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Original Research Article

Burden of hypertension and associated risk factors among the Nicobarese tribe of Car Nicobar Island, India

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ABSTRACT

Background: Hypertension, a significant risk factor for various non-communicable diseases, poses a preventable threat to mortality and disease burden. However, there remains a lack of data on hypertension within Indian tribes, particularly those residing in impoverished areas. Determining the prevalence of hypertension and identifying associated risk factors among the Nicobarese tribes. A cross-sectional survey was conducted, involving 2600 tribal individuals aged 18 years and above from ten randomly selected villages on Car Nicobar Island.
Methods: A structured questionnaire was utilized to gather data on blood pressure (BP), anthropometric measurements, and detailed participant characteristics. Prevalence of hypertension was determined and analyzed in relation to various identified risk factors using chi-square, Karl Pearson coefficient of correlation, and generalized linear models. Prevalence ratio and adjusted risk ratio calculated, along with their corresponding confidence intervals.
Results: Prevalence of hypertension was 57.9%. Several factors, including age, male gender, illiteracy, diabetes, smoking, alcohol consumption, and higher body mass index (BMI), were significantly associated with hypertension. Systolic and diastolic BP levels increased significantly with age, socio-economic scores, BMI, and weight.
Conclusions: The prevalence of hypertension among the Nicobarese tribes is significantly higher compared to the general population. Adapting preventive strategies based on an understanding of the tribe's specific culture and lifestyle is important for controlling hypertension. However, it is also crucial to consider genetic and environmental influences that may contribute to the high prevalence of hypertension in this tribe.

Keywords: Tribal health, Hypertension, Nicobarese, Alcohol, Obesity, Overweight, Tobacco

INTRODUCTION

Hypertension, also known as high BP, is a prevalent condition that can elevate the risk of various health issues, including ischaemic heart disease, stroke, other cardiovascular diseases (CVDs), and chronic kidney disease.[1] The global prevalence among adults was around 26% in 2002, and it is projected to rise to 29% by 2025.[2] Globally, around 9.4 million deaths occur annually, accounting for 16.5% of all deaths, due to high BP.[3] It is crucial to address hypertension as it is a preventable cause of mortality and disease burden associated particularly with the non-communicable diseases (NCD).[1,4]

In India, hypertension is a major NCD risk, causing 10% of deaths and 8.5% of DALYs in 2016. Studies show a consistent increase in hypertension prevalence over the past five decades.[5-7] Recent estimates show that approximately 25% of adults in India have hypertension, yet only around 12% of them have their BP adequately controlled.[8,9] Nevertheless, India has established a goal of

achieving a 25% relative reduction in the prevalence of hypertension by 2025.[10] Around 33% of urban and 25% of rural population of India have high BP. Among them, about 25% of rural and 42% of urban population are aware of their condition. However, only 25% of rural and 38% of urban receive treatment. Additionally, only 10% of rural and 20% of urban with high BP have it under control.[11]

India is a country characterized by its diverse population with the tribal population forming a significant indigenous minority, accounting for 8.6% of the total population of the nation.[12] Numerous research studies indicate that indigenous individuals seldom make use of contemporary healthcare services.[13] Most of the indicators of healthcare coverage or health status among tribal communities are significantly worse, with a maximum range of 25%, when compared to their non-tribal counterparts.[14] Systematic reviews indicate a prevalence range of 0.4% to 55.5% for hypertension among Indian tribes. However, these studies showed significant heterogeneity. This review demonstrates that the prevalence among tribal communities has increased over the course of three decades.[15-17]

The main factors contributing to this high prevalence among marginalized, poor and tribal communities were identified as nutritional transition and gene-environment interaction.[18] The current study aimed to estimate the prevalence of hypertension and investigate the association and risk estimates of established risk factors of hypertension among the Nicobarese tribes.

METHODS

Study area and study population

This is a community-based cross-sectional survey conducted from December 2019 to June 2021 on Car Nicobar Island among Nicobarese individuals aged 18 years or older. Those aged 18 and above who provided consent to participate were randomly included in study without any exclusion criteria until the required sample size for selected cluster was achieved. Nicobarese is one of 6 indigenous tribes, mongoloid in origin predominantly residing in Car Nicobar Island of Nicobar group of islands. For their livelihood they engage in agriculture mainly growing coconut, areca nut, bananas, mangoes and other fruits and they do pig rearing and marine fishing activities.[19] Majority of Nicobarese are Christians with a minority of Muslims. Most of them are educated and are in multiple government jobs as doctors, teachers, policemen and clerks, among other occupations.[18]

Sample size and design

The sample size was calculated based on a community survey on Nicobarese tribe in same study area by Manimunda, where they found the prevalence of hypertension to be 50.5%. With the total population of Car Nicobar Islands being 22,000 (based on the 2011 census), to estimate a prevalence of 50.5% with 5.0% absolute precision, 95% confidence interval, 20% refusal for the participation, and design effect of 1.3, the sample size was calculated to be 2,448 approximated to 2,600.[18] Car Nicobar Islands is divided into 10 villages. To get an overall sample of 2,600, the varying cluster size was determined by taking into account of the proportion of the selected village's population in relation to the total population size. The participants in the study were selected from specific households, chosen sequentially starting from a point determined by simple random sampling using information from the village census enumeration block.

Data collection and questionnaire

The field survey team was comprised of trained Nicobarese field worker, with a clinician accompanying them. The study principal investigator and data monitoring team verified the completeness and logical error on the data collected periodically. Prior to the survey, the interview schedule was piloted and standardized. A door-to-door survey was conducted to gather information from eligible participants aged 18 years and older. The participants' socio-demographic characteristics, such as age and gender, were recorded using a structured questionnaire. Additionally, data on the current use of tobacco and alcohol consumption either regularly or occasionally over the past one month, as well as dietary intake and the updated details for the socio-economic status were collected.[20]

BP measurements were taken by a clinician using an automated BP apparatus (HEM 7130; OMRON Health Care Co. Ltd., Kyoto, Japan) on the upper left arm. Three readings were recorded with a one-minute interval between each reading.[21] The average of the last two readings for both systolic and diastolic BP was calculated for analysis. During the measurement, participants were seated with their backs supported, legs resting on the ground, and in an uncrossed position for five minutes. Based on the BP readings, the individuals with systolic BP (SBP) of ≥140 and or diastolic pressure (DBP) of ≥90 were considered as hypertensive.[22]

Height and weight were measured using a digital weighing scale and stadiometer, ensuring that the devices were regularly calibrated and adjusted for any calibration drift. Participants were instructed to keep their legs straight, arms at their sides, shoulders level, and to look straight ahead with their line of sight parallel to the floor while their height and weight were being measured. The nutritional status of the adults were classified into different grades as per the international classification of adult underweight (BMI<18.50 kg/m^2), normal (BMI 18.50 to 24.99 kg/m^2), overweight (BMI≥25.0 to 29.99 kg/m^2), and obesity (BMI≥30 kg/m^2) according to BMI proposed by WHO.[23]

The data was gathered by administering a printed questionnaire and entering the data twice using the Epidata entry 3.1 software, which includes built-in logical checks.[24] The institutional human ethics committee has approved the study. The field staff from the Nicobarese tribe approached eligible individuals in the community and provided them with detailed explanations of the study procedures, as well as its risks and benefits, in the local language. Written consent was obtained from all individuals who agreed to participate.

Statistical analysis

The data were checked for completeness and consistency before being processed with STATA software version 15.1. (StataCorp., Texas, USA).[25] The data was presented as a frequency, percentages, median, first and third quartiles. The crude prevalence of hypertension, along with its 95 percent confidence interval, was calculated in relation to various other risk factors using binomial exact theory.[26] The chi-square test was used to examine the association between categorical risk factors and hypertension. Furthermore, the chi-square test for linear trend was utilized to analyze the increasing trend in hypertension prevalence with age and BMI. The Karl Pearson coefficient of correlation was used to assess the relationship between systolic and diastolic BP observations and continuous variables. Variables that were known to be linked to hypertension based on existing literature and data availability were selected for analysis. Generalized linear models with poisson regression and log link functions were used to identify factors associated with hypertension. Prevalence ratio (PR) and adjusted prevalence ratio (aPR) were calculated, along with their corresponding 95% confidence intervals (CIs). All statistical analyses were two-sided, with a type I error rate set at alpha=0.05.

RESULTS

Out of 2600 people screened, 1505 (57.9%) were found to have hypertension, resulting in a prevalence rate of 57.9 (95% CI: 56.0, 59.8). Among these hypertensive participants, 1179 (78.1%) had a systolic BP (SBP) of ≥140 mmHg, while 1281 (85.1%) had a diastolic BP (DBP) of ≥90 mmHg. Table 1 provides prevalence of hypertension, along with 95% CI, for various known factors. Age found to have a highly significant association with prevalence of hypertension ($p<0.001$). Additionally, being male ($p=0.003$), illiterate ($p<0.001$), having diabetes ($p=0.008$), smoking ($p=0.001$), being alcoholic ($p<0.001$), and having a higher-than-normal BMI ($p<0.001$) were all significantly associated with higher prevalence of hypertension.

Table 3 demonstrates that average systolic and diastolic BP levels increased significantly with age. Individuals who were illiterate, had a lower socio-economic index, and used tobacco (in any form) also had significantly higher average BP levels. Figure 1 shows the correlation analysis, indicating that systolic and diastolic BP values were significantly correlated with age, socio-economic scores, BMI, and weight. Specifically, age had a strong correlation with systolic BP (rho=56.3%, $p<0.001$) and diastolic BP (rho=31.8%, $p<0.001$).

Table 2 presents prevalence ratio, supporting the evidence that hypertension prevalence increases significantly with age. Chance of having hypertension was 2-4 times greater as age increased. Similarly, lower socio-economic scores were associated with a higher prevalence ratio. Males PR: 1.09 (95% CI: 1.04, 1.14) had a significantly higher chance of having hypertension compared to females. Diabetes PR: 1.37 (95% CI: 1.15, 1.64), using smokeless tobacco alone PR: 1.43 (95% CI: 1.03, 1.97), all forms of tobacco PR: 1.65 (95% CI: 1.21, 2.24), being alcoholic PR: 1.43 (95% CI: 1.24, 1.66), and having a BMI above the normal range PR: 1.45 (95% CI: 1.24, 1.69) were all significantly associated with a higher chance of having hypertension in this population. After adjusting for all covariates, age, being male, socio-economic class, alcohol consumption, and having a BMI above the normal range were the factors most likely to contribute to hypertension among these population.

Age was found to be a clear and highly correlated factor in hypertensive individuals. Therefore, an age group stratified analysis was conducted to understand the risk factors for hypertension. After excluding age from the model, factors such as diabetes aRR 1.34 (95% CI: 1.16, 1.56), belonging to the middle aRR 1.16 (95% CI: 1.04, 1.29) or lower socio-economic class aRR 1.18 (95% CI: 1.06, 1.31), being alcoholic aRR 1.37 (95% CI: 1.21, 1.56), and having a BMI above the normal range aRR 1.45 (95% CI: 1.17, 1.60) were found to be significantly associated with a higher chance of having hypertension. In age group of 18-34 years, being male, having diabetes, being alcoholic, and having a BMI above normal range were identified as relative risk factors for hypertension. None of factors were found to be significant in age group of 35 to 44 years. In age groups of 45 to 54 years and ≥55 years, being male and being female, respectively, were identified as risk factors for hypertension Figure 2. Findings were compared to a study conducted over decade ago. This comparison revealed that patterns are similar, but there has been a notable rise in hypertension among females, illiterate individuals, tobacco and alcohol users, and those who are obese Table 4.

Table 1 displays prevalence estimates of hypertension among Nicobarese tribes, categorized by sub-groups, along with the respective associations with the hypertension.

Table 2 displays prevalence ratios of potential factors and their degree of association with hypertension.

Table 3 displays the distribution of systolic and diastolic BP among the sub-groups and their relationship with the BP.

Table 4 compares the findings from survey conducted more than a decade apart among Nicobarese.

Figure 1 shows the correlation of systolic and diastolic BP with the potential factors like age in years, socio-economic score, BMI in kilograms/meters^2 and body weight in kilograms.

Figure 2 shows the prevalence ratios of potential factors and their degree of association with hypertension, stratified by age.

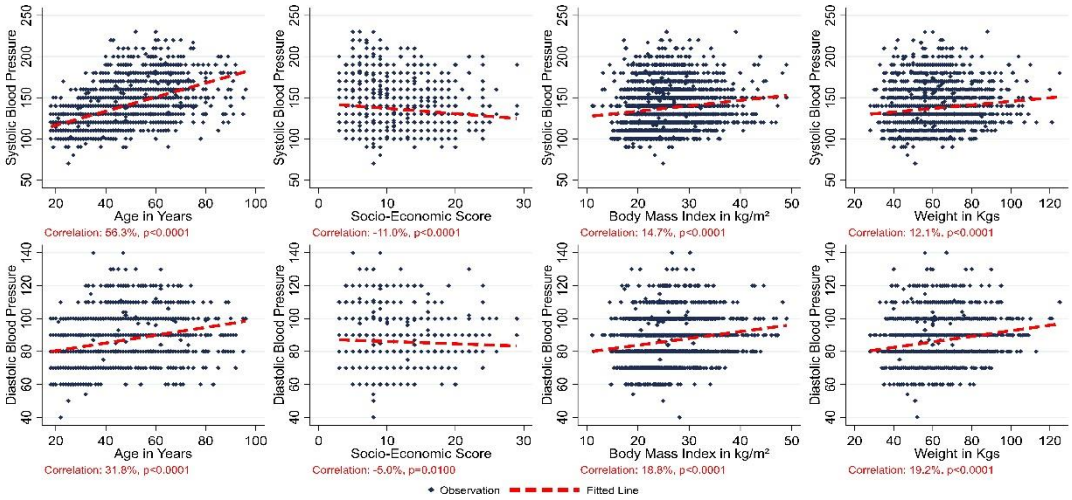

Figure 1: Correlation plot of relationship of systolic and diastolic BP with age in years, socio-economic score, BMI in kg/m^2 and body weight in kg.

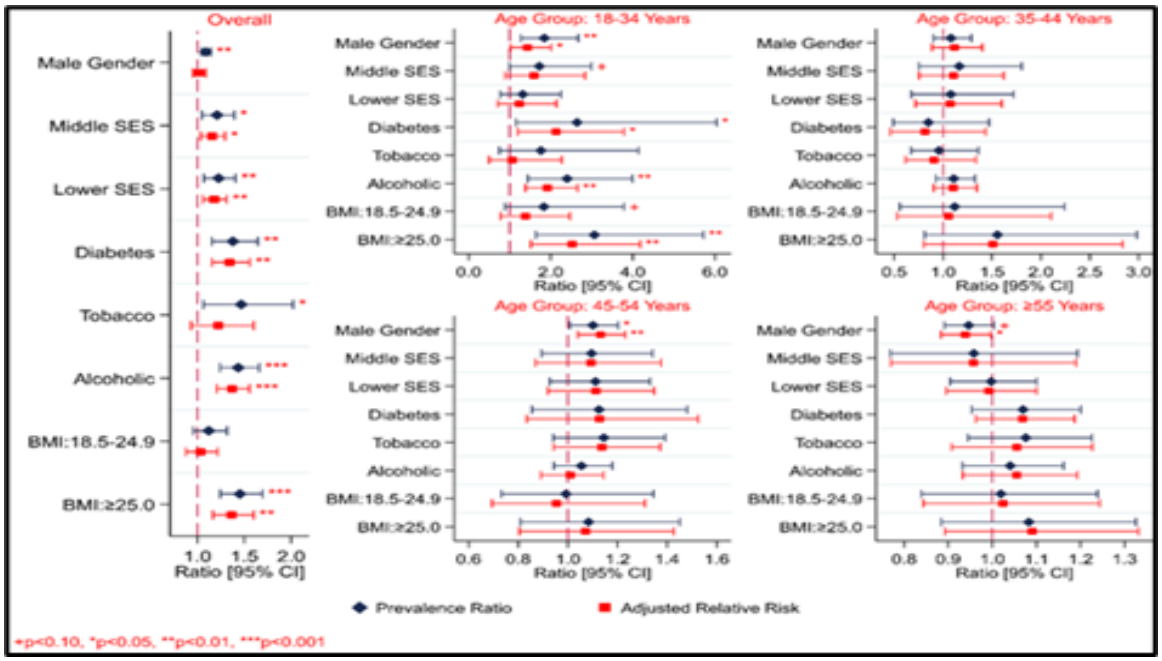

Figure 2: Factor associated with the hypertension, stratified by age.

Table 1: The prevalence of hypertension by factors among the Nicobarese tribes.

Variables	Total		Hypertension prevalence		P value
	N	%[a]	N	%[b] (95% CI)	
Overall	2600		1505	57.9 (56, 59.8)	
Age classification (in years)					
≤30	579	22.3	114	19.7 (16.5, 23.2)	<0.001

Continued.

Variables	Total		Hypertension prevalence		P value
31-40	590	22.7	305	51.7 (47.6, 55.8)	
41-50	560	21.5	385	68.8 (64.7, 72.6)	
51-60	426	16.4	334	78.4 (74.2, 82.2)	
>60	445	17.1	367	82.5 (78.6, 85.9)	
Gender					
Female	1513	58.2	844	55.8 (53.2, 58.3)	0.003
Male	1087	41.8	661	60.8 (57.8, 63.7)	
Marital status					
Unmarried	625	24.0	277	44.3 (40.4, 48.3)	<0.001
Married	1975	76.0	1228	62.2 (60, 64.3)	
Education attainment					
Illiterate	388	14.9	301	77.6 (73.1, 81.6)	
Primary schooling	392	15.1	280	71.4 (66.7, 75.9)	
Middle schooling	552	21.2	358	64.9 (60.7, 68.8)	<0.001
High schooling	972	37.4	434	44.7 (41.5, 47.8)	
College	296	11.4	132	44.6 (38.8, 50.5)	
Occupational status					
Employed	1852	71.2	1101	59.4 (57.2, 61.7)	0.118
Unemployed	748	28.8	404	54 (50.4, 57.6)	
Monthly income in rupees					
Less than Rs. 11,104	1606	61.8	943	58.7 (56.3, 61.1)	0.323
Rs. 11,104 and above	994	38.2	562	56.5 (53.4, 59.6)	
Socio-economic class					
Upper SES	245	9.4	118	48.2 (41.8, 54.6)	
Middle SES	467	18.0	272	58.2 (53.6, 62.8)	0.012
Lower SES	1888	72.6	1115	59.1 (56.8, 61.3)	
Do you have history of diabetes mellitus					
Non-diabetes	2524	97.1	1445	57.3 (55.3, 59.2)	0.008
Diabetes	76	2.9	60	78.9 (68.1, 87.5)	
Have you ever smoked any tobacco products?					
Non-smoker	2235	86.0	1256	56.2 (54.1, 58.3)	0.001
Smoker	365	14.0	249	68.2 (63.2, 73)	
Do you use smokeless tobacco such as snuff, chewing gutka/tobacco?					
No smokeless	472	18.2	237	50.2 (45.6, 54.8)	0.069
Smokeless	2128	81.8	1268	59.6 (57.5, 61.7)	
Do you consume alcoholic beverage?					
Non-alcoholic	1102	42.4	510	46.3 (43.3, 49.3)	<0.001
Alcoholic	1498	57.6	995	66.4 (64, 68.8)	
Type of diet					
Ovo-vegetarian and pure vegetarian	18	0.7	12	66.7 (41, 86.7)	0.623
Non-vegetarian	2582	99.3	1493	57.8 (55.9, 59.7)	
BMI classification (kg/m^2)					
Under weight, (BMI:<18.50)	146	5.6	66	45.2 (37, 53.6)	
Normal, (BMI:18.50-24.99)	1152	44.3	584	50.7 (47.8, 53.6)	<0.001
Over weight/obesity, (BMI:≥25.00)	1302	50.1	855	65.7 (63, 68.2)	

a-Column percentage; b-Row percentage. Crude prevalence and their Confidence interval is calculated with exact binomial probability theory. Chi-square test was performed after adjusting for the survey design/clustering effect.

Table 2: Factors associated with hypertension among the Nicobarese tribe.

Factors	PR 95% CI	P value	aPR 95% CI	P value
Age classification (in years)				
≤30	Reference		Reference	
31-40	2.62 (1.97, 3.49)	<0.001	2.36 (1.78, 3.11)	<0.001
41-50	3.49 (2.39, 5.08)	<0.001	3.10 (2.19, 4.38)	<0.001
51-60	3.98 (2.77, 5.71)	<0.001	3.55 (2.56, 4.92)	<0.001
>60	4.18 (3.01, 5.82)	<0.001	3.86 (2.83, 5.27)	<0.001
Gender				

Continued.

Factors	PR 95% CI	P value	aPR 95% CI	P value
Female	Reference		Reference	
Male	1.09 (1.04, 1.14)	0.002	1.07 (1.02, 1.13)	0.011
Socio-economic class				
Upper (16, 29)	Reference		Reference	
Middle (11, 15)	1.20 (1.04, 1.39)	0.015	1.14 (1.01, 1.30)	0.038
Lower (<11)	1.22 (1.07, 1.40)	0.008	1.11 (1.01, 1.22)	0.024
Diabetes mellitus				
Non-diabetes	Reference		Reference	
Diabetes	1.37 (1.15, 1.64)	0.003	1.11 (0.95, 1.29)	0.134
Tobacco users				
None	Reference		Reference	
Smokeless only	1.43 (1.03, 1.97)	0.033	1.11 (0.88, 1.40)	0.332
Smokeless and or smoker	1.65 (1.21, 2.24)	0.005	1.08 (0.88, 1.32)	0.404
Alcohol status				
Non-alcoholic	Reference		Reference	
Alcoholic	1.43 (1.24, 1.66)	<0.001	1.15 (1.04, 1.28)	0.009
BMI (kg/m²)				
Under weight, (BMI:<18.5)	Reference		Reference	
Normal, (BMI:18.5-24.9)	1.12 (0.95, 1.31)	0.139	1.05 (0.94, 1.18)	0.304
Over weight/ obesity, (BMI: ≥25.00)	1.45 (1.24, 1.69)	<0.001	1.29 (1.18, 1.41)	<0.001

PR-Prevalence ratio; aPR – Adjusted Prevalence Ratio.

Table 3: The distribution of systolic and diastolic blood pressure by the factors observed.

Variables	Non-hypertension	Hypertension	Total	Non-hypertension	Hypertension	Total
	Systolic blood pressure			Diastolic blood pressure		
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
Total, (n=2,600)	118.0 (117.0, 119.0)	151.3 (148.8, 153.8)	137.3 (134.4, 140.2)	76.6 (75.6, 77.5)	93.2 (91, 95.4)	86.2 (84.3, 88.1)
Age classification (in years)						
18-30, (n=579)	115.2 (113.9, 116.6)	131.3 (129.5, 133.0)	118.4 (116.7, 120.1)	75.8 (74.6, 77.1)	90.9 (90.0, 91.9)	78.8 (77.1, 80.6)
31-40, (n=590)	116.9 (115.6, 118.3)	139.5 (137.4, 141.5)	128.6 (126.5, 130.7)	76.5 (75.0, 78.0)	93.2 (90.7, 95.7)	85.1 (82.8, 87.5)
41-50, (n=560)	120.5 (119.0, 122.0)	151.1 (148.1, 154.1)	141.6 (137.7, 145.4)	77.7 (76.7, 78.8)	94.5 (91.9, 97.1)	89.3 (87.2, 91.4)
51-60, (n=426)	125.2 (123.8, 126.6)	156.8 (153.9, 159.6)	149.9 (147.6, 152.3)	78.3 (77.2, 79.3)	93.4 (91.0, 95.8)	90.1 (88.4, 91.8)
>60, (n=445)	124.8 (122.6, 127.1)	162.6 (158.2, 166.9)	155.9 (152.3, 159.6)	76.5 (74.7, 78.3)	92.3 (89.2, 95.4)	89.5 (86.9, 92.2)
P value	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Gender						
Female, (n=1,513)	116.1 (114.7, 117.6)	151.2 (148.6, 153.8)	135.7 (132.7, 138.7)	76.3 (75.4, 77.3)	93.2 (90.9, 95.4)	85.7 (83.8, 87.6)
Male, (n=1,087)	121.0 (120.2, 121.9)	151.4 (148.5, 154.3)	139.5 (136.6, 142.4)	76.9 (75.8, 78)	93.2 (90.8, 95.7)	86.8 (84.9, 88.8)
P value	<0.001	<0.001	0.868	0.016	0.098	0.866
Marital status						
Unmarried, (n=625)	117.4 (115.7, 119.2)	148.4 (145.6, 151.2)	131.2 (128.2, 134.1)	76.1 (75.0, 77.3)	93.3 (90.2, 96.4)	83.8 (81.4, 86.1)
Married, (n=1,975)	118.3 (117.2, 119.4)	152.0 (149.2, 154.7)	139.2 (135.9, 142.5)	76.8 (75.8, 77.7)	93.2 (91.0, 95.3)	87.0 (85.0, 88.9)
P value	<0.001	0.178	0.009	<0.001	0.108	0.836
Education attainment						
Illiterate, (n=388)	122.7 (120.1, 125.3)	159.2 (155.5, 162.9)	151.0 (148.3, 153.7)	77.4 (76.4, 78.5)	92.6 (89.6, 95.5)	89.2 (86.8, 91.5)
Primary schooling, (n=392)	121.2 (119.4, 123.0)	156.6 (153.2, 159.9)	146.5 (142.3, 150.6)	77.0 (75.5, 78.4)	93.4 (90.4, 96.4)	88.7 (86.3, 91.1)
Middle schooling,	119.4	150.6	139.7	76.6	94.5	88.2 (86.9, 89.5)

Continued.

Variables	Non-hypertension	Hypertension	Total	Non-hypertension	Hypertension	Total
(n=552)	(117.6, 121.2)	(146.4, 154.9)	(135.2, 144.1)	(75.3, 78.0)	(92.6, 96.4)	
High schooling, (n=972)	116.7 (115.4, 118.1)	145.1 (143.8, 146.4)	129.4 (127.0, 131.8)	76.2 (75.0, 77.5)	91.9 (89.5, 94.3)	83.2 (81.1, 85.4)
College, (n=296)	116.1 (114.4, 117.8)	144.3 (137.3, 151.4)	128.7 (125.0, 132.4)	76.8 (75.7, 77.9)	95.0 (92.8, 97.1)	84.9 (83.1, 86.7)
P value	<0.001	<0.001	<0.001	<0.001	0.338	<0.001
Occupation status						
Employed, (n=1,852)	118.7 (117.2, 120.2)	151.4 (149.2, 153.6)	138.1 (135.3, 141.0)	76.6 (75.6, 77.7)	92.7 (90.3, 95.2)	86.2 (84.1, 88.3)
Unemployed, (n=748)	116.6 (115.7, 117.5)	151.1 (146.6, 155.5)	135.2 (131.0, 139.3)	76.4 (75.3, 77.5)	94.5 (93.0, 96.0)	86.2 (84.4, 88.0)
P value	0.006	0.001	0.796	0.947	0.536	0.003
Monthly income in Rupees						
<₹ 11,104, (n=1,606)	117.8 (116.9, 118.8)	151.8 (148.8, 154.9)	137.8 (134.4, 141.2)	76.4 (75.4, 77.4)	93.1 (90.5, 95.6)	86.2 (84.3, 88.1)
≥₹ 11,104, (n=994)	118.3 (116.9, 119.8)	150.4 (147.9, 152.9)	136.5 (133.7, 139.2)	76.8 (75.7, 78.0)	93.4 (91.2, 95.7)	86.2 (84.0, 88.4)
P value	0.161	0.415	0.197	0.914	0.200	0.455
Socio-economic class						
Upper, (n=245)	117.6 (115.6, 119.5)	149.3 (144.1, 154.6)	132.9 (128.1, 137.6)	76.9 (75.3, 78.5)	93.6 (90.6, 96.5)	85.0 (81.8, 88.1)
Middle, (n=467)	118.9 (117.6, 120.1)	148.8 (145.7, 151.9)	136.3 (134.0, 138.5)	77.0 (75.7, 78.3)	93.2 (90.9, 95.5)	86.4 (84.4, 88.5)
Lower, (n=1,888)	117.9 (116.7, 119.1)	152.1 (149.3, 155.0)	138.1 (134.9, 141.3)	76.4 (75.5, 77.3)	93.2 (90.7, 95.6)	86.3 (84.5, 88.1)
P value	0.003	0.432	0.038	0.217	0.303	0.902
Do you have history of diabetes mellitus						
Non-diabetes, (n=2,524)	118.0 (117.0, 119.0)	151.1 (148.6, 153.6)	137.0 (134.0, 139.9)	76.5 (75.6, 77.5)	93.1 (90.8, 95.4)	86.0 (84.1, 88.0)
Diabetes, (n=76)	120.5 (114.6, 126.4)	155.2 (146.9, 163.5)	147.9 (138.6, 157.2)	77.9 (74.8, 81.1)	95.0 (93.0, 97.0)	91.4 (89.4, 93.4)
P value	<0.001	0.381	0.160	<0.001	0.290	0.123
Have you use smoke tobacco such as cigarette, cigar, beedi?						
Non-smoker, (n=2,235)	117.6 (116.5, 118.6)	150.4 (148, 152.8)	136 (133.2, 138.8)	76.7 (75.7, 77.6)	93.4 (91.2, 95.6)	86.1 (84.2, 87.9)
Smoker, (n=365)	122.0 (120.3, 123.6)	155.8 (151.1, 160.5)	145.0 (139.9, 150.2)	75.8 (74.3, 77.3)	92.2 (89.4, 95)	87 (84.6, 89.4)
P value	<0.001	<0.001	<0.001	0.177	0.146	0.094
Do you use smokeless tobacco such as snuff, chewing gutka/tobacco?						
No smokeless, (n=472)	116.2 (114.3, 118.2)	154.0 (150.7, 157.2)	135.2 (130.2, 140.2)	75.6 (74.1, 77.2)	91.7 (89.0, 94.4)	83.7 (80.8, 86.6)
Smokeless, (n=2,128)	118.5 (117.8, 119.3)	150.8 (148.2, 153.4)	137.8 (134.9, 140.6)	76.8 (76.0, 77.7)	93.5 (91.3, 95.7)	86.7 (85.0, 88.5)
P value	0.042	0.002	0.031	<0.001	0.010	0.014
Do you consume alcoholic beverage?						
Non-alcoholic, (n=1,102)	115.8 (113.9, 117.7)	149.9 (146.8, 153.0)	131.6 (127.7, 135.5)	76.0 (74.9, 77.1)	92.8 (90.5, 95.0)	83.7 (81.4, 86.1)
Alcoholic, (n=1,498)	120.6 (120.1, 121.1)	152.0 (149.3, 154.8)	141.5 (139.0, 144.0)	77.2 (76.4, 78.1)	93.4 (91.1, 95.8)	88.0 (86.2, 89.8)
P value	<0.001	<0.001	0.068	<0.001	<0.001	0.206
What is the type of diet you take?						
Ovo and pure veg, (n=18)	108.3 (104.3, 112.4)	144.2 (129.4, 159.0)	132.2 (113.7, 150.8)	68.3 (65.9, 70.8)	89.2 (87.5, 90.8)	82.2 (73.8, 90.7)
Non-veg, (n=2,582)	118.1 (117.1, 119.1)	151.4 (148.8, 153.9)	137.3 (134.5, 140.2)	76.6 (75.7, 77.5)	93.2 (91.0, 95.5)	86.2 (84.3, 88.1)
P value	0.359	0.059	0.180	0.148	0.004	0.020
BMI classification (kg/m²)						
BMI<18.50, (n=146)	112.1 (109.8, 114.4)	150.2 (143.9, 156.5)	129.3 (125.8, 132.8)	76.1 (74.8, 77.4)	92.4 (88.9, 95.9)	83.5 (81.6, 85.3)
BMI:18.50-24.99, (n=1,152)	117.9 (116.8, 119.0)	150.9 (147.5, 154.2)	134.6 (131.6, 137.6)	76.1 (75.1, 77.1)	92.5 (90.7, 94.3)	84.4 (82.7, 86.2)
BMI≥25.00, (n=1,302)	119.3 (117.6, 121.0)	151.7 (149.3, 154.0)	140.6 (137.6, 143.5)	77.2 (76.2, 78.3)	93.7 (90.9, 96.6)	88.1 (85.6, 90.5)

Continued.

Variables	Non-hypertension	Hypertension	Total	Non-hypertension	Hypertension	Total
P value	<0.001	<0.001	0.714	<0.001	0.006	0.063

Term "veg" indicates vegetarian; values are given as mean and 95% confidence interval of the mean; independent Z-test and ANOVA was performed to assess the difference in BP observation between sub groups and significance was adjusted for Bonferroni correction

Table 4: Comparison of findings between a survey with a duration gap of more than a decade among Nicobarese.

Variables	2017			2021			P value
	N	N	% (95%CI)	N	N	% (95%CI)	
Age classification (in years)	975	492	50.5 (47.3, 53.6)	2,600	1,505	57.9 (56.0, 59.8)	<0.001
18-29	270	78	28.9 (23.6, 34.7)	509	96	18.9 (15.6, 22.5)	0.001
30-39	251	109	43.4 (37.2, 49.8)	587	277	47.2 (43.1, 51.3)	0.317
40-49	166	100	60.2 (52.4, 67.7)	554	370	66.8 (62.7, 70.7)	0.120
50-59	152	105	69.1 (61.1, 76.3)	412	315	76.5 (72.1, 80.5)	0.075
≥60	136	100	73.5 (65.3, 80.7)	538	447	83.1 (79.6, 86.2)	0.011
Gender	975	492	50.5 (47.3, 53.6)	2600	1,505	57.9 (56.0, 59.8)	<0.001
Male	424	215	50.7 (45.8, 55.6)	1513	844	55.8 (53.2, 58.3)	0.064
Female	551	277	50.3 (46.0, 54.5)	1087	661	60.8 (57.8, 63.7)	<0.001
Education attainment	824	410	49.8 (46.3, 53.2)	2600	1,505	57.9 (56.0, 59.8)	<0.001
Illiterate	244	146	59.8 (53.4, 66.0)	388	301	77.6 (73.1, 81.6)	<0.001
1-5 years of schooling	139	77	55.4 (46.7, 63.8)	392	280	71.4 (66.7, 75.9)	<0.001
6-10 years of schooling	357	160	44.8 (39.6, 50.1)	552	358	64.9 (60.7, 68.8)	<0.001
College	84	27	32.1 (22.4, 43.2)	1268	566	44.6 (41.9, 47.4)	0.025
Tobacco consumption	831	411	49.5 (46.0, 52.9)	2600	1,505	57.9 (56.0, 59.8)	<0.001
No tobacco	100	48	48.0 (37.9, 58.2)	368	152	41.3 (36.2, 46.5)	0.230
Tobacco	731	363	49.7 (46.0, 53.3)	2232	1353	60.6 (58.6, 62.7)	<0.001
Alcohol	831	411	49.5 (46.0, 52.9)	2600	1,505	57.9 (56.0, 59.8)	<0.001
Non alcoholic	371	168	45.3 (40.1, 50.5)	1102	510	46.3 (43.3, 49.3)	0.739
Alcoholic	460	243	52.8 (48.1, 57.5)	1498	995	66.4 (64.0, 68.8)	<0.001
BMI classification (kg/m²)	667	334	50.1 (46.2, 53.9)	2600	1,505	57.9 (56.0, 59.8)	<0.001
Under weight (BMI<18.50)	34	11	32.4 (17.4, 50.5)	146	66	45.2 (37.0, 53.6)	0.173
Normal (BMI:18.50-24.99)	387	159	41.1 (36.1, 46.2)	1152	584	50.7 (47.8, 53.6)	0.001
Over weight/pre-obesity (BMI:25.00-29.99)	172	102	59.3 (51.6, 66.7)	800	501	62.6 (59.2, 66.0)	0.415
Obesity (BMI:≥30.00)	74	62	83.8 (73.4, 91.3)	502	354	70.5 (66.3, 74.5)	0.017

2017 indicates the observations from Manimunda et al indicates the observation from the current study, a two-proportion Z-test was used to determine the difference between proportions.

DISCUSSION

A recent systematic review reported 50.5% of the tribal population had hypertension, with a range of 10.0% to 55.5%.[17] In this study, we found a high prevalence of hypertension among the Nicobarese population, with 57.9% of individuals affected. High prevalence of hypertension was also reported among the Lepchas tribe of Himalayas and Kani tribe (48.3%) of Kerala.[27,28] The prevalence reported among these tribes is significantly higher than what has been reported among the general population in urban and rural region.[17]

Red meat like pork and beef are established a risk factor of cardiovascular morbidity and mortality, such as hypertension and hyperlipidaemia.[29] This community was found to have high consumption of alcohol, tobacco and red meat, which may all lead to hypertension and cardiovascular morbidities. Moreover, the post tsunami period brought a socio cultural transformation in this tribe, which altered their diet as well.[19] Hence the high prevalence of hypertension may be attributed the nutritional transition. Similar high prevalence of 45.5% hypertension was reported among the South East Asian tribes like the hill tribe of Thailand.[30] Being over-weight, high salt intake and increase use of oil for cooking were the factors associated with hypertension among the tribes of Thailand.

Among Nicobarese, several factors were associated with hypertension including illiteracy (77.6%), lower socio-economic status (59.1%), diabetes (78.9%), smoking tobacco (68.2%), smokeless tobacco (59.6%), alcohol consumption (57.8%), and overweight/obesity (65.7%). Other studies in India have also shown an increasing trend in hypertension prevalence with age, particularly among the elderly population.[18,31-33] The mean systolic and diastolic BPs showing linear increase with advancing age. Men tend to have a higher prevalence of hypertension than women, which is consistent with previous epidemiological studies.[16,18,32] Additionally, lower levels of education and lower socio-economic status are associated with higher hypertension rates. There was a gradual rise in the occurrence of hypertension as BMI class increased, as well as for individuals with diabetes. Similar patterns were observed in the majority of hypertension studies conducted.

Alcohol and tobacco use, both in the form of smoking and smokeless consumption, have been identified as major risk factors for hypertension in multiple studies.[34,35]

It is important to note that marginalized and tribal communities in India are disproportionately affected by NCD, including hypertension.[14,17,32] A recent longitudinal study highlighted a significant disparity in hypertension control rates between rich and poor individuals, with tribal communities facing a clear disadvantage. This study originally aimed to assess the risk factors associated with hypertension. However, it failed to consider the significant role of diet and dietary salt consumption, which were later discovered to be influential factors in the development of hypertension. This relationship between salt intake and hypertension has been established for nearly 60 years, including among tribal populations.[36]

Limitations

The study failed to capture the metric on their awareness, treatment availing nature, treatment adherence, treatment facilities, lifestyle risk factors like dietary salt, fibre, saturated fat, trans-fat, physical activities, physical and mental stress and other strategies that were in practice.

CONCLUSION

The prevalence rate of hypertension among the Nicobarese tribal population is significantly higher than the general population, with a rate of 57.9%. Various factors such as age, gender (being male), education level (illiterate), diabetes, smoking, alcohol consumption, and higher than normal BMI are all strongly linked to hypertension. Promoting a healthy lifestyle, encouraging physical activities and raising awareness about the risks of excessive alcohol consumption could help in prevention and control of hypertension. Promoting a healthy lifestyle, encouraging physical activities and raising awareness about the risks of excessive alcohol consumption could help in prevention and control of hypertension. The preventive strategies has to be tailored by understanding their specific culture and lifestyle so as to control hypertension among the Nicobarese community. Further research to understand the dietary factors as well as evaluating their adherence to the treatment is required especially among the Nicobarese. These data can inform and guide policies and programs to specifically address the key determinants of uncontrolled hypertension among the Nicobarese population.

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