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Risk factors for non-communicable diseases in Bangladesh: findings of the population-based cross-sectional national survey 2018

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ABSTRACT

Objectives To determine the national prevalence of risk factors of non-communicable diseases (NCD) in the adult population of Bangladesh.

Design The study was a population-based national cross-sectional study.

Setting This study used 496 primary sampling units (PSUs) developed by the Bangladesh Bureau of Statistics. The PSUs were equally allocated to each division and urban and rural stratum within each division.

Participants The participants were adults aged 18 to 69 years, who were usual residents of the households for at least 6 months and stayed the night before the survey. Out of 9900 participants, 8185 (82.7%) completed STEP-1 and STEP-2, and 7208 took part in STEP-3.

Primary and secondary outcome The prevalence of behavioural, physical and biochemical risk factors of NCD. Data were weighted to generate national estimates.

Results Tobacco use was significantly (p<0.05) higher in the rural (45.2%) than the urban (38.8%) population. Inadequate fruit/vegetable intake was significantly (p<0.05) higher in the urban (92.1%) than in the rural (88.9%) population. The mean salt intake per day was higher in the rural (9.0 g) than urban (8.9 g) population. Among all, 3.0% had no, 70.9% had 1 to 2 and 26.2% had ≥3 NCD risk factors. The urban population was more likely to have insufficient physical activity (adjusted OR (AOR): 1.2, 95% CI: 1.2 to 1.2), obesity (AOR: 1.5, 95% CI: 1.5 to 1.5), hypertension (AOR: 1.3, 95% CI: 1.3 to 1.3), diabetes (AOR: 1.6, 95% CI: 1.6 to 1.6) and hyperglycaemia (AOR: 1.1, 95% CI: 1.1 to 1.1).

Conclusions Considering the high prevalence of the behavioural, physical and biochemical risk factors, diverse population and high-risk group targeted interventions are essential to combat the rising burden of NCDs.

Strengths and limitations of this study

► The survey covered the entire country for the first time to estimate the prevalence of non-communicable diseases (NCD) risk factors comprising all the three steps of the WHO STEPS approach.
► Rigorous methodology and cross-matching the data with their physical and biochemical parameters helped us to generate country representative data by controlling bias.
► Comprehensive findings on behavioural, physical and biochemical risk factors could be used to devise diverse intervention programmes to reduce the rising burden of NCD.
► As a cross-sectional study, limits its ability to infer causal relationships among the risk factors.
► Behavioural data may have little bias as the participants of this self-report survey may tend to report in socially desirable ways.

Three-fourths of this global mortality due to NCDs occur in low- and middle-income countries.[2] Each year premature deaths affect equally both men and women (15 million each) due to NCDs.[3] Four major NCDs; cardiovascular disease, cancer, diabetes and respiratory diseases are responsible for 82% of NCD mortality.[4]

Demographic transition and rapid urbanisation have led to changes in lifestyles; food and tobacco consumption continues to experience high morbidity and mortality from NCDs. The rise in NCDs largely stems from four behavioural risk factors: tobacco use, unhealthy diet, insufficient physical activity and the harmful use of tobacco and alcohol.[5] Lifestyle change in an individual following the trend of globalisation, supermarket growth, rapid urbanisation and sedentary lifestyles invites these risk factors around him.[6]

INTRODUCTION

Non-communicable diseases (NCDs) are the result of a combination of genetic, socio-demographic, physical, biochemical and behavioural factors. The global report on death by cause shows that more than 65% of 56 million global deaths were due to NCDs.[1]

In the Bangladeshi adult population, NCD risk factors are found to exist in clusters that become more prominent with the increasing age of that individual.[7] Bangladesh is passing through a demographic transition and an epidemiological transition and currently has a double burden of diseases.[8] NCDs account for 67% of total deaths in Bangladesh.[9] Diverse epidemiological studies have identified risk factors including unhealthy food consumption, tobacco use, insufficient physical inactivity, high body mass index (BMI), raised blood pressure, unfavourable blood lipid and raised blood glucose level.[10] Tobacco consumption is the leading risk factor for major NCDs in Bangladesh.[11] The first STEPS survey was done in 2010, but there was a lack of biochemical measurements and hence no national estimations of diabetes and dyslipidaemia prevalence existed. There is limited evidence on certain risk factors that exist in Bangladesh at the national level.[12] This second nationwide STEPS survey along with biochemical measurement for blood glucose, lipid profile and urinary sodium helped to provide the first comprehensive estimates of NCD risk factors in the country.

Member states of WHO have agreed 25 indicators across three areas that focus on the key outcomes, risk factors and national systems response needed to prevent and control NCDs. One mortality target, six risk factor targets and two national systems targets are considered.[13] As a member state, Bangladesh intends to estimate the prevalence of NCD risk factors in the adult people of the country. STEP-wise approach is a WHO-developed, standardised framework for monitoring the magnitude of NCD risk factors comprising three steps; STEP-1 determines behavioural risk factors; STEP-2 determines physical risk factors and STEP-3 finds out biological risk factors. The STEPS survey 2018 for NCD risk factors in Bangladesh was carried out to determine the national prevalence of NCDs risk factors in the adult population of Bangladesh.

METHODS

Study design and setting

The STEPS survey 2018 was a countrywide population-based cross-sectional study conducted from September 2017 to June 2018. The samples were collected by multistage, geographically stratified probability-based sampling using the primary sampling units (PSUs) developed by the Bangladesh Bureau of Statistics (BBS) for the census.

Study population

The study population included adults aged 18 to 69 years, the usual residents of the household for at least 6 months and were present there the night before the survey. We excluded those people who primarily resided in a military base or group quarters, hospitals, prisons, nursing homes and other institutions or those too frail and mentally or physically unfit to participate in the study or those unable or unwilling to participate in the study.

Sample size

To ensure generalisation and reliability of the study results to the entire target population in Bangladesh, the WHO recommended sample size calculator (sample size calculator STEPS) was used to derive a sample size. The calculated sample size was sufficient to produce reliable estimates for all the indicators for men and women and four age-groups (18 to 24, 25 to 39, 40 to 54 and 55 to 69). The prevalence of NCD risk factors, relative precision rate (20%) and the feasibility of the survey were considered to calculate the sample size. Based on the prevalence of obesity, 472 people were required for effective analysis for each group. Considering the person non-response rate (10%) and household non-coverage rate (10%) shared by the previous surveys of Bangladesh Demographic Health Survey and BBS, overall, 20% non-response rate and a design effect of 2 were used to calculate the final sample size. Initially, we considered 496 PSUs updated by BBS in 2017. During the fieldwork, we excluded one PSU due to inaccessibility. As a result, the final adjusted sample size was 9900 adults of 495 PSUs.

Sampling frame

The sampling frame was developed based on the complete list of PSUs prepared by the BBS containing information about PSU location, type of residence and the estimated number of residential households. All the PSUs were mapped for the survey and comprised of 293 533 PSUs: 65 193 urban and 228 340 rural PSUs. The household lists updated by BBS served as the sampling frame for the selection of households. Twenty households were randomly selected from each PSU and randomly assigned as 'male' or 'female' in a ratio that produced equal numbers of male and female households. One individual was sampled randomly from all the eligible adults in a household. No replacement or change of the preselected households was allowed at the implementing stage to prevent bias.

Sampling strategy

The PSUs were allocated equally to each division (62 each), and urban and rural stratum (248 PSUs each). The PSUs were arranged by population size in terms of household numbers for both urban and rural stratum. In each stratum, 31 PSUs were selected independently in each division by probability proportional to size sampling.

Data collection

Data were collected using a standardised pretested questionnaire developed considering WHO STEPS questionnaire (V.3.2) by incorporating all of the core questions with some selected expanded and country-specific questions. The questionnaire was translated into Bengali and validated by translation and back translation. Data collection techniques included a face-to-face interview (STEP 1), physical measurements (STEP 2) and body fluid (blood and urine) collection (STEP 3). Data were collected by an android device on the spot and transferred into the cloud through ODK software.

STEP-1 (behavioural risk factors ascertainment)

Core items included demographic information and measures of tobacco use, fruit and vegetable, alcohol and salt consumption, physical activity, blood pressure, diabetes and total cholesterol. Data enumerators having post-graduation in sociology/psychology/anthropology conducted the interviews and physical measurements. Medical technologists having diploma/bachelor/master's degree in medical laboratory science collected and processed the samples. The recruited staff underwent training covering all the steps with interactive sessions, skill development and pilot testing.

STEP-2 (physical measurements)

Core items included measurement of blood pressure, height, weight, hip and waist circumference. Validated instruments were used for measuring these parameters. The height and weight of the participants were measured with barefoot and light clothing. Weight was measured to the nearest 10 g using a digital weight measuring machine, while height was measured to the nearest 0.1 cm using a portable stadiometer. The tailor measuring tape was used for measuring waist and hip circumference. All the instruments were calibrated routinely during the survey. A digital blood pressure measuring machine, supplied by WHO with uniform cuff-size with automatic measurement of blood pressure and pulse, was used for measuring blood pressure.

STEP-3 (biochemical measurements)

For estimation of blood sugar and lipid profile level, each participant was advised to remain nothing per mouth (except plain water) for at least 12 hours before blood collection. Blood and urine samples were collected under strict aseptic precautions. On the first visit of STEP-3, written instructions on fasting state, and appointment date for the blood test were given to each participant and asked to visit maintaining the schedule. Initially, 5 mL of blood was collected by disposable syringe, and plasma and serum were separated by centrifuging within 30 min to 1 hour after collection. Followed by 2 mL of this blood was transferred to a fluoride-oxalate vacutainer for serum glucose testing, and 3 mL of the blood was kept in a normal tube and allowed to stand for the separation of plasma (for lipid profile) with proper labelling. The sample for blood glucose was left in the upright position in a vacutainer rack and then centrifuged and separated serum was kept in the cold box (2°C to 8°C) surrounded by ice packs.

The participants were asked to collect 20 mL urine in supplied labelled screw-capped plastic urine pot in the evening before bedtime to submit to the medical technologist on the following day for blood sample collection at the prefixed place. All the collected blood and urine samples of a day were sent to the NIPSOM laboratory within 24 hours of collection. At the central laboratory, the blood and urine samples were received and sent with a laboratory ID number for testing sodium and urine.

After the estimation of blood glucose and lipid profile, the remaining serum sample was kept in Cryo vials at −70°C. After the estimation of urinary sodium, and the remaining urine sample was discarded.

Quality control

Quality control procedures included regular field supervision and daily review of collected data. Laboratory instruments were calibrated following the standard procedure and the findings were validated with the same sample findings of another standard national laboratory. The blood and urine samples were tested in the NIPSOM central laboratory dividing the sample into multiple samples and the same samples multiple times to compare the findings and to validate the instruments and procedure. To ensure accurate findings of the biochemical samples; pretesting was done in both urban and rural areas from where samples were sent to the NIPSOM laboratory. Accordingly, samples were received at different time intervals after collection and were tested at different times and the findings were compared.

Data management

Data were entered directly in the ODK software on the personal digital assistants (PDAs). Data were sent electronically and stored in the ONA database server. The field team uploaded data daily on the server. The stored data were downloaded into Microsoft Excel format for consistency and validity check at the central office. Each participant had a unique identifier QR-code and personal identification number, which were used for merging data of STEP-1, STEP-2 and STEP-3. Data were cleaned and analysed following WHO STEPS recommended guidelines.

Statistical methods

We weighted the data considering selection probabilities of PSU, household, sex and individuals within the household so that the study results conform to the population of Bangladesh. Calibration was done to replicate population distribution. Prevalence was estimated using the STEPS recommended cut-off values.[14] Data were analysed using Stata V.15.0, and Epi Info V.3.4 was used as a reference for programming purposes and cross-validation of Stata outputs. Missing data were excluded from the analysis. Economic status was determined by the principal component analysis of the wealth index based on household assets. Descriptive statistics included percentage, and inferential statistics included logistic regression to determine the NCD risk factors. Background characteristics were cross-tabulated with NCD risk factors, and the X^2 test was performed to investigate the significance of the relationships. Outcome measures and differences between groups were calculated at 95% CI and significant at p value <0.05. To assess the degree of association of the risk factors, we used the adjusted OR (AOR). We tested multicollinearity and adjusted the risk factors through multivariable logistic regression analysis.

We took informed consent from each participant before data collection. Confidentiality and privacy of the participants and anonymity of data were maintained strictly. We carried out all of the activities in conformity with the revised declarations of Helsinki.

RESULTS

Among the target 9900 population, 8185 (82.7%) completed STEP-1 and STEP-2 while 7208 took part in STEP-3. Out of 7208 participants, 7056 gave the blood and 7028 urine sample. The majority of the urban participants were men (51.5%), and the majority of the rural participants were women (51.4%). Around 33.0% of urban and 47.0% of rural participants had no education or less than primary level education. The majority of the rural (45.7%) and urban (36.9%) participants were homemakers. The 'richest' comprised 28.5% urban and 12.6% rural, and the 'poorest' included 18.1% urban and 17.6% rural population (table 1).

Mean serving of fruits and/or vegetables per day was 2.6 (95% CI: 2.5 to 2.7), and the mean duration of physical activity per day was 247.9 (95% CI: 247.8 to 248.0) min. Mean BMI was 22.7 (95% CI: 22.5 to 22.8) kg/m², and mean waist circumference was 78.6 (95% CI: 78.2 to 79.1) cm. Both mean systolic blood pressure (122.6 (95% CI: 122.0 to 123.1) mm Hg) and diastolic bloodpressure (80.6 (95% CI: 80.2 to 81.0) mm Hg) was higher in urban population. Both mean fasting blood glucose (5.6 (95% CI: 5.5 to 5.6) mmol/L) and mean total cholesterol (4.4 (95% CI: 4.4 to 4.5) mmol/L) was higher in the richest but mean salt intake per day was (9.1 (95% CI: 9.1 to 9.1) g) in the poor population (table 2).

The prevalence of tobacco consumption was 43.7% and was significantly (p<0.05) higher in men (59.6%) and rural (45.2%) population. The prevalence of alcohol consumption was 1.5% and was significantly (p<0.05) higher in men (2.9%) and businessman (3.2%). The prevalence of inadequate fruit and vegetable intake was 89.6% and was significantly (p<0.05) higher in the elderly (92.3%) and urban (92.1%) population. The prevalence of insufficient physical activity was 12.3% and was significantly (p<0.05) higher in the women (14.8%) and urban (14.1%) population (table 3).

The prevalence of overweight and obesity was 25.9% and was significantly (p<0.05) higher in the women (33.7%), urban (34.3%) and 'richest' (34.3%) population. The prevalence of hypertension was 21.0% and was significantly (p<0.05) higher in the urban (25.2%) and 'richest' (24.9%) population. The prevalence of diabetes was 8.3% and was significantly (p<0.05) higher in the urban (13.2%), elderly (16.3%) and 'richest' (11.9%) population. The prevalence of hypercholesterolaemia was 28.4% and was significantly (p<0.05) higher in women (29.3%) and urban (32.4%) population (table 3).

The elderly (AOR: 4.5, 95% CI: 4.5 to 4.5) and ever married (OR: 1.4, 95% CI: 1.4 to 1.4) were more likely to have the smoking habit. The urban population was more

Background characteristics	Urban, %	Rural, %	Both, %
Age			
18–24	23.6	24	23.9
25–39	42.1	39	39.7
40–54	19.7	19.7	19.7
55–69	14.6	17.2	16.6
Sex			
Male	51.5	48.6	49.3
Female	48.5	51.4	50.7
Highest level of education			
No education / <primary	32.9	47	43.9
Primary	27.8	32	31.1
Secondary	18.6	10.8	12.6
More than secondary	20.7	10.1	12.5
Marital status			
Never married	14.2	11.8	12.3
Currently married	80.9	83.2	82.7
Ever married*	4.8	5.1	5
Occupation			
Employed	36.7	35.7	35.9
Businessman	13.3	10.1	10.9
Student	8.4	5.4	6.1
Homemaker	36.9	45.7	43.7
Unemployed	2.3	2.1	2.1
Others	2.3	1	1.3
Economic status (Based on Wealth Index)			
Poorest	18.1	17.6	17.7
Poor	15.5	22.2	20.7
Average	16.2	24.6	22.7
Rich	21.7	23	22.7
Richest	28.5	12.6	16.2

Table 1 Background characteristics (weighted) of the adult population of Bangladesh (n=8185)

*Ever married: Separated/divorced/widow/widowed.
%, weighted percentage; n, number.

likely to consume alcohol (AOR: 1.2, 95% CI: 1.2 to 1.2). The women (AOR: 1.7, 95% CI: 1.6 to 1.7), and unemployed (AOR: 7.8, 95% CI: 7.8 to 7.9) were more likely to have inadequate physical activity. The women were more likely to have hypertension (AOR: 1.5, 95% CI: 1.5 to 1.5), and obesity (AOR: 2.0, 95% CI: 2.0 to 2.0). The urban population was more likely to have insufficient physical activity (AOR: 1.2, 95% CI: 1.2 to 1.2), obesity (AOR: 1.5, 95% CI: 1.5 to 1.5), raised blood pressure (AOR: 1.3, 95% CI: 1.3 to 1.3), diabetes (AOR: 1.6, 95% CI: 1.6 to 1.6) and hyperglycaemia (AOR: 1.1, 95% CI: 1.1 to 1.1) (table 4).

Table 2 Means (CI) of behavioural, physical and biochemical parameters of the adult population

Means (CI) of behavioural risk factors of NCD

Attributes	Mean number of servings of fruits on average per day	Mean number of servings of vegetables on average per day	Mean number of servings of fruits and/or vegetables on average per day	Mean physical activity in minutes of moderate-intensity activity (min/day)*
Age				
18–24	0.4 (0.4 to 0.5)	2.3 (2.1 to 2.5)	2.7 (2.5 to 2.9)	213.3 (213.1 to 213.5)
25–39	0.4 (0.3 to 0.4)	2.4 (2.2 to 2.5)	2.7 (2.6 to 2.9)	272.2 (272.1 to 272.3)
40–54	0.3 (0.3 to 0.3)	2.2 (2.1 to 2.3)	2.5 (2.3 to 2.6)	291.8 (291.6 to 291.9)
55–69	0.3 (0.2 to 0.3)	2.1 (1.9 to 2.2)	2.3 (2.1 to 2.5)	187.7 (187.5 to 187.8)
Sex				
Male	0.4 (0.3 to 0.4)	2.2 (2.0 to 2.3)	2.5 (2.3 to 2.7)	354.6 (354.5 to 354.7)
Female	0.4 (0.3 to 0.4)	2.4 (2.2 to 2.5)	2.7 (2.6 to 2.8)	144.8 (144.7 to 144.8)
Residence				
Urban	0.5 (0.4 to 0.5)	1.9 (1.8 to 2.1)	2.4 (2.2 to 2.5)	196.7 (196.6 to 196.8)
Rural	0.3 (0.3 to 0.4)	2.4 (2.2 to 2.5)	2.7 (2.5 to 2.8)	262.7 (262.5 to 262.8)
Overall	0.4 (0.3 to 0.4)	2.3 (2.2 to 2.4)	2.6 (2.5 to 2.7)	247.9 (247.8 to 248.0)
Economic status				
Poorest	0.4 (0.4 to 0.4)	2.1 (2.1 to 2.1)	2.5 (2.4 to 2.5)	258.0 (257.9 to 258.2)
Poor	0.3 (0.3 to 0.3)	2.3 (2.2 to 2.3)	2.6 (2.5 to 2.6)	264.5 (264.4 to 254.7)
Average	0.4 (0.3 to 0.4)	2.4 (2.4 to 2.4)	2.8 (2.7 to 2.8)	260.0 (259.9 to 260.1)
Rich	0.4 (0.3 to 0.4)	2.1 (2.1 to 2.1)	2.5 (2.4 to 2.5)	221.5 (221.4 to 221.6)
Richest	0.5 (0.5 to 0.5)	2.3 (2.3 to 2.3)	2.7 (2.7 to 2.8)	231.2 (231.1 to 231.3)
Overall	0.4 (0.3 to 0.4)	2.3 (2.2 to 2.4)	2.6 (2.5 to 2.7)	247.9 (247.8 to 248.0)

Means (CI) of physical risk factors of NCD

Attributes	BMI (kg/m²)	WC (cm)	SBP (mm Hg)	DBP (mm Hg)
Age				
18–24	21.6 (21.3 to 22.0)	74.5 (73.7 to 75.3)	113.7 (112.9 to 114.4)	74.3 (73.7 to 74.9)
25–39	23.2 (23.0 to 23.4)	79.4 (78.8 to 79.0)	117.1 (116.7 to 117.6)	78.5 (78.1 to 78.8)
40–54	23.0 (22.8 to 23.3)	80.4 (79.7 to 81.0)	125.0 (124.2 to 125.8)	82.2 (81.6 to 82.7)
55–69	22.3 (21.8 to 22.7)	80.4 (79.2 to 81.7)	130.9 (129.6 to 132.3)	81.3 (80.6 to 82.1)
Sex				
Male	21.9 (21.7 to 22.0)	79.1 (78.5 to 79.6)	121.5 (120.9 to 122.0)	77.9 (77.5 to 78.3)
Female	23.5 (23.2 to 23.7)	78.2 (77.5 to 78.8)	120.7 (120.2 to 121.3)	80.8 (80.5 to 81.2)
Residence				
Urban	23.6 (23.3 to 23.9)	81.4 (80.7 to 82.1)	122.6 (122.0 to 123.1)	80.6 (80.2 to 81.0)
Rural	22.4 (22.2 to 22.6)	77.8 (77.3 to 78.3)	119.7 (119.1 to 120.2)	78.4 (78.0 to 78.8)
Overall	22.7 (22.5 to 22.8)	78.6 (78.2 to 79.1)	121.1 (120.7 to 121.5)	79.5 (79.2 to 79.7)
Economic status				
Poorest	22.0 (21.9 to 22.0)	77.0 (76.9 to 77.0)	120.4 (119.4 to 121.3)	79.2 (78.6 to 79.8)
Poor	22.5 (22.5 to 22.5)	78.4 (78.3 to 78.4)	120.4 (119.5 to 121.2)	79.1 (78.5 to 79.7)
Average	22.5 (22.4 to 22.5)	78.0 (78.0 to 78.0)	120.8 (119.9 to 121.7)	78.9 (78.3 to 79.5)
Rich	22.6 (22.5 to 22.6)	78.6 (78.6 to 78.7)	120.9 (120.1 to 121.7)	79.3 (78.7 to 79.9)
Richest	23.6 (23.6 to 23.6)	81.6 (81.5 to 81.6)	123.0 (122.1 to 123.9)	80.8 (80.3 to 81.4)
Overall	22.7 (22.5 to 22.8)	78.6 (78.2 to 79.1)	121.1 (120.7 to 121.5)	79.5 (79.2 to 79.7)

Means (CI) of biochemical risk factors of NCD

Table 2 Continued

Attributes	Fasting blood glucose (mmol/L)	Total cholesterol (mmol/L)	Salt intake (g/day)†
Age			
18–24	5.0 (5.0 to 5.1)	4.2 (4.1 to 4.3)	9.1 (8.9 to 9.3)
25–39	5.3 (5.3 to 5.4)	4.4 (4.3 to 4.4)	9.0 (8.9 to 9.1)
40–54	5.7 (5.6 to 5.8)	4.6 (4.6 to 4.7)	9.0 (8.9 to 9.1)
55–69	5.6 (5.5 to 5.6)	4.6 (4.5 to 4.8)	8.9 (8.8 to 9.1)
Sex			
Male	5.4 (5.3 to 5.5)	4.4 (4.3 to 4.4)	9.0 (8.9 to 9.2)
Female	5.4 (5.3 to 5.5)	4.4 (4.3 to 4.4)	9.0 (8.9 to 9.1)
Residence			
Urban	5.8 (5.7 to 5.8)	4.4 (4.4 to 4.5)	8.9 (8.7 to 9.0)
Rural	5.3 (5.3 to 5.4)	4.4 (4.3 to 4.4)	9.0 (8.9 to 9.1)
Overall	5.4 (5.3 to 5.5)	4.4 (4.4 to 4.5)	9.0 (8.9 to 9.1)
Economic status			
Poorest	5.4 (5.4 to 5.4)	4.4 (4.3 to 4.4)	9.0 (8.9 to 9.0)
Poor	5.4 (5.4 to 5.5)	4.4 (4.4 to 4.4)	9.1 (9.1 to 9.1)
Average	5.3 (5.3 to 5.4)	4.4 (4.4 to 4.5)	8.9 (8.8 to 8.9)
Rich	5.3 (5.2 to 5.3)	4.4 (4.4 to 4.4)	9.1 (9.0 to 9.1)
Richest	5.6 (5.5 to 5.6)	4.5 (4.4 to 4.5)	9.0 (9.0 to 9.0)
Overall	5.4 (5.3 to 5.5)	4.4 (4.4 to 4.5)	9.0 (8.9 to 9.1)

*Minutes spent on vigorous-intensity activities per day are multiplied by 2, to derive equivalent minutes of moderate-intensity activities and then summed up to obtain the total physical activity in minutes of moderate-intensity activity per day.

†Calculated using 'Tanaka Equation' (based on urinary Na+ concentration).

BMI, body mass index; DBP, diastolic blood pressure; min, minute; NCD, non-communicable diseases; SBP, systolic blood pressure; WC, waist circumference.

Inadequate servings: Intake less than five servings' fruits and/or vegetables on average per day; all of the findings are statistically significant at the p value <0.05.

Regarding combined risk factors, 3% (men 1.9% and women 4.0%) population had no risk factor while 70.9% had 1% to 2% and 26.2% had ≥3 NCD risk factors, which was higher in men (29.6%) than in women (22.8%) (figure 1).

DISCUSSION

Based on the analysis of weighted data, this country-wide survey determined the national prevalence of NCD risk factors in three steps including sociodemographic factors; tobacco and salt consumption; fruits and vegetable consumption, and physical activity; overweight and obesity; hypertension; hyperglycaemia; and hypercholesterolaemia. The prevalence of current tobacco consumption was higher than that observed in the Global Adult Tobacco Survey.[14] It was higher in the rural than the urban population but an average 10% reduction was observed in both areas compared with STEPS 2010,[15] which reflects the success of anti-tobacco intervention programmes. The higher prevalence of

tobacco uses in the men (OR=0.2) and elderly imitates the real picture of the South Asia region,[16 17] except Bhutan.[18]

The prevalence of alcohol consumption was much lower in Bangladesh than in India (1.5% vs 14.9%),[19] which could be due to cultural and religious differences. Despite some recall bias, the majority of the population consumed less than five servings of vegetables and fruits per day; though it is more than earlier[16] but lower than the neighbouring countries.[18 20] Public fear regarding the presence of heavy metals and pesticides in fruits and vegetables[20 21] is not tenuous rather their dietary habit seems to be the driving factor behind it.

The prevalence of insufficient physical activity (12.3%) is a glaring pointer towards a growing epidemic of overweight and obesity in our country. Insufficient physical activity was more in urban than in rural population (14.1% vs 11.7%), and in women than in men (OR=1.7), which is inconsistent with the previous studies in the low- and middle-income countries and South Asian countries.[22–24] The prevalence of insufficient physical activity has spiked up significantly in comparison with the previous STEPS survey.[16] Despite a little recall bias, it could be argued that men are involved in more laborious activities than

Table 3 Bivariate analysis between non-communicable diseases risk factors and background characteristics of the adult population of Bangladesh (X² test)

Background characteristics	Current tobacco consumption (in any form) (n=8185) %	Current alcohol consumption (in the past 30 days) (n=8185) %	*Inadequate fruits and/or vegetables intake (n=8185) %	†Insufficient physical activity (n=8185) %	‡Overweight/obese (n=8013) %	§Raised BP (hypertension) (n=8154) %	¶Raised glucose (diabetes) %	**Raised total cholesterol %
Age								
18–24	22.3	2.4	90.5	11.2	15.9	8.8	2.9	20.6
25–39	38.7	1.5	87.3	8.8	31.4	20.7	8.1	26.7
40–54	59.1	1	91.1	11.3	28.8	34.4	12.4	36.4
55–69	68.4	0.4	92.3	23.1	23.6	46.9	16.3	39.5
Sex								
Male	59.6	2.9	90	9.6	18.3	17.9	8.9	27.4
Female	28.3	0	89.3	14.8	33.7	24.1	7.9	29.3
Residence								
Urban	38.8	1.8	92.1	14.1	34.3	25.2	13.2	32.4
Rural	45.2	1.4	88.9	11.7	23.5	19.8	7.1	27.4
Highest level of education								
No education/ <primary	60.2	1.2	92.2	13	20.2	22.8	7.3	27
Primary	35.6	2	87.1	10.4	29.1	19.1	8.5	28.7
Secondary	26.9	1.4	88.9	11.9	29.8	17.8	8.3	29.4
>Secondary	22.8	1.1	88.1	14	33.9	22.5	13.1	33
Marital status								
Never married	31.6	3	90	7.7	11.4	9	2.2	18.8
Currently married	44.7	1.3	89.3	11.5	27.8	21.2	8.6	28.3
Ever married††	57.3	0.2	94.8	35.6	30.3	47	13.6	45.9
Occupation								
Employed	60	2.7	89.2	6.8	17.9	16.1	7	25.1
Businessman	62.4	3.2	90.3	13.7	26.8	21.2	12.9	38
Student	15.4	1.1	91.6	9.8	10	9.1	2	17.3
Homemaker	29.1	0	90.1	14.5	34.5	25	8	29.2
Unemployed	51.8	2	83.7	40.4	24.6	33.5	14.9	29.5
Others	49.9	0.7	84.9	36.2	33.8	53.1	33.2	39.1
Economic status								
Poorest	49.6	2.2	92.2	13.8	19.3	18.8	7.9	26.9
Poor	44.6	0.9	89.7	11.6	26.3	21.2	9.2	26.3
Average	42.9	1	89.1	10.6	23.9	19.7	6.2	30.4
Rich	42.8	2	90.8	13.7	26.3	21.1	7.9	28.5
Richest	38.6	1.2	85.9	11.5	34.3	24.9	11.9	29.7

Continued

Table 3 Continued

Background characteristics	Current tobacco consumption (in any form) (n=8185)	Current alcohol consumption (in the past 30 days) (n=8185)	*Inadequate fruits and/or vegetables intake (n=8185)	†Insufficient physical activity (n=8185)	‡Overweight/ obese (n=8013)	§Raised BP (hypertension) (n=8154)	¶Raised glucose (diabetes)	**Raised total cholesterol
Overall	43.7	1.5	89.6	12.3	25.9	21	8.3	28.4

All the differences of findings are statistically significant at the p value <0.05.

*Participants taking less than five servings of fruits and/or vegetables on average per day.

†Participants doing less than 150 min of moderate-intensity physical activity per week.

‡Overweight and obese: BMI ≥25 kg/m².

§Raised BP: Systolic BP ≥140 mm Hg or diastolic BP ≥90 mm Hg.

¶Raised blood sugar: ≥7.0 mmol/L or, ≥126 mg/dl.

**Raised total cholesterol: ≥5.0 mmol/L.

††Ever married: Separated/divorced/widow/widowed.

%, percentage; BMI, body mass index; BP, blood pressure; n, number.

women. High income also excites a sedentary lifestyle like smartphone and computer use.[25]

In comparison with the 2010 survey, the prevalence of overweight and obesity (25.9%) showed a rising trend with a higher proportion in women than men (33.7% vs 18.3%).[16] Shifting towards a sedentary lifestyle in the rural whereas growing health consciousness in the urban population may be the reasons behind it. The prevalence of obesity is comparable to the neighbouring,[19 26 27] and many developed countries.[28] About one-fourth of the population had hypertension with significant sex and age differences. The prevalence of hypertension was significantly higher in women (AOR=1.5), elderly (AOR=9.2), urban (AOR=1.3) and unemployed (AOR=1.8) population. Another population-based study reported the prevalence of hypertension as 12% to 13%.[29] A sedentary lifestyle predisposes hypertension and higher prevalence in women is possibly a bane from the revolutionary success of contraceptive usage among them.

Diabetes mellitus has been steadily creeping into the low- and middle-income countries to reach an epidemic proportion.[30] The current prevalence (8.3%) is a testament to the exponential trend of diabetes as reported in previous systemic reviews.[31 32] With the increasing ages, the prevalence rose steadily and a significant difference was observed in the urban population (OR=1.6). The effect of unplanned urbanisation, sedentary lifestyle and altered food habits could make the urban population more vulnerable to hypertension. If an effective strategy is not adopted, all these will pose an ominous potential to trigger a range of cardiovascular disease epidemics in the recent future.[33] Reviews from surrounding countries indicate that dyslipidaemias are slowly increasing in the region.[34 35] About 28.4% had higher serum cholesterol with a greater propensity in urban than rural population (32.4% vs 27.4%).

The current study found 3% had no, 70.9% had 1 to 2 and 26.2% had ≥3 NCD risk factors while the previous STEPS survey 2010 found 1.3%, 77.4% and 28.3%.[16] These discrepancies could be due to the positive impacts of comprehensive NCD prevention and control activities in the country. In 2018, ≥3 risk factors were higher in women than in men (31.5% vs 21.7%) while it was reversed in 2010 (22.8% vs 29.6%). This finding suggests an emphasised NCD risk factors alleviation programme for the women.

Despite few methodological limitations like recall bias with self-reported behavioural data of the participants, challenges of transportation of biological samples maintaining the cold chain, and the inability of the cross-sectional design to infer causal relationships among the risk factors, the study unveiled crucial nationally representative data on NCD risk factors.

Raising public awareness through health education seems to be a vital viable option for modifying the mass dietary habit and tobacco consumption behaviour of the people. Bangladesh can adopt several strategies like healthy urban community design making neighbourhoods

Table 4 Logistic regression analysis of the determinants of non-communicablediseases risk factors in the adult population of Bangladesh

Determinants	Adjusted OR (AOR) at 95% CI							
	Current smoking	Current alcohol consumption	Insufficient physical activity	Inadequate servings	Raised blood pressure (hypertension)	Obesity	Raised glucose (diabetes)	Raised total cholesterol
Age (years)								
18–29	1	1	1	1	1	1	1	1
30–44	1.7 (1.7 to 1.7)	0.4 (0.4 to 0.4)	0.7 (0.7 to 0.7)	0.7 (0.7 to 0.7)	1.9 (1.9 to 1.9)	2.4 (2.4 to 2.4)	3.3 (3.2 to 3.3)	1.4 (1.4 to 1.4)
45–59	3.5 (3.4 to 3.5)	0.3 (0.3 to 0.3)	0.9 (0.9 to 0.9)	0.9 (0.9 to 1.0)	6.1 (6.1 to 6.2)	2.5 (2.5 to 2.5)	7.7 (7.6 to 7.7)	2.6 (2.6 to 2.6)
60–69	4.5 (4.5 to 4.5)	0.1 (0.1 to 0.1)	1.5 (1.5 to 1.5)	1.1 (1.1 to 1.1)	9.2 (9.2 to 9.2)	2.0 (2.0 to 2.0)	8.7 (8.6 to 8.7)	2.7 (2.7 to 2.7)
Gender								
Male	1	1	1	1	1	1	1	1
Female	0.2 (0.2 to 0.2)	0.01 (0.01 to 0.01)	1.7 (1.6 to 1.7)	0.6 (0.6 to 0.6)	1.5 (1.5 to 1.5)	2.0 (2.0 to 2.0)	1.0 (1.0 to 1.0)	1.3 (1.3 to 1.3)
Residence								
Rural	1	1	1	1	1	1	1	1
Urban	0.9 (0.9 to 0.9)	1.2 (1.2 to 1.2)	1.2 (1.2 to 1.2)	1.8 (1.8 to 1.8)	1.3 (1.3 to 1.3)	1.5 (1.5 to 1.5)	1.6 (1.6 to 1.6)	1.1 (1.1 to 1.1)
Highest level of education								
No education / <primary	1	1	1	1	1	1	1	1
Primary	0.5 (0.5 to 0.5)	1.5 (1.5 to 1.5)	1.0 (1.0 to 1.0)	0.6 (0.6 to 0.6)	1.5 (1.5 to 1.5)	1.7 (1.7 to 1.7)	1.7 (1.7 to 1.7)	1.4 (1.4 to 1.4)
Secondary	0.3 (0.3 to 0.3)	0.9 (0.9 to 1.0)	1.1 (1.1 to 1.1)	0.7 (0.7 to 0.7)	1.5 (1.5 to 1.5)	2.2 (2.2 to 2.2)	1.6 (1.6 to 1.6)	1.6 (1.6 to 1.6)
>secondary	0.2 (0.2 to 0.2)	0.7 (0.7 to 0.7)	1.5 (1.5 to 1.5)	0.6 (0.6 to 0.6)	2.3 (2.3 to 2.3)	3.7 (3.7 to 3.7)	3.1 (3.1 to 3.1)	2.1 (2.1 to 2.1)
Marital status								
Never married	1	1	1	1	1	1	1	1
Currently married	0.9 (0.9 to 0.9)	1.0 (1.0 to 1.0)	1.9 (1.9 to 1.9)	0.9 (0.9 to 0.9)	1.1 (1.1 to 1.1)	1.7 (1.7 to 1.7)	2.2 (2.2 to 2.2)	1.2 (1.2 to 1.2)
Ever married	1.4 (1.4 to 1.4)	0.3 (0.3 to 0.3)	5.1 (5.1 to 5.1)	1.7 (1.7 to 1.7)	1.6 (1.6 to 1.6)	1.8 (1.8 to 1.8)	2.9 (2.8 to 2.9)	2.0 (2.0 to 2.0)
Occupation								
Employed	1	1	1	1	1	1	1	1
Business	1.1 (1.1 to 1.1)	1.0 (1.0 to 1.0)	2.5 (2.5 to 2.5)	1.1 (1.1 to 1.1)	1.4 (1.4 to 1.4)	1.7 (1.7 to 1.7)	1.8 (1.8 to 1.8)	1.9 (1.9 to 1.9)
Student	0.6 (0.6 to 0.6)	0.3 (0.3 to 0.3)	1.8 (1.8 to 1.8)	1.6 (1.6 to 1.6)	1.1 (1.1 to 1.1)	0.6 (0.6 to 0.6)	1.2 (1.2 to 1.2)	0.8 (0.8 to 0.8)
Homemaker	0.9 (0.9 to 0.9)	1.1 (1.0 to 1.1)	1.4 (1.4 to 1.4)	1.9 (1.8 to 1.9)	1.4 (1.4 to 1.4)	1.5 (1.5 to 1.5)	1.4 (1.4 to 1.4)	1.0 (1.0 to 1.0)
Unemployed	0.6 (0.6 to 0.6)	1.2 (1.2 to 1.2)	7.8 (7.8 to 7.9)	0.5 (0.5 to 0.6)	1.8 (1.8 to 1.8)	1.6 (1.6 to 1.6)	1.9 (1.9 to 1.9)	1.1 (1.1 to 1.1)
Others	0.6 (0.6 to 0.6)	1.0 (1.0 to 1.0)	4.2 (4.2 to 4.2)	0.7 (0.7 to 0.7)	2.0 (2.0 to 2.0)	1.3 (1.3 to 1.3)	2.9 (2.8 to 2.9)	1.1 (1.1 to 1.1)
Economic status								
1	1	1	1	1	1	1	1	1

Continued

Table 4 Continued

Determinants	Adjusted OR (AOR) at 95% CI							
	Current smoking	Current alcohol consumption	Insufficient physical activity	Inadequate servings	Raised blood pressure (hypertension)	Obesity	Raised glucose (diabetes)	Raised total cholesterol
Poor	0.8 (0.8 to 0.8)	0.3 (0.3 to 0.3)	0.8 (0.8 to 0.8)	0.8 (0.8 to 0.8)	1.2 (1.2 to 1.2)	1.6 (1.6 to 1.6)	1.2 (1.2 to 1.2)	1.0 (1.0 to 1.1)
Average	0.9 (0.9 to 0.9)	0.4 (0.4 to 0.4)	0.7 (0.7 to 0.7)	0.7 (0.7 to 0.8)	1.1 (1.1 to 1.1)	1.3 (1.3 to 1.3)	0.8 (0.8 to 0.8)	1.2 (1.2 to 1.2)
Rich	0.9 (0.9 to 0.9)	0.9 (0.9 to 0.9)	0.9 (0.9 to 1.0)	0.9 (0.9 to 0.9)	1.1 (1.1 to 1.1)	1.4 (1.4 to 1.4)	0.9 (0.9 to 0.9)	1.0 (1.0 to 1.0)
Richest	0.8 (0.8 to 0.8)	0.6 (0.6 to 0.6)	0.8 (0.8 to 0.8)	0.5 (0.5 to 0.5)	1.2 (1.2 to 1.2)	1.7 (1.7 to 1.7)	1.1 (1.1 to 1.1)	1.0 (1.0 to 1.1)
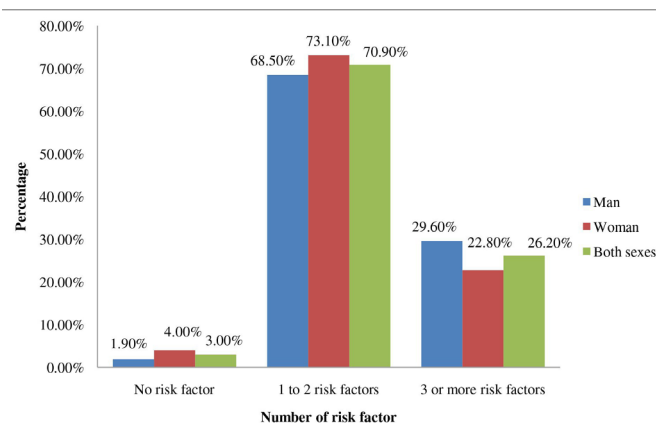
Figure 1 Summary of combined *risk factors of non-communicable diseases. *Risk factors: Current daily smokers, less than five servings of fruits and vegetables per day, insufficient physical activity, overweight (body mass index ≥25 kg/m²), raised blood pressure and raised total cholesterol.

more walkable and encouraging healthy foods in schools and cafeterias for modifying the growing obesogenic environment. Specific intervention programmes must be designed based on risk factors and high-risk groups for the early detection and treatment of the major NCDs.

CONCLUSION

Despite diverse challenges, this comprehensive survey aligned with the WHO protocol identified the major NCD risk factors and high-risk groups having three or more risk factors. The study findings recommend individual and collective programme interventions with an emphasis on the elderly, women and urban population. The study will also contribute to devising future comprehensive national action plan to combat the rising NCD burden.

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