure 2 shows the age and sex wise distribution of uncontrolled hypertension. The prevalence of uncontrolled hypertension among the males and females was higher after 45 years and it further peaked after 60 years of age. The rise in prevalence was markedly higher among females compared to males.

Table 1 shows the association of socio-demographic and economic factors with uncontrolled hypertension. A significantly higher proportion of the individuals were

females (OR 1.8; 95% CI 1.03-3.25) and were married (OR 1.8; 95% CI 1.0-3.5) as compared to males and those staying alone respectively. The illiterates (OR 4.6; 95% CI 0.93-23.37) were more at risk of developing uncontrolled hypertension as compared to those who were literates. The non-working group, consisting of housewives, unemployed and retired individuals, showed significantly higher proportion of (OR 2.27; 95% CI 1.24-4.17) uncontrolled hypertension as compared with the working group.

**Table 3: Association of health seeking behaviour, medication, health education, family history and adherence to medication with uncontrolled hypertension.**

Variables	Treated Hypertension (n=229)		OR (95%CI)#
	Uncontrolled (%) (n=159)	Controlled (%) (n=70)	
System of medicine utilized for treatment			
Modern medicine	64 (30.0)	149 (70.0)	1
Homeopathy and Ayurveda	6 (37.5)	10 (62.5)	1.39 (0.48-4.00)
Type of medicine (n=213)**			
CCB	70 (68)	33 (32)	1.72 (0.77-3.82)
B-Blocker	32 (76.2)	10 (23.8)	1.36 (0.95-6.73)
ARB	28 (82.4)	06 (17.6)	3.68 (1.21-11.19)
Combination	19 (55.9)	15 (44.1)	1
Frequency of regular follow up (n=216)#			
Monthly	47 (73.4)	17 (26.6)	1.74 (0.88-3.43)
3 months	65 (61.3)	41 (38.7)	1
≥6 months	38 (82.6)	8 (17.4)	3.00 (1.27-7.05)
Education by Healthcare personnel (n=205)##			
Doctor alone	110 (74.3)	38 (25.7)	2.6 (1.37-4.92)
Not doctor	30 (52.6)	27 (47.4)	1
Relatives with hypertension			
Yes	98 (66.2)	50 (33.8)	1
No	61 (75.3)	20 (24.7)	1.55 (0.84-2.86)
Knowledge about effects of uncontrolled hypertension			
Poor knowledge	132 (69.8)	57 (30.2)	1.11 (0.53-2.31)
Good knowledge	27 (67.5)	13 (32.5)	1
No. of people who discontinued treatment			
Yes	34 (79.1)	9 (20.9)	1.84 (0.83-4.08)
No	125 (67.2)	61 (32.8)	1



Variables	Treated Hypertension (n=229)		OR (95%CI)#
	Uncontrolled (%) (n=159)	Controlled (%) (n=70)	
Adherence to medication			
Poor adherence	35 (81.4)	8 (18.6)	2.18 (0.95-4.99)
Good adherence	124 (66.7)	62 (33.3)	1
Presence of Other co-morbidity			
Yes	72 (64.9)	39 (35.1)	1
No	87 (73.7)	31 (26.3)	1.52 (0.86-2.676)

(\*p value <0.05 is significant #Odds ratio with 95% Confidence Interval; \*\*only those who depend on modern medicine was analysed; #only those who regularly went for follow up was analysed; ##only those who received health education was analysed).

Table 2 shows the association of uncontrolled hypertension with dietary factors, physical activity, alcohol consumption and smoking. A high proportion (81.5%) of individuals with uncontrolled hypertension had habit of intake of additional salt while eating and the difference was found to be statistically significant (OR 2.41; 95%CI 1.19-4.88). About 78% of them were moderately active, that causes small increases in breathing or heart rate such as brisk walking or carrying light loads(<20kg loads) for at least 10minutes continuously. Nearly (91.1%) all those who did moderate physical activity did it for more than 3 days a week. About half (57.9%) of the study population, with uncontrolled hypertension, used to go for walk or cycling regularly. The risk of Uncontrolled hypertension was found to be more among the non-smokers (OR 2.27;95%CI 1.06-4.87) as compared to those who ever smoked.

Table 3 shows the association of health seeking behavior, medication, health education, family history and adherence to medication. Hypertensive patients on mono-therapy with Angiotensin receptor blocker (OR 3.68;95%CI 1.21-11.19) was found to be a significant risk factor for uncontrolled hypertension. Being educated by doctor alone about uncontrolled hypertension was found to be a risk factor as compared to educated by any other health care staffs(also included doctor and other healthcare staff teams)(OR 2.6;95%CI 1.37-4.92). A significantly higher proportion of uncontrolled hypertensive patients had (81.4%) poor adherence to antihypertensive medication (OR 2.18;95%CI 0.95-4.99).

Table 4 shows the multivariate analysis for finding independent predictors of uncontrolled hypertension. Using backward conditional method, logistic regression was done after adjusting for all possible confounders, such as age, BMI, socioeconomic status and physical activity, in this study. All variables with a p value less than 0.2 were considered for the logistic regression model. The final model had 13 variables of which additional salt intake (aOR 3.62;95%CI 1.36-9.66),health education by a doctor (aOR 3.58;95%CI 1.48-8.64), on mono-therapy (aOR 25.94;95%CI 2.67-251.26), poor adherence to medication (aOR 4.45;95%CI 1.23-16.03) and patients having no other co-morbidity (aOR

3.24;95%CI 1.36-7.72) were found to be the independent predictors of uncontrolled hypertension.

**Table 4: Multivariate logistic regression analysis for independent predictors of uncontrolled hypertension.**

Variable	Adjusted OR**	95% CI	P-value
Additional Salt intake			
Yes	3.62	1.36-	0.01
No	1	9.66	
Education by Health professional (n=205)			
Doctor	3.58	1.48-	0.005
Not Doctor	1	8.64	
Type of medicine			
Single medication	25.94	2.67-	0.00
Combination	1	251.26	
Adherence to medication			
Poor	4.45	1.23-	0.02
Good	1	16.03	
Presence of any other co-morbidity			
Yes	1	1.36-	0.008
No	3.24	7.72	

(\*p-value <0.05 is significant; \*\*OR – Odds Ratio).

## DISCUSSION

The prevalence of uncontrolled hypertension among the adult population aged 18 years and above residing in Kochi Corporation was found to be 13.14%. Similar estimates of prevalence of uncontrolled hypertension was reported by studies conducted in Kerala; 14.9% and 10.8% in studies conducted by Vimala et al and Zachariah et al respectively.<sup>4,5</sup> In a nationwide study conducted in India among 35-70 years old women, estimated prevalence rate was 11%,<sup>12</sup> while Prince MJ et al reported a prevalence rate of 12% in urban India.<sup>13</sup> Similarly, a study conducted in an urban setting in Sri Lanka showed 13% prevalence rate.<sup>14</sup> However, prevalence was low in a study conducted in Chennai in which only 2.51% had uncontrolled hypertension.<sup>15</sup> The difference of rate may be attributed to the difference in methodology adopted in each study, as well as other

factors like socio-cultural factors, healthcare facility in the community, awareness among the study population etc.

### ***Predictive factors of uncontrolled hypertension***

The present study reported a significant association of uncontrolled hypertension and adding additional salt to food (aOR 3.62;95%CI 1.36-9.66). Studies conducted in China also reported high salt intake among the population with uncontrolled hypertension.<sup>16</sup> Excessive salt intake and consequently, water retention by the kidneys leads to hypertension in an apparently normovolemic individual. Taking anti-hypertensive medication was found to be protective against uncontrolled hypertension. Individuals on single anti-hypertensive medication showed significantly high risk of uncontrolled hypertension (aOR 25.96;95%CI 2.67-251.26). Correspondingly, a study conducted in Nepal reported that use of more than one antihypertensive medication and good adherence to medication were two important factors that lead to upright hypertension control.<sup>17</sup>

According to the present study, educating about the ill effects of uncontrolled hypertension and the importance of control of hypertension by a doctor alone was a significant predictor for poor blood pressure control (aOR 3.58;95%CI 1.48-8.64). This significant observation may be pointing towards the inadequacy in time spent with each patient during consultation in view of high patient load. Similarly, a study conducted by Surya et al in Nepal reported high proportion of individuals with uncontrolled hypertension have had no advice from the healthcare provider.<sup>17</sup> A study conducted by Berlowitz et al reported that spending more time with patients was a significant factor for effective management of blood pressure.<sup>18</sup>

This study found that patients having no other co-morbidities were significantly at more risk of uncontrolled hypertension as compared to those with one or more co-morbidities (aOR 3.24;95%CI 1.36-7.72). Whereas a study conducted by Hathial et al reported high blood pressure among individuals with other co-morbidities.<sup>19</sup> This unforeseen correlation may be because, uncontrolled hypertension is rarely symptomatic and such patients with no other co-morbidities tends to have poor follow up and health seeking behaviour leading to poor blood pressure control. Poor adherence to antihypertensive medication was found to be a significant predictive factor for uncontrolled hypertension in the present study (aOR 4.45;95% CI 1.23-16.03). Similarly, a study conducted in Jodhpur reported noncompliance to medication as a predictive factor of uncontrolled hypertension.<sup>20</sup> Other studies conducted in other parts of the world by Li YT et al and Sandhu A et al showed significant association between poor adherence to anti-hypertensive medication and uncontrolled hypertension.<sup>21,22</sup>

### ***Other risk factors of uncontrolled hypertension***

Some of the potential risk factors such as gender, education, occupation, physical activity and intake of fruits and vegetables were not significant in the regression model. This was primarily due to the small sample size which was calculated only to determine the prevalence of uncontrolled hypertension.

The prevalence of uncontrolled hypertension was significantly high among females (OR 1.8;95%CI 1.03-3.25). Similarly a study conducted in Kollam reported significantly higher risk of uncontrolled hypertension among females (OR 2.17;95%CI 1.10-4.29).<sup>23</sup> Also, high prevalence of uncontrolled hypertension was reported among females in a study conducted by Gupta R et al.<sup>12</sup> This disparity in incidence among the gender may be because females are prone for hypertension after they attain menopause as premenopausal women are protected by natural estrogens and progesterone.<sup>24</sup> Data from National Health and Nutrition Examination Survey (NHNES) shows that women are less likely to achieve blood pressure control compared to men. Life style modifications have shown little effect on blood pressure control in women which may be because it is more difficult to obtain weight reduction among post-menopausal women.<sup>25</sup>

In this study, being illiterate was found to be a significant risk factor for uncontrolled hypertension (OR 4.6;95%CI 0.93-23.37). In a study conducted by Darabont R et al in Romania and Sadeghi E et al in Iran, showed similar results with higher proportion of uncontrolled hypertensive individuals having primary and lower education.<sup>26,27</sup> Uncontrolled hypertension was associated with unemployment in this study (OR 2.27;95%CI 1.24-4.17) and was found to be statistically significant. The high expenses attached to regular treatment and follow-up of hypertension may lead to heavy out of pocket expenditure for the unemployed individuals. This may result in discontinuation of medication and less frequent visit to the doctor. Similarly, a study conducted in Nepal reported that higher proportion of unemployed individuals had uncontrolled hypertension.<sup>17</sup>

The risk of uncontrolled hypertension was found to be 2.27(1.06-4.87) among the non-smokers as compared to the smokers. This unanticipated finding in this community based study may be because, smokers who have uncontrolled hypertension have the highest risk of mortality or getting hospitalized at the time of data collection. In this study, majority of the uncontrolled (73%) and controlled hypertensive (80%) individuals were involved in moderate level physical activity. Whereas, studies conducted in Nepal and China reported majority of uncontrolled hypertensive leading sedentary life style.<sup>16,17</sup> The association between decreased physical activity and uncontrolled hypertension was also reported by Degli Esposti E et al and Ahmed N et al in Italy and Abbottabad respectively.<sup>28,29</sup>

According to the National Institute of Nutrition (NIN), the recommended daily allowance of fruits and vegetables for Indians is 1 serving of 100grams and 3 servings of 100 grams respectively. Potassium, fibre and antioxidants present in fruits and vegetables provide protection from developing hypertension. This study found that a major part of the study population with uncontrolled hypertension had inadequate intake of fruits (97%) and vegetables (86%). These findings were similar to the studies conducted in West Indies which showed a lesser intake of fruits and vegetables among uncontrolled hypertensive.<sup>30</sup> Therefore policy makers should plan to create awareness about the benefits of consuming fruits and vegetables. Fruits like banana, grapes, papaya and water melon can be made available for those who can't buy expensive fruits.

**Limitations:** Blood pressure of all the study participants was recorded three times on the same day of visit. As the sample size for this study was calculated to find the prevalence of uncontrolled hypertension, some of the risk factors were not found significant.

## CONCLUSION

The present study concluded that the prevalence of uncontrolled hypertension among the adult population aged 18 years and above residing in Kochi Corporation was 13.14%. The mean age of the study population with uncontrolled hypertension was 62.43±11.33 years. Majority of them were females (67.3%), married at the time of study (62.3%), unemployed (77.4%), obese (47.2%) and belonged to lower middle class families (47.8%). Habit of intake of additional salt (aOR 3.62), getting health education by doctor alone (aOR 3.58), being on antihypertensive mono-therapy (aOR 25.94), poor adherence to medication (aOR 4.45) and patient having no other co-morbidity (aOR 3.24) were independent risk factors of uncontrolled hypertension.

## Recommendations

It is recommended that, it would be upright to launch a comprehensive program involving health care professionals including health workers and the lay community workers with the aim of disseminating awareness to the patients about the ill effects of uncontrolled hypertension, impact of diet with less salt and importance of compliance to therapy once diagnosed as hypertensive. Adherence to prescribed medications and regular follow-up is important in achieving optimum blood pressure control. Doctors must ensure patient's knowledge regarding blood pressure control and antihypertensive medications especially in specialised out-patient clinics such as the "Non-Communicable Disease Clinics" established under the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) launched in 2010. In a developing country like India, implementation of cost lowering policies, to keep cost of

medicines sufficiently low in order to achieve out of pocket expenditure to the minimum is important.

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## REFERENCES

1. World Health Organization. A global brief on Hypertension-Silent killer, global public health crisis [Internet]. WHO; 2013. Available from: [http://ish-world.com/downloads/pdf/global\\_brief\\_hypertension.pdf](http://ish-world.com/downloads/pdf/global_brief_hypertension.pdf) [Last accessed on 15th Oct. 2020]
2. Krishnan A, Garg R, Athula K. Hypertension in the South East Asia: an overview. WHO Regional Health Forum. 2013;1;17
3. Gupta R, al-Odat NA, Gupta VP. Hypertension epidemiology in India: meta-analysis of 50 year prevalence rates and blood pressure trends. J Hum Hypertens. 1996;10(7):465-72.
4. Zachariah MG, Thankappan KR, Alex SC, Sarma PS, Vasanth RS. Prevalence, correlates, awareness, treatment, and control of hypertension in a middle-aged urban population in Kerala. Indian Heart J. 2003;55(3):245-51.
5. Vimala A, Ranji SA, Jyosna MT, Chandran V, Mathews SR, Pappachan JM. The prevalence, risk factors and awareness of hypertension in an urban population of Kerala (South India). Saudi J Kidney Dis Transplant off Publ Saudi Cent Organ Transplant Saudi Arab. 2009;20(4):685-89.
6. Thankappan KR, Sivasankaran S, Sarma PS, Mini G, Khader SA, Padmanabhan P, et al. Prevalence-correlates-awareness-treatment and control of hypertension in kumarakom, Kerala: baseline results of a community-based intervention program. Indian Heart J. 2006;58(1):28-33.
7. Centers for Disease Control and Prevention (CDC). Vital signs: awareness and treatment of uncontrolled hypertension among adults--United States, 2003-2010. MMWR Morb Mortal Wkly Rep. 2012;61:703-9.
8. Moser KA, Agrawal S, Davey Smith G, Ebrahim S. Socio-Demographic Inequalities in the Prevalence, Diagnosis and Management of Hypertension in India: Analysis of Nationally-Representative Survey Data. Guo Y, editor. PLoS ONE. 2014;9(1):e86043.
9. Pereira M, Lunet N, Azevedo A, Barros H. Differences in prevalence, awareness, treatment and control of hypertension between developing and



- developed countries. *J Hypertens*. 2009;27(5):963-75.
10. Mohan S, Campbell N, Chockalingam A. Time to effectively address hypertension in India. *Indian J Med Res*. 2013;137(4):627-31.
11. Kalavathy MC, Thankappan KR, Sarma PS, Vasana RS. Prevalence, awareness, treatment and control of hypertension in an elderly community-based sample in Kerala, India. *Natl Med J India*. 2000;13(1):9-15.
12. Gupta R, Pandey RM, Misra A, Agrawal A, Misra P, Dey S, et al. High prevalence and low awareness, treatment and control of hypertension in Asian Indian women. *J Hum Hypertens*. 2012;26(10):585-93.
13. Prince MJ, Ebrahim S, Acosta D, Ferri CP, Guerra M, Huang Y, et al. Hypertension prevalence, awareness, treatment and control among older people in Latin America, India and China: a 10/66 cross-sectional population-based survey. *J Hypertens*. 2012;30(1):177-87.
14. Kasturiratne A, Warnakulasuriya T, Pinidiyapathirage J, Kato N, Wickremasinghe R, Pathmeswaran A. P2-130 Epidemiology of hypertension in an urban Sri Lankan population. *J Epidemiol Community Health*. 2011;65(Suppl 1):A256-A256.
15. Mohan V, Deepa M, Farooq S, Datta M, Deepa R. Prevalence, awareness and control of hypertension in Chennai--The Chennai Urban Rural Epidemiology Study (CURES-52). *J Assoc Physicians India*. 2007;55:326-32.
16. Yang L, Xu X, Yan J, Yu W, Tang X, Wu H, et al. Analysis on associated factors of uncontrolled hypertension among elderly hypertensive patients in Southern China: a community-based, cross-sectional survey. *BMC Public Health*. 2014;14(1):903.
17. Devkota S, Dhungana RR, Pandey AR, Bista B, Panthi S, Thakur KK, et al. Barriers to Treatment and Control of Hypertension among Hypertensive Participants: A Community-Based Cross-sectional Mixed Method Study in Municipalities of Kathmandu, Nepal. *Front Cardiovasc Med*. 2016;3:26.
18. Berlowitz DR, Ash AS, Hickey EC, Friedman RH, Glickman M, Kader B, et al. Inadequate management of blood pressure in a hypertensive population. *N Engl J Med*. 1998;339(27):1957-63.
19. Hathi M. Blood pressure control among Indians with hypertension: the I-Target survey. *J Indian Med Assoc*. 2007;105(7):404-10.
20. Meena J, Raghav P, Rustagi N. LBOS 03-06 Anti Hypertensive Treatment Compliance And Adverse Effect Profile Among Hypertension Clinic Attendees In Jodhpur, India. *J Hypertens*. 2016;34 Suppl1:e552.
21. Li YT, Wang HHX, Liu KQL, Lee GKY, Chan WM, Griffiths SM, et al. Medication Adherence and Blood Pressure Control Among Hypertensive Patients With Coexisting Long-Term Conditions in Primary Care Settings: A Cross-Sectional Analysis. *Medicine (Baltimore)*. 2016;95(20):e3572.
22. Sandhu A, Ho PM, Asche S, Magid DJ, Margolis KL, Sperl-Hillen J, et al. Recidivism to uncontrolled blood pressure in patients with previously controlled hypertension. *Am Heart J*. 2015;169(6):791-7.
23. Aslami AN, Jobby A. Compliance to Hypertension Treatment in Residents of a Fishermen Colony in District Kollam, Kerala. *Nepal J Epidemiol*. 2015;5(2):1-4.
24. Borghi C, Tubach F, De Backer G, Dallongeville J, Guallar E, Medina J, et al. Lack of control of hypertension in primary cardiovascular disease prevention in Europe: Results from the EURICA study. *Int J Cardiol*. 2016;218:83-8.
25. Gudmundsdottir H, Hoieggren A, Stenehjelm A, Waldum B, Os I. Hypertension in women: latest findings and clinical implications. *TherAdv Chronic Dis*. 2012;3(3):137-46.
26. Darabont R, Tautu O, Ardeleanu M, Dorobantu M. [OP.7A.10] Common and Emergent Factors Associated With Hypertension Control in Romania. *J Hypertens*. 2016;34 Suppl 2:e84-5.
27. Sadeghi E, Behnood-Rod A, Aerab-Sheibani H, Shobeiri E, Pourzargar P, Ormoz E, et al. Controlled Blood Pressure in Iranian Patients: A Multi-Center Report. *Glob J Health Sci*. 2015;8(4):188.
28. DegliEsposti E, Di Martino M, Sturani A, Russo P, Dradi C, Falcinelli S, et al. Risk factors for uncontrolled hypertension in Italy. *J Hum Hypertens*. 2004;18(3):207-13.
29. Ahmed N, Abdul Khaliq M, Shah SH, Anwar W. Compliance to antihypertensive drugs, salt restriction, exercise and control of systemic hypertension in hypertensive patients at Abbottabad. *J Ayub Med Coll Abbottabad JAMC*. 2008;20(2):66-9.
30. Simpson SH, Duff EM, Whittle S, Wilks R. Profile of uncontrolled hypertensive patients attending the Specialist Hypertension Clinic, University Hospital of the West Indies. *West Indian Med J*. 2000;49(2):118-22.

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