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Prevalence and Correlates of Prehypertension Among Adults in Urban South India

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Abstract

Prehypertension is one of the most common conditions affecting human beings worldwide. It is associated with several complications including hypertension. The blood pressure between normal and hypertension is prehypertension as per the Seventh Report Joint National Committee (JNC-7) classification. The current study was done to measure the magnitude of prehypertension and to study their sociodemographic correlates in the urban field practice area of Kasturba Medical College, Mangalore, India, among 624 people aged ≥20 years. The measurements of blood pressure were done (JNC 7 criteria) with the anthropometric measurements and lifestyle factors. Data analysis was done using Statistical Package for Social Sciences version 16. Adjusted odds ratios were calculated. Overall, 55% subjects had prehypertension and 30% had hypertension. Prehypertension was higher among males. Those from the higher age groups, those from upper socioeconomic status, obese individuals, and those with lesser physical activity had significantly higher association with prehypertension, and it was least among those who never used tobacco and alcohol.

Keywords

prehypertension; hypertension; prevalence; India; noncommunicable diseases; lifestyle

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Authors' Note

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Background

High blood pressure (BP) is one of the most common worldwide diseases affecting human beings. Because of the associated morbidity & mortality and financial burden on the society, hypertension is already a noted public health issue.[1] It is a known predictor of cardiovascular disease (CVD), cerebrovascular accidents, and death with regionally variable and increasing magnitude.[2] The Seventh Report of the Joint National Committee (JNC 7) on prevention, detection, evaluation, and treatment of high BP (JNC 7) defines hypertension as BP ≥140/90 mm Hg.[3] Persons with BP above optimal levels (systolic BP of 120-139 mm Hg or diastolic BP of 80-89 mm Hg) are defined as having "prehypertension."[3,4]

People with prehypertension have a greater risk of developing hypertension, and it is independently associated with increased risk of major cardiovascular events, irrespective of other cardiovascular risk factors, as proved by several studies done in the past.[1,4-6] Previous studies carried out among Indian urban population reported the prevalence of prehypertension close to 32%, and it was associated with several socio-demographic factors.[1,5] In addition, urban population has already been proved to be at an increased risk of higher levels of BP compared with rural population.[4,5] Therefore, the knowledge of the rates and the determining factors is essential to define the optimum level of BP and also to decide the preventive strategies in the population.[6]

However, not much attention has been paid to prehypertension, because it also includes the high normal range of BP. There is paucity of information on magnitude and risk factors associated with prehypertension in the developing parts of the world, including India. In Indian hyper-tension guidelines, the term *prehypertension* is not included so as to prevent anxiety among people with high normal BP.[7] However, for understanding the current situation of prehypertension in India and for international comparisons, previous studies have used JNC 7 criteria.[5] The current study was carried out to address the research question about magnitude of prehypertension and hypertension, and their sociodemographic correlates among the urban adult population in coastal south India.

Materials and Methods

This community-based cross-sectional study was conducted in the Boloor area of Mangalore city in southern India, which is the field practice area of Kasturba Medical College (Manipal University), Mangalore, after obtaining prior approval from the institutional ethics committee. The study period extended from January 2012 to April 2013. The sample size was calculated as 624, using the anticipated prevalence of prehypertension in the study population as 32%[5] with 12% relative precision, 95% CI, and 10% nonresponse error. The households were the units of the study, and lists of houses in the study area were obtained from the authorities of the Mangalore City Corporation. The study units selected using stratified random sampling technique, where 18 wards in the locality of the area were the strata, out of which probability proportionate to size. The data collectors, from the field of social sciences, who were trained in interview techniques and BP measurements, visited the houses for data collection.

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All the members of the visited houses whose age was ≥20 years (eligible participants) were listed. One study subject (≥20 years) was selected using a simple random sampling at each selected household. Those who were already diagnosed with hypertension, those on antihypertensive medications, those with severe medical illnesses, and others not willing to participate were excluded from the study. The next house was visited as per the list till the required sample size was reached.

The study subjects were explained about the study and a written informed consent was obtained from each one of them. Data collection was done using a pretested, structured, and validated proforma. The proforma was divided into two parts. The first part included socio-demographic details, diet patterns, family history of hypertension and diabetes mellitus, and usage of tobacco in any form and alcohol usage of any type; and the second part included physical activity scores (which were composed and graded after extensive literature review and consultation with the subject experts, followed by pilot testing and validation at the field) and measurements of BP and anthropometry. The measurement of BP was done 2 times by the investigator after participants have rested for a minimum of 5 minutes, using a mercury column sphygmomanometer, along with a stethoscope on the right arm in sitting position, and the average reading was used to classify them into the JNC 7 criteria.[3] The anthropometric measurements included weight and height as per the standard methods prescribed by the World Health Organization.[8] Using the height and weight, the body mass index (BMI) was computed using the formula BMI = (weight in kilograms)/(height in meter)^2. BMI cutoff levels were <18.5 kg/m^2 (underweight), 18.5 to 22.9 kg/m^2 (normal), 23 to 24.9 kg/m^2 (overweight), and ≥25 kg/m^2 (obese), based on the Asia Pacific adaptations of World Health Organization classifications.[9] Socioeconomic status (SES) of the subjects was determined using the modified Kuppuswamy scale. This scale included details about their education, occupation, and income, whose scores were totaled and SES was graded.[10]

Data analysis was done using Statistical Package for Social Sciences version 16. For comparison and further analysis, the categories of prehypertension and hypertension were merged to a single group since both of them are part of the same continuum in the BP classification scale. Also, tobacco and alcohol usage were merged together as ever used and never used. The association of prehypertension and hypertension with the socio-demographic variables was measured using chi-square and binary logistic regression method with Hosmer and Lemeshow goodness-of-fit model. Unadjusted and adjusted odds ratios (ORs) were calculated with 95% CI, and for the aforementioned statistical tests, $P < .05$ was considered statistically significant.

Results

The study included 624 subjects and their mean age was 46.4 years (SD = 1.2). Overall, 343 (55%) had prehypertension and 185 (29.6%) had hypertension (i.e., previously unknown). The socio-demographic details of the study population and their relation with BP are depicted in Table 1. Among the study subjects, higher proportion belonged to 20 to 39 years (40.5%) and 40 to 59 years (32.5%) age groups, whereas 69.1% of them were females.

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In total, 83.7% of them belonged to the middle SES according to the modified Kuppuswamy scale,[10] and 55% were having a predominantly fish-based diet. With the increase in the age group, there was an increase in the level of prehypertension and hypertension; males had a higher proportion of prehypertension and hypertension. Both of these were found to be statistically significant ($P < .05$). Also, those in the middle and upper SES had a higher proportion of prehypertension and hypertension as compared with those in the lower SES.

Overall, those who had predominantly fish-based diet recorded higher rates of normal BP compared with vegetarians and those on predominantly meat-based diet. Those among the study population who had a predominantly meat-based diet had the highest rates of prehypertension and hypertension. However, these differences were not found to be statistically significant. In addition, the family history of hypertension and diabetes mellitus were compared with the BP status of the study population. As depicted in Table 2, those who had a history of hypertension among either of the parents (86.1% vs 81.5%, $P = .139$), among siblings (85.4% vs 74.5%, $P = .045$) had higher levels of prehypertension and hypertension. With respect to diabetes mellitus, those who had a family history had higher levels of prehypertension and hypertension (85.3% vs 82.5% and 89.4% vs 84.2%, respectively). However, these differences were not found to be statistically significant.

The lifestyle factors and BMI were compared with the BP status of the study population. As described in Table 3, tobacco usage in one or the other form, alcohol usage of any type, and physical activity were included, which were classified as ever used (including current use, used regularly and quit the same, and never used). Overall, 14.6% of the study population used tobacco in one or the other form, and 11.5% used alcohol. Those who used alcohol (88.9%) and tobacco (90.1%) had higher levels of prehypertension and hypertension as compared with non-users. However, these differences were not found to be statistically significant. With respect to the BMI classification of the study population, obese individuals had higher levels of BP as compared with normal and individuals who were underweight (88.7% among obese, 82.2% among normal, and 57.1% among underweight). This difference was found to be statistically significant ($P = .009$).

In total, 41.2% of the study population was obese, 57.7% was normal, and 1.1% was underweight. Also, 11.2% had moderate physical activity, 72% had light physical activity, and 16.8% had sedentary lifestyles. The differences of levels of prehypertension and hypertension across the grades of physical activity were found to be statistically significant ($P = .004$), wherein higher BP was present among 94.3% of those with sedentary lifestyle, 83.1% of those with light physical activity, and 80% of those with moderate physical activity.

Furthermore, the binary logistic regression analysis of the above stated predictors of prehyper-tension and hypertension substantiated the previous findings and the unadjusted and adjusted ORs are depicted in Table 4. The extent and strength of association were found to be similar with both unadjusted and adjusted ORs. Increasing age group, overweight and obesity, and low physical activity significantly increased the risk of prehypertension and hypertension ($P < .05$) with ORs >1. In addition, tobacco use, alcohol use, family history of

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hypertension, and diabetes mellitus carried higher risks of abnormal increase in BP in the study population.

Discussion

The study population had high levels of prehypertension (55%) and hypertension (29.6%). Previous reports from India had predicted the rise of prehypertension among young individuals and recommended the need for preventive strategies for the same.[6,11] The term *prehypertension* is of recent origin, provided by JNC 7.[3] Though JNC is from the American Panel, it is widely used in Indian clinical scenario.[5] Also, the more recent JNC 8 has not changed the cutoff levels and classification of the BP readings. It has revised the interventions for management and control of elevated BP.[12] In the past, prehypertension was called transient hypertension, borderline hypertension, and high-normal BP. Although the terminology has changed, what is increasingly agreed on is that prehypertension is frequently a precursor of hypertension and is associated with an excess morbidity and mortality from CVD.

In the Framingham Heart Study, 50% of patients age 65 years with a BP of 130 to 139/85 to 89 mm Hg progressed to hypertension within 4 years. Among the patients who had prehypertension, 26% developed hypertension within 4 years [6] with evidence of sociodemographic factors involved in the progression as evidenced by a study by Player et al[13] and Vasan et al[6] Thus, prehypertension is considered as a starting point for the cardiovascular and several other morbidities. However, it is a relatively less explored area in terms of prevention and management.[5]

Several of the previous studies have highlighted the magnitude and brought out the significance of prehypertension and hypertension in contributing to noncommunicable diseases (NCDs).[14,15] A meta-analysis of the worldwide studies on prehypertension by Guo et al,[16] showed the pooled prevalence of prehypertension as 38%. Ferguson et al[17] in Jamaica estimated the prevalence of prehypertension and evaluated the relationship between prehypertension and other risk factors for CVD. The prevalence of prehypertension among Jamaicans was 30%. Prehypertension was more common in males than in females (35% vs 25%), which was similar to our current study. Also, studies by Yadav et al[1] from Lucknow in northern India (prevalence of prehypertension was 32.3% and hypertension was 32.2%), Mohan et al[11] from Chennai in southern India (prevalence of prehypertension was 36.1% and hypertension was 20%) showed similar findings to our study with respect to the magnitude and risk factors of elevated BP. Both these previous studies also reported higher levels of prehypertension and hypertension among males and increasing age.[1,11]

Our study showed that those with tobacco and alcohol use, those who were obese, and those with reduced physical activity had significantly higher levels of prehypertension and hypertension, similar to the findings of studies of Ferguson et al.[17] They found that these factors were significantly associated with prehypertension and hypertension. Wang and Wang,[15] in their national representative survey from United States, observed that approximately 60% of American adults had prehypertension or hypertension, and some population groups, such as African Americans, older people, low-SES groups, and

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overweight groups are disproportionately affected. Their findings were in line with that of our study, except the higher prevalence of prehypertension and hypertension among the subjects belonging to upper SES group in our study. Studies by Vasan et al[6] from India, Zheng et al[4] and Yu et al[18] from China, Tocci et al[19] from Italy, and Erem et al[20] from Turkey also observed that obesity and weight gain also contributed toward progression to hypertension. Also, according to the previous report, trends in BP status of people showed an increase.[21]

Wilks et al,[14] in their lifestyle survey conducted in Jamaica, reported diabetes mellitus, family history of hypertension and other chronic diseases, physical inactivity, and dietary practices related to occurrence of NCDs, and in specific, the elevation of BP. Our study revealed that prevalence of prehypertension and hypertension was higher among those with siblings suffering from hypertension (85.4% vs 74.5%). Similar findings were reported in a study conducted in Delhi by Panesar et al.[22] According to their study, the levels of hypertension was significantly higher among those who had sibling/s and either of parents with history of known hypertension.[22]

Our study also evaluated the association of presence of diabetes mellitus among either of parents and siblings with prehypertension and hypertension. There are limited studies that have evaluated these factors. Similar to our study, Erem et al[20] found that those with prehypertension had higher level of family history of diabetes mellitus compared with normotensives. But the association was not significant.

Thus, it is evident from the current study and previous studies conducted that family history of hypertension and diabetes mellitus, lifestyle factors, and nutritional status contribute significantly toward the magnitude of prehypertension. In countries like India, owing to changing socioeconomic factors and unhealthy lifestyles as evidenced by a previous study by Chockalingam et al[23] (which evaluated the predictors and correlates of prehypertension among adults in urban India), there has been an increase in the magnitude of hypertension. Many other studies done on hypertension like Jaipur Heart Watch study,[24] Chennai Urban Rural Epidemiology Study,[11] and a study by Joshi et al[25] posed an important question of consequences of uncontrolled prehypertension and hypertension. Most of the people with prehypertension go unrecognized, thereby adding to the hidden burden of the problem.[26] This would worsen the existing burden of noncommunicable diseases worldwide and in developing South Asian countries, in particular.[27-29]

The current study is a first-time effort to evaluate the magnitude and associated socio-demographic factors of prehypertension and hypertension in the southern part of Karnataka State, India. However, the home visits were done during the day time and most of the menfolk would be outside for their work; hence, the study population included higher number of females and further follow up of the subjects was not done to track the BP status and level of risk factors for NCDs.

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Conclusions

The prevalence of prehypertension among the adults in the study population was high. Increasing age, male gender, lack of physical activity, obesity, tobacco and alcohol use, and family history of chronic diseases are associated with prehypertension and hypertension.

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Recommendations

The high burden and associated risk factors of prehypertension reported in this study point toward a need for screening of BP among all adults. Also, there is a need for creating awareness and implementation of lifestyle modification among the general public, so that there is no synergistic effects of lifestyle factors like diet and physical activity with the genetic and environmental factors.

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Table 1

Sociodemographic Profile of the Study Population and Relation With Blood Pressure (n = 624).

Characteristics	Normal, n (%)	Prehypertension and Hypertension, n (%)	Total, n (%)	*P* Value
Age group (in years)				<.0001[a]
20-39	64 (25.3)	189 (74.7)	253 (40.5)	
40-59	21 (10.3)	182 (89.7)	203 (32.5)	
≥60	11 (06.5)	157 (93.5)	168 (26.9)	
Gender				
Male	21 (10.9)	172 (89.1)	193 (30.9)	.037[a]
Female	75 (17.4)	356 (82.6)	431 (69.1)	
Socioeconomic status[b]				
Upper	03 (10.3)	026 (89.7)	029 (04.6)	.522
Middle	79 (15.1)	443 (84.9)	522 (83.7)	
Lower	14 (19.2)	059 (80.8)	073 (11.7)	
Diet				
Vegetarian	20 (14.9)	114 (85.1)	134 (21.5)	.281
Predominantly fish based	59 (17.2)	284 (82.8)	343 (55.0)	
Predominantly meat based	17 (11.6)	130 (88.4)	147 (23.6)	
Total	96 (15.4)	528 (84.6)	624 (100)	

[a] *P* value significant at.05 level.

[b] According to modified Kuppuswamy scale, the subcategories are merged into 3 main categories (upper, middle, and lower).

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Table 2

Family History of Chronic Diseases and Levels of Blood Pressure Among the Study Population (n = 624).

Characteristics	Normal, n (%)	Prehypertension and hypertension, n (%)	Total, n (%)	χ^2 *P* Value
Hypertension among parents				.139
Absence	37 (18.5)	163 (81.5)	200 (32.1)	
Presence	59 (13.9)	365 (86.1)	424 (67.9)	
Hypertension among siblings				
Absence	12 (25.5)	035 (74.5)	047 (07.5)	.045[a]
Presence	84 (14.6)	493 (85.4)	577 (92.5)	
Diabetes mellitus among parents				
Absence	28 (17.5)	132 (82.5)	160 (25.6)	.390
Presence	68 (14.7)	396 (85.3)	464 (74.4)	
Diabetes mellitus among siblings				
Absence	91 (15.8)	486 (84.2)	577 (92.5)	.348
Presence	05 (10.6)	042 (89.4)	047 (07.5)	

[a] *P* value significant at .05 level.

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Table 3

Blood Pressure Levels and Their Relation With the Lifestyle Factors and Nutritional Status Among the Study Subjects (n = 624).

Characteristics	Normal, n (%)	Prehypertension and Hypertension, n (%)	Total, n (%)	χ^2 *P* Value
Tobacco usage				.116
Ever used	9 (9.9)	82 (90.1)	91 (14.6)	
Never used	87 (16.3)	446 (83.7)	533 (85.4)	
Alcohol usage				
Ever used	8 (11.1)	64 (88.9)	72 (11.5)	.285
Never used	88 (15.9)	464 (84.1)	552 (88.5)	
Physical activity				
Sedentary	6 (05.7)	99 (94.3)	105 (16.8)	.009[a]
Light	76 (16.9)	373 (83.1)	449 (72.0)	
Moderate	14 (20.0)	56 (80.0)	70 (11.2)	
Body mass index				
Underweight	3 (42.9)	4 (57.1)	7 (1.1)	.004[a]
Normal	64 (17.8)	296 (82.2)	360 (57.7)	
Obese	29 (11.3)	228 (88.7)	257 (41.2)	

[a] *P* value significant at .05 level.

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Table 4

Univariate and Multivariate Analyses of the Correlates of Prehypertension and Hypertension Among the Study Population (n = 624).

Correlates of Prehypertension and Hypertension	Odds Ratio (Unadjusted)	95% CI	Odds Ratio (Adjusted)	95% CI	*p* Value
Age group (in years)					
20-39	—		—		
40-59	3.44	1.84-6.43	2.75	1.42-5.36	<.0001[a]
≥60	4.13	1.94-8.82	2.66	1.13-6.28	<.0001[a]
Gender					
Female	—		—		
Male	1.45	0.74-2.82	1.36	0.07-1.89	.281
Socioeconomic status					
Lower	—		—		
Middle and upper	1.43	0.67-3.04	1.31	0.61-2.84	.352
Diet					
Vegetarian	—		—		
Predominantly fish	0.84	0.49-1.47	1.02	0.52-1.97	.548
Predominantly meat	1.34	0.67-2.69	1.15	0.54-2.43	.406
Body mass index					
Undernourished	—		—		
Normal	4.89	0.96 - 24.97	4.78	0.97-26.51	.056
Overweight and obese	5.11	0.96 - 26.93	4.93	1.09-32.08	.054
Physical activity grade					
Moderate	—		—		
Mild	2.48	1.04-5.91	2.66	1.09-6.51	.041[a]
Sedentary	5.44	1.65-17.96	6.49	1.90-21.77	.005[a]
Tobacco use					
Never used	—		—		
Ever used	1.27	0.53-3.08	1.32	0.78-2.34	.590
Alcohol use					
Never used	—		—		
Ever used	1.33	0.44-4.04	1.32	0.39-4.45	.614
Hypertension in parents					
No	—		—		
Yes	0.89	0.51-1.55	0.95	0.36-1.39	.677
Hypertension in siblings					
No	—		—		
Yes	0.30	0.13-1.71	0.29	0.11-0.68	.663
Diabetes mellitus in parents					
No	—		—		

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Correlates of Prehypertension and Hypertension	Odds Ratio (Unadjusted)	95% CI	Odds Ratio (Adjusted)	95% CI	*p* Value
Yes	0.83	0.46 - 1.48	0.799	0.15-1.60	.519
Diabetes mellitus in siblings					
No	—		—		
Yes	1.21	0.38 - 3.88	1.250	0.38-4.20	.745

[a] *P* value significant at .05 level.