

A Mobile Phone-based Cross-Sectional National Survey of Risk Factors for Non-Communicable Diseases Risk Factors in Bangladesh

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Abstract

Background

Non-communicable diseases (NCDs) are the leading cause of mortality in Bangladesh, yet the high cost of traditional face-to-face surveys limits frequent data collection. Mobile phone surveys (MPS) offer a potentially cost-effective and timely alternative for monitoring NCD risk factors. We aimed to determine the prevalence of key NCD risk factors in Bangladesh using a national mobile phone survey.

Methods

We conducted a nationwide cross-sectional survey using computer-assisted telephone interviews (CATI) with random digit dialing (RDD) between November 2023 and March 2024. We utilized a shortened version of the WHO STEPS tool to collect data on behavioral and metabolic risk factors. Complex quota sampling was employed to recruit participants across 48 strata based on age, sex, residence, and education. Iterative proportional fitting (IPF) weighting was used to ensure the representativeness of national estimates.

Results

A total of 7,757 participants were included in the analysis (weighted: 50.5% female; 68.5% rural). The weighted prevalence of current smoking was 20.5% (95% CI: 19.6%–21.5%), while 23.7% (95% CI: 22.6%–24.8%) used smokeless tobacco. Alcohol consumption was low at 1.3% (95% CI: 0.9%–1.6%). Inadequate fruit and vegetable intake was prevalent at 58.1% (95% CI: 56.8%–59.5%), and 54.0% (95% CI: 52.7%–55.4%) of respondents reported adding salt to food while eating. Approximately 20.1% (95% CI: 19.1%–21.0%) and 9.7% (95% CI: 8.9%–10.4%) of participants reported a known diagnosis of hypertension and diabetes, respectively. Multivariable analysis revealed that older age groups had significantly higher odds of hypertension (AOR: 27.0 for age 60+) and diabetes (AOR: 14.9 for age 60+) compared to those aged 18–29. Additionally, females had higher odds of inadequate fruit and vegetable intake (AOR: 2.0), hypertension (AOR: 1.9), and diabetes (AOR: 1.8) compared to males.

Conclusion

The high prevalence of clustered NCD risk factors underscores the urgent need for targeted public health interventions in Bangladesh. Our findings demonstrate that CATI-based surveillance is a feasible and effective method for providing timely, population-level NCD data in low- and middle-income countries.

Introduction

Globally, non-communicable diseases (NCDs), particularly cardiovascular disease, cancer, chronic respiratory diseases, and diabetes- poses significant health challenges and responsible for a large number of deaths and disabilities each year [1–3]. In 2021, about three-fourths of the deaths (equivalent to 43 million) related to non-pandemic disease have been attributed to NCDs. The burden is higher in the low- and middle-income countries (LMICs) and majority of these deaths (73%) occur in LMICs [2, 3]. Several estimates suggest that with the current trend, NCDs will be responsible for a higher number of deaths in 2050 [4, 5]. With limited surveillance, screening, diagnostic, preventive or treatment resources, Bangladesh and other similar LMICs are more likely to face the dire NCD consequences and achieving the aims of sustainable development goals will be at stake without immediate further intervention [6, 7]. These dire predictions underscores the urgent need for robust public health strategies focused on surveillance and intervention. In Bangladesh, NCDs are responsible for 61% of the total disease burden and 67% of all deaths, translating to an annual loss of approximately 5.7 million lives.[8, 9] Moreover, unregulated health sector and an aging population complicates efforts to effectively track and manage the growing burden of NCDs in Bangladesh [10].

The primary risk factors contributing to the NCD burden include tobacco use, excessive alcohol consumption, poor (i.e., unhealthy) diets, lack of physical activity, and air pollution [11]. Effective prevention and control hinge on reducing exposure to

these major NCD risk factors and obtaining timely, accurate risk factor data, which are often impeded by reliance on the infrequently conducted resource-intensive traditional survey methods [12]. An increase in mobile phone access, subscription, and ownership have opened new avenues for data collection in LMICs. For instance, according to the estimates from World Bank, in 2000, the mobile subscription rate was 0.22 per 100 people in Bangladesh; in 2005, 2010, 2015, and 2020, this rate gradually increased to 6, 46, 84, and 107 per 100 individuals, respectively. [13, 14] Mobile phone based data has proven to extract valid and reliable data worldwide, and the method is valuable especially in situations where traditional face-to-face surveys are not feasible, such as during conflicts, natural disasters, or epidemics [12, 15–18].

From 2012, the Institute of Epidemiology, Disease Control and Research (IEDCR) in Bangladesh is utilizing its Cell Phone Based Surveillance (CPBS) platform to collect vital health data, setting a precedent for public health interventions within the country. Furthermore, since 2015, IEDCR in collaboration with the Johns Hopkins Bloomberg School of Public Health, has pioneered the use of mobile technology for continuous and efficient NCD risk factor data collection.[19, 20] The current mobile phone based study utilizes a computer-assisted telephone interview (CATI) system with random digit dialing (RDD), to obtain nationally representative NCD risk factor data, reflecting a strategic shift towards more dynamic, timely, and cost-effective public health surveillance and intervention measures.

Methods

Study Design/Settings

In this cross-sectional study, we conducted a nationally representative mobile phone survey in Bangladesh. We accommodated a shortened and feasible WHO-recommended STEPS tools[21] in our developed CATI software.

We aimed to determine the prevalence of NCD risk factors across urban and rural areas of the country, specifically targeting males and females across four age groups (18–29, 30–44, 45–59, and 60 + years) under three educational categories. Briefly, forty-eight quotas based on age, sex, area of residence, and education level were assigned to ensure that each stratum was proportionally represented in the survey data. The sampling frame was designed to reflect the demographic and educational distribution of the rural and urban populations within each of the eight administrative divisions of Bangladesh, based on the Bangladesh Demographic and Health Survey (BDHS) 2017-18 data[22].

In line with the implemented national STEPS NCD survey 2022 in Bangladesh²³ we adopted those questionnaires which were feasible and appropriate for mobile based data collection. For this mobile phone based survey using random digit dialing adequate mobile phone numbers of the four existing operators were randomly generated. Considering the existing market share of the operators, generated phone numbers were then fed into the developed data collection software to be randomly picked to contact the eligible respondents through mobile phone.

After informed verbal consent and eligibility screening, the interviewers tried to collect brief information on respondents' demography, tobacco and alcohol use, fruit, vegetable and salt consumption, sedentary behavior, physical health related to hypertension and diabetes. Our data collection system was designed to optimize respondent participation along with yield of high-quality reliable data for analyzing NCD risk factors across diverse populations in Bangladesh. To enhance survey completion rates we implemented strategies such as multiple contact attempts and scheduled appointments for callback. Furthermore, we employed snowball sampling to fulfill unfilled quotas where deemed applicable. To make a contact with a respondent three call attempts were made, and for those respondents who did not complete the survey on initial contact, two additional callbacks were scheduled in consultation with the respondents. The snowball sampling approach was applied for those participants whose demographic quotas had already been met but who could refer another eligible participant of unfilled quota within their household. This method was supported by our developed data collection software, which flagged instances where additional participants were needed to fill specific demographic quotas. In-built quality checks were set in the software to minimize errors. Beside the investigators, two supervisors were there to assist and oversee the data collection process throughout the survey period. In the first month of data collection, 1% data of each of the interviewers were checked once a week to ensure data quality. Later it was done in each month. Identified errors were discussed with the interviewers immediately and through need based refresher meetings.

CATI Survey was conducted between November 09, 2023, and March 11, 2024. Adopted complex quota sampling required more time for filling up several quota specific respondents, particularly the aged and females of urban area. Even after applying snowball technique some quotas of urban “no formal education” couldn’t be fulfilled.

During the data collection our interviewers entered the data in the developed software in each computer, and all data were then merged and stored in a dedicated server. Confidentiality, privacy and anonymity of participants’ data were strictly maintained.

Outcome Variables (NCD Indicators)

We reported the prevalence of following indicators: current tobacco smoke; current smokeless tobacco use; daily tobacco smoke; daily smokeless tobacco use; current (i.e., past 30 days) alcohol consumption; eating less than 5 servings of fruits-vegetables in a day; adding salt to food while eating; known diagnosis and treatment compliance of diabetes and hypertension. NCD indicators were created using STEPs standardized definitions [21].

To facilitate analysis, all risk factor indicators were converted into binary (i.e., yes or no) variables based on the presence or absence of the factor. The calculation of these indicator variables accounted for the specific skip patterns used in the study questionnaires. For example, the prevalence of current smoking was determined by dividing the total number of affirmative responses by the total number of respondents (i.e., yes + no) for that question. Next, the ‘daily smoking’ question was asked for participants who responded ‘yes’ to the ‘current smoking’ question. Therefore, the denominator of the ‘daily smoker’ variable included total ‘yes’ response to this variable plus the number of ‘no’ responses to the ‘current smoking’ variable.

Study Variables (Sociodemographic Factors)

Participants reported their current age, sex, education level, religion, place of residence, and administrative divisions. Age was categorized as ‘18–29’, ‘30–44’, ‘45–59’, and ‘60 or more’ years. The education level was reported as ‘no formal education’, ‘up to primary school’, ‘secondary/higher secondary’, and ‘graduate/above’. Marital status was categorized as ‘never married’, ‘currently married’, and ‘widowed, separated or divorced’. Religions other than Islam (e.g., Hinduism, Christianity, and Buddhism) were grouped together. During the time of survey administration Bangladesh had eight administrative divisions, namely, Dhaka, Chattogram, Rajshahi, Khulna, Barishal, Sylhet, Rangpur and Mymensingh).

Sample Size Calculation

Our required sample size of completed survey of 7,680 respondents was aligned with the Bangladesh STEPS NCD survey conducted in 2022-23,[23] balanced equally between males and females. The sample size for each demographic stratum was determined using the formula, $n = (Z^2 p (1-p)) / r^2$, where p is the prevalence of hypertension (0.21), Z is the confidence level (1.96 for 95% confidence), and r is the relative precision (20%). Adjusting for a design effect of 2 due to clustering within the sample and an anticipated response rate of 80%, employing a quota sampling technique necessary sample size was calculated to ensure representation across different demographic groups.

Data Analysis

First, we reported unweighted and weighted sociodemographic characteristics of the study participants, and compared the distribution according to gender using chi-square test. Then, we reported the prevalence and means of studied indicators. As each sociodemographic groups had different number of participants, while analyzing the data to report the prevalence/mean, to ensure representativeness and reduce potential biases in survey data, iterative proportional fitting (IPF) weighting method was used. The IPF algorithm adjusted the initial weights by iteratively matching the sample distributions to the target population distributions for each variable. Each iteration recalculated the weights to minimize discrepancies between the sample and population margins. The iterative process continued until convergence was achieved, where the sample proportions closely matched the population proportions, or until the maximum number of iterations was reached. This approach adjusts survey data so that it aligns with known population distributions across key demographic and geographic strata. The weights were generated

incorporating predefined margins for age, sex, place of residence (i.e., rural/urban), and administrative divisions. After reporting the prevalence/mean of the key indicators by sociodemographic factors, we conducted logistic regression analysis to identify the associated factors and reported odds ratios (ORs). All the prevalence, means, and ORs were presented along with 95% confidence intervals (CI). R was used to analyze data.

Results

Table 1: Sociodemographic characteristics of the respondents (N = 7734)¹

Indicators	Overall (N=7757)		Unweighted, %			Weighted, %		
	n	%	Male, N =3984	Female, N =3773	P value	Male (49.5%)	Female (50.5%)	P value
Age group (in year)								
18-29	2149	34.4	29.3	26.0	.012	37.4	31.4	<.001
30-44	1918	32.8	24.1	25.3		31.3	34.3	
45-59	1884	20.3	23.7	24.9		19.4	21.2	
60+	1806	12.5	22.8	23.8		11.9	13.1	
Education								
No formal schooling	2245	23.8	23.0	35.2	<.001	19.2	28.2	<.001
Primary	2279	29.2	29.5	29.2		28.4	29.9	
Secondary/higher secondary	2308	35.1	32.8	26.5		38.6	31.6	
Graduate/above	925	12.0	14.6	9.1		13.7	10.3	
Marital status								
Never married	995	16.0	19.2	6.1	<.001	25.1	7.1	<.001
Currently married	5880	75.6	78.5	72.9		73.5	77.6	
Widowed, separated or divorced	882	8.4	2.3	21.0		1.4	15.3	
Religion								
Islam	7048	91.6	90.2	91.6	.028	90.9	92.3	.071
Others	709	8.4	9.8	8.4		9.1	7.7	
Place of residence								
Urban	3698	31.5	46.9	48.5	.14	30.4	32.6	.10
Rural	4059	68.5	53.1	51.5		69.6	67.4	
Division								
Dhaka	1006	26.8	13.0	12.9	.99	27.0	26.7	.72
Chattogram	1002	20.1	12.9	12.9		20.0	20.2	
Rajshahi	1031	12.3	13.8	12.8		13.0	11.6	
Khulna	990	10.5	12.7	12.8		10.4	10.6	
Barishal	904	5.5	11.4	11.9		5.3	5.7	
Sylhet	917	6.7	11.7	11.9		6.5	6.9	
Rangpur	989	10.7	12.9	12.6		10.8	10.6	
Mymensingh	918	7.4	11.6	12.1		7.1	7.7	

1. Column percentage (%)

Table 1 shows unweighted and weighted sociodemographic characteristics of the respondents. A total of completely surveyed 7757 participants were included in the analysis. The weighted sample had 50.5% females, and more than two-third of the

participants were from rural areas (68.5%). Respondents were distributed across age groups, with 18–29 years representing 34.0% and those aged ≥60 years 12.0%. Most participants were currently married (75.6%). A vast majority of the respondents (91.5%) identified as Muslim, and respondents were geographically represented across all divisions, with the highest proportion from Dhaka followed by Chattogram. Males and females of both unweighted and weighted samples differed by age, education, and marital status.

Table 2: Weighted prevalence/means with 95% confidence interval for risk factor indicators

Risk Factor	Urban		Rural		Overall
	Male	Female	Male	Female	
Current smoker	41.7(39.0,44.3)	0.9(0.4,1.5)	40.3(37.8,42.7)	0.7(0.3,1.2)	20.5(19.6,21.5)
Current smokeless tob user	21.3(19.1,23.4)	22.5(20.3,24.6)	22.7(20.7,24.7)	26.3(24.2,28.5)	23.7(22.6,24.8)
Daily smoker	37.9(35.3,40.5)	0.5(0.1,0.9)	34.5(32.1,36.9)	0.6(0.2,0.9)	17.8(16.9,18.8)
Daily smokeless tob use	15.1(13.3,16.9)	18.4(16.5,20.4)	16.2(14.5,17.9)	21.2(19.2,23.2)	18.1(17.2,19.0)
Current alcohol	2.2(1.3,3.0)	0.0(0.0,0.0)	2.8(1.8,3.7)	0.0(0.0,0.1)	1.3(0.9,1.6)
<5 fruit-veg servings/day	49.6(46.9,52.3)	67.5(64.9,70.0)	49.0(46.5,51.5)	66.6(64.1,69.1)	58.1(56.8,59.5)
Use of salt during cooking					
Add salt to food in eating	46.5(43.8,49.1)	49.0(46.3,51.7)	52.9(50.4,55.4)	61.0(58.4,63.5)	54.0(52.7,55.4)
Known raised BP/HTN	16.4(14.4,18.3)	28.4(26.1,30.8)	14.5(12.9,16.1)	23.3(21.2,25.4)	20.1(19.1,21.0)
Take BP/HTN medication	61.8(55.5,68.2)	70.2(65.6,74.7)	56.0(49.9,62.1)	73.6(68.9,78.3)	67.0(64.2,69.7)
Known raised DM	8.6(7.2,10.0)	14.1(12.3,16.0)	6.6(5.4,7.8)	11.0(9.5,12.6)	9.7(8.9,10.4)
Take DM medication	82.6(76.0,89.3)	77.1(70.6,83.6)	72.0(63.5,80.6)	77.9(71.9,83.9)	76.9(73.4,80.5)
Fruit servings(mean)	1.34(1.28,1.40)	1.02(0.97,1.07)	1.36(1.30,1.42)	0.92(0.88,0.97)	1.15(1.12,1.18)
Veg servings(mean)	3.60(3.50,3.70)	3.11(3.02,3.19)	3.73(3.62,3.83)	3.23(3.15,3.32)	3.44(3.39,3.49)

1. Mean with 95% CI; Abbreviations: DM: Diabetes mellitus; HTN: Hypertension

Table 2 presents prevalence and mean estimates (95% CIs) for behavioral risk indicators by sex and rural-urban place of residence. Overall, about 20.5% (95% CI: 19.6% to 21.5%) were current smokers, with markedly higher prevalence among males than females across both urban and rural regions. Smokeless tobacco use was higher among females than males in both urban (22.5% (95% CI: 20.3% to 24.6%) vs 21.3% (95% CI: 19.1% to 23.4%)) and rural (26.3% (95% CI: 24.2% to 28.5%) vs 22.7% (95% CI: 20.7% to 24.7%)) regions. Only 1.3% (95% CI: 0.9% to 1.6%) reported alcohol consumption in the past 1 month, with near-zero prevalence among females. Additional salt intake during meals was reported by more than half of the respondents, at 54.0% (95% CI: 52.7% to 55.4%). Sex and rural-urban differences were also observed for most other indicators.

As we can see from Table 3, the prevalence of most selected risk factor indicators differed by demographic characteristics. While current smoking peaked among those aged 45–59 (22.2%, 95% CI: 20.1% to 24.4%), smokeless tobacco use showed a much steeper age-related climb, rising from 11.0% (95% CI: 9.5% to 12.5%) in the youngest group to 44.0% (95% CI: 41.3% to 46.7%) among those aged 60 and older. Alcohol consumption was overall low. Older participants were the most likely to consume inadequate fruits and vegetables (72.9%) or reported about adding salt to their meals (61.0%). Tobacco use declined with increasing education level, while inadequate diet and additional salt intake were more common among individuals with lower educational level. Rural residents reported slightly higher tobacco and salt use; however, the prevalence of diabetes and hypertension were higher in urban areas. Regional variation was also observed for most indicators.

In Table 4, we reported the multivariable logistic regression results for associations between sociodemographic factors and selected indicators. Compared to 18–29-year-olds, older age was significantly associated with higher odds of smokeless tobacco

use, diabetes, and hypertension. For instance, people with 60 or more years of age had substantially higher odds of hypertension (AOR: 27.0; 95% CI: 15.3–47.8) and diabetes (AOR: 14.9; 95% CI: 11.1–20.0); however, alcohol consumption declined with age and current smoking was lower in this age group. Although females had lower odds of smoking and alcohol use, had higher odds of inadequate fruit and vegetable intake, additional salt use, hypertension, and diabetes compared to their male counterparts. Higher education, especially secondary or higher secondary level, was associated with lower odds of tobacco use and salt intake. Rural residence was associated with higher smokeless tobacco use and salt consumption but lower odds of diabetes and hypertension.

Table 3: Prevalence (95% confidence interval) of selected indicators by sociodemographic characteristics

Variable	Current smoker	Curr smokeless tobacco user	Alcohol past month	Fruit or veg less than 5 servings	Add salt during eating	Hypertension diagnosis	Diabetes diagnosis
Age (in year)							
18-29	19.8 (17.9, 21.7)	11.0 (9.5, 12.5)	2.4 (1.6, 3.2)	52.4 (49.9, 54.9)	51.0 (48.5, 53.5)	5.1 (4.1, 6.2)	1.3 (0.7, 1.9)
30-44	21.7 (19.6, 23.7)	22.7 (20.5, 24.9)	1.0 (0.5, 1.6)	54.9 (52.3, 57.5)	52.7 (50.0, 55.3)	18.2 (16.2, 20.3)	8.2 (6.7, 9.6)
45-59	22.2 (20.1, 24.4)	34.3 (31.8, 36.8)	0.5 (0.1, 0.8)	64.0 (61.4, 66.5)	57.1 (54.5, 59.8)	33.9 (31.3, 36.5)	18.6 (16.5, 20.7)
60+	16.7 (14.6, 18.8)	44.0 (41.3, 46.7)	0.3 (0.0, 0.6)	72.9 (70.4, 75.3)	61.0 (58.4, 63.7)	43.3 (40.6, 46.0)	22.0 (19.6, 24.3)
Sex							
Male	40.7 (38.8, 42.6)	22.3 (20.8, 23.8)	2.6 (1.9, 3.3)	49.2 (47.3, 51.1)	50.9 (49.0, 52.9)	15.1 (13.8, 16.3)	7.2 (6.3, 8.1)
Female	0.8 (0.5, 1.1)	25.1 (23.5, 26.7)	0.0 (-0.0, 0.1)	66.9 (65.0, 68.8)	57.1 (55.1, 59.0)	25.0 (23.4, 26.5)	12.0 (10.8, 13.2)
Education level							
No formal schooling	21.6 (19.5, 23.7)	40.2 (37.7, 42.7)	0.7 (0.1, 1.3)	72.7 (70.3, 75.0)	62.0 (59.5, 64.5)	26.7 (24.5, 28.9)	11.9 (10.3, 13.5)
Primary	24.4 (22.3, 26.4)	28.3 (26.0, 30.5)	1.2 (0.7, 1.7)	56.1 (53.6, 58.7)	61.6 (59.2, 64.1)	20.8 (18.9, 22.8)	11.0 (9.4, 12.5)
Sec/high secondary	18.4 (16.6, 20.3)	13.3 (11.7, 14.9)	1.9 (1.2, 2.6)	51.8 (49.3, 54.2)	48.6 (46.2, 51.1)	15.0 (13.3, 16.6)	6.4 (5.3, 7.5)
Graduate/above	15.1 (12.3, 17.9)	10.2 (7.9, 12.5)	0.9 (0.0, 1.8)	52.7 (48.7, 56.7)	35.6 (31.7, 39.4)	19.9 (16.8, 22.9)	11.5 (9.2, 13.9)
Marital status							
Never married	25.4 (22.2, 28.6)	9.6 (7.5, 11.6)	3.4 (2.0, 4.9)	50.4 (46.7, 54.1)	47.0 (43.4, 50.7)	3.5 (2.0, 4.9)	1.1 (0.2, 1.9)
Currently married	21.4 (20.2, 22.5)	24.4 (23.1, 25.6)	1.0 (0.6, 1.3)	57.3 (55.8, 58.9)	54.9 (53.3, 56.5)	21.0 (19.8, 22.2)	10.5 (9.6, 11.4)
Wid, sep or divorced	3.7 (2.3, 5.2)	44.7 (40.5, 48.8)	0.2 (-0.2, 0.5)	80.2 (76.9, 83.6)	59.7 (55.6, 63.8)	43.5 (39.4, 47.6)	18.7 (15.5, 21.9)
Place of residence							
Urban	20.4 (18.8, 21.9)	21.9 (20.4, 23.4)	1.0 (0.6, 1.5)	58.9 (57.0, 60.8)	47.8 (45.9, 49.7)	22.7 (21.1, 24.2)	11.5 (10.3, 12.7)

Rural	20.6 (19.3, 21.9)	24.5 (23.1, 26.0)	1.4 (0.9, 1.9)	57.8 (56.0, 59.5)	56.9 (55.1, 58.7)	18.9 (17.6, 20.2)	8.8 (7.8, 9.8)
Administrative divisions							
Dhaka	20.2 (17.6, 22.9)	21.4 (18.6, 24.1)	1.7 (0.8, 2.7)	58.0 (54.6, 61.4)	58.2 (54.9, 61.6)	19.8 (17.3, 22.4)	11.6 (9.7, 13.6)
Chattogram	20.6 (17.9, 23.3)	20.5 (17.9, 23.1)	1.4 (0.5, 2.2)	64.1 (60.8, 67.4)	50.9 (47.4, 54.3)	22.3 (19.6, 25.0)	10.8 (8.8, 12.7)
Rajshahi	22.2 (19.5, 25.0)	15.7 (13.4, 18.1)	1.6 (0.7, 2.4)	54.3 (51.0, 57.7)	47.1 (43.7, 50.5)	18.7 (16.2, 21.2)	9.4 (7.5, 11.3)
Khulna	18.7 (16.1, 21.4)	22.5 (19.7, 25.4)	0.8 (0.2, 1.5)	53.6 (50.2, 57.1)	59.5 (56.1, 62.9)	19.7 (17.1, 22.3)	8.2 (6.5, 10.0)
Barishal	17.0 (14.3, 19.8)	30.0 (26.7, 33.4)	0.9 (0.2, 1.6)	57.3 (53.7, 61.0)	73.7 (70.6, 76.9)	21.1 (18.2, 24.0)	9.0 (7.1, 10.9)
Sylhet	20.7 (17.8, 23.6)	38.3 (34.8, 41.8)	1.3 (0.5, 2.1)	64.7 (61.3, 68.2)	49.0 (45.5, 52.6)	21.7 (18.8, 24.6)	8.4 (6.6, 10.2)
Rangpur	20.4 (17.7, 23.2)	28.0 (25.0, 31.0)	0.8 (0.1, 1.4)	54.1 (50.6, 57.5)	43.2 (39.8, 46.7)	18.1 (15.5, 20.6)	6.5 (4.9, 8.0)
Mymensingh	23.6 (20.6, 26.7)	31.5 (28.2, 34.8)	0.7 (0.1, 1.3)	55.6 (52.0, 59.1)	56.8 (53.2, 60.3)	18.1 (15.5, 20.8)	7.8 (6.1, 9.6)
National							

Table 4: Logistic regression analyses to investigate sociodemographic factors associated with selected indicators¹, AOR (95% CI)

Variable	Current smoker	Curr smokeless tobacco user	Alcohol past month	Fruit or veg less than 5 servings	Add salt during eating	Hypertension diagnosis	Diabetes diagnosis
Age (Ref: 15-29-years)							
30-44	1.1 (0.8,1.4)	1.8 (1.4,2.3)	0.5 (0.2,1.1)	1 (0.8,1.2)	0.9 (0.8,1.1)	6 (3.4,10.6)	3.7 (2.8,4.9)
45-59	1 (0.8,1.3)	2.6 (2.1,3.3)	0.2 (0.1,0.5)	1.3 (1.1,1.5)	1 (0.8,1.2)	18.9 (10.8,33)	9.6 (7.3,12.8)
60+	0.6 (0.4,0.8)	3.4 (2.6,4.3)	0.1 (0,0.4)	1.7 (1.4,2.1)	1.1 (0.9,1.4)	27 (15.3,47.8)	14.9 (11.1,20)
Sex (Ref: Male)							
Female	0.009 (0.006,0.015)	0.9 (0.8,1)	0.007 (0.001,0.1)	2 (1.7,2.2)	1.2 (1.1,1.4)	1.9 (1.6,2.4)	1.8 (1.6,2.1)
Education level (Ref: No formal education)							
Primary	1.2 (1,1.3)	1.1 (1,1.3)	0.9 (0.5,1.5)	0.9 (0.8,1.1)	1.1 (1,1.3)	1.1 (0.9,1.3)	0.9 (0.8,1.1)
Secondary/hig sec	0.4 (0.3,0.5)	0.3 (0.3,0.4)	0.7 (0.3,1.7)	0.7 (0.6,0.8)	0.4 (0.4,0.5)	2 (1.6,2.5)	1.7 (1.4,2)
Graduate/above	0.9 (0.7,1.1)	0.9 (0.7,1)	0.8 (0.4,1.8)	1.4 (1.2,1.5)	0.8 (0.7,0.9)	0.9 (0.7,1)	0.8 (0.7,1)
Marital status (Ref: never married)							
Currently married	1.3 (1,1.7)	1.3 (0.9,1.7)	0.9 (0.5,1.8)	0.9 (0.7,1.1)	1.1 (0.9,1.3)	1.9 (0.7,4.8)	2 (1.3,3.2)
Widowed, sep, or divorced	1.1 (0.6,2)	1.9 (1.3,2.7)	1.8 (0.2,17.4)	1.3 (1,1.9)	0.9 (0.7,1.3)	1.7 (0.7,4.5)	2.8 (1.7,4.8)
Place of residence (Ref: Urban)							
Rural	1 (0.8,1.1)	1.2 (1.1,1.4)	1.1 (0.7,2)	1 (0.9,1.1)	1.5 (1.3,1.6)	0.8 (0.7,0.9)	0.8 (0.7,0.9)
Division (Ref: Dhaka)							
Barishal	0.8 (0.6,1)	1.7 (1.3,2.1)	0.6 (0.2,1.6)	1 (0.8,1.2)	2 (1.6,2.5)	0.7 (0.5,1)	1.1 (0.8,1.4)
Chattogram	1.1 (0.8,1.4)	0.9 (0.7,1.2)	0.8 (0.3,1.8)	1.3 (1.1,1.6)	0.7 (0.6,0.9)	0.9 (0.7,1.2)	1.2 (0.9,1.5)
Khulna	0.9 (0.7,1.2)	1.1 (0.8,1.4)	0.5 (0.2,1.3)	0.8 (0.7,1)	1 (0.9,1.3)	0.7 (0.5,0.9)	1 (0.8,1.3)
Mymensingh	1.4 (1,1.8)	1.8 (1.4,2.2)	0.4 (0.1,1.2)	0.9 (0.7,1.1)	0.9 (0.8,1.1)	0.6 (0.4,0.8)	0.9 (0.7,1.1)
Rajshahi	1.1 (0.9,1.5)	0.7 (0.5,0.9)	0.8 (0.4,1.8)	0.9 (0.7,1.1)	0.6 (0.5,0.8)	0.8 (0.6,1.1)	1 (0.8,1.3)
Rangpur	1 (0.8,1.3)	1.5 (1.2,1.9)	0.4 (0.2,1.2)	0.9 (0.7,1.1)	0.5 (0.4,0.6)	0.5 (0.4,0.7)	0.9 (0.7,1.2)
Sylhet	1.1 (0.8,1.4)	2.5 (2.3,2)	0.8 (0.4,2)	1.3 (1.1,1.7)	0.7 (0.5,0.8)	0.7 (0.5,0.9)	1.1 (0.9,1.5)

1. Adjusted for all variables in the column

Abbreviations: AOR: Adjusted odds ratio; CI: Confidence interval.

Discussion

In this nationally representative population based MPS, we studied the burden of NCD risk factors in Bangladesh. Our study showed that MPS using CATI can provide estimates on the distribution of major NCD risk factors; therefore, integrating mobile technology into large-scale public health surveillance could be feasible. When we looked into NCD burden, several important findings emerge from CATI. First, tobacco use in any form remains highly prevalent, affecting nearly two in five adults. Furthermore, we observed disparities by sex, age, education, and geographic division. Second, behavioral risks related to diet and salt intake are common. About half of the participants reported inadequate fruit and vegetable consumption almost all reported using salt while cooking and more than half reported additional salt intake during meals. Third, self-reported diabetes and hypertension increase sharply with age and are more frequently reported among women, suggesting both biological and health-system-related differences in diagnosis and care-seeking patterns.

The high prevalence of tobacco consumption observed in this study aligns with earlier national and regional surveys showing tobacco use as a major public health challenge in South Asian countries [21, 24]. Smoking was predominantly concentrated among men. However, smokeless tobacco use was substantial among women, particularly in rural areas, reflects long-standing sociocultural norms and differential perceptions of harm. The finding that older age and lower educational level were strongly associated with tobacco use indicates cumulative exposure and also gaps in knowledge and awareness. Although most people in LMICs, including Bangladesh initiate smoking during their adolescence, our findings suggests that tobacco control policies must move beyond youth-focused messaging to include cessation programs tailored for older adults, especially populations with limited formal education [24, 25]. The regional differences observed in tobacco use further emphasizes the need for localized interventions that account for social practices, marketing environments, and enforcement of tobacco control regulations.

Dietary patterns reported in this survey indicate that inadequate fruit and vegetable intake remains common despite national and global recommendations advocating a minimum intake of five daily servings [21]. Low-educated, widowed or socially vulnerable respondents had the highest prevalence of inadequate fruits/vegetable intake, which may underscore the role of social and economic determinants in shaping dietary behaviors. Although mean combined servings appeared close to recommended thresholds in some subgroups, such estimates may mask uneven distribution and seasonal variability in food access [21, 26]. Traditionally peoples in Bangladesh invariably uses salt while cooking food, but the persistence of additional salt intake among a considerable proportion of respondents is also concerning given the established relationship between salt consumption and hypertension [27, 28]. These findings suggest that population-level interventions aimed at improving dietary literacy, affordability, and food environments may be as critical as individual-level behavior change approaches.

Self-reported diabetes and hypertension prevalence patterns observed in this survey are consistent with the epidemiological transition occurring in Bangladesh, where chronic diseases increasingly dominate morbidity profiles [21, 29, 30]. The sharp increase in odds of both conditions with advancing age reflects expected physiological risk accumulation but also highlights the importance of preventive strategies initiated earlier in adulthood [22, 29]. Notably, women demonstrated higher odds of reported diabetes and hypertension despite lower levels of tobacco smoking and alcohol use. Disparities in burden and receiving care for NCDs have been reported and this could result from higher healthcare utilization among women (e.g. during antenatal check-up), differential diagnosis rates, or the influence of other risk factors (e.g., physical inactivity, sedentary work pattern, obesity, or psychosocial stress) that were not fully captured within this survey design [30, 31]. The relatively similar distribution of hypertension and diabetes across administrative divisions in ours and previous studies suggests that these conditions are becoming widespread, indicating a national rather than localized challenge [22].

An important contribution of this study is the methodological demonstration of mobile phone-based surveillance as a practical complement to traditional face-to-face surveys [12, 32]. The use of CATI combined with quota-based sampling and iterative proportional fitting allowed for rapid data collection while maintaining demographic representativeness [12, 33]. In contexts where field-based data collection may be logistically difficult or costly, such approaches can substantially improve surveillance frequency and responsiveness [12, 32]. However, mobile surveys may still underrepresent populations without reliable phone access or those less likely to respond to calls, such as marginalized groups or older women in certain settings. Although similar to earlier studies, weighting adjustments were applied to reduce such biases, potential residual selection effects should be acknowledged when interpreting prevalence estimates [12, 32, 34].

The limitations of the present study also warrant discussion. First, the cross-sectional design precludes causal inference regarding associations between sociodemographic factors and NCD indicators. Then, key outcomes, including diabetes and hypertension, were based on self-report of prior diagnosis and may underestimate true prevalence because undiagnosed conditions are common in low-resource settings. Behavioral measures such as diet, tobacco use, and alcohol consumption rely on participant recall and may be influenced by social desirability bias, particularly for culturally sensitive behaviors. Furthermore, while the quota-based approach enhanced representativeness, some demographic strata (e.g., urban participants with no formal education) were difficult to fill, this may influence precision in subgroup estimates.

From a policy perspective, our findings highlight a persistent and multifaceted NCD risk landscape in Bangladesh. Coordinated prevention strategies spanning behavioral, social, and disease related domains could be helpful. These findings reinforce the urgency of strengthening multisectoral NCD prevention strategies in Bangladesh. Tobacco control remains a priority, but interventions must simultaneously address unhealthy dietary practices, high salt consumption, and early detection of metabolic conditions. The observed disparities by education, sex, and residence underscore the need for equity-focused programming that targets socially disadvantaged groups. Integrating mobile phone-based data collection into routine surveillance systems could support more frequent monitoring and enable timely adjustments to public health strategies, particularly as the country advances toward universal health coverage and sustainable development targets.

Conclusion

This study provides contemporary national estimates of major NCD risk factors and illustrates the utility of mobile phone-based surveillance for monitoring rapidly evolving health challenges in Bangladesh. The coexistence of widespread behavioral risks and increasing chronic disease burden calls for sustained investment in prevention, health promotion, and early diagnosis. Future research should explore longitudinal monitoring using repeated mobile surveys and linkage with clinical data to better understand trends over time and guide evidence-based policy responses.

Abbreviations

AOR
Adjusted odds ratio
CI
Confidence interval.

Declarations

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Author Contributions

IAK and DG contributed to the conceptualization, methodology, supervision, and review and editing of the manuscript. SH, MN, TS, TSK, and FIK contributed to project administration, investigation, and data curation. MN and GMAK was responsible for the statistical methodology, formal data analysis using software, and writing the original draft. All authors have reviewed, edited, and approved the final version of the manuscript for submission.

Ethical Approval: The ethical approval for this study was provided by the Institutional Review Boards of the Johns Hopkins Bloomberg School of Public Health (JHBSPH), Baltimore, Maryland and Institute of Epidemiology Disease Control and Research (IEDCR), Dhaka, Bangladesh. The study was conducted following all relevant policies and guidelines provided by the institutional review boards of the participating institutions (JHBSPH and IEDCR).

Consent to Participate: Verbal informed consent was obtained from all respondents.

Consent to Publish: Not applicable

Data Availability Statement: The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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