ORIGINAL ARTICLE

Sexual disparity and the burden of NCD Risk: A community-based study among Hindu Bengali adults of Brahmaputra Valley, Assam

Immon Ghosh[1*], *Gulrukh Begum*[1]

[1]*Department of Anthropology, Gauhati University, Guwahati-781014 (Assam), India*

Abstract

Background: In several populations around the world, there have been cases of sexual discrepancy in the incidence of Non-Communicable Diseases (NCDs) risk factors. *Aim and Objectives:* The present study aimed to examine the sexual disparity in the prevalence of key risk factors for NCDs among the adult Hindu Bengali population of the Brahmaputra Valley, Assam, to identify sex-specific patterns. *Material and Methods:* Data were collected from 473 individuals aged 20 years and above using a structured schedule. Statistical analyses were performed using SPSS-26, including independent samples t-tests, chi-square tests, and binary logistic regression to estimate odds ratios. *Results:* A greater proportion of men reported tobacco (58.67%) and alcohol (43.80%) use compared to women (34.94% and 13.63%). Men were found to be 1.831 times more likely to have systolic hypertension (OR = 1.831, 95% CI: 1.136–2.952), 1.647 times more likely to have diastolic hypertension (OR = 1.647, 95% CI: 1.082–2.506), and 1.823 times more likely to have diabetes (OR = 1.823, 95% CI: 1.114–2.982) than women. In contrast, males had 39.1% lower odds of obesity compared to females (OR = 0.609, 95% CI: 0.397–0.936). *Conclusion:* These findings highlight the substantial role of behavioral risk factors in shaping the burden of NCDs. Evaluating their influence is essential to understanding the underlying causes of sex-based disparities in NCD incidence.

Keywords: Alcohol, Diabetes, Hypertension, Obesity, Tobacco

Introduction

The Indian subcontinent is grappling with a pressing health concern related to Non-communicable Diseases (NCDs) [1]. With rapid urbanization, there is a transition in the economic spectrum of the country. Shift in the eating habits and more consumption of tobacco related products have transitioned the disease spectrum from communicable to NCDs [2]. The incidence of NCDs in India is influenced by a range of factors. National surveys indicate that key risk factors for NCDs include tobacco use (both smoking and smokeless forms), alcohol intake, poor dietary habits, elevated blood pressure, high cholesterol levels, raised blood glucose, overweight, and obesity [3].

The primary conditions responsible for NCDs related deaths include cardiovascular diseases, stroke, diabetes mellitus, cancer, respiratory disorders, and kidney diseases [4]. While the burden of risk factors tends to be greater in older individuals, most behavioral risks originate in early adulthood [5]. NCDs contribute to about 38 million (68%) of all the mortalities globally [6] and to about 5.87 million (60%) of all mortalities in India [7]. The rising burden of NCDs is largely driven by rapid population growth and an ageing demographic in low- and middle-income countries [8]. However, lifestyle is a major factor contributing to the occurrence of NCD [9].

In several populations around the world, there have been cases of sexual discrepancy in the incidence of NCD risk factors. Men tend to have more prevalence of cardiovascular and renal diseases as compared to women of similar age group [10], though after menopause the tendency to have raised blood pressure increases among women [11]. For diabetes mellitus diagnosis, men generally tend to get detected at a younger age. However, because of a number of complications, including PCOS, elevated testosterone levels, gestational diabetes, and early menopause, women have a greater load of risk factors at the time of diagnosis [12]. Also, women all over the world have reported to be more overweight and obese thus, increasing the risk factors for the emergence of various NCDs at a later stage in life [13]. There are biological theories suggesting that genetics and hormonal differences are the root cause of variation in the health outcomes of men and women [14].

There are many different types of behavioural risk factors for NCDs, including stress, sleep patterns, food, degree of physical activity, and excessive salt intake [15]. Mostly among the teenagers, there is a tendency to incorporate unhealthy habits such as smoking, drinking alcohol and usage of smokeless tobacco products [16]. Research has indicated that men are more prone than women to smoke daily, and that men also consume more cigarettes on average [17]. These issues could be crucial while dealing with sexual disparity in the pervasiveness of risk factors for NCDs.

Nevertheless, apart from the genetic factors, the behavioral factors can be taken care of and prevention strategies can be implemented if proper measures are executed. Nutritional therapies, lifestyle and awareness monitoring, national and international health policy decisions, and information and innovation initiatives are the most effective ways to prevent and manage NCDs [18]. Thus, the purpose of the following study is to evaluate the sexual gap in the prevalence of NCD risk factors among the adult Hindu Bengali population in Assam's Brahmaputra valley.

Material and Methods

Ethical clearance

The Institutional Ethical Committee (IEC) at Gauhati University provided ethical approval for this work (Reference no. GUIEC-10/2024).

Study population and sampling methods

Adult Hindu Bengali people living in the Brahmaputra valley who were at least 20 years old made up the target group. Purposive sampling was used to choose the participants. The Bengali population is the second largest population in the valley mainly concentrated in the Hojai district where 53 percent of the population speak the language, followed by Goalpara, Nagaon, Dhubri, Tinsukia, Jorhat and other districts with percentage ranging from 15-25 percent. Therefore, the three districts i.e. Jorhat (Upper Assam), Hojai (Central Assam) and Kamrup (Lower Assam) have been considered for the study of Hindu Bengali population in Brahmaputra Valley. The Open Epi software version 3.01, 2006 was used to determine the sample size. With 95% confidence interval, design effect of 1.0 and 50% anticipated frequency, the estimated sample size was calculated to be 384. Data was gathered from 473 people in the age category of 20 years and older, of whom 352 were female and 121 were male. Three Brahmaputra Valley zones had been taken into consideration for data collection, viz., Upper Assam (Jorhat district: Banshbari, Joynagar), Central Assam (Hojai district: Hojai town; Villages-Siliguri basti, Maynapur, Jamuhandal), Lower Assam (Kamrup district: Adabari, Shakuntala Colony and Kailashnagar from Guwahati city.

Data collection and variables

The fieldwork took place between March 2024 and December 2024. Data were gathered using a planned schedule that includes the respondent's basic sociodemographic details, viz; individual data, family history of NCD, behavioral data (tobacco use; both smoking and chewing and alcoholism) and physical activity. Participants in the study were split up into age groups 20-29, 30-39, 40-49, 50-59 and 60 and above. Five categories were established for educational qualifications: illiterate, primary, higher secondary, graduate, and other higher studies. Five categories were also established for occupational status such as, government job holder, business/self-employed, unskilled worker/ daily wage earner, student and unemployed. Four categories were established for marital status, viz., married, unmarried, divorced/separated and widow/widower. The family type was separated into two main groups: nuclear families and joint families. Lastly, an asset-based approach was used to divide Socioeconomic Status (SES) according to the wealth index. The approach was a basic two-tier classification viz., low SES (economically disadvantaged households with limited assets, lack of modern amenities, poor housing quality and financial insecurity) and high SES (economically advantaged households with modern amenities, durable assets, good housing quality and financial stability).

Linear measurements like height (cm), sitting height (cm) and lower extremity length (cm) were measured using anthropometric rod. Body weight (kg) was measured using a portable weighing machine. Skinfold measurements like biceps (mm), triceps (mm), subscapular (mm) and supra-illiac (mm) were measured using a Lange skinfold caliper. Circumferential measurements like mid-upper arm circumference (cm), waist circumference (cm), hip circumference (cm) and calf girth were measured using the non-stretching measuring tape. Humerus width (cm) and femur width were measured using the sliding caliper. Body fat percentage was measured using a portable body fat analyzer which uses bioelectrical impedance analysis. Data on diabetes and hypertension were gathered by measuring the blood glucose using Glucometer (Accu-Chek active) and blood pressure using a sphygmomanometer (Omron – HEM 7124 fully digital). All the measurements were taken following standard techniques of measurements by Martin (1920) and Weiner and Lourie (1969). The 7^{th} report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure was the source of the reference values for the Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) categories. The American Diabetes Association Guidelines 2023 was followed in the analysis of blood sugar categories. Data for physical activity was collected following WHO STEP wise method [19].

Data analysis methods

Utilizing Statistical Package for the Social Sciences (SPSS) version 26, statistical techniques like the independent samples t-test, chi-square test, and binary logistic regression odds ratio were applied. Results from the National Family Health Survey – 5 (NFHS-5) were compared with data from the Brahmaputra valley when appropriate.

Results

A total of 473 adult Hindu Bengali individuals participated in the study, with a representation of both the sexes. Table 1 provides a summary of the study sample's demographic attributes. It demonstrates that, in comparison to women, men have somewhat better educational attainment and are more likely to be employed, particularly as self-employed or unskilled workers. Men are more likely than women to have greater financial standing, according to socioeconomic level in this population.

Table 1: Sex wise socio-demographic profile of the study population

Variables	Females (n =352) n(%)	Males (n =121) n(%)
Age group		
20-29	85 (24.14%)	19 (15.70%)
30-39	87 (24.71%)	31 (25.61%)
40-49	52 (14.77%)	25 (20.66%)
50-59	61 (17.32%)	15 (12.39%)
Above 60	67 (19.03%)	31 (25.61%)
Education		
Illiterate	79 (22.44%)	21 (17.35%)
Primary	167 (47.44%)	61 (50.41%)
Higher Secondary	66 (18.72%)	24 (19.83%)
Graduate	31 (8.80%)	11 (9.09%)
Higher degree	9 (2.55%)	4 (3.27%)
Occupation		
Government job	23 (6.53%)	14 (11.57%)
Business / Self employed	14 (3.96%)	59 (48.75%)
Unskilled worker / Daily wage earner	38 (10.79%)	29 (23.96%)
Student	26 (7.38%)	5 (4.13%)
Unemployed	251 (68.74)	14 (11.57)
Marital Status		
Married	231 (65.62%)	93 (76.85%)
Unmarried	51 (14.48%)	26 (21.48%)
Divorced / Separated	6 (1.7%)	0 (0%)
Widow / Widower	64 (18.18%)	2 (1.65%)
Family Type		
Joint	111 (31.53%)	35 (28.92%)
Nuclear	241 (68.46%)	86 (71.07%)
Socio-economic status		
High SES	204 (57.95%)	79 (65.28%)
Low SES	148 (42.04%)	42 (34.71%)

Table 2 displays the mean values and standard deviations for diabetes and hypertension, according to sex and Table 3 displays the t-test to determine the significance. Strongly significant differences between the two sex groups (male and female) were revealed by the t-test results. The values for blood glucose levels were significant at $p < 0.05$ (significant), while the values for SBP and DBP were significant at $p < 0.01$ (very significant). With a mean difference of -7.182 (p = 0.001), the SBP varied statistically significantly across the groups, indicating that females had lower SBP. With a mean difference of -4.082 (p = 0.001), there was also a statistically significant difference in DBP, suggesting that women had lower DBP. The Random Blood Glucose (RBG) level showed a significant difference (p = 0.010), with females having a lower RBG by 16.264 units. One interpretation is that risk factors are generally higher in men for NCDs as compared to females. For SBP, DBP, and RBG, males tend to have higher mean values as compared to females.

The SBP and DBP statistical values in Table 4 are significant, indicating that the risk factors for hypertension differ significantly between the sexes. The blood glucose level is not noteworthy.

Table 2: Mean and standard deviation values for systolic blood pressure, diastolic blood pressure and random blood glucose based on sex

Sex	Female (n =352) (Mean ± SD)	Male (121) (Mean ± SD)	Total (473) (Mean ± SD)
Systolic Blood Pressure	123.00 ± 21.450	130.18 ± 20.923	124.84 ± 21.524
Diastolic Blood Pressure	80.28 ± 11.364	84.36 ± 13.464	81.33 ± 12.054
Random Blood Glucose	120.84 ± 53.349	137.10 ± 75.620	125.00 ± 60.173

Table 3: t-test for hypertension and diabetes based on sex

Variable	F	t value	df	Sig. (2-tailed)	Mean difference	Standard error difference	95% CI of the difference	
							Lower	Upper
Systolic Blood Pressure	0.064	-3.19**	471	0.001**	-7.182	2.246	-11.596	-2.768
Diastolic Blood Pressure	7.625	-3.24**	471	0.001**	-4.082	1.258	-6.554	-1.611
Random Blood Glucose	12.427	-2.58**	471	0.010*	-16.264	6.303	-28.650	-3.878

*** p-value is significant at 0.01, *p-value is significant at 0.05*

Males and females had significantly different distributions of SBP levels (χ^2 = 154.616, likelihood ratio = 170.412, df = 93, p <.001). Compared to women (25.56% and 11.08%, respectively), a greater percentage of men fell into the prehypertensive (40.49%) and hypertension stage I (22.31%) groups. The sex-based variance was also statistically significant for DBP (χ^2 = 83.438, likelihood ratio = 88.024, df = 63, p = 0.043). Males were significantly more likely than females to have stage II hypertension (16.52%) compared to 4.82%. On the other hand, there was no statistically significant variation in RBG levels based on sex (χ^2 = 163.366, likelihood ratio = 189.672, df = 147, p = 0.169). Males had a higher prevalence of diabetes (36.36%) than females (26.13%), although the difference was not statistically significant.

Table 5 suggests that males had higher odds of hypertension and diabetes as compared to females. Males had 1.83 times higher odds of being hypertensive (systolic) compared to females (Exp(B) = 1.831, p = 0.013, 95% CI: 1.136–2.952). Males had 1.65 times higher odds of being hypertensive (diastolic) than females (Exp(B) = 1.647, p = 0.020, 95% CI: 1.082–2.506). Males were 1.82 times more likely to be diabetic compared to females (Exp(B) = 1.823, p = 0.017, 95% CI: 1.114–2.982). It's significant to note that men were much less likely than women to be obese (Exp(B) = 0.609, p = 0.024, 95% CI: 0.397–0.936), which may indicate that women are more likely to be fat. The results indicate a clear sex disparity in NCD risks. While males are more prone to hypertension and diabetes, females are at greater risk of obesity.

It is evident from Table 6 that tobacco use (both smoking and chewing) was significantly high among males (58.67%) as compared to females (34.94%). In case of alcohol consumption too the scenario was similar with the prevalence rate in males being 43.80% and females being 13.63%. Women were more likely than men to be overweight or obese (46.59%) compared to males (34.71%) and the rate of sedentary lifestyle was fairly comparable in both the sexes with females being 29.54% and males being 25.62%.

All these results were substantiated with the help of the chi-square test shown in Table 7. Sex was substantially correlated with the three risk factors tobacco use, alcohol use, and obesity at $p < 0.01$, $p < 0.01$, and $p < 0.05$, respectively. However, the data for sedentary lifestyle was not significant.

Discussion

Public health studies frequently note sex-based disparities in the risk factors and prevalence of NCDs [20]. The present study highlights significant disparities in the socio-economic and NCDs' behavioural risk factors between men and women, corroborating findings from global studies. Socio-economic inequalities persist in the study population, aligning with broader research that identifies gender gaps favouring men in education, occupation, and healthcare access in developing countries [21].

Risk factors for behaviour, including smoking and alcohol consumption show stark differences between sexes. Males were substantially more likely than females to consume smokeless tobacco, and regularly use alcohol. This is consistent with global trends, where it is more common for men in developing nations to use tobacco [22] and alcohol [23]. In the present study, 34.67% of women used tobacco (either smoking or chewing), which exceeds the state average of 22.1% reported in NFHS-5. Additionally, 6.81% of women consumed alcohol regularly, a figure comparable to the state average of 7.3%. For men,

Table 4: The NCD prevalence of the studied population based on sex and their Chi-square value based on sex

NCDs	Female (%)	Male (%)	Total (%)	Chi-square	Likelihood ratio	Significance
Systolic Blood Pressure						
Prehypertension	25.56	40.49	29.38	**154.616**	**170.412**	**0.000**
Hypertension stage I	11.08	22.31	13.95			
Hypertension stage II	7.10	6.61	6.97			
Diastolic Blood Pressure						
Prehypertension	28.12	24.79	27.27	**83.438**	**88.024**	**0.043**
Hypertension stage I	11.42	15.70	12.47			
Hypertension stage II	4.82	16.52	7.82			
Random Blood Glucose						
Pre-diabetic	33.24	33.05	33.19	**163.366**	**189.672**	**0.169**
Diabetic	26.13	36.36	28.75			

*Significant ** p-value at 0.01, * p-value at 0.05*

Table 5: Binary logistic regression odds ratio (95% confidence interval) of sex with hypertension and diabetes category based on sex

Sex (Female and Male)					
	Sex categories	**Exp (B)**	**p**	**95% CI for Exp (B)**	
				Lower bound	**Upper bound**
Hypertension (SBP)	**Male**	1.831	0.013*	1.136	2.952
	Female	Ref.			
Hypertension (DBP)	**Male**	1.647	0.020*	1.082	2.506
	Female	Ref.			
Diabetes	**Male**	1.823	0.017*	1.114	2.982
	Female	Ref.			
Obesity	**Male**	0.609	0.024*	0.397	0.936
	Female	Ref.			

a. Reference category: Female *b. Statistically significant at p < 0.05:**

Table 6: Prevalence of risk factors for NCDs among the adult Hindu Bengali population of Brahmaputra valley based on sex

Variables	Female (n =352)	Male (n =121)	Total (n =473)
	n(%)	n(%)	n(%)
Tobacco intake (Both smoking and chewing)	123 (34.94%)	71 (58.67%)	194 (41.01%)
Alcohol intake	48 (13.63%)	53 (43.80%)	101 (21.35%)
Sedentary lifestyle	104 (29.54%)	31 (25.62%)	135 (28.54%)
Obesity	164 (46.59%)	42 (34.71%)	206 (43.55%)

Table 7: Chi-square test for risk factors based on sex differences

Variables	Pearson Chi-square value	Likelihood ratio	Significance
Tobacco intake (Both smoking and chewing)	20.967[a]	20.726	0.000**
Alcohol intake	48.791[a]	44.307	0.000**
Sedentary lifestyle	0.680[a]	0.690	0.409
Obesity	5.170[a]	5.246	0.023*

*a. 0 cells (.0%) have expected count less than 5. b. Statistically significant at p<0.01: **, p<0.05:**

the rates were substantially higher with 83.46% using tobacco (compared to the state average of 51.8%), and 43.80% consuming alcohol (exceeding the state average of 25.1%). These findings indicate an alarmingly high frequency of risk variables for behavioural factors among the adult Hindu Bengali population, specifically among men in the Brahmaputra Valley.

The pervasiveness of overweight and obesity is also strikingly high. In this study, 46.58% of women and 34.7% of men were classified as obese far exceeding the state averages of 15.2% and 16.2%, respectively (NFHS-5). Notably, the higher prevalence of obesity among women is consistent with global findings [24]. Women in the study population, however, had lower prevalence rates of diabetes and hypertension than males do, while having greater obesity rates. This suggests that behavioural risk factors are more important in the development of NCDs in men.

Another serious issue was hypertension, which affected over 40% of women with over 55% of men falling into pre-hypertensive or hypertensive categories. Despite higher obesity rates among women, men exhibited greater susceptibility to hypertension, likely due to behavioural risk factors such as smoking and alcohol consumption. This is consistent with studies showing that hypertension is generally more prevalent in men [25], although women experience increased risk post-menopause due to hormonal shifts and renin-angiotensin-aldosterone system interactions [26]. The results of statistical analysis show that women had lower odds of being in pre-hypertensive and hypertensive stage 1 groupings for SBP and were less likely to be in the hypertensive stage 2 category for DBP.

Diabetes mellitus, a leading NCD globally, is highly prevalent in the studied population. Among women, only 38.63% maintained appropriate blood sugar levels, while 33.24% were pre-diabetic and 26.13% were diabetic, significantly exceeding the NFHS-5 state prevalence of 12.8%. Among men, 33.05% were pre-diabetic, and 36.36% were diabetic, compared to the NFHS-5 state average of 16%. The sex-based disparity in diabetes prevalence corresponds with studies indicating that tobacco use almost doubles the chance of diabetes [27]. Men's mean random blood glucose levels were substantially higher, according to t-test results, although chi-square analysis did not show statistically significant correlations. However, the odds ratio result demonstrated that men were more likely than women to have diabetes. This further emphasizes that behavioural risk factors, such as smoking and alcohol consumption, may be more influential in determining NCD susceptibility than obesity alone.

Conclusion

The findings suggest that men face a higher risk of developing hypertension and diabetes, accompanied by greater exposure to behavioural risk factors, including smoking, tobacco use, and alcohol consumption. Conversely, women exhibit higher rates of obesity and lower physical activity levels. These findings underline the importance of targeted, gender-sensitive health treatments. Strategies such as men-specific smoking and alcohol cessation programs, as well as obesity prevention and physical activity promotion for women, could help reduce NCD risk. Policymakers should consider these sex-specific health disparities when creating public health measures to effectively address the incidence of NCD.

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***Author for Correspondence:**
Immon Ghosh, Doctoral Research Scholar, Department of Anthropology, Gauhati University
Email: immonghosh100@gmail.com, immonghosh@gauhati.ac.in
Cell: +91 9531088599, +91 7896911498

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