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PREVALENCE OF UNDIAGNOSED HYPERTENSION AND ASSOCIATED LIFESTYLE RISK FACTORS AMONG ADULTS IN PERI-URBAN COMMUNITIES: IMPLICATIONS FOR PRIMARY CARE INTERVENTION

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ABSTRACT

Introduction: Hypertension remains underdiagnosed in peri-urban transitional communities of India, where demographic shifts and healthcare infrastructure gaps create a unique epidemiological burden. This study aimed to determine the prevalence of undiagnosed hypertension and associated lifestyle risk factors among adults in peri-urban communities of Villupuram and Cuddalore districts of Tamil Nadu, and to outline implications for primary care intervention. **Methods:** A community-based cross-sectional study was conducted among 600 adults aged 18 years and above residing in peri-urban localities. Structured questionnaires captured sociodemographic details, dietary habits, physical activity, tobacco use, alcohol consumption, and family history. Blood pressure was measured using standardized mercury sphygmomanometers on two separate occasions. Undiagnosed hypertension was defined as systolic BP ≥140 mmHg or diastolic BP ≥90 mmHg in participants with no prior diagnosis. Data were analyzed using SPSS v26.0 employing chi-square tests, independent t-tests, and binary logistic regression. **Results:** The overall prevalence of undiagnosed hypertension was 38.3% (n=230/600). Males had a significantly higher prevalence (43.1%) compared to females (33.7%) (p=0.012). Age above 45 years (OR=3.14; 95% CI: 2.18–4.53), high salt intake >8 g/day (OR=2.67; 95% CI: 1.89–3.77), tobacco use (OR=2.31; 95% CI: 1.63–3.27), physical inactivity (OR=2.18; 95% CI: 1.54–3.09), and family history of hypertension (OR=2.89; 95% CI: 2.04–4.09) were significant independent predictors. Healthcare access was poor with only 41.2% having had a blood pressure measurement in the past two years. **Conclusion:** The high burden of undiagnosed hypertension in peri-urban Tamil Nadu underscores a critical gap in primary care outreach. Region-specific interventions targeting modifiable lifestyle risk factors, strengthened community screening programs, and enhanced primary health centre capacity are urgently needed to address this silent epidemic.

Keywords: Undiagnosed Hypertension, Peri-urban Communities, Tamil Nadu, Lifestyle Risk Factors, Primary Care, Blood Pressure Screening

1. INTRODUCTION

Hypertension is a dominant modifiable risk factor for cardiovascular diseases, stroke, renal failure, and premature mortality, and currently affects approximately 1.28 billion adults worldwide.[1] In India, hypertension constitutes one of the foremost non-communicable disease (NCD) burdens, with population-level surveys estimating a prevalence ranging from 25–35% among adults.[2] Despite this magnitude, a disproportionate fraction remains undiagnosed, particularly among populations residing in peri-urban and rural transitional zones where healthcare infrastructure is still catching up with demographic expansion.

Peri-urban communities represent a unique epidemiological stratum, sharing characteristics of both rural and urban settings while simultaneously experiencing the adverse health transitions typically associated with urbanization—including dietary changes toward processed and salt-rich foods, sedentary behaviors, tobacco use, and erosion of traditional physical work patterns—without yet benefiting from the healthcare access advantages of established urban centers.[3,4] In Tamil Nadu, rapid industrial development along national highway corridors and the emergence of satellite townships has accelerated peri-urban growth, creating communities that are underserved by both rural primary health infrastructure and urban specialty facilities.

Several studies have documented a high prevalence of hypertension in rural and semi-urban Tamil Nadu.[5,6] However, specific epidemiological data on undiagnosed hypertension and the behavioral determinants driving it in peri-urban communities remain sparse. The awareness–treatment–control cascade for hypertension in India reveals significant attrition at each stage, with awareness rates as low as 25–30% in community settings.[7] Early identification of undiagnosed cases through community screening and primary care engagement is therefore an imperative public health priority.

High dietary salt consumption is embedded in the food culture of Tamil Nadu, where tamarind-rich curries, pickled preparations, and salted fish are dietary staples.[8] Combined with the growing influence of processed snack foods in peri-urban markets, salt intake patterns constitute an important locally modifiable risk factor. Similarly, tobacco use in the form of cigarettes, bidis, and smokeless products such as gutka remains prevalent among male adults in these communities.[9]

This study was therefore undertaken to determine the prevalence of undiagnosed hypertension in peri-urban communities of Villupuram and Cuddalore districts of Tamil Nadu, to profile the associated lifestyle and sociodemographic risk factors, and to generate evidence toward the design of targeted primary care and public health interventions.

1.1 Aim

To determine the prevalence of undiagnosed hypertension and identify associated lifestyle risk factors among adults in peri-urban communities of rural Tamil Nadu.

1.2 Objectives

1. To estimate the prevalence of undiagnosed hypertension among adults in selected peri-urban communities of Villupuram and Cuddalore districts, Tamil Nadu.
2. To identify and analyze sociodemographic and lifestyle risk factors associated with undiagnosed hypertension in the study population.
3. To evaluate the current status of healthcare access and blood pressure monitoring in the study communities.
4. To suggest evidence-based implications for primary care intervention in the context of rural Tamil Nadu.

2. MATERIAL AND METHODOLOGY

2.1 Study Design

A community-based cross-sectional descriptive study was conducted in peri-urban localities of Villupuram and Cuddalore districts of Tamil Nadu, India.

2.2 Study Setting and Duration

The study was conducted across eight peri-urban revenue villages classified under the Tamil Nadu government's Panchayat Raj framework, located within a 15 km radius of Villupuram and Chidambaram towns. Data collection was carried out from June 2017 to November 2017.

2.3 Sample Size

The sample size was calculated using Cochran's formula: $n = Z^2pq/d^2$, assuming a 35% expected prevalence of hypertension (p=0.35), 5% absolute precision (d=0.05), and 95% confidence level (Z=1.96), yielding a minimum of 350. Accounting for a design effect of 1.5 for cluster sampling and 15% non-response, the final target sample was 600 participants, proportionately allocated across the eight study villages.

2.4 Inclusion and Exclusion Criteria

All adults aged 18 years and above who had been residing continuously in the study area for at least one year prior to commencement of data collection and provided written informed consent were included. Individuals with previously diagnosed and documented hypertension under treatment, pregnant women, those with severe psychiatric illness precluding interview participation, and individuals with chronic kidney disease were excluded.

2.5 Data Collection

Data were collected through structured interviewer-administered questionnaires covering sociodemographic profile (age, sex, education, occupation, socioeconomic status by modified Kuppuswamy scale), dietary habits (salt intake, vegetable and fruit consumption, processed food

frequency), physical activity levels (IPAQ short form), tobacco use, alcohol consumption, and family history of hypertension and cardiovascular diseases.

Blood pressure was measured twice by trained field investigators using validated mercury sphygmomanometers with appropriate cuff sizes, following WHO/ISH guidelines. Measurements were taken in the sitting position after a 5-minute rest, with the second reading used for analysis. Participants with no prior diagnosis of hypertension recording systolic BP ≥140 mmHg or diastolic BP ≥90 mmHg on at least one of two separate measurement occasions (minimum 7-day interval confirmed by field re-visit in positive cases) were classified as having undiagnosed hypertension.

Anthropometric measurements including weight, height, and waist circumference were recorded using calibrated instruments. Body mass index (BMI) was calculated as weight (kg) divided by height $(m)^2$, and participants were classified per the Asia-Pacific BMI cut-offs for Indians.

2.6 Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY). Descriptive statistics including frequencies, percentages, means, and standard deviations were computed. Chi-square tests were used to compare categorical variables and independent sample t-tests for continuous variables. Binary logistic regression was performed to identify independent predictors of undiagnosed hypertension, reporting adjusted odds ratios (OR) with 95% confidence intervals (CI). Statistical significance was set at $p<0.05$.

2.7 Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of Bharath Medical College and Hospital (Ref: BMCH/IEC/2017/08). Written informed consent was obtained from all participants. Participants identified with hypertension during the study were referred to the nearest Primary Health Centre for further evaluation and management.

3. RESULTS

3.1 Sociodemographic Profile

A total of 600 participants were enrolled. The mean age of the study population was 42.6 ± 13.8 years. Males constituted 52.3% (n=314) and females 47.7% (n=286). The majority of participants belonged to the 35–54 years age group (42.0%). Regarding education, 38.5% had completed secondary schooling, 27.3% were illiterate or had only primary education, and 34.2% had completed higher secondary or above. The predominant occupations were agricultural labour (31.2%), self-employed/trade (24.8%), homemakers (21.7%), and skilled workers (14.3%). According to the modified Kuppuswamy scale, 54.2% belonged to the lower socioeconomic class.

Table 1: Sociodemographic Characteristics and Prevalence of Undiagnosed Hypertension

Variable	Total (N=600)	Undiagnosed HTN n(%)	p-value
Sex: Male	314 (52.3%)	135 (43.0%)	0.012

Sex: Female	286 (47.7%)	95 (33.2%)	
Age 18–34 yrs	186 (31.0%)	38 (20.4%)	<0.001
Age 35–54 yrs	252 (42.0%)	112 (44.4%)	
Age ≥55 yrs	162 (27.0%)	80 (49.4%)	
Lower SES	325 (54.2%)	141 (43.4%)	0.008
Middle/Upper SES	275 (45.8%)	89 (32.4%)	
BMI ≥25 kg/m²	264 (44.0%)	126 (47.7%)	<0.001
BMI <25 kg/m²	336 (56.0%)	104 (30.9%)	
Family H/O Hypertension	198 (33.0%)	107 (54.0%)	<0.001
No Family History	402 (67.0%)	123 (30.6%)	

3.2 Prevalence of Undiagnosed Hypertension

The overall prevalence of undiagnosed hypertension in the study population was 38.3% (n=230/600). Among males, the prevalence was 43.0% (135/314) compared to 33.2% (95/286) among females, with a statistically significant difference (p=0.012). The prevalence increased progressively with age: 20.4% in the 18–34 years group, 44.4% in the 35–54 years group, and 49.4% in those aged ≥55 years (p<0.001). Among participants with a family history of hypertension, the prevalence was 54.0% versus 30.6% in those without a family history (p<0.001).

Table 2: Prevalence of Undiagnosed Hypertension by Sex and Age Group

Category	**Number (n)**	**Undiagnosed HTN n(%)**	**95% CI**	**p-value**
Overall	600	230 (38.3%)	34.5–42.3	—
Male	314	135 (43.0%)	37.5–48.5	0.012
Female	286	95 (33.2%)	27.8–38.9	
Age 18–34 yrs	186	38 (20.4%)	14.9–27.0	<0.001
Age 35–54 yrs	252	112 (44.4%)	38.3–50.7	
Age ≥55 yrs	162	80 (49.4%)	41.7–57.1	

3.3 Lifestyle and Dietary Risk Factors

Significant differences in lifestyle parameters were identified between those with and without undiagnosed hypertension. High dietary salt intake (>8 g/day) was reported in 52.2% of hypertensives versus 28.4% of normotensives (p<0.001). Tobacco use was significantly higher among hypertensives (44.3% vs. 24.1%; p<0.001). Physical inactivity was present in 61.3% of hypertensives compared to 38.2% in normotensives (p<0.001). Low fruit and vegetable intake (<5 servings/day) was observed in 71.7% of hypertensives versus 54.9% of normotensives (p<0.001). Mean BMI was significantly higher among those with undiagnosed hypertension (27.8 ± 4.6 vs. 24.9 ± 3.9 kg/m²; p<0.001). Waist circumference exceeding cut-offs (≥90 cm in males, ≥80 cm in females) was noted in 58.3% of hypertensives.

Table 3: Lifestyle and Dietary Risk Factors in Relation to Undiagnosed Hypertension

Factor	HTN (n=230)	Non-HTN (n=370)	OR (95% CI)	p-value
High salt intake >8 g/day	120 (52.2%)	105 (28.4%)	2.67 (1.89–3.77)	<0.001
Tobacco use (any form)	102 (44.3%)	89 (24.1%)	2.31 (1.63–3.27)	<0.001
Physical inactivity	141 (61.3%)	141 (38.2%)	2.18 (1.54–3.09)	<0.001
Alcohol consumption	68 (29.6%)	78 (21.1%)	1.57 (1.07–2.32)	0.021
Low fruit/veg intake	165 (71.7%)	203 (54.9%)	2.09 (1.47–2.97)	<0.001
BMI ≥25 kg/m² (Mean±SD)	27.8 ± 4.6	24.9 ± 3.9	t-test p<0.001	<0.001
Abdominal obesity	134 (58.3%)	131 (35.4%)	2.52 (1.80–3.54)	<0.001

3.4 Healthcare Access and Blood Pressure Monitoring

Healthcare access indicators revealed significant deficiencies. Only 41.2% of participants (n=247/600) reported having had a blood pressure measurement in the preceding two years, and merely 28.3% had visited a physician for a general health check-up in the same period. Awareness about hypertension as a condition was present in 54.7% of participants overall, but was significantly lower among those belonging to the lower socioeconomic strata (43.2%) compared to middle/upper strata (68.7%; $p<0.001$). Availability of BP measurement equipment at the nearest healthcare facility was confirmed in 72.3% of cases, but regular functioning of primary health centres was reported by only 61.0% of respondents in their locality.

Table 4: Healthcare Access and Hypertension Awareness Indicators

Indicator	Yes n(%)	No n(%)	p-value
BP measured in last 2 years	247 (41.2%)	353 (58.8%)	<0.001
General health checkup last 2 yrs	170 (28.3%)	430 (71.7%)	<0.001
Aware of hypertension as a disease	328 (54.7%)	272 (45.3%)	—
Access to functional PHC nearby	366 (61.0%)	234 (39.0%)	0.003
BP monitoring device at PHC	434 (72.3%)	166 (27.7%)	0.018
Received health education on HTN	182 (30.3%)	418 (69.7%)	<0.001

3.5 Independent Predictors of Undiagnosed Hypertension (Logistic Regression)

On multivariate binary logistic regression controlling for all significant variables from univariate analysis, age above 45 years, family history of hypertension, high salt intake, tobacco use, physical

inactivity, and BMI ≥25 kg/m² emerged as significant independent predictors of undiagnosed hypertension. The model had a Nagelkerke R^2 of 0.38 and correctly classified 73.2% of cases.

Table 5: Logistic Regression — Independent Predictors of Undiagnosed Hypertension

Predictor Variable	Adjusted OR	95% CI	p-value
Age >45 years	3.14	2.18–4.53	<0.001
Family history of hypertension	2.89	2.04–4.09	<0.001
High salt intake (>8 g/day)	2.67	1.89–3.77	<0.001
Tobacco use (any form)	2.31	1.63–3.27	<0.001
Physical inactivity	2.18	1.54–3.09	<0.001
BMI ≥25 kg/m²	1.98	1.42–2.77	<0.001
Male sex	1.52	1.09–2.12	0.014
Alcohol consumption	1.38	0.94–2.02	0.099
Low SES (Kuppuswamy)	1.44	1.03–2.01	0.032

4. DISCUSSION

This study reports a prevalence of undiagnosed hypertension of 38.3% among adults in peri-urban communities of Tamil Nadu, a finding that is both alarming and consistent with the growing body of evidence indicating a high but under-detected burden of hypertension in semi-rural and transitional communities of South India. Anchala et al. (2014)[10] in a systematic review reported an awareness rate of only 25.5% among hypertensives in rural India, underscoring that the problem of undiagnosed hypertension is long-standing and structurally embedded.

The higher prevalence of undiagnosed hypertension among males (43.0%) compared to females (33.2%) in this study is consistent with findings from the ICMR-INDIAB study,[11] where male sex was a significant predictor of hypertension in South Indian cohorts. The biological explanation may involve protective effects of estrogen on vascular endothelial function in premenopausal women, while social determinants such as occupational stress, tobacco use, and alcohol consumption in men may compound risk.[12]

The progressive increase in undiagnosed hypertension prevalence with age is well-established and supported by findings from the Annual Health Survey Collaborators (2016)[13] and Gupta et al. (2016).[14] Vascular stiffening, reduced baroreceptor sensitivity, and cumulative lifestyle exposure are recognized pathophysiological contributors. Notably, however, the prevalence of 44.4% in the 35–54 years working-age group is particularly significant from a public health perspective, as this is a productive demographic with high potential for cardiovascular morbidity and economic burden.

Dietary salt intake emerged as one of the strongest modifiable predictors in this study (OR=2.67), which is consistent with extensive epidemiological evidence. A meta-analysis by Aburto et al. (2013)[15] established that reducing sodium intake significantly lowers systolic blood pressure. The high salt consumption in peri-urban Tamil Nadu likely reflects both traditional dietary practices—including tamarind, salted fish, and pickle-based preparations—and the increasing penetration of sodium-rich

packaged snacks in these communities.[8] This finding reinforces the WHO's recommendation to reduce dietary sodium below 5 g/day as a cost-effective population-level intervention.[16]

Tobacco use, whether smoked or smokeless, was a significant independent predictor (OR=2.31). Tobacco-associated hypertension operates through sympathetic stimulation, endothelial dysfunction, and oxidative stress pathways. The Global Adult Tobacco Survey India Round 2 (2016–17)[17] reported that 42.4% of men in Tamil Nadu use tobacco in some form, consistent with the high prevalence in this study's male participants. The dual epidemics of tobacco use and hypertension demand co-management strategies within primary health infrastructure.

Physical inactivity was documented in 61.3% of hypertensives in this study (OR=2.18). This is notable because peri-urban populations, once characterized by physically active agricultural livelihoods, are increasingly transitioning to sedentary employment—particularly in roadside shops, small industries, and construction—without a compensatory increase in leisure-time physical activity. Huai et al. (2013)[18] in a meta-analysis confirmed that regular aerobic exercise reduces both systolic and diastolic blood pressure by 3–5 mmHg.

The significantly poor healthcare access data in this study are perhaps the most actionable finding. Only 41.2% of participants had a BP measurement in the past two years, and awareness of hypertension as a condition was present in barely 54.7% of the population. The data on regular PHC functioning (61.0%) point to systemic service delivery gaps. Nulu et al. (2012)[19] similarly found that health system barriers, including lack of regular services and poor provider-patient communication, were major contributors to low hypertension detection in rural South Asian settings. Strengthening the primary healthcare pipeline is therefore essential for transitioning from detection to treatment and control.

This study also found that lower socioeconomic status was an independent predictor of undiagnosed hypertension (OR=1.44). This is multifactorial: poorer households have lower capacity to utilize healthcare services, purchase fresh produce, or afford antihypertensive medications. The inverse socioeconomic gradient of hypertension control is well-documented in India[20] and reinforces the need for social protection elements within NCD intervention frameworks.

The implications of this study's findings for primary care are substantial. First, community-level blood pressure screening camps operated through Accredited Social Health Activists (ASHAs) and Village Health Nurses (VHNs) should be intensified, particularly targeting adult males above 35 years and those from lower socioeconomic groups. Second, dietary counseling integrating culturally contextualized salt reduction strategies needs to be mainstreamed into routine PHC consultations. Third, tobacco cessation support through the National Tobacco Control Programme (NTCP) must be more actively integrated with NCD clinics at PHC level. Fourth, school and workplace health promotion programs addressing physical activity can provide intergenerational prevention.

5. CONCLUSION

This community-based cross-sectional study demonstrates a high and clinically significant prevalence of undiagnosed hypertension (38.3%) in peri-urban communities of Tamil Nadu. The condition is predominantly driven by modifiable lifestyle risk factors including excessive dietary salt intake, tobacco use, physical inactivity, and abdominal obesity, in conjunction with non-modifiable factors such as increasing age, male sex, and family history. The striking deficit in healthcare utilization and awareness underlines the need for proactive, community-integrated screening programs.

The convergence of lifestyle transition, demographic vulnerability, and healthcare access gaps in peri-urban Tamil Nadu creates a perfect storm for the silent epidemic of undiagnosed hypertension. A comprehensive, multi-pronged response embedding awareness, screening, dietary behavior change, tobacco cessation, and strengthened primary care delivery is needed. The Tamil Nadu state government's existing platforms including the Tamil Nadu Health Systems Reform Programme (TNHSRP) and the HOPE initiative (Hypertension Outreach and Prevention Effort) provide institutional scaffolding upon which such intensified efforts can be built. Longitudinal cohort studies examining the cardiovascular outcomes of undiagnosed hypertension in this transitional community profile are warranted.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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