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Quick Response Code:

Website: www.jehp.net
DOI: 10.4103/jehp.jehp_32_23

# Undiagnosed hypertension and its correlates among adults attending urban and rural health training centers in a South Indian district

Praveena Daya Appadurai<sup>1</sup>, Abel Rodger Nayagam Rajanayagam<sup>2</sup>,  
Riaz Mohamed Asharaf<sup>3</sup>, Prema Priya Govindan<sup>4</sup>

<sup>1</sup>Department of Community and Family Medicine, All India Institute of Medical Sciences (AIIMS), Madurai, Tamil Nadu, India, <sup>2</sup>Department of Community Medicine, Government Medical College Karur, Karur, Tamil Nadu, India, <sup>3</sup>Department of Community Medicine Tirunelveli Medical College, Tamil Nadu, India, <sup>4</sup>Department of Obstetrics and Gynecology, Vinayaka Missions Kirupanandavariyar Medical College, VMRF (DU), Salem, Tamil Nadu, India

## Address for correspondence:

Dr. Prema Priya Govindan,  
Department of Obstetrics and Gynecology,  
Vinayaka Missions Kirupanandavariyar Medical College,  
VMRF (DU), Salem, Tamil Nadu, India.  
E-mail: dr.premapriya.r@gmail.com

Received: 08-01-2023  
Accepted: 14-03-2023  
Published: 31-05-2023

## Abstract:

**BACKGROUND:** In developing countries, many people with high blood pressure are not aware of their disease. Those who are diagnosed to have elevated hypertension may not have access to treatment. It contributes to the high burden of heart diseases, kidney failure stroke, and premature mortality and disability. The objective of this study is to estimate the burden of undiagnosed hypertension and to describe the factors associated with it among adults attending outpatient department of an urban and rural health centers in a South Indian district.

**MATERIALS AND METHODS:** A hospital-based cross-sectional study was done among 539 outpatient adults of rural and urban health centers in a South Indian district during May–December 2021 recruited through consecutive sampling. Data were collected using a pretested semistructured questionnaire. Variables significant in univariate analysis were further analyzed using multivariate logistic regression.

**RESULTS:** One-hundred and ninety-nine (36.9%) out of 539 participants had undiagnosed hypertension. Multivariate analysis showed the following risk factors as significantly associated with undiagnosed hypertension (age more than 50 (AOR = 5.936, 95% CI = 3.787–9.304), adults with a family history of hypertension (AOR = 1.826, 95% CI = 1.139–2.929), participants without physical activity (AOR = 1.648, 95% CI = 1.089–2.496), and participants from urban area (AOR = 1.837, 95% CI = 1.132–2.982)).

**CONCLUSION:** A high burden of undiagnosed hypertension was identified emphasizing the need for strict implementation and monitoring of health promotion, awareness generation, and promotion of healthy lifestyle strategies proposed by the government.

## Keywords:

Hypertension, noncommunicable diseases, risk factors, undiagnosed

## Introduction

Noncommunicable diseases (NCDs) are the major challenges for public health not only in terms of morbidity and mortality they cause but also their impact on the socioeconomic development of a country. Each year NCDs kill 41 million people equivalent to 71% of all deaths globally. Every year more than 15 million people die

between the ages of 30 and 69 years due to an NCD and 85% of these “premature” deaths are occurring in low- and middle-income countries.<sup>[1]</sup> Majority of these premature deaths due to NCDs are preventable. Major metabolic risk factors that contribute to key metabolic changes that increase the risk of NCDs are raised blood pressure (BP), overweight/obesity, hyperglycemia, and hyperlipidemia. Among them, elevated

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**How to cite this article:** Appadurai PD, Rajanayagam AR, Asharaf RM, Govindan PP. Undiagnosed hypertension and its correlates among adults attending urban and rural health training centers in a South Indian district. J Edu Health Promot 2023;12:162.

BP attributes to 19% of global deaths followed by overweight, obesity, and raised blood glucose.<sup>[1]</sup>

As per WHO estimates, 1.13 billion people have hypertension, most of them living in low- and middle-income countries. In India, the overall prevalence of hypertension is about 29.8%; in urban areas, it is about 33.8% and 27.6% in rural areas.<sup>[2]</sup> According to NFHS-5 reports, 25% of women and 24% of men aged 15 and above have hypertension while 39% women and 49% men aged 15 and above have pre-hypertension.<sup>[3]</sup> As per WHO, around 46% people with elevated BP in developing countries are not aware of their disease and less than 42% of adults with hypertension are diagnosed and treated.<sup>[2]</sup> Almost one in five women in India aged 15–49 years has undiagnosed hypertension with implications on personal and reproductive health.<sup>[4]</sup>

Long-term hypertension can lead to congestive heart failure, coronary artery diseases, cerebrovascular (ischemic and hemorrhagic stroke) diseases, and chronic kidney diseases.<sup>[5]</sup>

In order to prevent and control major NCDs, Government of India launched the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) in the year 2010 with focus on infrastructure strengthening, human resource development, health education, health promotion, early diagnosis, treatment, and referral.<sup>[6]</sup> Under NPCDCS, NCD cells are established at national, state, and district levels for program management and NCD clinics are being set up at district level and CHC levels to provide services on early diagnosis, management, and follow-up for common NCDs. But even after several initiatives from government for early screening and detection of hypertension, the burden of hypertension remains to be high and increasing in India.

India is a country with varied social, demographic, and cultural diversities. The prevalence of hypertension varies across regions of the country and across income groups. Early detection and appropriate treatment is crucial for reducing the complications of long-term undiagnosed hypertension. As the burden of undiagnosed hypertension varies across the geographical zones, evidence on the burden and determinants of undiagnosed hypertension in this current geographic region is lacking and it is essential for appropriate planning and implementation of health services. So, the current study is designed to describe the burden and determinants of undiagnosed hypertension among adults attended the health centers in South India.

## Objectives

The objective of this study is to estimate the burden of undiagnosed hypertension and to describe the factors associated with it among adults attending outpatient department of an urban and rural health centers in a South Indian district.

## Materials and Methods

### Study design and setting

This was a hospital-based cross-sectional analytical study conducted among adults who attended the outpatient department of a rural and urban health centers in a South Indian district during May–December 2021.

### Study participants and sampling

Adults aged more than 18 years of both genders, clinically stable, were invited for participation in the study. Eligible participants who attended the outpatient department during the study period were approached for participation in the study and those who consented for the study were included in the study through consecutive sampling. Pregnant ladies were excluded from the study.

### Procedure

After getting approval from the Institute Ethical Committee, all the eligible participants attending OPD of selected rural and urban health training centers were approached for participation in this study. Purpose of the study was informed and confidentiality was assured and written informed consent was obtained. A pretested semistructured questionnaire was used for data collection from the participants. The initial part of the questionnaire is framed to retrieve the demographic characteristics of the participants like age, gender, year of study, residence, education, occupation, income, religion, marital status, and so on. The second part of the questionnaire contains questions derived from the WHO STEPS instrument<sup>[7]</sup> that captures information on tobacco use, alcohol use, dietary habits, physical activity, and sleep habits. The third part of the questionnaire comprises information regarding the clinical examination of the participants including height, weight, BMI, and BP readings.

Before taking BP reading, participants were seated comfortably, with their back supported, legs uncrossed, and arms were supported at the heart level. BP was measured in left arm using a well-maintained standard mercury sphygmomanometer with Korotkoff's sound technique. BP was measured on two different occasions minimum 5 min apart and the average was taken for analysis. Participants were classified as normal, prehypertension, and hypertension according to Joint National Committee 7 guidelines.<sup>[8]</sup>

## Operational definitions

Pre-hypertension is defined as systolic BP 120–139 mm Hg or diastolic BP 80–89 mmHg. Hypertension is defined as systolic BP  $\geq$ 140 mmHg or diastolic BP  $\geq$ 90 mmHg. Undiagnosed hypertension is defined as systolic BP  $\geq$ 140mmHg and/or diastolic BP  $\geq$ 90mmHg during the survey but never took any prescribed antihypertensive drugs to lower or control BP and was never diagnosed as having hypertension by a healthcare professional prior to the survey.

Height and weight measurements were taken from participants to calculate body mass index (BMI), used to determine overweight and obesity. To measure height, a portable height measuring board will be used. Portable electronic weighing scale will be used to measure weight. Instruments will be calibrated and accuracy will be checked. Physical measurements will be taken as per Guide to Physical Measurements (Step 2 of the WHO STEPS Instrument). BMI is defined as a person's weight in kilograms divided by the square of the person's height in meters ( $\text{kg}/\text{m}^2$ ). BMI will be classified as per WHO adult BMI classification into normal (18.50–24.99), overweight ( $\geq$ 25), and obese ( $\geq$ 30).

## Ethical considerations

Tirunelveli Medical College Institute Research Ethics Committee approval was obtained before the initiation of the study (Protocol ID-20222271: approved on March 12<sup>th</sup>, 2022). Informed written consent was obtained from all the participants.

## Method of analysis

Data were entered in Microsoft Excel sheet 2019, descriptive analysis was done using IBM SPSS software version 26,<sup>[9]</sup> and the outcome was expressed in prevalence percentages with 95% confidence interval. Categorical variables were expressed in frequency and percentages. Continuous variables expressed in mean, standard deviation with bell-shaped distributions, and medians and interquartile ranges used reported for variables with skewed distributions. Association between various determinants like gender, alcohol use, tobacco use, physical activity levels, obesity, and hypertension was tested using Chi-square test for independence and *P* values  $<$  0.05 will be considered statistically significant. Variables significant in bivariate analysis were further analyzed using multivariate logistic regression.

## Results

### Sociodemographic characteristics of study participants

A total of 539 participants were included in the study. The median age of the study participants was 51.9 years in both urban and rural participants. Females

comprised 55.6%. Unemployment was more in rural participants (63.7%). Illiteracy was more among rural participants (27.9%). Sociodemographic characteristics of the study participants were shown in Table 1.

### Behavioral characteristics of study participants

Behavioral characteristics of study participants were shown in Table 2. The proportion of smokers was equal in both urban and rural participants, 14.5% and 14.4%, respectively. Alcohol users were slightly higher in the rural participants. Consumption of fruits and vegetables were poor altogether. More than two-thirds of participants in both rural and urban areas used oil high in saturated fatty acid every day. The level of physical activity was considerably higher in the urban participants (62.4%).

### Anthropometric characteristics of study participants

Anthropometric characteristics of study participants were shown in Table 3.

**Table 1: Sociodemographic characteristics of study participants (n=539)**

Variables	Urban		Rural	
	Number	(%)	Number	(%)
Sex				
Male	136	40.2	103	51.2
Female	202	59.8	98	48.8
Educational status				
Illiterate	35	10.4	56	27.9
Primary	98	29	49	24.4
Middle	90	26.6	43	21.4
High school and above	115	34	53	26.3
Marital status				
Married	275	81.4	161	80.1
Single	17	5	14	7
Divorced, widowed, or separated	46	13.6	26	12.9
Occupation				
Employed	179	53	73	36.3
Unemployed	159	47	128	63.7
Monthly income				
$\leq$ 7500 Rs	152	45	107	53.2
$>$ 7500 Rs	186	55	94	46.8

**Table 2: Behavioral characteristics of study participants (n=539)**

Variables	Urban		Rural	
	Number	(%)	Number	(%)
Smoking (current)	49	14.5	29	14.4
Alcohol use (current)	53	15.7	41	20.4
Vegetable intake in the recommended level	12	3.6	6	3
Fruits intake in the recommended level	2	0.6	1	0.5
Daily use of saturated fatty acid (oil)	230	68	144	71.6
Physical activity	211	62.4	78	38.8

Participants from rural area had higher proportion of subjects with normal BMI. The prevalence of overweight and obesity were relatively higher in urban participants.

**Prevalence of undiagnosed hypertension**

In the current study, it was observed that 199 (36.9%) out of 539 participants had undiagnosed hypertension. Among them 102 (51.3%) were females and 97 (48.7%) were males. Among the 199 participants with undiagnosed hypertension, 119 (59.7%) were in Grade I hypertension followed by 80 (40.3%) in Grade II hypertension. Distribution of undiagnosed hypertension among rural versus urban area among the study participants was shown in Table 4 and multivariable analysis showing

**Table 3: Anthropometric characteristics of study participants (n=539)**

Variable	Urban		Rural	
	Number	(%)	Number	(%)
Body mass index (BMI)				
Underweight	7	2.1	9	4.5
Normal	149	44.1	126	62.7
Overweight	122	36.1	60	29.9
Obesity class I	54	16	6	3
Obesity class II	5	1.5	-	-
Obesity class III	1	0.3	-	-

**Table 4: Distribution of undiagnosed hypertension based on residence among study participants**

Variables	Urban		Rural		Total
	Number	(%)	Number	(%)	
Undiagnosed hypertension					
Yes	132	39.1	67	33.3	199 (36.9%)
No	206	60.9	134	66.7	340 (63.1%)
Total	338	100	201	100	539

**Table 5: Multivariable analysis of undiagnosed HTN and factors associated with it**

Category	Undiagnosed hypertension		Total Number (%)	Crude odds ratio (95% CI)	P	Adjusted odds ratio (95% CI)	P
	Yes Number (%)	No Number (%)					
Age							
>50 years	162 (54.4)	136 (45.6)	298 (100)	6.56 (4.32-9.97)	<0.001	5.93 (3.78-9.30)	<0.001*
≤50 years	37 (15.4)	204 (84.6)	241 (100)				
Education							
Up to middle school	159 (42.9)	212 (57.1)	371 (100)	2.40 (1.59-3.61)	<0.001	1.74 (1.05-2.89)	0.031*
High school and above	40 (23.8)	128 (76.2)	168 (100)				
Area of living							
Urban	132 (39.1)	206 (60.9)	338 (100)	1.28	0.183	1.83 (1.13-2.98)	0.014*
Rural	67 (33.3)	134 (66.7)	201 (100)	(0.88-1.84)			
Family history of hypertension							
Yes	54 (40)	81 (60)	135	1.19 (0.79-1.77)	0.392	1.82 (1.13-2.92)	0.012*
No	145 (35.9)	259 (64.1)	404				
Physical activity							
Absent	109 (43.6)	141 (56.4)	250	1.70 (1.20-2.43)	0.003	1.64 (1.08-2.49)	0.018*
Present	90 (31.1)	199 (68.9)	289				

significant factors associated with undiagnosed hypertension is shown in Table 5.

Among the 338 participants from urban residence, 132 (39.1%) had undiagnosed hypertension, and among the 201 participants from rural area, 67 (33.3%) had undiagnosed hypertension.

In the current study, the risk of undiagnosed HTN was 36.9% (199), and, from this, females contributed 102 (51.3%) and males contributed 97 (48.7%). We found nine variables for multivariate analysis and, of them, five variables (age, education of the participant, area of living, family history of hypertension, and physical activity) showed a significant association with undiagnosed HTN.

The odds of having undiagnosed hypertension if age is more than 50 were found to be almost six times higher (AOR = 5.936, 95% CI = 3.787–9.304). Adults with a family history of hypertension showed a 1.83 times (AOR = 1.826, 95% CI = 1.139–2.929) higher risk of undiagnosed HTN than adults with no family history of hypertension. The risk of undiagnosed hypertension was 1.64 times (AOR = 1.648, 95% CI = 1.089–2.496) higher among participants without physical activity than participants with physical activity. Participants from urban area had higher odds of having undiagnosed hypertension when compared to rural area (AOR = 1.837, 95% CI = 1.132–2.982).

**Discussion**

As per NPCDCS program, opportunistic screening of persons above the age of 30 years is recommended at all levels in the healthcare delivery system from subcenter and above for early detection of diabetes, hypertension, and common cancers. Such screening involves history



taking such as family history of diabetes, history of alcohol, tobacco consumption, dietary habits, and so on.<sup>[7]</sup> General physical examination, BMI calculation, BP measurement, blood sugar estimation, and so on were also done to identify the disease at an earlier stage. Even then lack of awareness and inaccessibility to services among the general population prevents early screening and identification of the disease. World Health Organization states that 46% people with elevated BP in developing countries are not aware of their disease and less than 42% of adults with hypertension are diagnosed and treated.<sup>[2]</sup> So the current study is designed to estimate the prevalence of undiagnosed hypertension among adults attending health centers in a South Indian district.

Elevated BP remains a major public health problem because it is one of the most important risk factors for premature death worldwide. The prevalence and incidence of HTN have increased rapidly in recent decades. Indians experience cardiovascular event-related deaths almost a decade earlier than developed countries. Cardiovascular events are responsible for 52% of all deaths in those aged < 70 years in India, as compared with 23% in other developing countries.<sup>[10]</sup>

The aim of this study was to know the burden of undiagnosed hypertension and factors associated with it. The overall prevalence of undiagnosed hypertension was 36.9% among the study participants. We observed that the prevalence of undiagnosed hypertension was more among males than females. In addition, certain urban-rural disparities were detected which were associated with undiagnosed hypertension. The prevalence of undiagnosed hypertension was more among urban participants.

It was found in our study that age, education, area of living, family history of hypertension, and physical activity were significantly associated with undiagnosed hypertension. This was similar to the national data (NFHS-4) in which age, geographical zone, and education were significantly associated with undiagnosed hypertension.<sup>[11]</sup>

The national data for undiagnosed hypertension among females of age 15–49 years of age (NFHS-4) showed prevalence to be 18.69%. It was 17.09% and 21.73% in rural and urban areas, respectively. In our study, it was significantly higher at 34%. This difference could be due high median age of 51.9 years in this study.<sup>[4]</sup>

The age of study participants was significantly associated with HTN. The risk of undiagnosed hypertension increases with age. As age increases, there will be an increased stiffness of the arterial walls which might in this case contribute to increased BP. Studies done in India

and other countries have showed few findings similar to this study.

A study done in Ahmadabad, India, among apparently healthy 3629 individuals of  $\geq 18$  years of age in western India found a 26% prevalence of undiagnosed HTN. The prevalence of undiagnosed hypertension was 11% and 40% in the young ( $\leq 40$  years) and old ( $>40$  years) population.<sup>[12]</sup>

A study by Boro and Banerjee<sup>[11]</sup> done in a nationally representative data collected in the Longitudinal Ageing Study of India, Wave-1 (2017–18), showed overall prevalence rates of undiagnosed, untreated, and undertreated hypertension among the older adults as 42.3%, 6%, and 18.7%, respectively. They also reported that the prevalence of undiagnosed and untreated hypertension was higher in rural areas (12.4%), while the undertreated hypertension was more prevalent in urban areas (7.2%).<sup>[13]</sup>

A study by Haligamo *et al.*<sup>[14]</sup> among 644 participants in Southern Ethiopia showed the burden of undiagnosed hypertension as 28.8%. Overweight, unrecognized diabetic mellitus, habit of alcohol consumption, triglyceride, and age 31–43 years were significantly associated factors with undiagnosed hypertension.

Study by Hasan *et al.*<sup>[15]</sup> done in Nepal among 3334 hypertensive patients reported that 50.4% participants remained undiagnosed during the survey. Male patients, patients belonging to households other than the highest wealth quintile, were at a higher risk of remaining undiagnosed for hypertension. This study has mentioned that patients aged  $\geq 65$  years were at a lower risk of remaining undiagnosed for hypertension. But the present study showed an increasing burden of undiagnosed hypertension with age.

The prevalence of undiagnosed hypertension was more among urban participants which was 39% as compared to rural participants which was 33%. The disparity observed was similar to another study done which showed about 33% urban and 25% rural Indians are hypertensive. In the same study, analysis for South Indian participants showed a similar disparity which showed the pooled prevalence of HTN for the rural and urban South Indian population was 21.1% (20.1–22.0) and 31.8% (30.4–33.1), respectively.<sup>[16]</sup>

It is well established that physical activity is directly associated with hypertension in its every stage as evidenced in the study by Gamage and Seneviratne.<sup>[17]</sup> This is proven in our study where people who are sedentary are at increased risk of developing hypertension [AOR 1.648 (1.089–2.496); *P* value 0.019]. Physical and mental

health determinants play a major role in hypertension causation and adherence to drugs.<sup>[18]</sup>

Other than NPCDCS, Government of Tamilnadu state has launched Makkalai Thedi Maruthuvam scheme across several districts of the state. The scheme aims to not only provide required medications at the doorsteps of the people but also provide medical services right to their homes including screening for NCDs.<sup>[19]</sup> But lack of awareness among people can prevent the utilization of these health services and increase the burden of undiagnosed hypertension. Awareness about hypertension, its complications, and the need for early screening are required at individual level to check BP level routinely. Literatures have highlighted the necessity of health education and health promotion theory-based interventions and interventions based on transtheoretical models to promote the quality of hypertension management.<sup>[20,21]</sup>

## Conclusion

The risk of undiagnosed HTN in the current study was high. Age, living area, level of education, family history of hypertension, and lack of physical activity were found to be factors for it. Due to the presence of the higher risk of hypertension in this study population, there will be a great risk of stroke, heart attack, and other cardiovascular diseases secondary to hypertension. High prevalence observed in the study could be due to the fact that the study was done among people who visited hospital for various other health problems. Nonetheless, early diagnosis and treatment is pivotal to reduce the impending burden from cardiovascular diseases.

## Acknowledgment

We acknowledge the interns who were involved in the collection of the data for this study.

## Financial support and sponsorship

Self funding by investigators. No external funding availed for this project

## Conflicts of interest

There are no conflicts of interest.

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