ORIGINAL ARTICLE

Burden and Risk Factors of Hypertension Among Tribals in Odisha: A Community-Based Cross-Sectional Study

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ABSTRACT

Background: Odisha, home to a substantial tribal population, lacks robust community-based data on hypertension prevalence and its determinants among tribal groups. **Aims & Objectives:** This study aimed to assess the prevalence of hypertension and identify associated socio-demographic and behavioural determinants among tribal adults in a tribal-dominated area of Odisha. **Methodology:** A community-based cross-sectional study was conducted from April 2022 to March 2023 in 22 tribal villages under the Rural Health and Training Centre (RHTC), Mendhasala, Khordha district, Odisha. Adults aged ≥18 years residing in the area for at least six months were included. Using probability proportionate to size sampling, 669 participants were enrolled. Data were collected through house-to-house surveys using a standardized proforma and Computer-Assisted Personal Interviews (CAPI). Multivariable logistic regression was performed to identify independent determinants of hypertension, with statistical significance set at $p<0.05$. **Results:** The mean age of participants was 42.8 ± 15.7 years, with females constituting 55.2% of the sample. Overall, 31.2% of participants were hypertensive. Hypertension was significantly associated with age >40 years (AOR: 1.61; 95% CI: 1.12–1.82), higher BMI (>24 kg/m²) (AOR: 1.35; 95% CI: 1.18–2.52), unmarried/divorced/widowed status (AOR: 6.16; 95% CI: 1.97–9.29), and tobacco use (AOR: 2.62; 95% CI: 1.56–4.39). **Conclusion:** The study demonstrates a high burden of hypertension among tribal adults in Odisha, driven predominantly by modifiable behavioural and social determinants such as tobacco use and marital status. The findings highlight the need for culturally appropriate, community-based screening, targeted tobacco cessation strategies, and lifestyle interventions to address the growing NCD burden among tribal populations.

KEYWORDS

Hypertension, Indigenous Populations, Prevalence, Risk factors, India

INTRODUCTION

India is home to one of the world's largest tribal populations, officially classified as Scheduled Tribes (STs), encompassing over 104 million people as per the Census of 2011.(1) Representing approximately 8.6% of the country's total population, these communities are distributed across various ecological and geographical zones and comprise around 705 distinct tribal groups.(1–3) Tribal populations in India, living in remote regions with distinct cultural practices, experience marked socio-economic and health disparities due to geographic isolation and historical marginalization.(4) Tribal health in India remains suboptimal despite government initiatives, with persistent disparities compared to national averages, largely due to limited data for targeted planning and intervention evaluation.(5)

Non-communicable diseases, particularly hypertension, are an emerging public health challenge among tribal populations, reflecting a shift from traditionally low-risk lifestyles to increasing rates of lifestyle-related disorders.(6) This shift is largely attributed to rapid socio-economic transitions, urbanization, and acculturation processes. Rising hypertension in tribal areas is driven by diet changes, reduced physical activity, and high tobacco and alcohol use.(7) Tribal populations face multiple systemic barriers to healthcare, including geographic inaccessibility, limited infrastructure and personnel, language and literacy challenges, and reliance on traditional healing practices.(6) In Odisha, home to over 22% tribal residents and 60+ tribal groups including PVTGs, healthcare barriers delay diagnosis and management of hypertension and other chronic conditions.(8)

Studies across India, including Jharkhand, Madhya Pradesh, and the Northeast, report a rising prevalence of hypertension among tribal populations, ranging from 20% to 50%, with limited data from Odisha indicating rates above 30%, comparable to or exceeding the national average.(4,9,10)

However, a substantial gap persists in the existing literature when it comes to the systematic assessment of the burden and determinants of hypertension among tribal populations in Odisha. Most studies conducted in tribal areas are either limited in geographic scope or are part of broader national surveys that do not capture the unique socio-cultural contexts of tribal life. Consequently, there is a pressing need for community-based, contextually grounded research that explores the epidemiology of hypertension in tribal areas of Odisha.

AIMS & OBJECTIVES

Aim: To determine the prevalence of hypertension and its determinants among the tribal population of Mendhasala, Odisha.

Objectives

- To estimate the prevalence of hypertension among tribal adults in Mendhasala.
- To assess socio-demographic and behavioural risk factors associated with hypertension.
- To examine the association between selected risk factors and hypertension.
- To generate evidence to support prevention and control strategies for hypertension in tribal areas.

MATERIAL & METHODS

Study Design: Cross-sectional study

Study Setting: This study was conducted as a part of House-Hold Health & Demographic Survey conducted by department of Community Medicine and Family Medicine, AIIMS, Bhubaneswar, in the field practice area of Rural Health & Training Centre (RHTC) in Mendhasala, the northernmost Khorda district. It is surrounded by Khorda Tahsil towards the South, Bhubaneswar Tahsil towards the East, Banki-Dampara Tahsil towards the North, Banki Tahsil towards the West. It is around 22 km from AIIMS, Bhubaneswar. The catering area is divided into five sectors namely, Mendhasala, Chandaka, Kalarahanga, Itipur and Patrapada. Administratively RHTC Mendhasala covers 19 Panchayats, 5 Health & Wellness centers, 20 subcentres & 119 villages with around 1,47,985 population. A total of 103 ASHA workers & 147 Anganwadi workers were distributed in villages coming under CHC Mendhasala. Many villages are home to tribal people. This provides a unique opportunity to understand the health & socio-demographic characteristics of tribal people as well as generate evidence about their prevailing communicable & non-communicable diseases, morbidity pattern and health care seeking behaviour

Study Population: The study was conducted in 22 selected tribal villages in the field practice area, with individuals residing in these villages for at least six months forming the study population.

Study Duration: It was a community-based observational study carried out over one year, from April 2022 to March 2023.

Sample Size Calculation: The sample size was calculated from a study by Aswin et al, taking the prevalence of hypertension as 23% in the tribal population, 10% relative precision, 2.5% alpha error, design effect 1.5, a attrition rate of 10% the sample size was calculated to be 693.(11)

Inclusion & Exclusion Criteria: Participants >18 years were selected from each village by probability proportionate to size sampling. A total of 693 participants were approached but 24 participants did not give consent. Finally, 669 participants were recruited in the study. A standardized proforma was developed, and manpower was recruited and trained to collect data through house-to-house visits. Universal sampling was employed, including all residents who consented to participate, irrespective of age and sex, while those who did not consent were excluded. Complicated cases (diagnosed cases of hypertensive urgency and hypertensive emergency) were also excluded.

Strategy for Data Collection: Data collection followed a mixed-method approach, combining qualitative and quantitative techniques. Initially, focus group discussions (FGDs) were conducted in each sector, involving health workers (male and

female), ASHAs, and AWWs to assess community needs. Two teams, each comprising two trained surveyors, collected data using Computer-Assisted Personal Interviews (CAPI). Census data were used to determine the number of households and total population, with house-to-house surveys capturing sociodemographic details, socio-cultural practices, vital events, health conditions, substance use, and healthcare-seeking behavior. The Household Demographic Surveillance System (HDSS) database was established through an initial census, mapping household and individual characteristics, and assigning unique identifiers for follow-up. Periodic follow-ups were planned, with additional surveys introduced as needed.

Working Definitions: Hypertension – A blood pressure reading of > 140/90 mm Hg was taken as hypertension. Indigenous Population – Indigenous people are the communities with pre-colonial societies which written social, cultural, distinct, economic, and political traditions. Odisha has 62 scheduled tribe (20-23% of state's population) and 13 Particularly Vulnerable Tribal Groups (PVTG).

Ethical Issues & Informed Consent: Ethical approval was obtained from the Institute Ethics Committee of AIIMS Bhubaneswar, and written informed consent was secured from the Gram Sabha, individual adult participants, and parents or guardians of minors.

Data Analysis – Software: Data analysis was conducted using both qualitative and quantitative methods. Coding and thematic analysis ensuring credibility through key informant interviews. Quantitative data were entered into Epicollect5 and analysed using SPSS 24.0, with categorical variables expressed as proportions and continuous variables as means with standard deviations. Statistical significance was set at $p<0.05$, and appropriate statistical tests were applied. Multivariable logistic regression analysis was conducted for variables with a p-value <0.05 in univariate logistic regression.

RESULTS

The study population consisted largely of middle-aged adults, with women forming a slightly higher share than men. About three-fourths of the participants were married, while roughly one-fourth were unmarried or had experienced marital disruption. Educational attainment was generally low, with nearly half of the participants having no formal education and only a negligible fraction having completed higher education. In terms of occupation, almost half of the participants were unemployed, and a similar proportion were engaged in unskilled work, reflecting limited livelihood opportunities. Household income levels indicated a predominantly low socio-economic background.

The average body mass index of the participants fell within the normal to overweight range. Tobacco use was widespread, with nearly half reporting the use of smokeless tobacco and a smaller proportion reporting dual use; overall, close to half of the participants were current tobacco users. Alcohol consumption was reported by over two-fifths of the study population, with traditional locally brewed alcohol being the most commonly consumed. A history of migration was present in about one-third of the households.

With respect to tribal affiliation, over half of the participants belonged to the Sabara tribe, followed by around one-third from the Munda tribe. Housing conditions varied, with nearly half residing in kachha houses, about one-third in mixed-type dwellings, and less than one-fourth living in pucca houses. Basic household amenities were limited, as nearly two-thirds of participants reported the absence of a separate kitchen within their household.

Table 1: Socio-demographic Characteristics of the study participants (N=669)

Variables	Frequency (proportion) n (%)
Age	
<40	422(63.0)
>=40	247(27.0)
Gender	
Male	300 (44.8)
Female	369 (55.2)
Marital Status	
Unmarried	82 (12.3)
Married	502 (75.0)
Widowed/Separated/Divorced	85 (12.7)
Education	
Illiterate	285 (42.6)
Below primary	64 (9.6)
Primary	111 (16.6)
Middle school	104 (15.5)
Secondary	89 (13.3)
Higher secondary	11 (1.6)
Graduate and above	5 (0.7)
Occupation	
Unemployed	303 (45.3)
Unskilled	308 (46.0)
Semiskilled	36 (5.4)
Skilled	22 (3.3)
Monthly family income – Median (IQR)	10,000 (8,000 – 12,000)
BMI	
<24	376(56.0)
>24	293(44.0)

Tobacco Products	
None	250 (37.4)
Smoking	12 (1.8)
Smokeless tobacco	327 (48.9)
Both smoking and Smokeless tobacco	80 (12.0)
Tobacco user	
Never	272 (40.6)
Ever user	109 (16.3)
Current	288 (43.0)
Alcohol beverages	
None	386 (57.7)
Handiya	232 (34.7)
Other local	14 (2.1)
Foreign liquor	23 (3.4)
Other	14 (2.1)
Migrated family	
No	453 (67.7)
Yes	216 (32.3)
Type of Tribe	
Munda	224 (33.5)
Sabaro	380 (56.8)
Santhali	15 (2.2)
Others	50 (7.5)
Type of House	
Kachha	297 (44.4)
Pucca	159 (23.8)
Mix	213 (31.8)
Kitchen	
Separate	262 (39.2)
Not separate	407 (60.8)

A multivariable logistic regression model was used to examine how different socio-demographic characteristics were related to hypertension. Age was found to be significantly associated with hypertension. Among participants aged more than 40 years, 42.6% were hypertensive compared to 34.4% in the normotensive group. In contrast, 57.4% of hypertensive individuals were aged 40 years or younger. The adjusted odds ratio (AOR) for hypertension among participants older than 40 years was 1.61 (95% CI: 1.12–1.82, p < 0.001), indicating a significantly higher likelihood of hypertension in this age group.

Body mass index (BMI) was also associated with hypertension. Among individuals with a BMI greater than 24.0, 56.9% were hypertensive, compared to 43.1% with BMI ≤23.9. Although the unadjusted odds ratio was not statistically significant (OR: 1.26; 95% CI: 0.88–2.52; p = 0.065), the adjusted model showed that individuals with higher BMI had increased odds of hypertension (AOR: 1.35; 95% CI: 1.18–2.52; p = 0.050).

Marital status showed a strong association with hypertension. Among hypertensive individuals, 56.4% were unmarried or divorced, whereas only 10.6% of normotensive individuals belonged to this group. Conversely, 89.4% of those without hypertension were married. The adjusted odds of hypertension were significantly higher among unmarried or divorced individuals (AOR: 6.16; 95% CI: 1.97–9.29; p = 0.001), suggesting a substantial risk associated with marital status.

Educational status did not show a statistically significant association with hypertension. Among hypertensive individuals, 53.1% were illiterate, whereas 46.9% were literate. In the normotensive group, 37.8% were illiterate and 62.2% literate. The adjusted odds ratio for illiterate participants was 1.40 (95% CI: 0.74–2.64; p = 0.764), indicating no significant difference.

Tobacco use was significantly associated with hypertension. Among tobacco users, 74.6% were hypertensive compared to 57.2% in the normotensive group. In contrast, 25.4% of hypertensive and 42.8% of normotensive participants did not use tobacco. The adjusted analysis showed that tobacco users had significantly increased odds of hypertension (AOR: 2.62; 95% CI: 1.56–4.39; p < 0.001).

Table 2: Socio-demographic factors associated with Hypertension (Multivariate analysis) [N=669]

Variables	Hypertension Present [N=209] n (%)	Hypertension Absent [N = 460] n (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age						
≤ 40 years	120 (57.4)	302 (65.6)	1.31(1.10-1.67)	<0.001	1.61(1.12-1.82)	<0.001
> 40 years	89 (42.6)	158 (34.4)				
BMI						
>24.0	90 (43.1)	203 (44.2)	1.26(0.88-2.52)	0.065	1.35(0.18-2.52)	0.430
≤ 24	119 (56.9)	257 (55.8)				
Marital Status						
Unmarried/Divorced	118 (56.4)	49 (10.6)	3.12(2.45-5.67)	0.034	6.16(1.97-9.29)-	0.001
Married	91 (43.6)	411 (89.4)				
Education						

Illiterate	111(53.1)	174(37.8)	1.58(.74-	0.890	1.40(.74-	0.764
Literate	98 (46.9)	286 (62.2)	2.64)		2.64)-	
Tobacco use						
Present	156 (74.6)	263 (57.2)	1.37(1.25-	0.003	2.62(1.56-	<0.001
Absent	53 (25.4)	197 (42.8)	5.78)		4.39)-	

DISCUSSION

Hypertension is a multifactorial condition influenced by a range of socio-demographic, behavioural, and genetic factors. In tribal populations, these influences may be shaped by unique cultural practices, lifestyle patterns, and environmental exposures. Understanding which variables are significantly associated with hypertension in such populations is essential for developing tailored interventions.

In the present study, a statistically significant association was observed between hypertension and factors such as marital status, educational attainment, tobacco use, alcohol consumption, and tribal affiliation. These findings suggest that social and behavioural determinants play a crucial role in the risk profile for hypertension within the studied tribal community. Conversely, no significant associations were found between hypertension and variables such as age, gender, occupation, household income, body mass index (BMI), or migration history, indicating that these factors may not independently influence blood pressure levels in this specific population group.

A large-scale cross-sectional study involving over a million individuals across 26 LMICs found that low education and household wealth were significantly associated with higher hypertension prevalence. These socioeconomic disadvantages accounted for approximately 19.4% of the hypertension burden in these countries. Many studies have consistently shown that increasing age and male gender are significant risk factors for hypertension.(12–14) However in our study, although age was a significant predictor of hypertension but it was not associated with gender distribution. **Age is a** well-documented risk factor for hypertension. Aging is linked to vascular changes such as arterial stiffness and endothelial dysfunction, contributing to elevated blood pressure, resulting in higher incidence of elevated blood pressure with an increased age. This trend has been consistently observed across multiple population-based studies, such as the National Family Health Survey (NFHS-5) and the WHO STEPwise approach to surveillance (STEPS) surveys, which report increasing prevalence of hypertension with age in both urban and rural settings of India and globally.(15,16) On contrary in our study was that hypertension was higher among younger individuals which can be due to early onset of hypertension among the tribal population. Our study reported Higher prevalence of hypertension among widowed/separated/divorced individuals. Similar findings were reported by Ramezankhani et al. showed that social isolation and loss of a partner are associated with higher blood pressure.(17)

Although obesity contributes to hypertension through multiple mechanisms, including increased sympathetic nervous system activity, insulin resistance, and inflammation, all of which elevate vascular tone and blood pressure.(18,19) In the present study we could not find any impact of obesity on the hypertension of the individual. Our findings are not consistent with literature that demonstrate a linear increase in hypertension risk with rising BMI including ICMR-INDIAB study also highlighted a similar correlation between increased BMI and the burden of hypertension, underscoring the public health importance of obesity prevention.(20) It can be due to lower prevalence of obesity among the tribal population in our study because of socio-demographic & nutritional factors in the tribal culture.

Marital status showed one of the strongest associations in our study. Unmarried or divorced individuals had a significantly higher odds of hypertension compared to married participants indicating a potential psychosocial component in blood pressure regulation. Marriage is often associated with emotional support, shared responsibilities, and healthier behaviours, which may help buffer stress and contribute to better cardiovascular outcomes. Conversely, being single, divorced, or widowed may predispose individuals to social isolation, mental stress, and unhealthy lifestyle choices, all of which are known risk factors for hypertension.(21) A meta-analysis by Wong et al. supports this observation, noting that married individuals tend to have better cardiovascular profiles and lower risk of hypertension compared to unmarried individuals(22)

Tobacco use was another significant variable. Individuals reporting tobacco use had 2.6 times the odds of being hypertensive compared to non-users. The harmful effects of tobacco on blood pressure are well-documented.(23,24) Nicotine increases heart rate, cardiac output, and vasoconstriction, leading to acute and chronic elevations in blood pressure. Our findings are consistent with global literature, including the GATS (Global Adult

Tobacco Survey), indicating that tobacco users in low- and middle-income countries tend to exhibit higher rates of hypertension.(25) This association also reflects the broader burden of non-communicable diseases (NCDs) linked with tobacco consumption and underlines the need for integrated tobacco cessation and hypertension screening programs.

The study's findings may not be generalizable beyond the selected tribal villages of Odisha. Potential biases include self-reported data, recall bias, and non-response from some individuals. Despite rigorous training, data collection errors may have occurred. The cross-sectional design also limits causal inference regarding observed associations.

Conclusion

The study demonstrates a high prevalence of hypertension among tribal adults in Mendhasala, Odisha. Hypertension was significantly associated with socio-demographic and behavioural factors, including age, marital status, BMI, and tobacco use. These findings provide important evidence on the burden and determinants of hypertension in tribal populations, contributing to the understanding of cardiovascular risk in these communities.

Recommendation

The findings indicate a substantial burden of hypertension among tribal adults, highlighting the need to prioritise hypertension prevention and control in tribal areas of Odisha. Regular blood pressure screening should be strengthened through primary healthcare facilities, Health and Wellness Centres, and community outreach activities to enable early detection. Behavioural risk factors, particularly tobacco use and unhealthy lifestyle practices, should be addressed through culturally appropriate health education and tobacco cessation interventions.

Frontline health workers should be trained to support screening, referral, treatment adherence, and follow-up of hypertensive individuals at the community level. Ensuring continuous availability of antihypertensive medicines and strengthening referral linkages are essential for effective management. Targeted counselling and community support may help address social vulnerabilities associated with hypertension. Overall, the study supports the need for integrated, community-based NCD interventions tailored to tribal populations to reduce cardiovascular risk and improve health outcomes.

Limitation of the Study

The cross-sectional design limits the ability to establish causal relationships between identified risk factors and hypertension. Blood pressure measurements were taken during a single visit, which may have led to misclassification due to white-coat effect or short-term variability. Information on behavioural risk factors such as tobacco and alcohol use was self-reported and may be subject to recall and social desirability bias. The study was conducted in selected tribal villages within a single field practice area, which may limit the generalizability of the findings to other tribal populations of Odisha or India.

Relevance of the Study

This study adds to the limited community-based evidence on the burden and determinants of hypertension among tribal populations in Odisha. By identifying key socio-demographic and behavioural factors associated with hypertension, it provides context-specific insights that are often underrepresented in existing literature. The findings contribute to a better understanding of the emerging NCD burden in tribal settings and offer evidence to inform targeted, culturally appropriate prevention and control strategies.

Authors Contribution

PR, PB conceptualized the study. PR, PB, NJ, DP, DPS contributed to the first manuscript drafting. Further corrections were done by PR, DP, PB, NJ, DPS, BKP, MT. They reviewed and provided critical revisions. All authors reviewed, edited, and approved the final manuscript All authors have reviewed the final version of the manuscript and approved it for submission.

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Nil

Conflict of Interest

None declared.

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Declaration of Generative AI and AI Assisted Technologies in the Writing Process

During the preparation of this work, the authors did not use any generative AI or AI-assisted tools in writing, editing, or formatting the manuscript. All content, analysis, and interpretations were generated solely by the authors, who take full responsibility for the accuracy and integrity of the publication.

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