Original Research Article

Prediction of 10-year cardiovascular disease risk among Nicobarese Tribes of Andaman and Nicobar Islands

Manjunatha R.*, Muruganandam N., Kannan T.

ICMR-Regional Medical Research Centre, Port Blair, Andaman and Nicobar Islands, India

*Correspondence:
Dr. Manjunatha R.,
E-mail: r.manjunatha@icmr.gov.in

ABSTRACT

Background: WHO data on increased CVDs in India is estimated to be one of the greatest of any country in the world. The Nicobarese tribes of India are indigenous tribes, habited in difficult to reach, rural, and remote Islands in the Bay of Bengal.
Methods: A community-based cross-sectional study was conducted among 365 Nicobar Tribes using WHO HEARTS risk prediction charts to study the distribution and determinants of NCD risk factors and to predict the 10-year CVD risk.
Results: 66.8% were obese, 24.4% were smokers. Smokeless tobacco use was prevalent among 74.8 and 62.5% reported alcohol consumption. Based on the non-laboratory component of the CVD risk assessment chart, 83 (22.7%) had a risk <5%, 132 (36.2%) had a risk of 5-9%, 114 (31.2%) had a risk of 10-19%, 34 (9.3%) had a risk of 20-29%. Illiteracy (aRR: 2.24, 95% CI: 1.34 to 3.78, p=0.002) and lower vegetable consumption (aRR: 1.71, 95% CI: 1.04 to 2.81, p=0.035) were associated with a CVD risk score of 10-19%. Employment and lower vegetable consumption were associated with a higher risk score of ≥20% (aRR: 2.59, 95% CI: 1.14 to 6.01, p=0.024).
Conclusions: The prediction of 10-year CVD risk levels shows moderate to high CVD risk levels are higher among Nicobarese tribes than reported levels among general populations. Illiteracy, lower level of educational status, consumption of alcohol, and low consumption of vegetables in the diet are the main predictors of such moderate to high CVD risk levels.

Keywords: CVD, HEARTS, Hypertension, Nicobarese, Prediction, Risk, Tribal

INTRODUCTION

Globally, cardiovascular diseases (CVDs) are the number one cause of mortality, and higher burden is seen in low- and middle-income countries, leading to overburdening of the public health system.[1-3.] WHO data on increased CVDs in India is estimated to be one of the greatest of any country in the world and is the largest cause of morbidity and mortality in the Country.[4]

World Health Organization (WHO) and the International Society of Hypertension (ISH) provided CVD risk prediction charts for use in 2014.[5,6] In 2019, WHO released WHO HEARTS CVD Risk Management Charts [WHO HEARTS package, 2020] for conducting the community-based risk prediction. Using a risk score is a cost-effective tool to stratify the entire population. It provides a 10-year risk of major cardiovascular diseases. Its valuable tool for taking appropriate actions by respective health authorities and helpful in counseling patients to modify their lifestyles and comply with medical advices.[6,7]

In the Indian sub-continent, as measured through surveys of NFHS-4 (2015-16) and NFHS-5 (2019-20), data

related to risk factors of CVDs has shown an increase in trends in recent years, same is the trend in Andaman and Nicobar Islands, which is still on the higher side and the data is worrisome when we compare it with National averages in India.[8,9] With the increase in risk factors and an increased burden of NCDs, the Country is facing a double burden of both Communicable and non-communicable diseases.[10] Few studies have been undertaken in India on the estimation of common CVD risk factors using these WHO risk prediction charts. Most of the studies were conducted in mainland India, and the availability of such evidence from the Andaman and Nicobar Islands is limited.

Our earlier studies on the general population of South Andaman have revealed that 32.4% and 5.8% of the rural population in South Andaman Islands are at moderate and high CVD risk, respectively.[19] However, there are no studies on the indigenous tribal population of these Islands. The Nicobarese tribes are an Austroasiatic-speaking people of the Nicobar Islands, a chain of islands in the Bay of Bengal, north of Sumatra. These tribes are indigenous tribes, and these Islands are difficult to reach, rural, and remote in nature.[18] Very little information on NCD risk factors is known among these tribes, and there are no studies on CVD risk stratification in these tribes. Therefore, this study is undertaken in these Islands to gather evidence on the distribution of NCD risk factors and to predict 10-year CVD risk for the Nicobarese tribal population. This study aimed to study the distribution and determinants of NCD risk factors among Nicobarese Tribes, and to predict the 10-year CVD risk among Nicobarese Tribes using WHO HEARTS risk based CVD tools.

METHODS

A community-based cross-sectional study was conducted during July 2023 to June 2024, among Nicobarese tribes residing in the Nicobar Islands. Adults aged≥40 years of age who do not have any established coronary heart disease and strokes were included in the study.

Inclusion criteria

Individuals ≥40years of age, who do not have any established coronary heart disease and stroke.

Sampling technique

Multi-stage random sampling technique was used. Nicobar district is divided into 03 tehsils, out of which one tehsil was selected through random sampling. All revenue villages in the tehsil were listed, and in the second stage, ten villages were randomly selected for the study. At the community level, in the selected villages, the first line list of all eligible individuals was prepared, and then, 38 individuals from the selected villages were randomly selected irrespective of gender who fulfilled the eligibility criteria.

Sample size

The sample size was calculated using the formula to estimate the proportion of one sample situation. To detect the prevalence of 22.14 % of moderate to high CVD risk, as determined by a previous relevant study conducted in South India,[12] minimum sample size required was 265, with an allowable error of 5% and a confidence interval of 95%. An additional 25% of the sample was added to account for non-response rate and with a design effect of 1.2, the final sample calculated was 384.

Study tools

WHO HEARTS CVD risk assessment tools for the South Asian region were used to assess the CVD risk. The predictor variables for the risk prediction were - age, gender, smoking, systolic BP, and BMI.A semi-structured interview schedule adapted from the WHO STEPS instrument for non-communicable diseases to collect socio-demographic details and CVD risk-related details.[30]

Ethical approval

Owing to ethical considerations, ethical approval was obtained from the Institutional Ethics Committee (Human) of the ICMR–Regional Medical Research Centre, Port Blair.

Operational definitions

Diagnosis of hypertension: Classification of hypertension [National High BP Education program, 2004].[21]

Table 1: Blood pressure classification.

Blood pressure classification	SBP mmHg	DBP mmHg
Normal	<120	and <80
Prehypertension	120–139	or 80–89
Stage 1 hypertension	140–159	or 90–99
Stage 2 hypertension	≥160	or ≥100

Diagnosis of type-2 diabetes mellitus: RBS: 200 mg/dL or above. [21]

Smokers: All current smokers and those who used any tobacco product (cigarettes, beedis, chewing tobacco, or snuff) on a regular basis for at least the previous 01year before the assessment. [22]

Alcohol users: Alcohol use refers to the intake of any form of alcohol in the past 12 months.

Overweight: BMI >23kg/m^2. BMI calculated using Quetelet's Index formula [WHO Expert Consultation 2004].[23]

Data collection and statistical analysis

Anthropometric measurements

Weight was calculated using an EQUAL digital weighing scale with 180 kg capacity and with an accuracy of 100 gm, and height was measured using a stadiometer.

Assessment of blood pressure and blood sugar

Blood pressure was measured using Omron HEM-7120 Automatic Blood Pressure Monitor with two different-sized cuffs-one medium and one large size. Accu-Chek active blood glucose meter kit was used to measure blood glucose.

Statistical analysis

The statistical analyses were conducted using STATA 16 (Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC). For risk assessment, the study employed the WHO CVD risk (non-laboratory–based) charts. Continuous variables were summarized using the median (interquartile range, IQR), while categorical variables were expressed as frequency and percentages. Bivariate analyses included Pearson's Chi-squared test and Fisher's exact test to examine associations among categorical variables. Subgroup comparisons for continuous variables utilized the Kruskal-Wallis rank sum and Wilcoxon rank sum tests. Factors influencing CVD risk classification were evaluated via univariable and multivariable multinomial logistic regression to determine relative risk ratios. Additionally, prevalence ratios for smoking, tobacco usage, obesity, hypertension, and alcohol consumption were computed using simple and multiple generalized linear models with binomial and log link functions. The selection of factors for regression models considered statistical significance and relevant literature after addressing multicollinearity and confounding effects. All statistical tests were two-sided with a type I error rate of alpha = 0.05.

RESULTS

With a response rate of 95.05%, 365 individuals participated in the study (Figure 1). Among the enrolled cohort, 161 (44.1%) were male, with a median age of 54 years (interquartile range: 47 to 62 years). A substantial proportion, 125 (34.2%), were illiterate. The majority, 361 (98.9%), identified as Nicobarese, and 199 (54.5%) were classified as lower socio-economic status. A notable portion, 244 (66.8%), had a BMI ≥23.0 (indicating obesity), while 89 (24.4%) were smokers. Smokeless tobacco use was prevalent among 273 (74.8%), and 228 (62.5%) reported alcohol consumption. None of the female participants were screened for cervical cancer during their lifetime. The median weekly intake of fruits and vegetables was three servings (interquartile range: 2 to 4), with 54 (14.8%) consuming excessive salt. Only 125 (34.2%) engaged in regular physical activity.
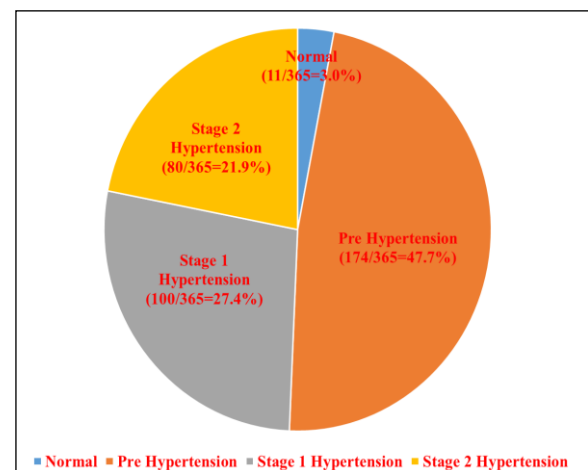

Figure 1: Distribution of pre-hypertension and hypertension.

Based on the non-laboratory component of the CVD risk assessment chart, 83 (22.7%) had a risk <5%, 132 (36.2%) a risk of 5-9%, 114 (31.2%) a risk of 10-19%, 34 (9.3%) a risk of 20-29%, and 2 (0.5%) a risk of 30% and above.

Statistical analysis revealed several significant associations, including that moderate to high CVD risk scores were significantly associated with illiteracy and lower educational status (P=0.04), salaried/self-employment (P=0.029), alcohol use (P=0.006), lower level of vegetable consumption (P=0.007).

Table 2: Participants profile by CVD risk classification.

Variable	n=365[1] (%)	<10% n=215 (58.9%)[2]	10-19% n=114 (31.2%)[2]	≥20% n=36 (9.9%)[2]	P value
Educational status					
No formal education	125 (34.2)	61 (48.8)	51 (40.8)	13 (10.4)	
Primary school	95 (26.0)	57 (60.0)	28 (29.5)	10 (10.5)	0.040[3]
High school and above	145 (39.7)	97 (66.9)	35 (24.1)	13 (9.0)	
Working status					
Salaried/self-employed	177 (48.5)	98 (55.4)	54 (30.5)	25 (14.1)	0.029[3]
Non-paid/unemployed	188 (51.5)	117 (62.2)	60 (31.9)	11 (5.9)	
Socioeconomic class					

Continued.

Variable	n=365[1] (%)	<10% n=215 (58.9%)[2]	10-19% n=114 (31.2%)[2]	≥20% n=36 (9.9%)[2]	P value
Lower (IV-V)	199 (54.5)	120 (60.3)	58 (29.1)	21 (10.6)	0.617[3]
Upper/middle(I-III)	166 (45.5)	95 (57.2)	56 (33.7)	15 (9.0)	
Type of family					
Nuclear	132 (36.2)	79 (59.8)	37 (28.0)	16 (12.1)	0.411[3]
Joint/extended	233 (63.8)	136 (58.4)	77 (33.0)	20 (8.6)	
Ever used smokeless tobacco					
Non-tobacco user	92 (25.2)	32 (34.8)	44 (47.8)	16 (17.4)	<0.001[3]
Ever tobacco user	273 (74.8)	183 (67.0)	70 (25.6)	20 (7.3)	
Ever used, alcohol					
Non-alcohol user	137 (37.5)	76 (55.5)	54 (39.4)	7 (5.1)	0.006[3]
Ever used, alcohol	228 (62.5)	139 (61.0)	60 (26.3)	29 (12.7)	
Consumption of Fruits per week	365; 3.0 (2.0, 4.0)	215; 2.0 (2.0, 4.0)	114; 3.0 (2.0, 4.8)	36; 3.0 (2.0, 4.3)	0.163[4]
Consumption of fruits per week					
≤2 Servings	180 (49.3)	116 (64.4)	53 (29.4)	11 (6.1)	
3-5 Servings	117 (32.1)	62 (53.0)	37 (31.6)	18 (15.4)	0.072[3]
>5 Servings	68 (18.6)	37 (54.4)	24 (35.3)	7 (10.3)	
Consumption of vegetables per week	365; 6.0 (4.0, 8.0)	215; 6.0 (4.0, 8.0)	114; 6.0 (4.0, 8.0)	36; 6.0 (3.0, 8.3)	0.107[4]
Consumption of vegetables per week					
≤2 Servings	32 (8.8)	10 (31.3)	15 (46.9)	7 (21.9)	
3-5 Servings	101 (27.7)	57 (56.4)	34 (33.7)	10 (9.9)	0.007[5]
>5 Servings	232 (63.6)	148 (63.8)	65 (28.0)	19 (8.2)	
Consumption of salt					
Right amount	286 (78.4)	168 (58.7)	91 (31.8)	27 (9.4)	
Low amount	25 (6.8)	11 (44.0)	9 (36.0)	5 (20.0)	0.277[5]
High amount	54 (14.8)	36 (66.7)	14 (25.9)	4 (7.4)	
Any form of physical exercise/activity					
No physical activity	240 (65.8)	147 (61.3)	74 (30.8)	19 (7.9)	0.184[3]
Physical activity	125 (34.2)	68 (54.4)	40 (32.0)	17 (13.6)	
Fasting blood sugar (FBS)	194; 100.0 (97.0, 110.0)	107; 99.0 (92.0, 109.5)	70; 101.5 (99.0, 111.0)	17; 99.0 (99.0, 114.0)	0.180[4]
Random blood sugar (RBS)	361; 124.0 (110.0, 143.0)	211; 121.0 (109.5, 138.0)	114; 128.0 (110.3, 151.0)	36; 121.5 (110.0, 147.3)	0.187[4]
Self-reported diabetes status					
Non-diabetes	339 (92.9)	205 (60.5)	102 (30.1)	32 (9.4)	0.064[5]
Diabetes	26 (7.1)	10 (38.5)	12 (46.2)	4 (15.4)	
Diagnosed of diabetes					
Diabetes	27 (7.4)	15 (55.6)	11 (40.7)	1 (3.7)	
Pre-diabetes	80 (21.9)	43 (53.8)	31 (38.8)	6 (7.5)	0.252[5]
Normal	258 (70.7)	157 (60.9)	72 (27.9)	29 (11.2)	

[1]n; Median (IQR) or n (Col.), [2]n; Median (IQR) or n (Row.), [3]Pearson's Chi-squared test, [4]Kruskal-Wallis rank sum test, [5]Fisher's exact test

Factors such as male gender (p<0.001), employment status (p=0.008), non-tobacco use (p<0.001), alcohol consumption (p=0.004), and lower salt intake (p=0.004) were significantly associated with smoking status (Table 3). Smokeless tobacco use showed no significant associations except with smoking status (Table 4).

Alcohol consumption showed a significant association with higher risk scores (p=0.006) (Table 2). Factors associated with alcoholism included male gender (p<0.001), employment status (p<0.001), lower socio-economic status (p=0.006), smoking (p=0.004), tobacco use (p=0.002), non-diabetes (p=0.009), and lower salt consumption (p=0.032) (Table 5).

Obesity was significantly associated with higher blood pressure readings, known hypertension (p<0.001), diagnosed hypertension (p=0.011), and diabetes (p=0.046) (Table 6).

Table 3: Participants profile by ever smoker.

Variable	Non-smoker, n=276 (75.6%)[1]	Ever smoker, n=89 (24.4%)[1]	P value
Gender of the participants			
Female	168 (82.4)	36 (17.6)	<0.001[2]
Male	108 (67.1)	53 (32.9)	
Age in years	276; 54.0 (47.0, 62.0)	89; 54.0 (48.0, 64.0)	0.367[3]
Age classification in years			
40-50	109 (79.0)	29 (21.0)	
51-60	89 (73.6)	32 (26.4)	0.505[2]
61-74	78 (73.6)	28 (26.4)	
Educational status			
No formal education	99 (79.2)	26 (20.8)	
Primary school	66 (69.5)	29 (30.5)	0.237[2]
High school and above	111 (76.6)	34 (23.4)	
Working status			
Salaried/self-employed	123 (69.5)	54 (30.5)	0.008[2]
Non-paid/unemployed	153 (81.4)	35 (18.6)	
Socioeconomic classification			
Lower (IV-V)	147 (73.9)	52 (26.1)	0.395[2]
Upper/Middle(I-III)	129 (77.7)	37 (22.3)	
Type of family			
Nuclear	97 (73.5)	35 (26.5)	0.475[2]
Joint/extended	179 (76.8)	54 (23.2)	
BMI in kg/m²	276; 25.1 (21.6, 28.6)	89; 24.4 (21.7, 28.1)	0.779[3]
BMI classification			
BMI: 18.50 - 22.99	78 (72.9)	29 (27.1)	
BMI: <18.50	13 (92.9)	1 (7.1)	0.296[4]
BMI: ≥23.00	185 (75.8)	59 (24.2)	
Ever used smokeless tobacco			
Non-tobacco user	34 (37.0)	58 (63.0)	<0.001[2]
Ever tobacco user	242 (88.6)	31 (11.4)	
Ever used, alcohol			
Non-alcohol user	115 (83.9)	22 (16.1)	0.004[2]
Ever used, alcohol	161 (70.6)	67 (29.4)	
Consumption of fruits per week			
	276; 2.0 (2.0, 3.0)	89; 4.0 (2.0, 6.0)	<0.001[3]
Consumption of fruits per week			
≤2 Servings	157 (87.2)	23 (12.8)	
3-5 Servings	78 (66.7)	39 (33.3)	<0.001[2]
>5 Servings	41 (60.3)	27 (39.7)	
Consumption of vegetables per week			
	276; 6.0 (4.0, 8.0)	89; 6.0 (3.0, 8.0)	0.056[3]
Consumption of vegetables per week			
≤2 Servings	18 (56.3)	14 (43.8)	
3-5 Servings	71 (70.3)	30 (29.7)	0.004[2]
>5 Servings	187 (80.6)	45 (19.4)	
Consumption of salt			
Right amount	223 (78.0)	63 (22.0)	
Low amount	12 (48.0)	13 (52.0)	0.004[2]
High amount	41 (75.9)	13 (24.1)	
Any form of physical exercise/activity			
No physical activity	180 (75.0)	60 (25.0)	0.704[2]
Physical activity	96 (76.8)	29 (23.2)	

Continued.

Variable	Non-smoker, n=276 (75.6%)[1]	Ever smoker, n=89 (24.4%)[1]	P value
Systolic BP	276; 154.0 (136.8, 174.0)	89; 156.0 (143.0, 180.0)	0.226[3]
Diastolic BP	276; 91.0 (83.0, 101.0)	89; 94.0 (85.0, 103.0)	0.098[3]
Self-reported, hypertensive			
Non-hypertensive	156 (76.1)	49 (23.9)	0.809[2]
Known hypertensive	120 (75.0)	40 (25.0)	
Classification of hypertension based on systolic and diastolic BP			
Non-hypertension	59 (81.9)	13 (18.1)	0.163[2]
Hypertension	217 (74.1)	76 (25.9)	
Fasting blood sugar	132; 102.0 (97.0, 111.0)	62; 99.0 (98.3, 108.3)	0.296[3]
Random blood sugar	273; 126.0 (112.0, 147.0)	88; 118.0 (103.8, 140.3)	0.023[3]
Self-reported diabetes status			
Non-diabetes	257 (75.8)	82 (24.2)	0.754[2]
Diabetes	19 (73.1)	7 (26.9)	
Diagnosed of diabetes			
Diabetes	22 (81.5)	5 (18.5)	
Pre-diabetes	61 (76.3)	19 (23.8)	0.736[2]
Normal	193 (74.8)	65 (25.2)	

[1]n; Median (IQR) or n (Row.), [2]Pearson's Chi-squared test, [3]Wilcoxon rank sum test, [4]Fisher's exact test

Table 4: Participants profile by ever used, smokeless tobacco.

Variable	Non-tobacco user, n=92 (25.2%)[1]	Ever tobacco user, n=273 (74.8%)[1]	P value
Gender of the participants			
Female	50 (24.5)	154 (75.5)	0.730[2]
Male	42 (26.1)	119 (73.9)	
Age in years	92; 55.0 (48.0, 63.3)	273; 53.0 (47.0, 62.0)	0.259[3]
Age classification in years			
40-50	30 (21.7)	108 (78.3)	
51-60	32 (26.4)	89 (73.6)	0.468[2]
61-74	30 (28.3)	76 (71.7)	
Educational status			
No formal education	28 (22.4)	97 (77.6)	
Primary school	23 (24.2)	72 (75.8)	0.523[2]
High school and above	41 (28.3)	104 (71.7)	
Working status			
Salaried/self-employed	48 (27.1)	129 (72.9)	0.414[2]
Non-paid/unemployed	44 (23.4)	144 (76.6)	
Socioeconomic classification			
Lower (IV-V)	47 (23.6)	152 (76.4)	0.444[2]
Upper/middle (I-III)	45 (27.1)	121 (72.9)	
Type of family			
Nuclear	33 (25.0)	99 (75.0)	0.946[2]
Joint/extended	59 (25.3)	174 (74.7)	
BMI in kg/m^2	92; 25.1 (21.5, 28.1)	273; 24.7 (21.9, 28.6)	0.818[3]
BMI classification			
BMI: 18.50 - 22.99	25 (23.4)	82 (76.6)	
BMI: <18.50	6 (42.9)	8 (57.1)	0.291[4]
BMI: ≥23.00	61 (25.0)	183 (75.0)	
Ever smoker			
Non-smoker	34 (12.3)	242 (87.7)	<0.001[2]
Ever smoker	58 (65.2)	31 (34.8)	
Ever used, alcohol			
Non-alcohol user	47 (34.3)	90 (65.7)	0.002[2]

Continued.

Variable	Non-tobacco user, n=92 (25.2%)[1]	Ever tobacco user, n=273 (74.8%)[1]	P value
Ever used, alcohol	45 (19.7)	183 (80.3)	
Consumption of fruits per week	92; 4.0 (3.0, 6.0)	273; 2.0 (2.0, 3.0)	<0.001[3]
Consumption of fruits per week			
≤2 Servings	22 (12.2)	158 (87.8)	
3-5 Servings	42 (35.9)	75 (64.1)	<0.001[2]
>5 Servings	28 (41.2)	40 (58.8)	
Consumption of vegetables per week	92; 6.0 (3.0, 8.0)	273; 6.0 (4.0, 8.0)	0.232[3]
Consumption of vegetables per week			
≤2 Servings	15 (46.9)	17 (53.1)	
3-5 Servings	27 (26.7)	74 (73.3)	0.008[2]
>5 Servings	50 (21.6)	182 (78.4)	
Consumption of salt			
Right amount	73 (25.5)	213 (74.5)	
Low amount	10 (40.0)	15 (60.0)	0.082[2]
High amount	9 (16.7)	45 (83.3)	
Any form of physical exercise/activity			
No physical activity	59 (24.6)	181 (75.4)	
Physical activity	33 (26.4)	92 (73.6)	0.704[2]
Systolic BP	92; 154.0 (142.8, 174.0)	273; 154.0 (137.0, 175.0)	0.363[3]
Diastolic BP	92; 94.0 (82.0, 103.0)	273; 92.0 (85.0, 101.0)	0.724[3]
Self-reported, hypertensive			
Non-hypertensive	45 (22.0)	160 (78.0)	
Known hypertensive	47 (29.4)	113 (70.6)	0.105[2]
Classification of hypertension based on systolic and diastolic BP			
Non-hypertension	16 (22.2)	56 (77.8)	
Hypertension	76 (25.9)	217 (74.1)	0.515[2]
Fasting blood sugar	66; 99.0 (97.3, 110.0)	128; 102.0 (95.8, 110.3)	0.722[3]
Random blood sugar	92; 124.0 (106.0, 141.0)	269; 123.0 (110.0, 143.0)	0.499[3]
Self-reported diabetes status			
Non-diabetes	85 (25.1)	254 (74.9)	
Diabetes	7 (26.9)	19 (73.1)	0.834[2]
Diagnosed of diabetes			
Diabetes	4 (14.8)	23 (85.2)	
Pre-diabetes	23 (28.8)	57 (71.3)	0.354[2]
Normal	65 (25.2)	193 (74.8)	

[1]n; Median (IQR) or n (Row.), [2]Pearson's Chi-squared test, [3]Wilcoxon rank sum test, [4]Fisher's exact test

Table 5: Participants profile by ever used, alcohol.

Variable	Non-alcohol user n=137 (37.5%)[1]	Ever used, alcohol n=228 (62.5%)[1]	P value
Gender of the participants			
Female	108 (52.9)	96 (47.1)	
Male	29 (18.0)	132 (82.0)	<0.001[2]
Age in years	137; 55.0 (48.0, 64.0)	228; 53.5 (47.0, 62.0)	0.645[3]
Age classification			
40-50	49 (35.5)	89 (64.5)	
51-60	43 (35.5)	78 (64.5)	0.463[2]
61-74	45 (42.5)	61 (57.5)	
Educational status			
No formal education	55 (44.0)	70 (56.0)	
Primary school	31 (32.6)	64 (67.4)	0.170[2]
High school and above	51 (35.2)	94 (64.8)	
Working status			

Continued.

Variable	Non-alcohol user n=137 (37.5%)[1]	Ever used, alcohol n=228 (62.5%)[1]	P value
Salaried/self-employed	47 (26.6)	130 (73.4)	<0.001[2]
Non-paid/unemployed	90 (47.9)	98 (52.1)	
Socioeconomic classification			
Lower (IV-V)	62 (31.2)	137 (68.8)	0.006[2]
Upper/middle (I-III)	75 (45.2)	91 (54.8)	
Type of family			
Nuclear	41 (31.1)	91 (68.9)	0.055[2]
Joint/extended	96 (41.2)	137 (58.8)	
BMI in kg/m^2	137; 25.6 (22.1, 29.7)	228; 24.3 (21.6, 28.0)	0.121[3]
BMI classification			
18.50 - 22.99	36 (33.6)	71 (66.4)	
<18.50	9 (64.3)	5 (35.7)	0.083[2]
≥23.00	92 (37.7)	152 (62.3)	
Ever smoker			
Non-smoker	115 (41.7)	161 (58.3)	0.004[2]
Ever smoker	22 (24.7)	67 (75.3)	
Ever used smokeless tobacco			
Non-tobacco user	47 (51.1)	45 (48.9)	0.002[2]
Ever tobacco user	90 (33.0)	183 (67.0)	
Consumption of fruits per week			
	137; 3.0 (2.0, 6.0)	228; 2.0 (2.0, 4.0)	0.020[3]
Consumption of fruits per week			
≤2 Servings	57 (31.7)	123 (68.3)	
3-5 Servings	45 (38.5)	72 (61.5)	0.016[2]
>5 Servings	35 (51.5)	33 (48.5)	
Consumption of vegetables per week			
	137; 6.0 (4.0, 8.0)	228; 6.0 (4.0, 8.0)	0.432[3]
Consumption of vegetables per week			
≤2 Servings	14 (43.8)	18 (56.3)	
3-5 Servings	38 (37.6)	63 (62.4)	0.738[2]
>5 Servings	85 (36.6)	147 (63.4)	
Consumption of salt			
Right amount	116 (40.6)	170 (59.4)	
Low amount	4 (16.0)	21 (84.0)	0.032[2]
High amount	17 (31.5)	37 (68.5)	
Any form of physical exercise/activity			0.372[2]
No physical activity	94 (39.2)	146 (60.8)	
Physical activity	43 (34.4)	82 (65.6)	
Systolic BP	137; 154.0 (138.0, 175.0)	228; 153.5 (137.0, 173.0)	0.495[3]
Diastolic BP	137; 91.0 (80.0, 99.0)	228; 92.0 (85.0, 103.0)	0.200[3]
Self-reported, hypertensive			
non-hypertensive	70 (34.1)	135 (65.9)	0.130[2]
known hypertensive	67 (41.9)	93 (58.1)	
Classification of hypertension based on systolic and diastolic BP			
Non-hypertension	24 (33.3)	48 (66.7)	0.411[2]
Hypertension	113 (38.6)	180 (61.4)	
Fasting blood sugar	68; 101.5 (97.8, 113.3)	126; 99.5 (95.0, 109.0)	0.251[3]
Random blood sugar	136; 128.0 (116.0, 147.0)	225; 119.0 (107.0, 140.0)	0.006[3]
Self-reported diabetes status			
Non-diabetes	121 (35.7)	218 (64.3)	0.009[2]
Diabetes	16 (61.5)	10 (38.5)	
Diagnosed of diabetes			
Diabetes	14 (51.9)	13 (48.1)	0.239[2]

Continued.

Variable	Non-alcohol user n=137 (37.5%)[1]	Ever used, alcohol n=228 (62.5%)[1]	P value
Pre-diabetes	27 (33.8)	53 (66.3)	
Normal	96 (37.2)	162 (62.8)	

[1]n; Median (IQR) or n (Row.), [2]Pearson's Chi-squared test, [3]Wilcoxon rank sum test

Table 6: Participants profile by obesity.

Variable	Non-obese n=121 (33.2%)[1]	Obesity n=244 (66.8%)[1]	P value
Gender of the participants			
Female	69 (33.8)	135 (66.2)	0.759[2]
Male	52 (32.3)	109 (67.7)	
Age in years	121; 54.0 (47.0, 60.0)	244; 54.0 (48.0, 63.3)	0.573[3]
Age classification			
4050	49 (35.5)	89 (64.5)	
51-60	43 (35.5)	78 (64.5)	0.323[2]
61-74	29 (27.4)	77 (72.6)	
Educational status			
No formal education	48 (38.4)	77 (61.6)	
Primary school	32 (33.7)	63 (66.3)	0.210[2]
High school and above	41 (28.3)	104 (71.7)	
Working status			
Salaried/self-employed	59 (33.3)	118 (66.7)	0.943[2]
Non-paid/unemployed	62 (33.0)	126 (67.0)	
Socioeconomic classification			
Lower(IV-V)	64 (32.2)	135 (67.8)	0.660[2]
Upper/middle (I-III)	57 (34.3)	109 (65.7)	
Type of family			
Nuclear	46 (34.8)	86 (65.2)	0.604[2]
Joint/extended	75 (32.2)	158 (67.8)	
Ever smoker			
Non-smoker	91 (33.0)	185 (67.0)	0.898[2]
Ever smoker	30 (33.7)	59 (66.3)	
Ever used smokeless tobacco			
Non-tobacco user	31 (33.7)	61 (66.3)	0.898[2]
Ever tobacco user	90 (33.0)	183 (67.0)	
Ever used, alcohol			
Non-alcohol user	45 (32.8)	92 (67.2)	0.924[2]
Ever used, alcohol	76 (33.3)	152 (66.7)	
Consumption of fruits per week			
	121; 2.0 (2.0, 4.0)	244; 3.0 (2.0, 4.0)	0.875[3]
Consumption of fruits per week			
≤2 Servings	62 (34.4)	118 (65.6)	
3-5 Servings	38 (32.5)	79 (67.5)	0.853[2]
>5 Servings	21 (30.9)	47 (69.1)	
Consumption of vegetables per week			
	121; 6.0 (4.0, 8.0)	244; 6.0 (4.0, 8.0)	0.711[3]
Consumption of vegetables per week			
≤2 Servings	7 (21.9)	25 (78.1)	
3-5 Servings	43 (42.6)	58 (57.4)	0.038[2]
>5 Servings	71 (30.6)	161 (69.4)	
Consumption of salt			
Right amount	92 (32.2)	194 (67.8)	
Low amount	7 (28.0)	18 (72.0)	0.401[2]
High amount	22 (40.7)	32 (59.3)	

Continued.

Variable	Non-obese n=121 (33.2%)[1]	Obesity n=244 (66.8%)[1]	P value
Any form of physical exercise/activity			
No physical activity	82 (34.2)	158 (65.8)	0.568[2]
Physical activity	39 (31.2)	86 (68.8)	
Systolic BP	121; 149.0 (134.0, 171.0)	244; 156.0 (140.5, 175.0)	0.031[3]
Diastolic BP	121; 90.0 (81.0, 98.0)	244; 93.0 (85.0, 103.0)	0.028[3]
Self-reported, hypertensive			
non-hypertensive	85 (41.5)	120 (58.5)	<0.001[2]
known hypertensive	36 (22.5)	124 (77.5)	
Classification of hypertension based on systolic and diastolic BP			
Non-hypertension	33 (45.8)	39 (54.2)	0.011[2]
Hypertension	88 (30.0)	205 (70.0)	
Fasting blood sugar	60; 99.0 (91.8, 111.0)	134; 102.0 (98.0, 110.0)	0.073[3]
Random blood sugar	121; 125.0 (107.0, 140.0)	240; 124.0 (112.0, 146.0)	0.113[3]
Self-reported diabetes status			
Non-diabetes	117 (34.5)	222 (65.5)	0.046[2]
Diabetes	4 (15.4)	22 (84.6)	
Diagnosed of diabetes			
Diabetes	5 (18.5)	22 (81.5)	
Pre-diabetes	19 (23.8)	61 (76.3)	0.017[2]
Normal	97 (37.6)	161 (62.4)	

[1]n; Median (IQR) or n (Row.), [2]Pearson's Chi-squared test, [3]Wilcoxon rank sum test, [4]Fisher's exact test

Being male (aPR: 5.60, 95% CI: 3.39 to 9.54, p<0.001) and ever being married (aPR: 2.16, 95% CI: 1.01 to 4.65, p=0.048) were associated with higher prevalence of alcoholism, whereas upper or middle socio-economic status was associated with lower prevalence (aPR: 0.42, 95% CI: 0.26 to 0.68, p<0.001). Being male was also associated with a higher prevalence ratio (aRR: 2.01, 95% CI: 1.01 to 4.10, p=0.049) for being a smoker (Figure 2).
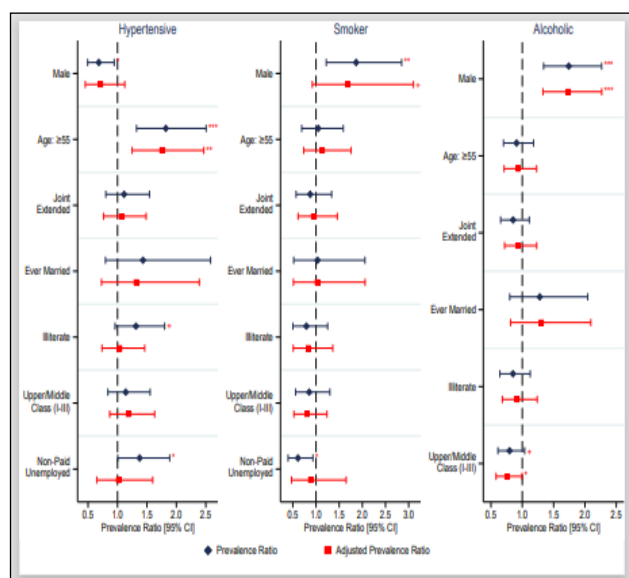
Figure 2: Analysis of prevalence ratios and adjusted prevalence ratios (aPR).

Analysis of relative risk ratios (aRR) highlighted that illiteracy (aRR: 2.24, 95% CI: 1.34 to 3.78, p=0.002) and

lower vegetable consumption (aRR: 1.71, 95% CI: 1.04 to 2.81, p=0.035) were associated with a higher CVD risk score of 10-19%. Employment and lower vegetable consumption were associated with a higher risk score of ≥20% (aRR: 2.59, 95% CI: 1.14 to 6.01, p=0.024) (Figure 3).
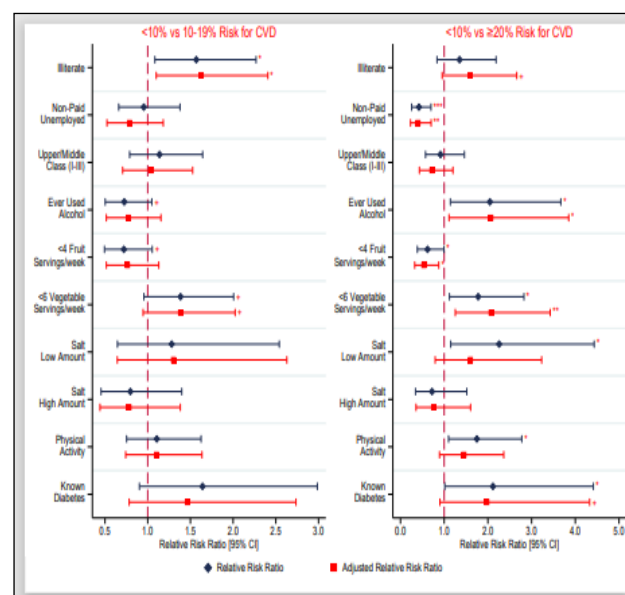

Figure 3: Analysis of relative risk ration and adjusted relative risk ratios (aRR).

Hypertension

160 (43.8%) individuals reported a history of hypertension. Still, it was found that during the study,

almost half of the participants (49.3%) had hypertension, and nearly another half were in pre-hypertension (47.7%). Among those who reported that they knew their status, only 63.1% were regularly taking treatment. Adjusted prevalence ratios (aPR) indicated that being male was associated with a lower prevalence of hypertension (aPR:

0.54, 95% CI: 0.29 to 0.99, p=0.049), while older age (55 years and above) was associated with higher prevalence (aPR: 2.82, 95% CI: 1.78 to 4.51, p<0.001). 26 (7.1%) individuals reported diabetes prevalence, and 27 (7.4%) were newly diagnosed as having diabetes during the study.

Table 7: Distribution of mean and standard deviation (SD) of different CVD risk factors among study participants.

Variable	Male		Female		Total	
	Mean	SD	Mean	SD	Mean	SD
Systolic BP	154.07	25.43	156.67	24.14	155.52	24.71
Diastolic BP	95.70	18.09	90.64	13.69	92.88	15.96
RBS	132.53	43.17	134.05	47.47	133.39	45.59
BMI	28.54	37.52	26.61	6.98	27.46	25.45
CVD risk score	10.88	7.09	8.78	5.44	9.71	6.30

DISCUSSION

This study used a non-laboratory method for the assessment of 10-year CVD risk using WHO risk prediction charts; previous studies on evaluation of concordance between laboratory and non-laboratory methods have shown that high concordance exists between results obtained by both methods, Das et al conducted a cross-sectional study in rural Ballabgarh, Haryana, India, involving 1,018 participants aged 30-69 years to assess the reliability of non-laboratory-based WHO cardiovascular disease (CVD) risk assessment charts; the study aimed to determine the concordance between non-laboratory-based and laboratory-based CVD risk charts and estimate the prevalence of selected CVD risk factors, their results showed a high concordance rate of 83.3% between the two types of charts. The sensitivity and specificity of the non-laboratory-based charts were 86.5% and 90.3%, respectively, using a 5% risk threshold. Their study concluded that non-laboratory-based WHO CVD risk assessment charts are suitable for estimating CVD risk in resource-limited settings like rural India, providing a reliable alternative to laboratory-based assessments. [15] Another study by Trideep and a group among the rural population in Lucknow has concluded that earlier available WHO/ISH risk prediction charts, which were available before WHO HEARTS risk prediction charts, were also feasible and valuable tools to predict CVD risk among asymptomatic individuals, and, such tools help in early detection and prevention of CVDs in resource-scarce settings.[13] Initially, in our study, even though we had a laboratory component to study blood sugar and lipid levels, convincing the tribal community for blood drawing at the household and community level and transportation of blood samples from far off Islands to Port Blair was one of the challenges due to which this study was limited to use non-laboratory method only.

In this study, 58.9%, 31.2%, and 9.9% of the population were detected with low, moderate, and high CVD risk levels respectively, indicating that moderate and high CVD risk levels were high among Nicobarese tribes while compared with previous studies conducted in Northern and Southern parts of India.[12-14] This could be because a notable portion (66.8%) had a BMI ≥23.0 (indicating obesity), while 24.4% were smokers. Smokeless tobacco use was prevalent among 74.8%, and a substantial proportion (62.5%) reported alcohol consumption. Moderate to high CVD risk levels were associated with alcohol use (P=0.006) and lower levels of vegetable consumption (P=0.007). More than half of these tribes were classified as lower socio-economic status, and lower socioeconomic status was significantly associated with alcohol consumption and higher blood pressure levels. Our earlier reports from South Andamans on the general population have revealed that 32.4% and 5.8% of the rural population in the South Andaman Islands are at moderate and high CVD risk, respectively.[19] It is found that Nicobarese have a higher level of moderate to high CVD risk scores compared to the general population in these groups of Islands, WHO HEARTS risk based CVD management tools has recommendations for management of CVD risk factors based on risk stratification levels and these tools can be adopted for risk reduction activities. [7]

It is observed that 43.8% of individuals reported a history of known hypertension. Still, it was found that during the study, almost half of the participants (49.3%) had hypertension, and nearly another half of the participants were in pre-hypertension (47.7%) among those who reported that who knew their status, only 63.1% regularly taking treatment. One of our previous reports from South Andaman in the general population has shown that 48.1% were hypertensives, and among those who knew their status, only 63.41% were on regular treatment.[25] In this study, the reports are comparable to the burden of

hypertension and status of taking regular treatment to hypertension; it could be because there is enculturation; and lifestyle risk factors including smoking, smokeless tobacco consumption, alcoholism, sedentary lifestyle exists among Nicobar tribes, and 14.8% self-reported that they consume excessive salt in their diet. Lower levels of fruit and vegetable consumption are observed among these tribes. The availability of vegetables and fruits in these Islands is a question that needs to be addressed as they depend on the frequency of ships that transport goods once a week or fortnightly. As a result, anecdotally, it is a known factor that prices of fruits and vegetables are high in these Islands.

One of the studies on oral lesions in the Nicobar Islands by A Rajkuwar et al has shown that there is a high prevalence of tobacco consumption (88.25%), especially the smokeless form of tobacco. They reported that oral mucosal lesions were present in 25.75% of the population, and keratosis was the most prevalent among oral mucosal lesions, at 56.3% and they have concluded that this high consumption of smokeless form of tobacco in the Nicobari tribal population increases the risk of developing precancerous and cancerous lesions in both genders.[26] Early intervention and oral health education should be done frequently to prevent the development of oral cancer at preliminary stages in this tribal population. [26] Our reports are in the same agreement that higher levels of smokeless tobacco consumption are observed among both genders, and it requires an early intervention to prevent any morbid outcomes.

A report by Gopika et al on the status of cancer screening in India from the National Family Health Survey (NFHS)-5 report, has shown that the percentage of women who have ever undergone cervical cancer screening was only 1.9%; similarly one of our previous reports from South Andamans in the general population have shown that only 5.41% of women have undergone screening test for cervical cancer in their lifetime.[27,28] But in this current study, it is found that none of the women have undergone cervical cancer screening, and a population-based study on HPV infection and associated risk factors among South Andaman Islands conducted by Parvez et al has shown that the high prevalence of HPV as 5.9% and prevalence of HR-HPV16 was 4.1% and HR-HPV18 prevalence was 1.8%.[29] Therefore, it indicates to the health authorities and policymakers that cervical cancer screening activities are essential in these Islands.

CONCLUSION

Prediction of 10-year CVD risk levels shows moderate to high CVD risk levels are higher among Nicobarese tribes than reported levels among general populations. Illiteracy, lower level of educational status, consumption of alcohol, and low consumption of vegetables in the diet are the main predictors of such moderate to high CVD risk levels. NCD risk factors such as consumption of alcohol, smokeless tobacco, obesity, lower level of vegetable consumption, and excessive salt consumption are high among Nicobarese tribes. High prevalence of pre-hypertension, hypertension and its irregular treatment is a significant public health issue.

Recommendations

Immediate efforts to mitigate CVD risk levels should be undertaken along with attention to address elevated blood pressure levels and NCD risk factors including reduction of alcoholism, smokeless tobacco consumption, limiting salt intake and encouraging for regular physical activity. Public authorities should take appropriate measures to ease the availability of fruits and vegetables causing improvements in consumption levels in the tribal community, and measures for improving cervical cancer screening activities to be undertaken in these Islands.

ACKNOWLEDGEMENTS

REFERENCES

1. Abegunde DO, Mathers CD, Adam T, Ortegon M, Strong K. The burden and costs of chronic diseases in low-income and middle-income countries. Lancet. 2018;370(9603):1929-38.
2. Mathers CD, Boerma T, Fat DM. Global and regional causes of death. Br Med Bull. 2009;92(1):7-32.
3. World Health Organization. Cardiovascular diseases: Key facts. Available at: https://www.who.int/news-room/factsheets/detail/cardiovascular-diseases-(cvds)#:~:text=The%20most%20important%20behavioural%20risk,lipids%2C%20and%20overweight%20and%20obesity. Accessed 08 December 2021.
4. World Health Organization. Prevention of Cardiovascular Disease: Guidelines for assessment and management of cardiovascular risk. Available at: https://apps.who.int/iris/handle/10665/43685. Accessed 26 August 2021.
5. Nordet P, Mendis S, Dueñas A, Noval R De, Armas N. Total cardiovascular risk assessment and management using two prediction tools, with and without blood cholesterol. MEDICC Rev. 2013;15:36-40.
6. World Health Organization (WHO). World Health Organization/International Society of Hypertension

(WHO/ISH) risk prediction charts, 2014. Available at: https://www.who.int/ncds/management/WHO_ISH_ Risk_Prediction_Charts.pdf?ua=1. Accessed 10 December 2023.

7. World Health Organization. HEARTS technical package for cardiovascular disease management in primary health care: risk-based CVD management, 2020. Available at: https://www.who.int/publications/i/item/978924000 1367. Accessed 01 May 2024.

8. National Family Health Survey-4 (NFHS-4), 2015-16, Ministry of Health and Family Welfare (MoHFW), Government of India. Available at: https://dhsprogram.com/pubs/pdf/fr339/fr339.pdf. Accessed 01 May 2024.

9. National Family Health Survey-5 (NFHS-5), 2019-20, Ministry of Health and Family Welfare (MoHFW), Government of India. Available at: https://mohfw.gov.in/sites/default/files/NFHS-5_Phase-II_0.pdf. Accessed 01 May 2024.

10. Mohan P, Mohan SB, Dutta M. Communicable or noncommunicable diseases? Building strong primary health care systems to address double burden of disease in India. J Family Med Prim Care. 2019;8(2):326.

11. Ueda P, Woodward M, Lu Y, Hajifathalian K, Al-Wotayan R, Aguilar-Salinas C, et al. Laboratory-based and office-based risk scores and charts to predict 10-year risk of cardiovascular disease in 182 countries: a pooled analysis of prospective cohorts and health surveys. Lancet Diabetes Endocrinol. 2017;5(3):196-213.

12. Ghorpade AG, Shrivastava SRB, Kar SS, Sarkar S, Majgi SM, Roy G. Estimation of cardiovascular risk using World Health Organization/International Society of Hypertension (WHO/ISH) risk prediction charts in a rural population of South India. Indian J Public Health. 2020;64(2):172-6.

13. Deori TJ, Agarwal M, Masood J, Sharma S, Ansari A. Estimation of cardiovascular risk in a rural population of Lucknow district using WHO/ISH risk prediction charts. J Family Med Prim Care. 2020;9(9):4853-60.

14. Premanandh K, Shankar R. Predicting 10-year cardiovascular risk using WHO/ISH risk prediction chart among urban population in Salem. Int J Community Med Public Health. 2018;5(12):5228-34.

15. Das P, Dubey M, Kaur R, Salve H, Varghese C, Nongkynrih B. WHO non-lab-based CVD risk assessment: a reliable measure in a North Indian Population. Glob Heart. 2022;17.

16. Raghu A, Praveen D, Peiris D, Tarassenko L, Clifford G. Implications of Cardiovascular Disease Risk Assessment Using the WHO/ISH Risk Prediction Charts in Rural India. PLoS ONE. 2015;10(8).

17. Savitharani B, Madhu B, Renuka M, Ashok N. Utilization of WHO-ISH 10-year CVD risk prediction chart as a screening tool among supporting staff of a tertiary care hospital, Mysuru, India. Heart India. 2016;4(1):13-6.

18. Andaman and Nicobar Administration, UT profile, 2021. Available at: https://www.andaman.gov.in/about. Accessed on 10 November 2021.

19. Ramu M, Fatema A, Ghosal SR, Biji S, Saida K, et al. Prediction of 10-year cardiovascular disease risk using WHO HEARTS risk-based CVD management tools (non-laboratory-based) among rural population of south andaman islands in India. J Clin Stud Med Case Rep. 2023;10:170.

20. Singh A, Pedgaonkar S, Bansod D, Dwivedi L, Pradhan MR, Arnold F. Non-communicable diseases and associated risk factors in 17 states/UTs in India. Demography India. 2014;43(1&2):31-40.

21. National High Blood Pressure Education Program. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Bethesda (MD): National Heart, Lung, and Blood Institute (US); 2004.

22. CDC. NCHS, National Health Interview Survey: Adult Tobacco Use Information. Available at: https://archive.cdc.gov/www_cdc_gov/nchs/nhis/tob acco.htm. Accessed 01 May 2024.

23. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004;363:157.

24. Centers for Disease Control and Prevention. Tests for Type 1 Diabetes, Type 2 Diabetes, and Prediabetes, 2022. Available at: https://www.cdc.gov/diabetes/basics/getting-tested.html. Accessed 06 April 2022.

25. Ramu M, Fatema A, Ghosal SR, Biji S, Saida K, Mandal A. Burden of undiagnosed and uncontrolled hypertension and its associated factors among rural populations in South Andaman Islands, India. Int J Community Med Public Health. 2023;10(6):2219-23.

26. Rajkuwar A, Verma A, Vijayapandian H, Kumar P, Dheeraj M, Vincent V. Prevalence of Tobacco Use and Oral Mucosal Lesions among Nicobarese Tribal Population in Andaman and Nicobar Islands. J Contemp Dent Pract. 2021;22(9):975-8.

27. Gopika MG, Prabhu PR, Thulaseedharan JV. Status of cancer screening in India: An alarm signal from the National Family Health Survey (NFHS-5). J Family Med Prim Care. 2022;11(11):7303-7.

28. Ramu M, Ghosal SR, Biji S, Saida K, Mandal A, et al. Raising burden of NCD risk factors in rural and remote areas of South Andaman Islands in India. J Community Med Public Health Care. 2023;10:123.

29. Parvez R, Vijayachari P, Thiruvengadam K, Roy A, Saha MK, Ramasamy J, et al. A population-based study on human papillomavirus infection and associated risk factors among women of the remote South Andaman Island, India. BMC Womens Health. 2024;24(1):139.

30. World Health Organization. The WHO STEPwise approach to non-communicable disease risk factor surveillance (STEPS), Switzerland, 2020. Available at: https://www.who.int/publications/m/item/standard-steps-instrument. Accessed 05 August 2024.