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ORIGINAL ARTICLE

Distribution and disparities of healthy lifestyles and noncommunicable diseases risk factors between men and women aged 20–59 years in Bangladesh: Evidence from a nationwide survey

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Abstract

Background: Noncommunicable diseases (NCDs) are public health threats globally and recognized impediments to socioeconomic development. This study aimed to identify the prevalence and clustering of NCDs risk factors among Bangladeshi men and women aged 20–59 years using nationally representative data.

Methods: This study was conducted in 82 rural, nonslum urban, and slum clusters across all eight administrative divisions of Bangladesh using multistage cluster sampling. A total of 4917 men and 4905 women aged 20–59 years were included in the study. Descriptive analyses were performed to report the prevalence and distribution of behavioral and clinical risk factors. Multivariable binary logistic regression was performed to identify factors associated with the coexistence of three or more NCD risk factors.

Results: The prevalence of tobacco use (any form), insufficient physical activity, inadequate fruit and vegetable consumption, overweight and obesity, and central obesity were 38.3%, 13.6%, 87.1%, 42.3%, and 36.0%, respectively. Furthermore, 21.9% and 4.9% participants had hypertension and self-reported diabetes, respectively. Regarding the clustering of risk factors, 37.1% men and 50.8% women had at least three NCD risk factors. Only 3.0% men and 1.8% women reported no NCD risk factors. Age, place of residence, education, and wealth status were associated with the presence of at least three risk factors for both sexes.

Conclusion: Since a large proportion of Bangladeshi 20–59 years old population had multiple risk factors, population-based programs with multisectoral approaches are essential to reduce NCDs among Bangladeshi women and men.

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KEYWORDS

Bangladesh, men, noncommunicable diseases, risk factors, women

Key points

- *Significant findings of the study:* Among noncommunicable disease (NCD) risk factors, tobacco use in any form, insufficient physical activity, inadequate fruit and vegetable consumption, overweight and obesity, and central obesity were highly prevalent.
- *What this study adds:* We observed significant gender differences in the prevalence of selected behavioral and clinical NCD risk factors. About half of the women and more than one-third of men had three or more NCD risk factors.

1 | INTRODUCTION

Noncommunicable diseases (NCDs) are responsible for 41 million deaths worldwide each year, of which 15 million deaths occurred in the 30–69-year age group and are considered premature deaths.[1] About 85% of these premature deaths occur in low-middle-income countries.[1] According to recent estimates, by 2030, the global average age-standardized NCD mortality rate will be 510.54 per 100,000 population per year.[2] It is predicted that the four major NCDs, cardiovascular disease (CVD), diabetes, cancer, and chronic respiratory diseases, will be accountable for 75% of global deaths by 2030.[3] In most countries, the total number of deaths due to NCDs has now exceeded the total deaths caused by infectious diseases, maternal, perinatal, and nutritional conditions.[4]

As per the Centers for Disease Control and Prevention, risk factors are defined as "an aspect of personal behaviors or lifestyle, an environmental exposure, or a hereditary characteristic that is associated with an increased occurrence of a particular disease, injury, or other health condition". Modifiable behavioral risk factors such as unhealthy diet, inadequate physical activity (IPA), inadequate fruit and vegetable intake, and tobacco consumption; and clinical risk factors such as overweight and obesity, high blood pressure, high blood cholesterol, and high blood glucose are major contributors to NCDs.[3–5] Since NCDs are multifactorial, these factors are interrelated. About 80% of the CVDs, type 2 diabetes and 40% of cancer could be avoided through a healthy diet, adequate physical activity, and tobacco cessation.[6]

Over the past decades, Bangladesh has achieved tremendous success in several areas of public health, such as reducing maternal and neonatal mortality, increasing immunization coverage, improving oral rehydration therapy, and enhancing treatment options for tuberculosis.[7] Nonetheless, like many other countries, Bangladesh is going through an epidemiological transition from infectious diseases to the increasing problem of NCDs.[8] This epidemiological transition has been driven by several factors, including a move from traditional foods to processed foods high in salt and sugar, low physical activity with sedentary lifestyles, and changed cultural norms such as increasing the number of women using tobacco.[9] The proportion of NCD deaths in Bangladesh increased from 43.4% in 2000 to 66.9% in 2015,[10] suggesting a relatively higher burden of NCDs. As per STEPS Survey 2018, the prevalence of tobacco consumption, inadequate fruit and vegetable intake, IPA, overweight or obesity, high blood pressure, and diabetes among 18–69 year-old adults was 43.7%, 89.6%, 29.1%, 25.9%, 21.0%, and 8.3%, respectively.[11]

The burden of NCDs among Bangladeshi adult population is significantly high,[12] there has been little or no analysis of behavioral and clinical risk factors of NCD among 20–59 years population in Bangladesh though they are the most productive group of population and lie between adolescence and senescence. Current evidence suggests that the burden of NCD risk factors is higher in nonslum urban and rural areas, along with unequal distribution across different social classes and gender.[13–15] In addition, NCD risk factors tend to coexist frequently. Several international studies have revealed that in adults, two or more behavioral and clinical risk factors are present at the same time.[16] Understanding the nature of the coexistence of multiple risk factors might help design more specific prevention and treatment strategies. These indicate a clear need to increase the attention paid to the 20–59-year age group, and gender and socioeconomic differentials of the NCD risk factors in this population group in Bangladesh.

To develop evidence-based interventions for reducing the burden of NCDs, it is therefore necessary to better understand the prevalence, distribution, and clustering of NCD risk factors in this population group, and the factors associated with the clustering of risk factors. Considering this, we have analyzed data from a nationwide survey and reported the NCD risk factors, clustering of risk factors, and factors associated with the NCD risk factors clustering among 20–59-year-old men and women in Bangladesh.

2 | METHODS

2.1 | Study design, settings, and population

We extracted the data for this analysis from the 2018 to 2019 round of the "Food Security and Nutrition Surveillance Project" of Bangladesh conducted between September 2018 and October 2019. The study was designed and implemented to generate national and regional estimates of numerous health-related and nutritional indicators of six population groups, including 20–59-year-old men and women. Details of study design and methods have been described elsewhere.[17]

We calculated the required sample size to select study participants from the nonslum urban, rural, and slum areas from all administrative divisions of Bangladesh. We used a five-stage cluster sampling technique for rural clusters and a three-stage cluster sampling technique for nonslum urban and slum clusters. Rural clusters were chosen at random from each of the eight administrative divisions, following the steps outlined below: two districts from each division, followed by one subdistrict in each district, two unions in each selected subdistrict, and two clusters of 250–400 households in each union (a total of 64 rural sites). In the nonslum urban areas, we selected 16 wards (1–2 wards in each division, depending on population size), and from each ward, a cluster of 250–400 households was selected. The Census of Slum Areas and Floating Population 2014 was used to select study sites in slum areas.[18] Two slums or slum segments were randomly selected from the Dhaka and Chattogram divisions and one slum or slum segments from each of the remaining six divisions. There were 250–400 households in each slum or slum segment. Accordingly, we randomly selected 64 rural clusters, 16 nonslum urban clusters, and 10 slum clusters.

We determined the sample size to obtain national, subnational, and slum representative prevalence estimates for the key variables of the study. As per the initial sampling plan, there were 90 clusters and we were required to collect data from 62 participants for each population group from each cluster and thus the total sample size for each of the population groups was $(90 \times 62 = 5580)$. However, one of the designated clusters was common for nonslum urban and slum areas, and we had to drop seven clusters due to unavoidable administrative and financial constraints. Therefore, we could collect data from 82 clusters. As per the sample size estimation described previously,[17] we were required to collect data from 5084 men and 5084 women from the 20- to 59-year age group. However, we analyzed data from 4917 men and 4905 women in the 20–59-year age group (Figure 1).

2.2 | Study procedures and data collection

First, in the clusters, we conducted household visits to prepare the list of eligible participants from the population group. Then, we randomly selected participants for all population groups from each cluster with a condition that not more than one participant from each population group was recruited from any household. Lastly, face-to-face interviews with the randomly selected participants were performed. The data collectors and supervisors received a 5-day training on interview techniques, anthropometry, and blood pressure measurement. Data collection was done using tablet computers and a customized SurveyCTO application. Height was measured using locally made stadiometers, weight was measured using a TANITA UM-070 weighing scale, waist circumference was measured using measuring tapes, and blood pressure was measured using Omron HEM 7120. We followed the Food and Nutrition Technical Assistance anthropometry manual for anthropometric measurements.[19] The data collection tools were pretested, 5% of interviews were directly observed and 5% of research participants were reinterviewed to ensure data quality.

2.3 | Outcome measures

The outcome variables for this paper were NCD risk factors: tobacco consumption, IPA, insufficient fruit and vegetable intake, overweight and obesity, central obesity, hypertension, self-reported diabetes, and clustering (coexistence) of NCDs risk factors. A participant was considered a tobacco user if he/she smoked or consumed any tobacco products (smoked and/or smokeless) at least once daily in the last 30 days from the interview. IPA was defined by the 2010 WHO guidelines. According to the guideline, people aged 18–64 and ≥65 years are required to perform a minimum of 150 min of moderate intensity, or 75 min of vigorous intensity, or an equivalent combination of physical activity weekly.[20] Insufficient intake of fruits and vegetables was defined as the intake of less than five servings of fruits and vegetables in a day of a typical week. We calculated the Body Mass Index (BMI) by BMI = Weight (kg)/Height^2 (m) and categorized participants as underweight (BMI < 18.5 kg/m^2), normal weight (BMI 18.5–22.9 kg/m^2), and overweight or obese (BMI ≥ 23.0 kg/m^2).[21] Central obesity was defined as a waist circumference of ≥90 cm in males and ≥80 cm in females.[22] Hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg or if the participants were diagnosed as hypertensive by

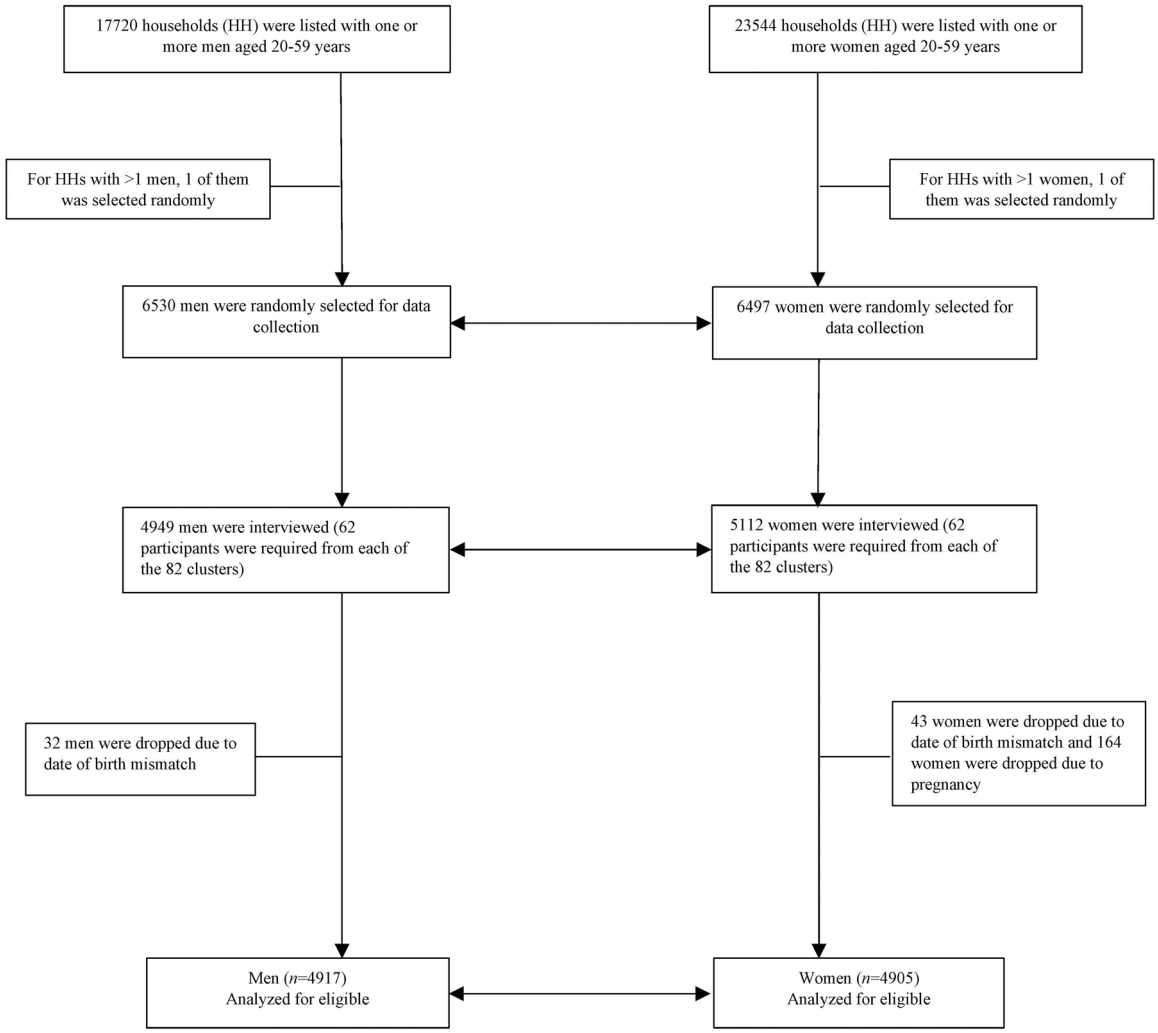

FIGURE 1 Study flowchart showing the process of selection of study participants.

any trained healthcare provider (self-reported).[23] Diabetes was defined as the participants were diagnosed as diabetic by any trained healthcare provider (self-reported).

2.4 | Other measures

We collected data on household assets, livestock, land ownership, remittance income, food security, water, sanitation, and hygiene practices using the household module of the data collection questionnaire. The household wealth index was defined and calculated using principal component analysis as guided in the Bangladesh Demographic and Health Survey procedures,[24] and described in one of our previous articles.[25] Food security was assessed at the household level using the Household Food Insecurity Access Scale and categorized as "food secure," "mild food insecure," "moderate food insecure," and "severe food insecure" households. Details of the food security assessment have been described elsewhere.[25,26]

2.5 | Statistical analysis

Data cleaning and analysis were done using STATA 17.0 (Stata Corp). We estimated the weighted prevalence of selected behavioral and clinical NCD risk factors. All analyses were done separately for 20–59 year-old men and women as gender differentials for NCD risk factors are programmatically important. We analyzed the coexistence of multiple risk factors among the study participants. We carried out multivariable logistic regression to identify the factors associated with having three or more risk factors. The variables having a p value of ≤0.2 in univariate logistic regression were included in the multivariable analysis.[27] Multicollinearity was checked and we found that the correlation

coefficients for all these variables were below 0.5, which indicates no significant correlation among variables.

3 | RESULTS

3.1 | Sociodemographic background

A total of 9822 (4917 men and 4905 women) individuals participated in this study. Of the total participants, 50.1% were men, and 49.9% were women (Table 1). More than one-fourth (27.7%) of the respondents belonged to the 20–29-year age group, and 15.2% of the study participants were in the 50–59-year age group. Nearly three-fourths of the respondents were from rural areas (70.3%). Most of the study participants (88.6%) were married and Muslims (85.7%). Three out of 10 study participants had no formal education. As per the food security status, 59.4% of the study participants were from food-secure households.

3.2 | Prevalence and distribution of risk factors

The prevalence of selected behavioral and clinical risk factors among the study participants is displayed in Figures 2 and 3. The prevalence of risk factors was stratified by the respondent's age, place of residence, marital status, education level, household food security status, and wealth index (Tables S1 and S2).

The overall prevalence of any tobacco consumption was 38.3% (95% CI 35.1%–41.6%) with a noticeable sex difference (men, 54.8%; women, 25.9%; $p < 0.01$). For the prevalence of tobacco consumption, an increasing trend was observed with the increase of age for both sexes. Nearly half (48.0%) of the slum dwellers were tobacco consumers. For both women and men, the prevalence of tobacco consumption was higher among the respondents with no formal education and lower among those who completed secondary or above. Compared with women, men had a high prevalence of tobacco consumption in all the strata of household food security status, which was also true for the wealth quintile (Table S1).

Almost 14% (95% CI 10.3%–17.7%) of the respondents were having IPA, with a striking difference between the men and women (men, 20.1%; women, 8.7%; $p < 0.01$). The prevalence of IPA increased with age among women, with the highest prevalence among the 50–59-year group. Respondents from nonslum urban areas had a higher prevalence of IPA for both men and women. Respondents with complete secondary or above education level had the highest prevalence of IPA. The proportion of men with IPA increased with the increase in education level; however, no such pattern was observed for women (Table S1).

More than 87% (95% CI 83.3%–90.1%) of the respondents consumed less than the recommended five servings of vegetables and fruits per day, with a slightly higher prevalence among women (83.0% vs. 90.2%, $p < 0.01$). The prevalence of inadequate fruits and vegetables intake was similar among the different strata of all socioeconomic variables (Table S1).

Overall, the prevalence of overweight and obesity was 42.3% (95% CI 39.3%–45.4%). Overweight or obesity was more prevalent among women (men, 33.9%; women, 48.6%; $p < 0.01$). In addition, a high prevalence of overweight and obesity was also observed among the nonslum urban dwellers (overall 60.2%, 69.8% in women vs. 49.4% in men, $p < 0.01$). A high prevalence of overweight and obesity among women in comparison to men was also observed in all the categories of education level, household food security status, and wealth quintile (Table S2).

Thirty-six percent (95% CI 33.2%–38.8%) of the respondents had central obesity with a significant sex difference (men, 19.4%; women, 48.5%; $p < 0.01$). The prevalence of central obesity was significantly higher in women than in men among different strata of all socioeconomic variables (Table S2).

More than one-fifth (21.9%; 95% CI 19.5%–24.6%; $p < 0.01$) of the respondents were diagnosed as hypertensive, and hypertension was more prevalent among women (24.4% vs 18.6%, $p < 0.01$). The prevalence of hypertension increased with an increase in age for both men and women, and the prevalence was higher in women for all the age groups (Table S2).

Around 5% (95% CI 4.1%–5.9%) of respondents were documented as diabetic (self-reported), with a higher prevalence among the women. The self-reported diabetes was higher among women than men for all the education groups. In addition, the prevalence of self-reported diabetes increased with the wealth index for both men and women, and once again, women had a higher prevalence of diabetes in comparison to men in all wealth quintiles (Table S2).

3.3 | Prevalence and factors associated with clustering of risk factors

We examined the clustering of risk factors among the participants. The prevalence of having at least one risk factor, at least two risk factors, at least three risk factors, at least four risk factors, and at least five risk factors among men was 97.0%, 73.8%, 37.1%, 17.3%, and 6.1%, respectively (Figure 4). In contrast, the prevalence among women was 98.2%, 73.6%, 50.8%, 22.3%, and 6.7%, respectively (Figure 4). The gender-stratified prevalence of the NCD risk factors clustering according to the socioeconomic characteristics is presented in Table 2. Men had the highest rate of coexistence of multiple risk factors in all the age groups, education

TABLE 1 Sociodemographic characteristics of the study population by sex.

	Total (n = 9822)		Men (n = 4917)		Women (n = 4905)	
Characteristics	***n***	**%**	***n***	**%**	***n***	**%**
Age of the respondent (years)						
20–29	2723	27.72	1243	25.28	1480	30.17
30–39	3284	33.43	1572	31.97	1712	34.90
40–49	2323	23.65	1243	25.28	1080	22.02
50–59	1492	15.19	859	17.47	633	12.91
Place of residence						
Rural	6903	70.28	3483	70.84	3420	69.72
Nonslum urban	1718	17.49	833	16.94	885	18.04
Slum	1201	12.23	601	12.22	600	12.23
Marital status						
Ever married[a]	8699	88.57	4247	86.37	4452	90.76
Never married	1123	11.43	670	13.63	453	9.24
Religion						
Muslim	8420	85.73	4195	85.32	4225	86.14
Other than Muslim[b]	1402	14.27	722	14.68	680	13.86
Educational status						
No education	2957	30.11	1424	28.96	1533	31.25
Partial primary	1354	13.79	704	14.32	650	13.25
Complete primary	1434	14.60	700	14.24	734	14.96
Partial secondary	2214	22.54	985	20.03	1229	25.06
Complete SSC or more	1863	18.97	1104	22.45	759	15.47
Household food security						
Food secure	5836	59.43	2982	60.66	2854	58.20
Mild food insecure	2363	24.06	1182	24.04	1181	24.08
Moderate food insecure	493	5.02	241	4.90	252	5.14
Severe food insecure	1128	11.49	511	10.39	617	12.58
Wealth quintile						
Poorest	1972	20.08	987	20.08	985	20.09
Poorer	1962	19.98	982	19.98	980	19.99
Middle	1965	20.01	985	20.04	980	19.99
Richer	1964	20.00	983	20.00	981	20.01
Richest	1956	19.92	979	19.91	977	19.93

Abbreviation: SSC, secondary school certificate.

[a]Ever married includes currently married and widow, divorced, and separated.

[b]Other than Muslim includes Hindu, Christian, Buddhist, and others.

levels, and among all strata of household food security status. Moreover, the prevalence of coexistence of multiple NCDs risk factors dropped sharply after having at least three risk factors. The prevalence of risk factor clustering increased with age for both men and women. The coexistence of at least three, four, and five risk factors among nonslum urban men and women was higher than participants living in rural and slum areas. The prevalence of at least three, four, and five risk factors increased with the education level of the men.

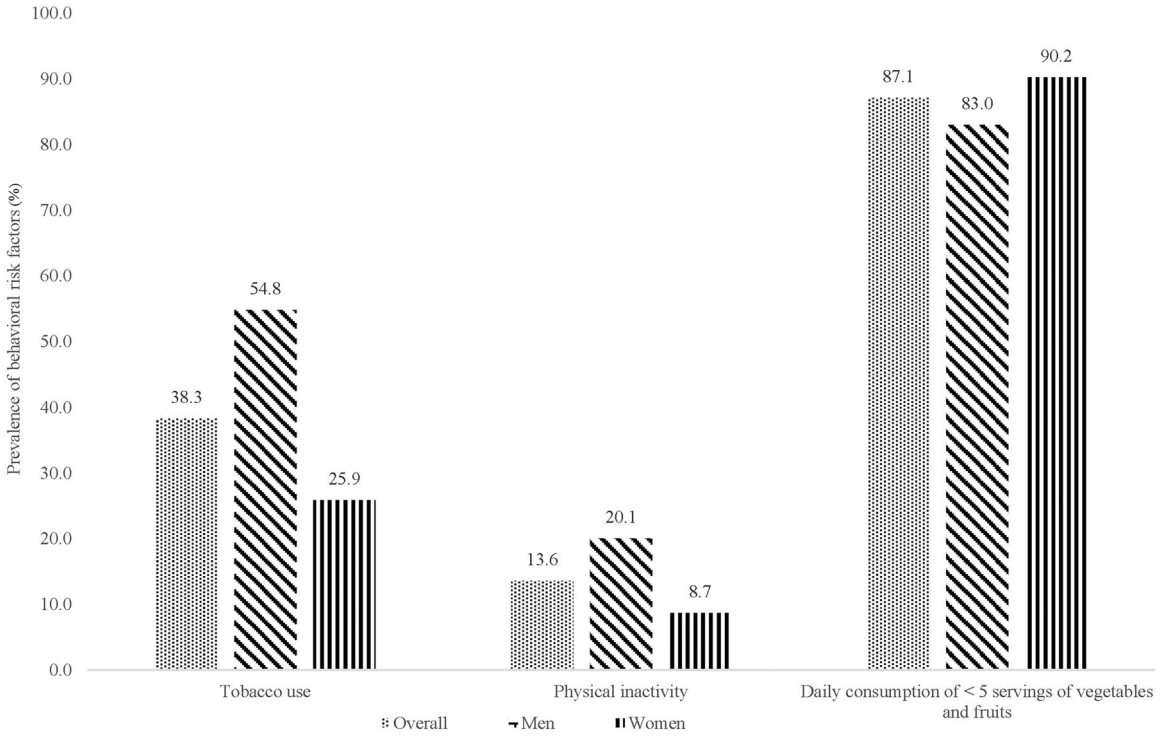

FIGURE 2 Prevalence of behavioral risk factors for noncommunicable diseases among adult men and women in Bangladesh.

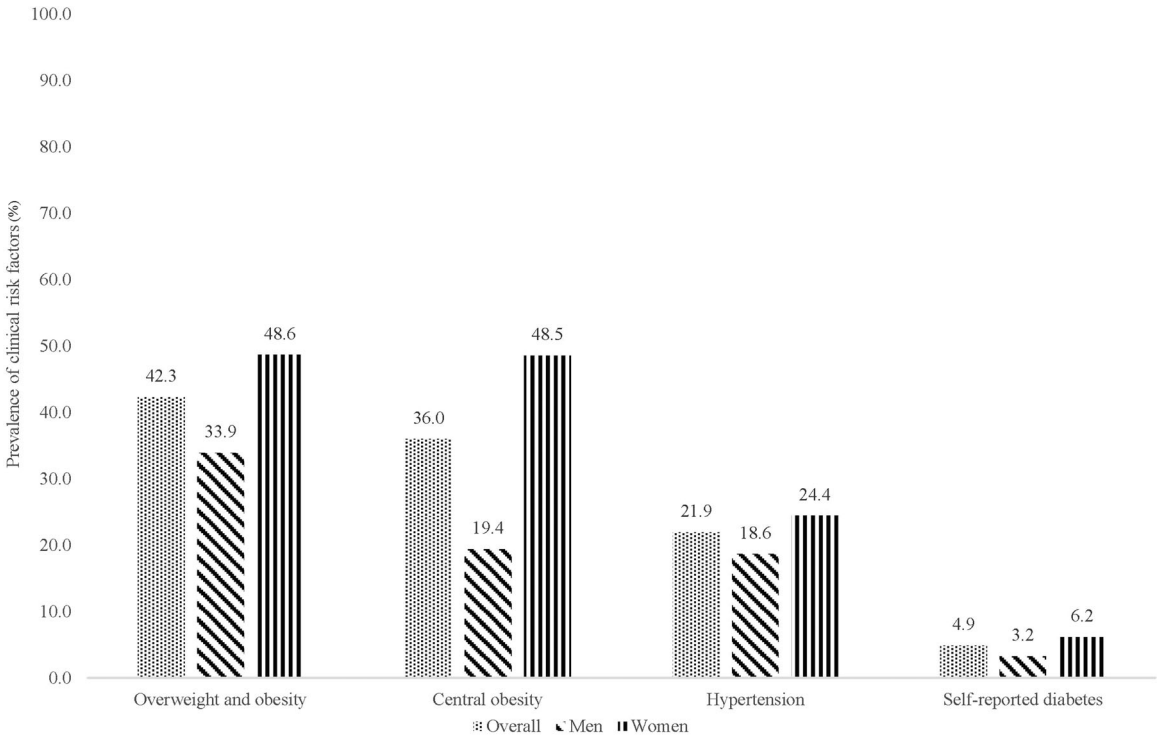

FIGURE 3 Prevalence of clinical risk factors for noncommunicable diseases among adult men and women in Bangladesh.

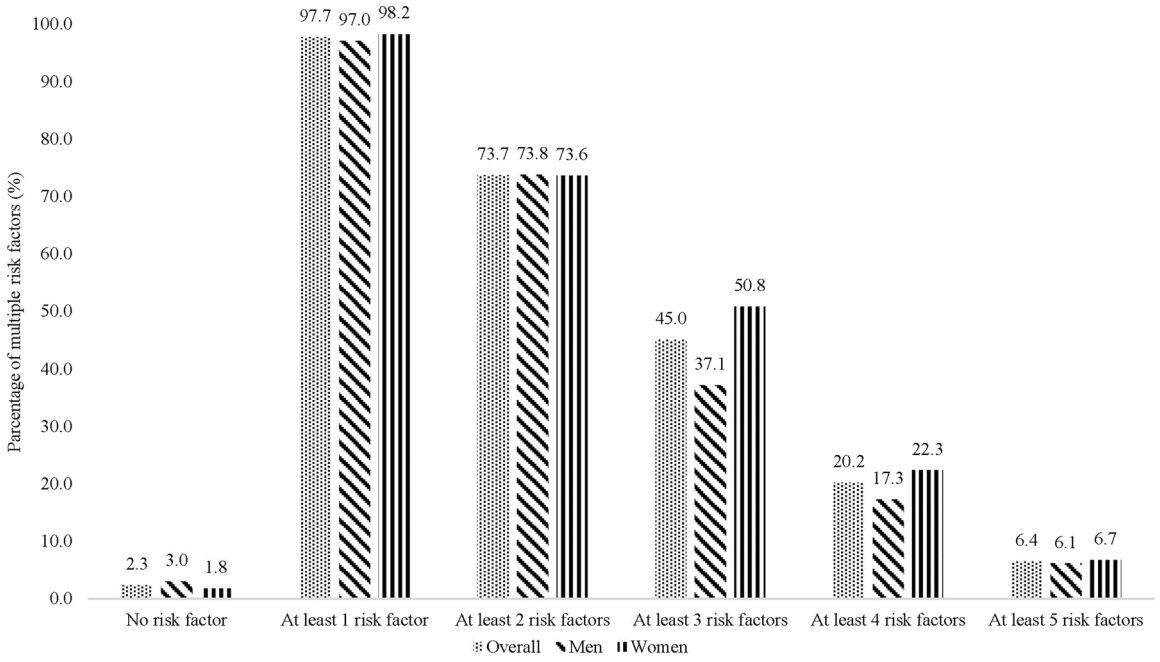

FIGURE 4 Prevalence of the presence of multiple risk factors among adult men and women in Bangladesh.

However, no such trend was observed for women. The presence of at least five risk factors was highest among men and women in food-secure households. For men, the presence of at least four risk factors increased with household wealth status (Table 2).

Gender-stratified associations of the clustering of NCD risk factors with different socioeconomic conditions were examined (Table 3). The presence of at least three risk factors was considered a threshold level, as the prevalence rate sharply dropped after this. Table 3 shows the univariate and multivariable analysis results with 95% confidence interval (CI) of odds ratio (OR) for the association of socioeconomic factors with the coexistence of at least three risk factors. The odds of having at least three risk factors increased with age, and the highest odds were observed among the 50–59-year-old respondents compared with 20–29 years old (for men: adjusted odds ratio [AOR] 3.6; 95% CI 2.9, 4.5; $p < 0.01$; for women: AOR 3.9; 95% CI 3.1, 4.9; $p < 0.01$). Both men and women from nonslum urban areas (for men: AOR 2.6; 95% CI 2.1, 3.1; $p < 0.01$; for women: AOR 2.5; 95% CI 2.1, 3.1; $p < 0.01$) and slum areas (for men: AOR 1.8; 95% CI 1.5, 2.2; $p < 0.01$; for women: AOR 1.9; 95% CI 1.6, 2.3; $p < 0.01$) had higher odds of having at least three NCD risk factors compared with the respondents living in rural areas. Ever-married men participants had 1.7 times (AOR 1.7; 95% CI 1.4, 2.2; $p < 0.01$) higher odds of having at least three NCD risk factors compared with never-married men, although no such association existed for women. For both sexes, the odds of having at least three risk factors increased with the increased level of education. Both men and women respondents from the richest socioeconomic quintile had higher odds of having at least three risk factors (for men: AOR 2.0; 95% CI 1.6, 2.5; $p < 0.01$; for women: AOR 1.7; 95% CI 1.4, 2.1; $p < 0.01$) compared with the lowest socioeconomic quintile. We found no association between household food security status and the odds of having at least three risk factors for both sexes.

4 | DISCUSSION

In this study, we assessed the prevalence of selected behavioral and clinical risk factors of NCD and factors associated with clustering of NCD risk factors among 20–59-year-old men and women in rural, nonslum urban, and slum areas in Bangladesh. We observed a high prevalence of NCD risk factors, particularly for tobacco consumption, inadequate fruits and vegetables consumption, overweight and obesity, central obesity, and hypertension, which persisted across gender, age, and socioeconomic status. These findings necessitate an urgent need for health education and health promotion interventions to reduce the future burden of NCDs in Bangladesh.

In this study, we observed a lower prevalence of tobacco use (38.3%) than the most recent nationwide NCD risk factors survey 2018 (STEPS Survey) in Bangladesh (43.7%). However, the STEPS Survey was conducted among a different age group (18–69 years) which might explain the difference.[11] A large number of NCDs, including stroke, heart attack, lung cancer, oral cancer, laryngeal cancer, chronic obstructive pulmonary diseases, and Buerger's disease, are attributable to tobacco use.[28] Our findings on current tobacco use in

TABLE 2 Clustering of NCD risk factors among men and women (aged 20–59 years) in Bangladesh.

	Men						Women					
Character-istics	**No risk factor**	**At least 1 risk factor**	**At least 2 risk factors**	**At least 3 risk factors**	**At least 4 risk factors**	**At least 5 or more risk factors**	**No risk factor**	**At least 1 risk factor**	**At least 2 risk factors**	**At least 3 risk factors**	**At least 4 risk factors**	**At least 5 or more risk factors**
Age of the respondent (years)												
20–29	4.40 [2.84,6.76]	95.60 [93.24,97.16]	61.00 [56.11,65.68]	22.43 [18.80,26.53]	7.45 [4.99,10.97]	2.04 [1.01,4.06]	3.21 [2.13,4.81]	96.79 [95.19,97.87]	56.38 [51.64,61.02]	35.50 [30.50,40.84]	10.98 [8.22,14.52]	1.36 [0.82,2.24]
30–39	2.78 [1.58,4.84]	97.22 [95.16,98.42]	75.33 [70.35,79.71]	36.54 [31.60,41.79]	17.02 [13.38,21.41]	4.74 [3.41,6.54]	1.51 [0.82,2.76]	98.49 [97.24,99.18]	76.08 [71.88,79.82]	53.90 [49.64,58.10]	20.37 [16.87,24.39]	4.95 [3.71,6.57]
40–49	2.27 [1.37,3.72]	97.73 [96.28,98.63]	80.33 [75.42,84.46]	45.57 [41.04,50.17]	21.84 [18.67,25.37]	8.23 [6.09,11.03]	1.09 [0.54,2.22]	98.91 [97.78,99.46]	85.64 [80.67,89.50]	61.56 [56.50,66.38]	31.89 [26.35,38.00]	10.63 [7.34,15.17]
50–59	2.00 [1.08,3.65]	98.00 [96.35,98.92]	82.48 [77.74,86.38]	49.98 [42.33,57.62]	26.94 [20.79,34.12]	11.78 [8.11,16.81]	0.32 [0.08,1.21]	99.68 [98.79,99.92]	88.25 [83.54,91.75]	61.94 [57.00,66.64]	37.40 [32.28,42.83]	16.32 [11.76,22.20]
Place of residence												
Rural	3.08 [2.15,4.41]	96.92 [95.59,97.85]	72.95 [69.42,76.21]	35.79 [31.94,39.84]	16.38 [13.59,19.61]	5.61 [4.32,7.25]	1.84 [1.23,2.74]	98.16 [97.26,98.77]	72.90 [69.87,75.73]	49.86 [46.59,53.12]	21.22 [18.63,24.06]	6.18 [4.88,7.79]
Nonslum urban	0.52 [0.15,1.81]	99.48 [98.19,99.85]	90.98 [78.53,96.53]	67.22 [49.17,81.29]	37.16 [27.11,48.46]	17.20 [12.63,22.9-9]	0.60 [0.13,2.61]	99.40 [97.39,99.87]	91.24 [75.62,97.22]	75.44 [61.54,85.51]	51.21 [30.76,71.26]	20.02 [12.78,29.96]
Slum	1.66 [0.53,5.07]	98.34 [94.93,99.47]	87.10 [78.91,92.42]	46.40 [32.30,61.11]	23.61 [13.29,38.40]	6.74 [3.06,14.20]	0.56 [0.11,2.88]	99.44 [97.12,99.89]	81.74 [77.67,85.20]	60.32 [56.65,63.86]	31.78 [26.99,36.99]	9.82 [7.48,12.78]
Marital status												
Ever married[a]	2.90 [2.02,4.14]	97.10 [95.86,97.98]	77.20 [73.55,80.48]	40.22 [35.82,44.77]	19.28 [16.30,22.65]	6.85 [5.41,8.62]	1.93 [1.30,2.87]	98.07 [97.13,98.70]	74.32 [71.35,77.09]	51.39 [48.07,54.69]	22.13 [19.33,25.21]	6.48 [5.16,8.11]
Never married	3.32 [1.85,5.87]	96.68 [94.13,98.15]	57.20 [51.84,62.39]	22.28 [18.34,26.79]	7.55 [4.54,12.30]	2.44 [1.04,5.62]	0.44 [0.12,1.62]	99.56 [98.38,99.88]	66.61 [58.31,73.99]	45.34 [39.43,51.39]	24.09 [19.41,29.49]	8.57 [5.25,13.67]
Religion												
Muslim	2.83 [1.94,4.11]	97.17 [95.89,98.06]	73.24 [69.47,76.70]	36.87 [32.80,41.13]	17.00 [14.03,20.45]	5.97 [4.59,7.73]	1.60 [1.02,2.51]	98.40 [97.49,98.98]	74.23 [71.18,77.05]	51.64 [48.25,55.02]	23.23 [20.23,26.53]	7.16 [5.66,9.00]
Other than Muslim[b]	3.71 [1.80,7.49]	96.29 [92.51,98.20]	76.51[71.00,-81.26]	38.51 [31.56,45.95]	18.63 [14.24,23.99]	6.74 [4.01,11.10]	2.93 [1.70,5.00]	97.07 [95.00,98.30]	69.66 [63.31,75.35]	45.70 [39.16,52.39]	16.76 [11.86,23.15]	3.8 [1.94,7.32]
Education status												
No education	2.13 [1.25,3.61]	97.87 [96.39,98.75]	75.28 [71.20,78.96]	31.83 [26.69,37.46]	12.23 [10.10,14.72]	3.75 [2.34,5.96]	0.89 [0.43,1.85]	99.11 [98.15,99.57]	80.86 [78.18,83.27]	53.67 [49.85,57.44]	26.14 [22.80,29.77]	8.71 [6.48,11.62]

TABLE 2 (Continued)

Characteristics	Men						Women					
	No risk factor	At least 1 risk factor	At least 2 risk factors	At least 3 risk factors	At least 4 risk factors	At least 5 or more risk factors	No risk factor	At least 1 risk factor	At least 2 risk factors	At least 3 risk factors	At least 4 risk factors	At least 5 or more risk factors
Primary incomplete	3.25 [1.86,5.60]	96.75 [94.40,98.14]	73.93 [69.66,77.80]	34.82 [28.93,41.21]	15.87 [11.87,20.91]	5.74 [3.56,9.12]	1.67 [0.78,3.52]	98.33 [96.48,99.22]	72.94 [67.65,77.66]	50.28 [45.43,55.12]	23.29 [18.32,29.13]	6.97 [4.51,10.64]
Complete primary	4.08 [2.17,7.55]	95.92 [92.45,97.83]	72.57 [66.37,78.01]	37.04 [30.86,43.66]	19.02 [13.09,26.80]	4.22 [2.53,6.96]	2.15 [1.10,4.13]	97.85 [95.87,98.90]	76.64 [70.82,81.60]	51.49 [46.26,56.69]	18.26 [13.62,24.03]	5.93 [3.58,9.66]
Secondary incomplete	4.25 [2.55,6.99]	95.75 [93.01,97.45]	74.72 [69.95,78.97]	38.26 [33.81,42.91]	17.57 [13.67,22.29]	6.72 [4.73,9.45]	2.63 [1.56,4.41]	97.37 [95.59,98.44]	67.80 [62.50,72.68]	47.60 [41.89,53.37]	19.14 [15.69,23.15]	4.72 [3.21,6.87]
Complete secondary or above	1.99 [1.02,3.82]	98.01 [96.18,98.98]	71.37 [65.86,76.30]	45.42 [39.02,51.98]	23.95 [18.41,30.53]	10.45 [7.66,14.10]	1.84 [0.81,4.13]	98.16 [95.87,99.19]	66.64 [59.34,73.22]	50.69 [42.65,58.71]	23.42 [17.57,30.49]	8.61 [6.26,11.73]
Household food security												
Food secure	3.01 [2.06,4.37]	96.99 [95.63,97.94]	74.08 [69.48,78.21]	40.95 [36.53,45.53]	20.06 [16.91,23.65]	7.52 [5.97,9.44]	1.89 [1.22,2.91]	98.11 [97.09,98.78]	72.52 [68.93,75.83]	50.38 [46.50,54.26]	22.25 [18.67,26.29]	6.95 [5.30,9.08]
Mild food insecure	3.73 [2.24,6.14]	96.27 [93.86,97.76]	70.34 [65.82,74.50]	31.68 [27.46,36.23]	11.72 [8.16,16.56]	3.13 [1.91,5.09]	2.28 [1.26,4.10]	97.72 [95.90,98.74]	73.60 [68.87,77.84]	48.96 [44.38,53.55]	20.67 [16.90,25.03]	7.29 [4.98,10.53]
Moderate food insecure	0.23 [0.03,1.79]	99.77 [98.21,99.97]	82.69 [72.29,89.75]	37.88 [30.40,45.98]	18.58 [9.49,33.18]	6.88 [2.18,19.66]	0.40 [0.11,1.43]	99.60 [98.57,99.89]	76.04 [67.16,83.12]	48.40 [41.37,55.49]	20.79 [14.59,28.73]	5.63 [2.78,11.07]
Severe food insecure	2.14 [0.99,4.58]	97.86 [95.42,99.01]	75.98 [71.12,80.25]	26.52 [20.46,33.62]	12.99 [8.85,18.68]	4.16 [1.97,8.58]	0.99 [0.43,2.28]	99.01 [97.72,99.57]	77.68 [72.13,82.40]	57.29 [48.39,65.74]	26.36 [20.74,32.86]	4.70 [3.01,7.27]
Wealth quintile												
Poorest	3.45 [2.04,5.79]	96.55 [94.21,97.96]	70.53 [64.68,75.77]	30.05 [25.17,35.44]	12.04 [8.91,16.07]	3.95 [2.42,6.36]	1.71 [0.87,3.32]	98.29 [96.68,99.13]	70.38 [66.05,74.37]	41.55 [35.37,48.02]	14.67 [11.09,19.15]	4.23 [2.47,7.14]
Poorer	3.42 [2.22,5.24]	96.58 [94.76,97.78]	71.40 [67.03,75.41]	33.39 [29.00,38.10]	13.18 [9.97,17.22]	3.67 [2.37,5.63]	2.60 [1.47,4.56]	97.40 [95.44,98.53]	70.90 [66.14,75.24]	50.20 [46.18,54.22]	22.68 [18.77,27.13]	6.42 [4.74,8.63]
Middle	3.62 [2.14,6.07]	96.38 [93.93,97.86]	68.38[62.34, 73.86]	29.2[24.56, 34.32]	15.01[11.38, 19.56]	4.98[3.16, 7.77]	1.65[0.92, 2.93]	98.35[97.07, 99.08]	73.27[67.38, 78.44]	51.16[46.54, 55.76]	23.17[18.97, 27.98]	6.78 [4.88,9.34]
Richer	2.30 [1.22,4.32]	97.70 [95.68,98.78]	77.28 [70.94,82.58]	44.16 [36.88,51.70]	21.83 [16.73,27.96]	8.64 [5.85,12.59]	1.39 [0.67,2.89]	98.61 [97.11,99.33]	78.54 [72.32,83.67]	53.53 [47.12,59.82]	22.03 [16.86,28.25]	5.73 [3.71,8.76]
Richest	1.28 [0.59,2.73]	98.72 [97.27,99.41]	86.73 [82.08,90.31]	58.09 [50.24,65.56]	30.82 [24.44,38.03]	12.42 [9.34,16.32]	1.34 [0.64,2.78]	98.66 [97.22,99.36]	77.08 [69.78,83.04]	62.66 [55.19,69.57]	33.18 [24.12,43.70]	12.25 [9.00,16.45]

[a]Ever married includes currently married, widow, divorced and separated.

[b]Other than Muslim includes Hindu, Christian, Buddhist, and others.

TABLE 3 Association between sociodemographic characteristics and copresence of at least three noncommunicable disease risk factors.

	Men				Women			
Characteristics	**COR[a] [95% CI]**	***p* Value**	**AOR[b] [95% CI]**	***p* Value**	**COR[a] [95% CI]**	***p* Value**	**AOR[b] [95% CI]**	***p* Value**
Age of the respondent (years)								
20–29	Ref[c]		Ref		Ref		Ref	
30–39	1.99 [1.69,2.34]	<0.01	2.06 [1.70,2.50]	<0.01	2.32 [2.02,2.68]	<0.01	2.68 [2.30,3.13]	<0.01
40–49	2.62 [2.21,3.10]	<0.01	2.98 [2.43,3.66]	<0.01	2.95 [2.51,3.48]	<0.01	3.86 [3.21,4.65]	<0.01
50–59	2.89 [2.41,3.47]	<0.01	3.62 [2.90,4.52]	<0.01	2.76 [2.28,3.35]	<0.01	3.91 [3.13,4.88]	<0.01
Place of residence								
Rural	Ref		Ref		Ref		Ref	
Nonslum urban	3.52 [3.00,4.12]	<0.01	2.57 [2.14,3.09]	<0.01	3.11 [2.64,3.67]	<0.01	2.53 [2.10,3.06]	<0.01
Slum	1.56 [1.31,1.86]	<0.01	1.80 [1.48,2.17]	<0.01	1.68 [1.41,2.01]	<0.01	1.89 [1.56,2.29]	<0.01
Marital status								
Never married	Ref		Ref		Ref		Ref	
Ever married[d]	2.02 [1.69,2.42]	<0.01	1.74 [1.38,2.18]	<0.01	1.07 [0.88,1.30]	0.482		
Religion								
Muslim	Ref		Ref		Ref		Ref	
Other than Muslim[e]	1.01 [0.86,1.19]	0.902			0.69 [0.58,0.81]	<0.01	0.71 [0.59,0.84]	<0.01
Education of the respondents								
No education	Ref		Ref		Ref		Ref	
Primary incomplete	1.27 [1.05,1.54]	0.012	1.48 [1.21,1.82]	<0.01	1.08 [0.90,1.30]	0.388	1.37 [1.12,1.67]	0.002
Complete primary	1.51 [1.25,1.82]	<0.01	1.65 [1.35,2.02]	<0.01	0.82 [0.69,0.98]	0.027	1.07 [0.88,1.30]	0.483
Secondary incomplete	1.61 [1.36,1.91]	<0.01	1.73 [1.44,2.08]	<0.01	0.92 [0.79,1.07]	0.299	1.38 [1.15,1.66]	<0.01
Complete secondary or above	2.37 [2.01,2.79]	<0.01	2.57 [2.11,3.14]	<0.01	1.28 [1.07,1.53]	0.006	1.54 [1.23,1.92]	<0.01
Household food security								
Food secure	Ref		Ref		Ref		Ref	
Mild food insecure	0.55 [0.48,0.64]	<0.01	0.68 [0.58,0.80]	<0.01	0.75 [0.66,0.86]	<0.01	0.85 [0.73,0.98]	0.026
Moderate food insecure	0.66 [0.50,0.87]	0.003	0.88 [0.66,1.18]	0.388	0.59 [0.45,0.76]	<0.01	0.69 [0.52,0.91]	0.008
Severe food insecure	0.66 [0.54,0.80]	<0.01	0.81 [0.65,1.00]	0.047	0.91 [0.76,1.08]	0.288	0.97 [0.80,1.17]	0.761
Wealth quintile								
Poorest	Ref		Ref		Ref		Ref	
Poorer	1.00 [0.83,1.21]	0.985	1.07 [0.88,1.31]	0.477	1.12 [0.94,1.34]	0.217	1.20 [0.99,1.44]	0.059
Middle	1.08 [0.90,1.31]	0.398	1.07 [0.87,1.30]	0.524	1.29 [1.08,1.54]	0.005	1.27 [1.06,1.53]	0.012
Richer	1.83 [1.52,2.20]	<0.01	1.35 [1.11,1.65]	0.003	1.77 [1.48,2.12]	<0.01	1.42 [1.17,1.72]	<0.01
Richest	3.32 [2.76,3.99]	<0.01	2.02 [1.64,2.49]	<0.01	2.61 [2.17,3.13]	<0.01	1.72 [1.39,2.12]	<0.01

[a]Crude odds ratio.

[b]Adjusted odds ratio: men—adjusted for age of the respondents, place of residence, marital status, education, household food security, and wealth index; women—adjusted for age of the respondents, place of residence, religion, education, household food security, and wealth index.

[c]Reference category.

[d]Ever married includes currently married and widow, divorced, and separated.

[e]Other than Muslim includes Hindu, Christian, Buddhist, and others.

Bangladesh are also higher compared with tobacco use in neighboring countries, including India (28.6%),[29] Nepal (19.0%),[30] and Sri Lanka (25.8%).[31] Although the age groups were different among the studies, our findings still reflect a high magnitude of tobacco use in Bangladesh. In Bangladesh, a review of existing literature suggested a slight decrease in tobacco consumption in the last 10 years in Bangladesh; for instance, as per the STEPS Survey 2010, the prevalence of tobacco consumption was 54%.[32] Our study also reconfirmed the decline in tobacco use. Moreover, we observed that men had a higher prevalence of tobacco use (in any form) than women, which was also documented previously in Bangladesh.[13] Women's smoking is seen disrespectfully in Bangladesh, but for women, smokeless tobacco has more cultural recognition than smoking. Initially, smokeless tobacco was not included in the Tobacco Control Act of Bangladesh. Considering the health effects of smokeless tobacco, it was later incorporated into a revised version of the Tobacco Control Act of 2013.[33] We also found a higher prevalence of tobacco consumption among the slum population, similar to a previous study carried out in the slums of Dhaka city.[34] To address this high percentage of tobacco consumption, the Government of Bangladesh has increased the tax for tobacco products and restricted tobacco use in public places. However, the expected health benefits have not been achieved yet. High taxes for tobacco products might be insufficient in low-middle-income countries like Bangladesh, where the raw tobacco products are relatively lowly prized and widely available.[35]

IPA is an important predictor of NCDs. It has been suggested that moderate-intensity physical activity of a minimum of 150 min/week can reduce the risk of NCD-related mortality and morbidity.[36] Even a small amount of regular physical exercise showed health benefits for high BMI, hypertensive, and diabetic individuals.[37] We observed that 13.6% Bangladeshi people failed to achieve the recommended level of physical activity. This estimate is lower than the estimate of the STEPS 2018 survey (29.1%) among Bangladeshi adults. Our findings on the low rate of IPA can be supported by a global survey that found IPA has a low prevalence in low-socioeconomic status and low-middle-income countries.[38] In our study, women were more physically active than men, which is the opposite of the previous two NCD studies.[13,32] Nearly three-fourths of our respondents were from rural areas where a substantial proportion of women actively participate in farming activities, and walking is still the primary mode of transport, which may explain the differences. We also observed that younger men had a higher prevalence of IPA than the older age groups. IPA among the nonslum urban population was about six times higher than the rural population and three times higher than the slum population. Similar pattern on IPA prevalence was observed in rural, urban and slum populations in India.[39,40] Rapidly growing urbanization, unplanned construction, and lack of playgrounds and parks may contribute to the high prevalence of IPA in nonslum urban areas and in slums. We also observed that most of the physical activities in Bangladesh are work and/or household-related, and leisure time activities are rare. In Bangladesh, only 3% population participate in recreational physical activity.[41] The government should establish more infrastructures such as parks, gymnasiums, and sports clubs to encourage sufficient physical activity. Besides, a national guideline for physical activity should be developed considering the cultural and sociodemographic situation of the country.

A minimum of five servings (1 serving = 80 g) or 400 g of vegetables and fruits per day is recommended by WHO and can reduce the risk of obesity, CVDs, and diabetes.[42] We observed a very high prevalence of inadequate vegetable and fruit intake across all groups, gender, place of residence, education, food security, and wealth status. Our findings are congruent with the findings from the most recent STEPS Survey in Bangladesh. It is also evident that Bangladesh has the highest prevalence of inadequate vegetable and fruit intake among the South Asian countries.[43] The government of Bangladesh should promote five servings of fruits and vegetables consumption all over the country, irrespective of age, gender, and wealth status.

We also reported a higher prevalence of overweight and obesity, and central obesity in Bangladeshi women and men, with a higher prevalence among the nonslum urban dwellers and high wealth status participants. The reported prevalence of overweight and obesity in rural areas was 10.2% in 2010,[32] and 41.5% in the present study, indicating that interventions for reducing overweight and obesity should be strengthened. Moreover, central obesity is a special characteristic among the South Asian population.[44] Like overweight and obesity, central obesity was also more prevalent among women in our study. It has also been documented that central obesity is more prevalent among women in low-middle-income countries.[45] The high burden of overweight and obesity among the younger age groups observed in our study is alarming. Importance should be given to educational programs in the community to increase awareness of healthy food habits and regular physical activity.

High blood pressure is also a documented risk factor for heart disease and stroke. A meta-analysis of population studies from 1995 to 2009 in Bangladesh stated that the prevalence of hypertension was 13.5%.[46] The 2013 STEPS Survey reported a prevalence of 21%;[13] however, in our study, we reported the prevalence of hypertension as 25.2%. This growing trend of hypertension over the decade may result from a rapid change in the lifestyle of Bangladeshi people. Moreover, the intake of dietary salt is very high in Bangladesh. The

mean amount of salt consumption is 16.5 g/day, which is more than three times the amount that the WHO recommends (<5 g/day).[11] This might partly explain the high prevalence of hypertension, as observed in this study. As documented in previous studies, differences in lifestyle factors like low physical activity and high waist circumference might put women at more risk of hypertension than men.[47] Immediate measures need to be taken to flatten the increasing trend of hypertension. Bangladesh has a good infrastructure for the primary healthcare system in the rural areas. Therefore, an approach through the primary healthcare system to detect and treat hypertension can be helpful. A high level of physical activity in our sample could explain the low prevalence of diabetes though self-reported diabetes is not a good indicator for diabetes prevalence. The recent STEPS Survey reported that the diabetes mellitus prevalence among 18–69-year-old people is 8.4%.[11]

We also observed that only 3.0% of adult men and 1.8% adult women were free from the NCD risk factors observed in our studies. Our findings indicate that the burden of NCDs is likely to increase further if the government does not properly address the NCD risk factors. In addition to the high prevalence of individual risk factors, the coexistence of multiple risk factors was also widely prevalent among the Bangladeshi population. We reported that the clustering of risk factors is higher among older participants for both men and women. In addition, clustering was higher among the nonslum urban and slum respondents and among the educated and wealthy respondents for both men and women. A previous analysis from the STEPS Survey results revealed that 38% of the Bangladeshi people had at least three risk factors similar to what we observed. This study also reported that clustering of NCD risk factors was associated with age, male sex, urban residence, and education level,[13] that also support our results. In the recent years, sedentary lifestyle has increased a lot among the Bangladeshi population, especially among the educated and wealthy person.[48] Educated and wealthy people tend to do brain work rather than physical work. That might explain this phenomenon in Bangladesh. Accordingly, our findings signify a considerable public health challenge and an opportunity for interventions focusing on the needs of specific subgroups and populations and effective resource allocation to address the coexistence of multiple risk factors.

A major strength of our study is the large sample size and the inclusion of rural, nonslum urban, and slum areas. Our study could be the first nationally representative study of NCD risk factors among the slum population. However, in this study we had several limitations. First, it was a cross-sectional study and the associations shown should be judged with caution due to the lack of temporality. Second, behavioral risk factors like tobacco use were self-reported; therefore, the prevalence might have been underestimated and might not be free from social desirability bias. Lastly, we did not measure the fasting blood glucose or HbA1c to confirm diabetes, therefore the self-reported prevalence of diabetes is lower than the actual prevalence of diabetes in Bangladesh.

5 | CONCLUSION

Our study presents the evidence on the status of NCD risk factors among the 20–59-year men and women in Bangladesh. We observed a significant gender difference in the prevalence of selected behavioral and clinical NCD risk factors. Moreover, we observed that age, place of residence, education, and wealth status were associated with the coexistence of at least three NCD risk factors. These findings are similar for both men and women. Our findings suggest the possibility of interventions focusing on multiple risk factors concurrently or sequentially, especially in cases where clustering of risk factors is evident.

Bangladesh has already taken several steps to tackle NCDs. A population-based, multisectoral approach utilizing the primary healthcare system for screening, early detection, and management of both behavioral and clinical risk factors and the coexistence of multiple risk factors is an urgent need for the prevention and control of NCDs in Bangladesh. The policy makers should take necessary steps to encourage people, healthcare and nonhealthcare organizations to participate actively in the prevention and control activities of NCD risk factors. Programs should also be designed for specific population groups as the distribution of NCD risk factors and their clustering differ by gender, area of residence, and economic conditions.

AUTHOR CONTRIBUTIONS

Md. Mokbul Hossain and Abhijeet Roy conceptualized and conducted the data analysis and drafted the initial manuscript. Abu Abdullah Mohammad Hanif, Fahmida Akter, Mehedi Hasan, Md. Showkat Ali Khan, Abu Ahmed Shamim, Md. Mokbul Hossain, Mohammad Aman Ullah, S. M. Mustafizur Rahman, Mofijul Islam Bulbul, and Dipak Kumar Mitra were involved in the conceptualization and design of the survey, as well as reviewing and approving the final version of the manuscript. Md. Showkat Ali Khan, Abu Abdullah Mohammad Hanif, and Mokbul Hossain administered the survey. Malay Kanti Mridha led the conceptualization/design of the survey and supervision of the data collection, critically reviewed, and approved the final version of the manuscript. Md. Mokbul Hossain and Abhijeet Roy contributed equally.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data are available upon reasonable request. All such requests can be sent to the Institutional Review Board, BRAC James P Grant School of Public Health, BRAC University, Dhaka, Bangladesh, to the email address: irb-jpgsph@bracu.ac.bd.

ETHICS STATEMENT

We received the ethical clearance from the Institutional Review Board (IRB) (Reference number: 2018-020-IR) of the BRAC James P Grant School of Public Health, BRAC University, and Dhaka, Bangladesh. Before collecting data in the clusters, we conducted community sensitization meetings with locally influential people to obtain community consent. Informed written consent forms were administered for each participant. The participants were provided with information regarding the research, the respondents' rights, confidentiality, and their involvement as study participants.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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