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Original Research

Burden of hypertension, diabetes, and hypercholesterolemia in relation to social and behavioral health determinants: Insights from the 2018 Bangladesh STEPS survey

Mohammad Meshbahur Rahman [a,g,*], Zaki Farhana [b], Abdullah Al Noman [c], Nazmul Hossain [d], Anton Abdulbasah Kamil [e], Baizid Khoorshid Riaz [f]

[a] Department of Biostatistics, National Institute of Preventive and Social Medicine (NIPSOM), Dhaka, 1212, Bangladesh
[b] Credit Information Bureau, Bangladesh Bank, Dhaka, Bangladesh
[c] Health and Rights, Agrogoti Sangstha, Satkhira, Bangladesh
[d] Dengue Project, Department of Biostatistics, National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka, 1212, Bangladesh
[e] Department of Business Administration, Istanbul Gelisim University, Turkey
[f] Directorate General of Medical Education, Ministry of Health and Family Welfare, Bangladesh
[g] Department of Public Health, Daffodil International University, Dhaka, 1216, Bangladesh

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ABSTRACT

Objectives: Bangladesh is experiencing a significant shift in its epidemiological landscape, moving from a predominance of communicable diseases to an increasing burden of non-communicable diseases (NCDs). This study aims to identify the risk factors for hypertension, diabetes, and hypercholesterolemia based on the recent STEPS survey in Bangladesh.
Study design: Secondary cross-sectional study.
Methods: This study analyze the publicly available "National STEPS Survey for Non-communicable Diseases Risk Factors in Bangladesh 2018" dataset. The sample size was 6875, after cleaning the three phases of dataset. Frequency distribution, Spatial distribution, Chi-square test, and Logistic regression models were employed in data analysis.
Results: The nationwide prevalence of NCDs revealed 27.3 % for hypertension, 9.8 % for diabetes, and 30.2 % for hypercholesterolemia. The NCDs prevalence significantly varied across divisions in Bangladesh, with Barisal having the highest hypertension (25 %) and Sylhet the lowest (18.1 %). Chittagong led in diabetes prevalence (12.0 %), while Rangpur had the lowest (4.8 %). For hypercholesterolemia, Barisal topped (34.9 %), and Mymensingh had the lowest (20.9 %). The significant risk factors of NCDs included age, occupational status, physical activity, and BMI category. Older age and obesity notably increased significantly ($p < 0.05$) the odds of hypertension, diabetes, and hypercholesterolemia, while urban residence increased the odds of diabetes.
Conclusion: Several factors, mostly age, occupational status, physical activity, and BMI category are responsible for higher prevalence of NCD diseases. The study explores common factors in NCDs and offers regional comparisons, aiding policymakers in focused interventions for specific regions.

1. Introduction

Like many other developing countries, Bangladesh is also experiencing a significant epidemiological shift from communicable diseases to non-communicable diseases (NCDs).[1–4] The World Health Organization (WHO) reported that 41 million people die of such as cardiovascular diseases (CVD) and diabetes mellitus (DM), which account for 74 % of global mortality. More than 75 % of these deaths occur in low- and middle-income countries (LMICs.[5] Furthermore, the WHO predicts that by 2030, annual NCD-related deaths will rise to 52 million, hindering the United Nations' goal of reducing premature mortality from NCDs by one-third.[6]

NCDs continue to affect Bangladesh, accounting for 73.2 % of all deaths in 2017. Among these, CVD (36.1 %), cancers (11.2 %) and DM

* Corresponding author. Department of Biostatistics, National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka, 1212, Bangladesh.
E-mail address: meshbah037@gmail.com (M.M. Rahman).

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(5.8 %) are predominant.[7–11] Hypertension (HTM), another critical health condition leading to angina and cardiac failure, is also widespread among the Bangladeshi population.[12] The Bangladesh Demographic and Health Survey (BDHS 2017-18) found that one in every four people aged 18 and older had increased blood pressure. Between 2011 and 2017, HTN prevalence increased from 32 % to 45 % in males and from 20 % to 34 % in females aged 35 and older.[13] Moreover, substantial evidence suggests that HTN is escalating in LMICs, particularly, with over 35 % of adults in South Asia are suffering from HTN.[14,15] Similarly, hypercholesterolemia (HC), that is the elevated cholesterol levels in the blood and can lead to stroke and ischemic heart diseases, has been on the rise in Bangladesh, with prevalence rates ranging from 5 % to 16 %.[16,17]

Numerous studies have found that older age, higher education, and higher income status are significantly associated are significantly associated with HTN and DM among the adult Bangladeshi population.[9,12,18–21] Moreover, findings from a study based on the BDHS-2011 revealed that unemployed and highly educated people were at a higher risk of developing HTN and DM.[22] Geographic variations in hypertension (ranging from 10 % to 35 %) and diabetes (ranging from 6 % to 19 %) have also been observed.[23–25] A large number of studies confirmed the association between regular physical activity (PA) and a reduced risk of coronary heart disease, hypertension, stroke, and diabetes is while also enhancing mental well-being and overall quality of life.[26] Inadequate PA contributes to the onset of various diseases. Studies have indicated that 27 % of individuals with diabetes and 20 % of those with heart disease have low levels of PA, which is a key factor in cardiac mortality.[27]

Prevention and control of NCDs have been integrated into Bangladesh government's national health initiatives. The government has devised an action plan called "Multisectoral Action Plan for Prevention and Control of Non-communicable Diseases 2018–2025" to facilitate early identification of risk factors, allocate resources and adopt public health measures to mitigate NCDs in the country.[28] Several attempts have been made to determine the prevalence and identify risk factors associated with HTN, diabetes and HC among the Bangladeshi population. The BDHS and the STEPS survey are the two most prominent population-wide studies for reporting NCD prevalence and risk factors.[29,30] Identifying and addressing behavioral risk factors pertinent to NCDs such as diet, physical activity, and tobacco and alcohol use, along with the social determinants of health, have been prioritized over clinical approaches.[6] This study aims to identify the prevalence of hypertension, diabetes and hypercholesterolemia, the three most common NCDs among the Bangladeshi population and to determine the behavioral and sociodemographic risk factors associated with these diseases. This research will contribute to the existing knowledge and help devise pragmatic, population-specific health interventions and policies to reduce the disease burden of non-communicable diseases.

2. Methods

2.1. Study design and data overview

The data for this study was derived from the 2018 STEPwise Approach to Surveillance (STEPS) survey on non-communicable diseases (NCDs) conducted in Bangladesh, funded by the World Health Organization (WHO).[29] The dataset obtained from the website of the WHO (e.g.: WHO data repository: https://extranet.who.int/ncdsmicrodata/index.php/catalog/770/study-description).[31]

2.2. Ethical consent and permission for data use

The dataset used in this study was obtained from the publicly available secondary source and therefore, the ethical consent is not required.

2.3. Response variables

The selected response variables include three distinct non-communicable diseases: Stage-I hypertension (defined as blood pressure exceeding 140/90 mmHg), diabetes (determined by a blood glucose level of $\geq$126 mg/dL or current use of insulin), and hypercholesterolemia (defined as total cholesterol levels of $\geq$190 mg/dL or current use of medication to manage cholesterol). Each of these three outcome variables was considered binary in nature. The cut-off values used to create these binary variables are well-documented in the literature.[29,32]

2.4. Possible risk factors

In this study, socio-demographic, behavioral, and health-related factors were examined as potential predictors and risk factors. The socio-demographic factors included age, sex, educational status, marital status, religion, residence, division, and occupational status or activity. The categories for these variables were based on existing literature.[33] The behavioral and health-related factors included alcohol consumption, tobacco use, processed food consumption, physical activity (classified according to the WHO physical activity questionnaire,[34] and Body Mass Index (BMI).[29,35]

2.5. Data cleaning

Following the 2018 STEPS guidelines, 496 PSUs were selected at the first stage and 9900 households at the second. Data collection followed a three-phase approach: (a) sociodemographic screening, (b) physical measurements, and (c) biochemical assessments. The final sample included 8185 participants in the first two phases and 7199 in the third. Data cleaning was conducted in accordance with the World Health Organization (WHO) guidelines outlined in the Global Physical Activity Questionnaire (GPAQ) Version 2. In the response variable, missing values were addressed through case-wise deletion, resulting in a final analytical sample of 6785 participants.

2.6. Statistical analysis

Frequency distributions and χ^2 tests were performed to explore the relationships between the response variables and possible risk factors. Spatial analysis was conducted to illustrate the prevalence of non-communicable diseases (NCDs) using the 'Bangladesh' package in R. Binary logistic regression models were applied to each of the three outcome variables, incorporating significant risk factors for the NCDs. A significance level threshold of 5 % was adopted, with 95 % confidence intervals. The statistical analysis was conducted using Statistical Package for Social Sciences (SPSS, version 26) and R programming language (version 4.3.1).

3. Results

3.1. Socio-demographic characteristics of the respondents

Of the total 8185 respondents, over 50 % were women. The average age was 39.3 years. The respondents had an average of 5.5 years of education, with men averaging 5.9 years and women 5.2 years. Education levels were higher in urban areas, where men had an average of 7.0 years of education and women 6.3 years, compared to rural areas where men had 4.7 years and women had 4.2 years. Detailed demographic characteristics of the respondents are provided in Table 1.

3.2. Prevalence of hypertension, diabetes and hypercholesterolemia

Among the total respondents (n = 6785), the nationwide prevalence of hypertension was 27.3 %, diabetes was 9.8 % and hypercholesterolemia was 30.2 %, respectively (Fig. 1).

Table 1
Background characteristics of respondents.

Background characteristic	Women		Men		Total	
	Weighted %	n	Weighted %	n	Weighted %	n
Age						
18–24	25.8	621	22.1	405	23.9	1026
25–39	40.1	2019	39.4	1470	39.7	3489
40–54	19.5	1284	19.9	1219	19.7	2503
55–69	14.7	457	18.7	710	16.6	1167
Residence						
Rural	78.5	2264	76.5	1919	77.5	4183
Urban	21.5	2117	23.5	1885	22.5	4002
Division						
Barishal	5.7	540	5.5	446	5.6	986
Chattogram	22.0	552	18.8	501	20.4	1053
Dhaka Rural	23.8	520	25.5	477	24.6	997
Khulna	11.1	560	11.9	480	11.5	1040
Mymensingh	9.1	552	7.9	469	8.5	1021
Rajshahi	12.0	569	14.0	497	13.0	1066
Rangpur	9.6	543	10.1	466	9.9	1009
Sylhet	6.7	545	6.3	468	6.5	1013
Marital status						
Never married	4.9	125	20.0	410	12.3	535
Currently married	85.5	3865	79.8	3385	82.7	7250
Ever married	9.6	391	0.3	9	5.0	400
Education						
No education/less than primary	44.1	1960	43.5	1718	43.8	3678
Primary	34.8	1525	27.2	1008	31.0	2533
Secondary	12.1	434	13.1	454	12.6	888
More than secondary	8.7	441	16.3	624	12.5	1065
Wealth quintile						
Lowest	22.4	978	17.6	661	20.0	1639
Second	20.3	912	19.9	758	20.1	1670
Middle	17.1	725	22.8	726	19.9	1451
Fourth	19.2	718	21.1	788	20.1	1506
Highest	21.1	1048	18.7	871	19.9	1919
Total (18–69)		**4381**		**3804**		**8185**

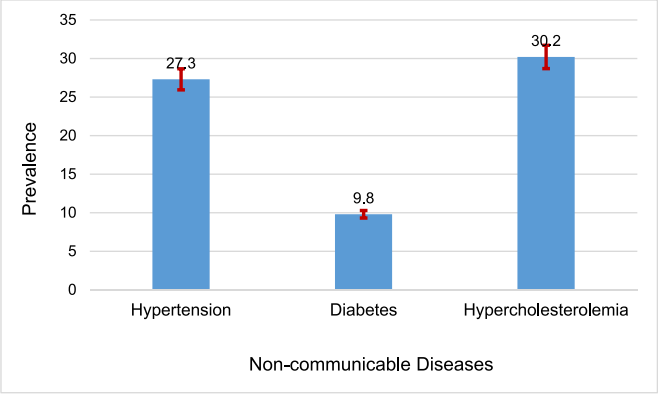


Fig. 1. Prevalence of three non-communicable diseases among the study participants.

3.3. Spatial distribution of hypertension, diabetes, and hypercholesterolemia

The highest prevalence of hypertension is observed in Barisal (25 %) and the lowest in Sylhet (18.1 %), as depicted in Fig. 2(a). Additionally, the prevalence rates for other divisions range from 18.6 % to 23.5 %. Fig. 2(b) shows that the prevalence rate for diabetes varies from 4.8 % in Rangpur to 12 % in Chittagong. Hypercholesteromia is also predominant in Barishal (34.9 %) with the lowest prevalence in Mymensing (20.9 %) as shown in in Fig. 2(c).

3.4. Factors associated with hypertension, diabetes, and hypercholesteromia

The chi-square test revealed all the sociodemographic, behavioral and physiological factors were significantly associated with at least one of the NCDs (Supplemental Table S1). Individuals older than the mean age had significantly higher prevalence of hypertension, diabetes, and hypercholesterolemia ($p < 0.001$ for all). Women had a higher prevalence of hypertension (27.69 % vs. 20.73 %) and hypercholesterolemia (28.28 % vs. 27.51 %), but no significant difference was observed for diabetes ($p = 0.279$). Illiterate individuals had higher rates of hypertension (25.06 %) and hypercholesterolemia (26.82 %). Higher education was associated with a lower prevalence of diabetes (17.27 % in higher secondary). Lower occupational status was significantly linked to higher prevalence of hypertension (26.52 %), diabetes (10.61 %), and hypercholesterolemia (28.83 %). Urban residents had a significantly higher prevalence of hypertension (29.89 % vs. 23.14 %) and diabetes (12.78 % vs. 7.05 %) compared to rural residents ($p < 0.0001$ for both). Low physical activity was associated with higher rates of hypertension (32.30 %), diabetes (12.94 %), and hypercholesterolemia (35.50 %) compared to moderate and high activity ($p < 0.0001$ for all). Obesity was strongly associated with hypertension (52.06 %), diabetes (20.54 %), and hypercholesterolemia (41.11 %).

3.5. Risk facotors of hypertension, diabetes, and hypercholestomia

Table 2 presents the results of the adjusted odds ratios (AOR) from binary logistic regression. The analysis reveals that older and obese individuals have higher odds of developing hypertension, diabetes, and hypercholesterolemia compared to their younger and underweight counterparts. Specifically, the risk of hypertension (HTN), diabetes (DM), and hypercholesterolemia (HC) among the older population is

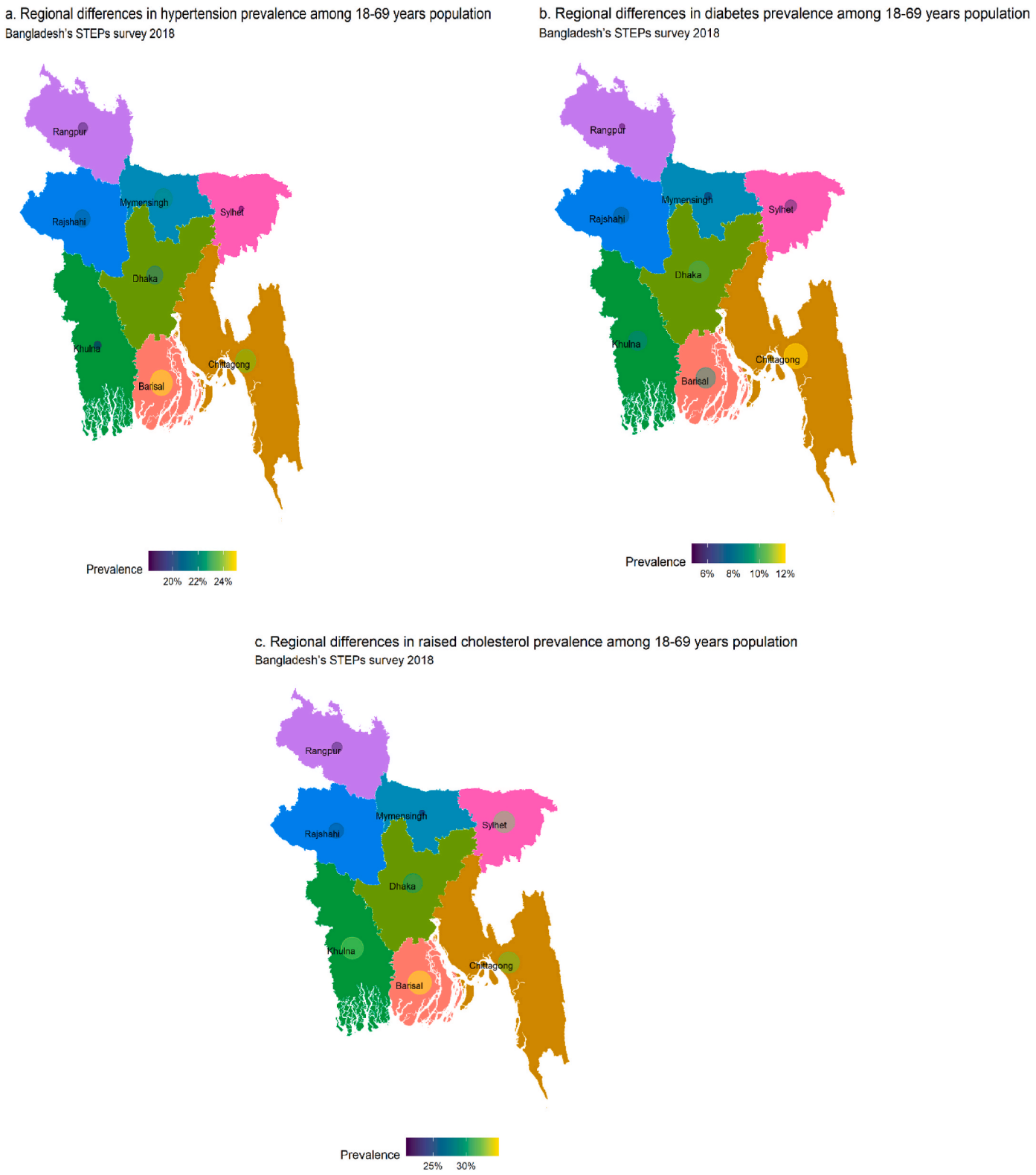


Fig. 2. Regional differences in prevalence of hypertension, diabetes, and hypercholesteromia.

4.56 (OR: 4.56, 95 % CI: 3.79–5.57, $p < 0.0001$), 3.44 (OR: 3.44, 95 % CI: 2.64–4.43, $p < 0.001$), and 2.15 (OR: 2.15, 95 % CI: 1.84–2.53, $P < 0.0001$) times higher, respectively, than among younger individuals. Similarly, obese individuals face significantly increased risks of developing HTN (OR: 8.44, 95 % CI: 5.25–13.61, $p < 0.0001$), DM (OR: 8.58, 95 % CI: 4.64–15.66, $p < 0.0001$), and HC (OR: 3.91, 95 % CI: 2.68–5.62, $p < 0.0001$) compared to those who are underweight. Urban dwellers exhibit 49 % higher odds of developing DM compared to their rural counterparts. Individuals with low physical activity levels have a 35 % (OR: 1.35, 95 % CI: 1.06–1.77, $P = 0.016$) and 41 % (OR: 1.41, 95 % CI: 1.14–1.77, $P = 0.003$) increased likelihood of developing HTN and HC, respectively (Table 2).

Table 2
Risk factors of hypertension, diabetes, and hypercholesterolemia obtained from binary logistic regression model.

Characteristics	Hypertension		Diabetes		Hypercholesterolemia	
	AOR (95 % CI)	P-value	AOR (95 % CI)	P-value	AOR (95 % CI)	P-value
Age groups						
Over mean age	4.56 (3.79–5.57)	0.0001	3.44 (2.64–4.43)	0.001	2.15 (1.84–2.53)	0.0001
Less than mean age	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–
Education						
Illiterate	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–
Primary	1.12 (0.93–1.34)	0.274	1.42 (1.2–1.88)	0.006	1.19 (0.97–1.42)	0.091
Secondary	1.29(0.99–1.66)	0.071	1.23 (0.82–1.74)	0.309	1.18 (0.93–1.55)	0.223
Higher secondary and above	0.93 (0.58–1.41)	0.667	2.54 (1.49–4.38)	0.001	1.57 (1.06–2.31)	0.019
Occupational status						
Low	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–
Medium	0.83 (0.65–1.05)	0.147	0.81 (0.57–1.15)	0.243	1.12 (0.88–1.43)	0.352
High	0.62 (0.45–0.87)	0.009	0.68 (0.39–1.17)	0.167	0.85 (0.63–1.15)	0.287
Residence						
Urban	1.16 (0.97–1.39)	0.109	1.49 (1.16–1.93)	0.002	1.10 (0.92–1.32)	0.291
Rural	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–
Physical Activity						
Low	1.35 (1.06–1.77)	0.016	1.34 (0.94–1.92)	0.106	1.41 (1.14–1.77)	0.003
Moderate	1.16 (0.91–1.48)	0.220	0.89 (0.67–1.19)	0.433	1.10 (0.92–1.31)	0.293
High	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–
Body Mass Index						
Underweight	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–	1.00 (Ref. cat.)	–
Normal	2.05 (1.44–2.96)	0.002	2.91 (1.77–4.79)	0.0001	2.44 (1.93–3.14)	0.0001
Overweight	4.40 (3.04–6.43)	0.0001	6.16 (3.66–10.57)	0.0001	3.66 (2.75–4.96)	0.0001
Obese	8.44 (5.25–13.61)	0.0001	8.58 (4.64–15.66)	0.0001	3.91 (2.68–5.62)	0.0001

AOR = Adjusted Odds Ratio, Ref. cat. = Reference category.

4. Discussion

The WHO STEPS study is a comprehensive method for identifying and disseminating socioeconomic and behavioral risk factors for NCDs. This study suggests that being older, low occupational status, low physical activity and obesity had higher odds of having hypertension. Moreover, older, highly educated people and obese people had a higher risk of developing DM and hypercholesterolemia than their counterparts. These findings are similar to the findings of previous studies where age, BMI, diet and physical activity were found to be significantly associated with the prevalence of HTN, DM, and HC among the Bangladeshi population.[1,22,36,37]

Age and BMI were associated with all the three NCDs. The risk of having HTN was 4.59, DM was 3.43 and HC was 2.14 times higher in older people. A study based on the Nepalese STEPS survey demonstrated that one in every three males and one in every five females aged >60 had hypertension. Moreover, one-third of the older females aged >60 had a high level of lipid.[38] Interestingly, a large study of 1.3 million adults in India reported that HTN was also prevalent among the younger population aged 18 to 35 while DM was prevalent among older people as usual.[39] Furthermore, the study also suggests that urban populations had an increased risk of HTN and DM, albeit our study found a significant association between living in urban locations and a higher risk of DM. Weakened immunity and less physical activity leading to increased BMI could be some significant factors behind the higher prevalence of NCDs among the older population in Bangladesh and worldwide.[40–42] Exceeding BMI or obesity was another predominant risk factor associated with all three of the studied NCDs. Compared to other studies, respondents with obesity in this study had considerably a higher risk of having HTN, DM and HC; 8.45, 8.55 and 3.90 times higher risk, respectively. For instance, a nationwide study of the Bangladeshi population by Das et al. showed that obese people had a 2.65 times higher risk of HTN and a 1.88 higher risk of DM than underweight adults.[43] A systematic review reported a 2.33 higher odds of having HTN among the South Asian population.[44] Another cohort study on 900,000 Asians from seven countries reported that obese people had 2.23 times higher odds of developing diabetes.[45] Likewise, the risk of developing HTN and HC was lower among people who are more physically active than people with low physical activity (35 % and 41 % lower risk for HTN and HC). It has been established low physical activity leads to a sedentary lifestyle and weight gain which makes people prone to cardiovascular diseases, HTN, diabetes and many NCDs.[42] Sedentary lifestyle and obesity have become serious public concerns since many diseases, particularly NCDs are strongly associated with these. A study found that compared to people with normal BMI, severely obese people lost 7 to 8 disease-free years. Even, mildly obese people lost 3 to 4 disease-free years.[46] Experts recommended that regular physical exercise, healthy food habits, and avoiding sedentary behavior and lifestyle including tobacco and alcohol have a significant impact in increasing 'Quality of Life' and controlling NCDs.[47–49]

Moreover, people with higher education had more risk of HTN and diabetes which is in line with the previous study.[1,50,51] Generally, it is common that people with higher education have better occupational status and income and are less likely to be involved in physical activity due to official duty escalating the chance to develop NCDs like HTN and DM.

On top of that, the risk of hypertension varies from one geographic location to another, with higher risks in the Rangpur and Barisal divisions, and a relatively lower risk in the Chittagong division compared to the Dhaka division. Similarly, Barisal tends to exhibit higher percentages in both hypertension and raised cholesterol in our study, indicating a potentially elevated cardiovascular risk in this division. This may be due to factors such as dietary patterns rich in saturated fats and salt, lower physical activity levels, genetic predisposition, and limited access to healthcare and preventive measures. Additionally, the both Barishal and Chittagong region's geographical location beside saline water bodies may contribute to higher salt intake through drinking water and food, potentially exacerbating hypertension risk. Environmental and socioeconomic factors, including stress, obesity prevalence, and healthcare infrastructure, may also play a role. The likelihood of diabetes was high among respondents in the Dhaka division and low among those in the Rangpur and Barisal divisions.[52] However, Chittagong stands out with a higher percentage of diabetes in our study, which may contribute to an increased overall diabetes risk. Additionally, Sylhet consistently shows lower percentages in all three conditions, suggesting a relatively healthier profile in terms of these risk factors. The variations in prevalence across divisions highlight the importance of regional differences in health and may provide insights for targeted

public health interventions in specific areas.

This study is unique as it examines common factors contributing to NCDs and provides a regional comparison. Consequently, it will assist policymakers in formulating targeted interventions for specific factors in particular regions. Although the study is limited to the Bangladeshi context, there are numerous ways to address this limitation. These include, but are not limited to, understanding the broader aspects of NCDs by studying the scenario at the country level. Such an approach will aids researchers and policymakers in assessing the current conditions and taking effective measures to alleviate this burden.

This study utilized the most recent STEPS survey to determine the prevalence and risk factors of hypertension, diabetes, and hypercholesterolemia. However, it has several limitations. Firstly, the study models did not account for the participants' complete diet information, which could have offered a better understanding of the behavior of NCDs and approaches for prevention and control. Secondly, since the study is cross-sectional, it restricts any causal inference. Lastly, a more accurate district or subdistrict level data could have given the spatial distribution of NCDs in Bangladesh, enabling more accurate policy intervention by geographic area. The study is presently restricted to divisional levels.

4.1. Policy recommendations

Region-Specific Public Health Interventions: Given the regional variations in NCD prevalence, particularly in areas like Barisal and Chittagong, public health efforts should be tailored to local needs. Focused campaigns should raise awareness about hypertension, diabetes, and hypercholesterolemia, highlighting prevention and early detection.

Encourage Physical Activity: The strong association between physical inactivity and NCDs emphasizes the need for policies that promote regular physical activity. Developing infrastructure like parks and cycling paths and encouraging workplace wellness programs would foster active lifestyles.

Promote Healthy Diets: With obesity linked to higher NCD risk, policies should focus on improving dietary habits. Public health initiatives should emphasize reducing processed food consumption and promoting balanced, nutritious diets.

Improve Access to Healthcare: Urban areas, where diabetes and hypertension rates are higher, need better access to healthcare. Expanding screening programs, improving early diagnosis, and ensuring equitable access to treatment facilities in both rural and urban areas are essential.

Focus on At-Risk Populations: Regular health screenings for individuals aged 40 and above, particularly in high-risk regions, should be prioritized. Additionally, those in lower occupational statuses should be identified as high-risk groups for early interventions.

Strengthen Health Literacy: Increasing public awareness about NCDs and their risk factors through educational campaigns can empower individuals to make healthier lifestyle choices, particularly in populations with lower education levels.

4.2. Conclusion

This study aims to assess the prevalence of diabetes, hypertension, and hypercholesterolemia with identifying the risk factors for these diseases among the study population. Our nationwide study provided valuable insights into the prevalence and distribution of hypertension, diabetes, and hypercholesterolemia. Importantly, the prevalence of these NCDs varies across divisions, with notable risk observed in Barisal and Chittagong divisions. Risk factors such as age, occupational status, physical activity, and BMI category were identified as influential contributors to NCD prevalence. Older age and obesity emerged as particularly significant, substantially increasing the odds of developing hypertension, diabetes, and hypercholesterolemia. Implementing strategies that consider age, physical activity levels, and BMI status can contribute to the effective prevention and management of NCDs in Bangladesh.

Author statements

Ethical approval

The dataset used in this study was obtained from the publicly available secondary source and therefore, the ethical consent is not required.

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Competing interests

None declared.

Data availability statement

The datasets used and analyzed in the current study are available at the website of WHO e.g.: WHO data repository: https://extranet.who.int/ncdsmicrodata/index.php).

Author contributors

MMR was involved for the study concept, design, data acquisition, data presentation, statistical analysis, interpretation, writing original draft, and supervision of the study. ZF, AAN and NH carried out the data preparation and statistical analysis, interpretation, and writing of the manuscript. AAK and BKR participated in the interpretation of data, critical revision of the manuscript for important intellectual content, fund acquisition, and approved the final version submitted for publication. All authors were involved in approval of the manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2025.105832.

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