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Hypertension, diabetes, and hypercholesterolemia in Bangladesh: Evaluating role of physical activity from cross-sectional STEPS 2018 survey

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Abstract

Background and Aims: The objective of this study was to assess current condition of three noncommunicable diseases (NCDs)-diabetes, hypertension, and hypercholesterolemia and vulnerable cohorts among adults in Bangladesh.

Methods: The STEPwise Approach to the NCD Risk Factor Surveillance survey of 2018 was analyzed to evaluate the association between NCDs and sociodemographic factors, levels of physical activity, and behavioral measurements. Complex survey weight-adjusted logistic models were fitted.

Results: From 6875 samples, prevalence of diabetes, hypertension and hypercholesterolemia were 27.3%, 9.8%, and 30.2%, respectively. The prevalence of the three NCDs were higher among older respondents. Low occupational activity with obese-BMI status people was more prone to NCDs. Lower prevalence of hypercholesterolemia was observed in Rangpur, Rajshahi, and Mymensingh, whereas lesser diabetes in Khulna region. Likelihood of NCDs were higher among highly educated, urban residents with low physical activity. Lesser physical activity, and lack of weight maintenance were found to be key factors in higher rates of NCDs in Bangladesh.

Conclusion: Greater education and less strenuous profession led to a higher chance of NCDs. Overall, physical activity and maintenance of weight seem to be factors driving higher rates of NCDs in Bangladesh. As a preventive measure against NCDs, an active lifestyle is to be encouraged, particularly to the most vulnerable cohort.

KEYWORDS

Bangladesh, BMI, noncommunicable diseases, physical activities, STEPS, weight

1 | INTRODUCTION

As prevention and treatment for communicable diseases increased worldwide in recent years, noncommunicable diseases (NCD) have spread steadily across the globe. Cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes comprise the bulk of NCDs.[1] Unlike communicable disease (CD) that are inheritable and generally occurred through pathogens, NCDs can be hereditary and spread across generations, and considered the leading cause of death and disability.[2] Comprehensive research on NCDs is needed to meet the Sustainable Development goals for of a 33% reduction in NCD-related early deaths by 2030.[1]

A systematic analysis conducted in 2019 reveals that 74.4% of all deaths and 63.8% of disability-adjusted life years (DALYs) were caused by NCDs globally[3] NCDs are expected to account for 80% of the global disease burden in 2020[4] and comprise 7 of the top 10 causes of death globally.[5] Around 17.9, 9.0, 7.6, 3.9, and 1.6 million deaths occur annually due to cardiovascular disease, cancers, respiratory disease, hypertension, and diabetes, respectively, reported in 2018.[1] Among them, over 85% of premature deaths occur in low and middle-income countries (LMICs),[1] which shows an increasing trend. For example, NCDs are responsible for nearly 62% of all deaths in South East Asia as of 2020.[6]

Physical activity (PA) directly contributes to healthcare, particularly for prevention of NCDs. There are substantial literature confirming that regular PA is associated with a lower risk of coronary heart disease, hypertension, stroke, diabetes, can improve mental health and quality of life.[7] Low level physical activity leads to various disease inceptions. Studies showed that 27% of diabetes patients and 20% of heart disease patients were habituated to low PA which acts as a determinant of cardiac mortality.[8] Physical inactivity leads to around 1.6 million deaths related to NCDs.[1] In response to the rise in NCDs, the World Health Assembly set a goal to eliminate 15% of the global prevalence of physical inactivity among adults and adolescents by 2030 (SDG Goals). Translating such calls for physical activity requires analyzing the latest available data from different regions, more so in LMICs such as Bangladesh where sedentary jobs are gradually replacing manual laboring.[9]

NCDs are identified as a significant cause of morbidity and mortality, which account for 59% of all deaths in Bangladesh estimated in 2015.[10] Cardiovascular diseases, diabetes, cancers, and chronic respiratory diseases account for 67% of all deaths estimated in 2019, most of which are premature.[11] Individuals, households, and communities suffer from financial and social burdens due to premature deaths and disability caused by NCDs.[11] A systematic review on Bangladesh has shown that the weighted pooled prevalence of hypertension is 20.0% among 305,432 subjects.[12] The prevalence of diabetes has increased from 28.97% in 2008 to 36.63% in 2018.[13] The prevalence of hypercholesterolemia is around 20%–25% among urban adults and 10%–12% in rural areas of Bangladesh reported in 2016.[14] As the prevalence of these diseases are on the rise in Bangladesh, an even greater burden of NCDs is expected, which requires an early intervention.

In the Southeast Asian region, urban development and modernization have led to a rapid shift in lifestyle related NCDs risk factors including unhealthy diet and physical inactivity. The prevalence of risk factors of NCDs which resulted from physical inactivity varied between 10% and 38% among different Southeast Asian countries. A systematic review conducted among adults aged 40 years or older found that adults from South Asian who were inactive or less involved had a 31% higher risk of hypertension. Inactive adults have 1.34 times higher risk of cardiometabolic outcomes. In both males and females, complete and leisure-time PA had a protective effect on osteoporosis.[15] Another study found that PA is accounted for 6% of the global burden of Coronary Heart disease (CHD) disease, with 3.2% in Southeast Asia.[16] The problems of chronic NCDs in Southeast Asia results from environmental factors including inadequate physical activity reported. However, the adult population of Bangladesh has a high rate of inadequate physical activity. According to STEPwise Approach to NCD Risk Factor Surveillance (STEPS) of 2002, 2010, and 2018 in Bangladesh, overall prevalence of low/insufficient PA were 27%, 34.5%, and 12.3%, respectively.[17]

Apart from PA, risk factors of NCDs include socioeconomic inequality, sedentary behavior, depression, including intake of processed food, unhealthy diet, use of tobacco, harmful use of alcohol, a high body mass index (BMI), elevated blood pressure, unfavorable blood lipids, and elevated blood glucose levels. Urban people were more likely to suffer from hypertension, diabetes, and hypercholesterolemia. Nujhat and colleagues showed that the risk factors for NCDs in Bangladesh are overweight, high waist circumference, high waist-hip ratio, use of tobaccos, insufficient physical exercise, insufficient intake of fruits and vegetables, and excessive salt consumption of food.[18] Hypertension in Bangladesh is more prevalent among the urban highly educated, who are less prone to manual work typically belonging to the higher socio-economic group. Individuals with a poor diet (consumption of excess saturated fat), obesity, smoking, age, diabetes, lack of exercise, alcohol abuse, and psychosocial stress were more prevalent of hypercholesterolemia.

NCDs are getting traction in developing nations such as Bangladesh.[19] However, nationally representative NCDs data in Bangladesh are still inadequate. Despite the major prevalence of three NCDs—diabetes, hypertension, and hypercholesterolemia—in Bangladesh, few studies had been conducted to identify the risk factors, particularly the role of PA, as well as identifying the most vulnerable cohort. Moreover, hypercholesterolemia remains to be studied extensively.[20] To contribute to these literature gaps, this study analyzed the STEPwise approach to surveillance (STEPS) of 2018 in Bangladesh to evaluate three NCDs—diabetes, hypertension, and hypercholesterolemia—to assess their prevalence, identify contributory factors including PA and define a vulnerable cohort.

2 | METHODS

2.1 | Data overview

The data is extracted from the STEP-wise approach to surveillance (STEPS) survey 2018 for non-communicable diseases (NCD) conducted in Bangladesh funded by World Health Organization (WHO). It was a nationally representative cross-sectional study based on a multistage cluster sampling design stratified geographically. A total of 496 Primary Sampling Units (PSUs) at the first stage and a total of 9900 households at the second stage were selected. A three phrase approach was adopted, which included (a) screening questions and sociodemographic information, (b) physical measurements, and (c) biochemical measurements, where sample sizes and weights were quantified for each phrase.[21] The final sample from first two phrases were 8185 men and women aged 18–69 years, and third phrase included 7199 participants. The data were cleaned as per WHO recommendations outlined in GPAQ version-2,[22] and missing values were case-wise deleted, which gave a final sample size of 6785 participants. Stratum, PSU, and STEP-3 survey weight for each participant were used as survey features in the analyses.

2.2 | Outcome variables

The outcome variables are chosen to be three different noncommunicable diseases: Stage-I hypertension (blood pressure >140/90 mmHg),[23] diabetes (blood glucose level ≥126 mg/dL or currently taking insulin)[24] and hypercholesterolemia (total cholesterol ≥190 mg/dL) or currently taking medication for controlling cholesterol.[24] All three outcome variables were binary.

2.3 | Independent variables

Sociodemographic factors and behavioral and health-related variables were taken as independent variables. Sociodemographic factors included age (binarized: under median, over median); respondent's level of education (none, primary completed, secondary completed, higher education); religion (Islam, others), marital status (not married, currently married); occupation (occupational activity: low, medium, high); division (Barisal, Chittagong, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur, and Sylhet); and region (Urban, Rural).

Behavioral and health-related variables included consumption of alcohol (yes and no); habit of tobacco (yes and no); level of PA (high, medium, and low); consumption of processed food (always, often, sometimes, rarely, and never); BMI category (underweight, normal, overweight, and obese). Occupation was categorized based on previously published literature on level of physical work required for day to day job related tasks.[25] PA was classified based on WHO's Global Physical Activity methodology,[22] and similar for BMI.[26]

2.4 | Statistical analysis

Incorporating the survey features, bivariate analyses with frequency distribution and χ^2 tests were conducted to assess primary associations between three NCDs and the sociodemographic factors, level of physical activity, physical, and biochemical measurements.[27] Survey weight, cluster, and strata-adjusted binary logistic regression for each of the three outcome variables was fitted with the significant variables from the primary tests, under the framework of complex survey data.

All analyses were conducted in *R*. The "Survey" package from *R* was used for computing survey-feature-enabled bi-variate analysis, χ^2 tests, and binomial logistic regression. Multicollinearity was assessed by variance inflation factors (VIF) (See Table S1). The threshold of level of significance was considered 5% with validation from confidence interval.

3 | RESULTS

From the study sample of size 6785, nationwide prevalence of hypertension, diabetes and hypercholesterolemia were 27.3%, 9.8%, and 30.2%, respectively. In the χ^2 test, level of significance varied across outcomes, where age, sex, education level, religion, profession, division, region, alcohol and tobacco use, physical activity, processed food consumption, and BMI were significant for one or all outcomes (Table 1).

Greater proportion of survey participants (35.8%, 13.7%, and 34.9%) who were above median age (38 years), had hypertension, diabetes, and hypercholesterolemia, respectively (Table 1). There was not much difference between males and females for diabetes and hypercholesterolemia; however, 27.7% of the females were hypertensive compared of 20.7% of the males. In the sample, 17.27% of the highly educated group had diabetes compared to other groups where proportion of diabetes was less than 8%. Marital status was not significantly associated with prevalence of any of the three studied NCDs. Interestingly, those with medium occupational activity (OA) had greater proportion of hypertension (27.1%) and hypercholesterolemia (29.9%) than low or high OA groups. Highest proportion of hypertension, diabetes and hypercholesterolemia were detected in Barisal (30.4%), Chittagong (12.5%), and Barisal (34.5%), respectively. Urban residents had higher proportion of all three studied NCDs.

Consumption of alcohol and use of tobacco were associated with hypertension and hypercholesterolemia (Table 1). Physical activity was also associated with all three NCDs ($p < 0.05$), as higher-level activity led to lesser percentage of hypertension (high PA: 21.6% to low PA: 32.3%), diabetes (6.9%–12.9%) and hypercholesterolemia (25.4%–35.5%). Consumption of processed food was associated with hypertension only, whereas BMI was associated with all three NCDs (Table 1).

In the logistic regression, BMI and age of the survey participants were consistently significant ($p < 0.05$) for all three outcomes (Table 2). For hypertension, religion, profession, division, tobacco use, PA levels; for diabetes, education, religion; and for hypercholesterolemia, education, division, PA levels were found to be associated with the disease outcomes.

TABLE 1 Bivariate distribution of hypertension, diabetes, and hypercholesterolemia across sociodemographic and physical activity factors.

		Hypertension			Diabetes			Hypercholesterolemia		
Variables	Categories	Yes [*N* (%)]	No [*N* (%)]	*p* Value (χ^2 test)	Yes [*N* (%)]	No [*N* (%)]	*p* Value (χ^2 test)	Yes [*N* (%)]	No [*N* (%)]	*p* Value (χ^2 test)
Age	Under median	547 (14.90)	3121 (85.10)	<0.001	177 (4.41)	3834 (95.59)	<0.001	805 (21.95)	2863 (78.05)	<0.001
	Over median	1115 (35.78)	2002 (64.22)		379 (13.65)	2395 (86.35)		1090 (34.98)	2027 (65.02)	
Sex	Female	1020 (27.68)	2666 (72.32)	<0.001	275 (8.04)	3147 (91.96)	0.280	1043 (28.29)	2643 (71.71)	0.591
	Male	642 (20.70)	2458 (79.30)		280 (8.33)	3083 (91.67)		853 (27.52)	2246 (72.48)	
Education level	None	831 (25.05)	2488 (74.95)	0.241	246 (7.85)	2883 (92.15)	<0.001	890 (26.81)	2429 (73.19)	0.089
	Primary completed	472 (22.51)	1623 (77.49)		160 (7.56)	1950 (92.44)		595 (28.39)	1500 (71.61)	
	Secondary completed	278 (26.19)	782 (73.81)		93 (7.63)	1120 (92.37)		297 (28.05)	763 (71.95)	
	Higher education	81 (26.11)	230 (73.89)		58 (17.27)	277 (82.73)		114 (36.52)	197 (63.48)	
Religion	Islam	1402 (23.63)	4530 (76.37)	0.009	471 (8.02)	5404 (91.98)	0.577	1649 (27.80)	4283 (72.20)	0.589
	Others	260 (30.48)	593 (69.52)		84 (9.28)	826 (90.72)		247 (28.92)	607 (71.08)	
Marital Status	Not married	1402 (23.63)	4530 (76.37)	0.623	471 (8.02)	5404 (91.98)	0.180	1649 (27.80)	4283 (72.20)	0.682
	Currently married	260 (30.48)	593 (69.52)		84 (9.28)	826 (90.72)		247 (28.92)	607 (71.08)	
Profession	Low OA	268 (26.52)	743 (73.48)	<0.001	128 (10.61)	1075 (89.39)	<0.001	291 (28.83)	719 (71.17)	<0.001
	Medium OA	1144 (27.08)	3080 (72.92)		345 (8.67)	3638 (91.33)		1263 (29.91)	2961 (70.09)	
	High OA	250 (16.11)	1301 (83.89)		83 (5.17)	1517 (94.83)		341 (21.99)	1209 (78.01)	
Division	Barisal	116 (30.36)	266 (69.64)	0.202	33 (9.08)	335 (90.92)	<0.001	132 (34.48)	251 (65.52)	<0.001
	Chittagong	355 (26.88)	965 (73.12)		168 (12.52)	1176 (87.48)		404 (30.57)	916 (69.43)	
	Dhaka	384 (25.20)	1139 (74.80)		138 (9.06)	1380 (90.94)		441 (28.99)	1081 (71.01)	
	Khulna	184 (22.41)	637 (77.59)		62 (7.42)	776 (92.58)		263 (32.01)	558 (67.99)	
	Mymensingh	158 (23.96)	500 (76.04)		31 (4.89)	599 (95.11)		137 (20.76)	521 (79.24)	
	Rajshahi	223 (23.22)	737 (76.78)		65 (6.81)	885 (93.19)		241 (25.05)	720 (74.95)	
	Rangpur	158 (22.00)	561 (78.00)		35 (4.95)	680 (95.05)		153 (21.26)	566 (78.74)	
	Sylhet	85 (21.02)	318 (78.98)		23 (5.45)	397 (94.55)		126 (31.33)	276 (68.67)	
Region	Rural	1252 (23.13)	4162 (76.87)	<0.001	381 (7.03)	5043 (92.97)	<0.001	1454 (26.85)	3960 (73.15)	0.542
	Urban	410 (29.88)	961 (70.12)		174 (12.79)	1186 (87.21)		442 (32.24)	929 (67.76)	

TABLE 1 (Continued)

Variables	Categories	Hypertension			Diabetes			Hypercholesterolemia		
		Yes [*N* (%)]	No [*N* (%)]	*p* Value (χ^2 test)	Yes [*N* (%)]	No [*N* (%)]	*p* Value (χ^2 test)	Yes [*N* (%)]	No [*N* (%)]	*p* Value (χ^2 test)
Alcohol use	Yes	88 (17.58)	414 (82.42)	0.005	45 (7.61)	547 (92.39)	0.906	149 (29.71)	353 (70.29)	0.065
	No	1574 (25.04)	4709 (74.96)		510 (8.24)	5683 (91.76)		1746 (27.79)	4537 (72.21)	
Tobacco use	Yes	249 (15.92)	1315 (84.08)	<0.001	108 (6.59)	1530 (93.41)	0.091	399 (25.50)	1165 (74.50)	<0.001
	No	1413 (27.06)	3809 (72.94)		447 (8.69)	4700 (91.31)		1497 (28.67)	3725 (71.33)	
Physical activity	High	873 (21.61)	3166 (78.39)	<0.001	276 (6.96)	3694 (93.04)	0.004	1025 (25.37)	3015 (74.63)	<0.001
	Moderate	486 (26.88)	1323 (73.12)		150 (8.26)	1670 (91.74)		538 (29.75)	1271 (70.25)	
	Low	302 (32.30)	634 (67.70)		129 (12.94)	866 (87.06)		332 (35.50)	604 (64.50)	
Food consumption	Always	70 (24.66)	215 (75.34)	<0.001	25 (8.37)	274 (91.63)	0.348	84 (29.51)	201 (70.49)	0.369
	Often	118 (20.20)	467 (79.80)		46 (7.63)	560 (92.37)		156 (26.75)	428 (73.25)	
	Sometimes	849 (22.41)	2940 (77.59)		280 (7.34)	3537 (92.66)		1019 (26.89)	2770 (73.11)	
	Rarely	361 (27.02)	974 (72.98)		142 (10.75)	1175 (89.25)		385 (28.87)	949 (71.13)	
	Never	263 (33.28)	528 (66.72)		62 (8.35)	683 (91.65)		251 (31.68)	541 (68.32)	
BMI category	Underweight	114 (11.93)	842 (88.07)	<0.001	22 (2.20)	975 (97.80)	<0.001	126 (13.15)	831 (86.85)	<0.001
	Normal	816 (20.43)	3179 (79.57)		259 (6.35)	3821 (93.65)		1073 (26.85)	2922 (73.15)	
	Overweight	530 (36.64)	917 (63.36)		201 (14.90)	1151 (85.10)		538 (37.18)	909 (62.82)	
	Obese	201 (52.06)	185 (47.94)		73 (20.54)	283 (79.46)		159 (41.11)	228 (58.89)	

TABLE 2 Binary logistic regression fitted to hypertension, diabetes, and hypercholesterolemia for sociodemographic and physical activity factors after adjusting for survey weights, cluster, and strata-wise variations.

Variables	Categories	Hypertension		Diabetes		Hypercholesterolemia	
		OR (95% CI)	*p* Value	OR (95% CI)	*p* Value	OR (95% CI)	*p* Value
Age	Under median	1.00	-	1.00	-	1.00	-
	Over median	4.59 (3.78–5.57)	<0.001	3.43 (2.65–4.43)	<0.001	2.14 (1.82–2.52)	<0.001
Sex	Women	1.00	-	-	-	-	-
	Men	0.90 (0.72–1.14)	0.390	-	-	-	-
Education level	None	1.00	-	1.00	-	1.00	-
	Primary completed	1.11 (0.92–1.35)	0.274	1.44 (1.1–1.89)	0.008	1.17 (0.98–1.41)	0.090
	Secondary completed	1.28 (0.98–1.67)	0.074	1.21 (0.84–1.75)	0.309	1.17 (0.91–1.52)	0.221
	Higher education	0.91 (0.59–1.40)	0.669	2.56 (1.49–4.39)	0.001	1.58 (1.08–2.30)	0.018
Religion	Islam	1.00	-	-	-	-	-
	Others	1.69 (1.20–2.38)	0.003	-	-	-	-
Profession	Low OA	1.00	-	1.00	-	1.00	-
	Medium OA	0.81 (0.61–1.07)	0.147	0.81 (0.57–1.15)	0.243	1.12 (0.88–1.43)	0.351
	High OA	0.62 (0.43–0.89)	0.009	0.68 (0.39–1.17)	0.166	0.85 (0.63–1.15)	0.289
Division	Barisal	1.00	-	1.00	-	1.00	-
	Chittagong	1.00 (0.65–1.54)	0.987	1.60 (0.98–2.6)	0.059	0.88 (0.66–1.17)	0.389
	Dhaka	0.85 (0.58–1.24)	0.393	1.03 (0.64–1.64)	0.915	0.77 (0.56–1.04)	0.088
	Khulna	0.67 (0.47–0.96)	0.032	0.99 (0.60–1.62)	0.955	0.96 (0.70–1.31)	0.798
	Mymensingh	1.04 (0.74–1.47)	0.805	0.68 (0.35–1.34)	0.272	0.58 (0.41–0.82)	0.002
	Rajshahi	0.85 (0.60–1.19)	0.336	0.86 (0.52–1.42)	0.555	0.70 (0.51–0.97)	0.030
	Rangpur	0.90 (0.62–1.30)	0.562	0.66 (0.39–1.14)	0.136	0.59 (0.42–0.83)	0.002
	Sylhet	0.88 (0.61–1.26)	0.491	0.82 (0.47–1.42)	0.470	1.03 (0.72–1.48)	0.873
Region	Rural	1.00	-	1.00	-	1.00	-
	Urban	1.16 (0.97–1.39)	0.109	1.49 (1.16–1.93)	0.002	1.10 (0.92–1.32)	0.293
Alcohol use	Yes	1.00	-	-	-	-	-
	No	1.21 (0.80–1.82)	0.369	-	-	-	-
Tobacco use	Yes	1.00	-	1.00	-	1.00	-
	No	1.52 (1.13–2.05)	0.006	1.02 (0.71–1.46)	0.912	0.95 (0.79–1.15)	0.596
Physical activity	High	1.00	-	1.00	-	1.00	-
	Moderate	1.16 (0.91–1.48)	0.220	0.89 (0.67–1.19)	0.430	1.10 (0.92–1.31)	0.293
	Low	1.37 (1.06–1.77)	0.016	1.34 (0.94–1.92)	0.107	1.42 (1.14–1.77)	0.002
Food consumption	Always	1.00	-	1.00	-	1.00	-
	Often	0.62 (0.34–1.15)	0.129	1.19 (0.55–2.59)	0.663	0.88 (0.55–1.43)	0.610
	Sometimes	0.74 (0.43–1.29)	0.290	0.96 (0.49–1.9)	0.918	0.90 (0.59–1.38)	0.637
	Rarely	0.83 (0.47–1.48)	0.525	1.20 (0.60–2.41)	0.608	0.90 (0.58–1.41)	0.652
	Never	1.26 (0.68–2.31)	0.461	1.05 (0.50–2.24)	0.892	1.01 (0.65–1.57)	0.966
BMI category	Underweight	1.00	-	1.00	-	1.00	-
	Normal	2.07 (1.48–2.91)	<0.001	2.92 (1.79–4.76)	<0.001	2.46 (1.91–3.15)	<0.001
	Overweight	4.40 (3.03–6.40)	<0.001	6.18 (3.63–10.51)	<0.001	3.66 (2.71–4.95)	<0.001
	Obese	8.45 (5.26–13.60)	<0.001	8.55 (4.65–15.69)	<0.001	3.90 (2.69–5.66)	<0.001

Respondents aging over median (38 years) were 4.6, 3.4, and 2.1 times more likely to have hypertension, diabetes, and hypercholesterolemia, respectively ($p < 0.001$). Highly educated respondents were 2.6 (95% CI: 1.19–4.39, $p < 0.001$) and 1.6 times (95% CI: 1.08–2.30, $p = 0.018$) more likely to develop diabetes, and hypercholesterolemia, respectively compared to the illiterate. Compared those with lower level of OA, participants whose jobs demanded higher OA were 38% less likely (95% CI: 0.43–0.89, $p = 0.009$) to have hypertension. On average, Khulna division residents less hypertensive than Barisal division residents. Similarly, residents of Mymensingh, Rajshahi and Rangpur were less likely to have hypercholesterolemia compared to Barisal residents. Urban residents were 49% more likely to have diabetes than people living in rural areas ($p < 0.05$).

Lower PA were 1.37 times (95% CI:1.06–1.77, $p = 0.016$) and 1.42 times (95% CI:1.14–1.77, $p = 0.002$) more likely to be associated with hypertension and hypercholesterolemia, respectively compared to higher PA. The greater the BMI, the more likelihood of a respondent falling victim to any three of the NCDs. For example, participants in the obese category had over eight times greater chance of being hypertensive or diabetic than the underweight (OR: 8.45, 95% CI: 5.26–13.60, $p < 0.001$). The VIF scores were all well below 5 (highest being 3.38) for all three models, which discards the possibility of multicollinearity (See Table S2).

4 | DISCUSSION

This study analyzed the STEPwise approach to surveillance (STEPS) of 2018 in Bangladesh to evaluate three NCDs—diabetes, hypertension, and hypercholesterolemia. Nationwide results suggest that one in every four adults (age ≥18) had developed hypertension or hypercholesterolemia, whereas 1 in 10 adults was diabetic. The modeling suggested respondents' age, area of residence, education, physical fitness, and lifestyle factors were associated with these three NCDs prevalence. Part of the challenges in controlling NCDs in Bangladesh is maintaining a healthy lifestyle.

As adults grow older, they are susceptible to NCDs, that is higher likelihood of developing hypertension, diabetes, and hypercholesterolemia. Societal and economic changes that comes with increased age often led to sedentary lifestyle, consumption of increased fat based diet and less physical movement or weight maintenance.[28] These changes increase the propensity of setting in risk factors for NCDs. The growing burden of aging and NCDs are well documented, even for LMICs.[29] For a country like Bangladesh, where nearly 45% of the population is under 25 years old,[30] the immediate threat of noncommunicable diseases (NCDs) might not appear to be significant. However, in the next decade or so, with low child mortality rate and as a greater section of population would cross middle age, prevalence of NCDs would only increase unless interventions are put in place.

Urbanization has been identified as a key risk factor for NCDs. Over the years, exponential growths in number of cities have been observed, which brought about major changes in lifestyle. This has led to more sedentary jobs, fewer opportunities for physical activities, and a rise in indoor entertainment. Although there has been recent advocacy for the development of green cities, the rapidly growing cities in Bangladesh mostly remain unplanned and overpopulated. Studies have shown that urban lifestyle in Bangladesh led to increased obesity.[31] Active routines in village life in Bangladesh were more protective against diabetes and hypertension,[32] which is consistent with current study findings.

Part of lifestyle changes include shift in profession. Some jobs can be more physically demanding and force more activity in day-to-day lifestyle. This can be a protective factor against NCDs.[33] The survey results showed that higher occupational activity was associated with lesser prevalence of hypertension, which is homogenous to previous findings as prolonged sitting time was found to be associated with the onset of different NCDs.[34,35] However, there are debates on categorizing physical activity based on occupations.[36] Similarly, tobacco use was found to be a risk factor. These ultimately reduce quality of life and increase burden on the healthcare system.[37]

Education was found to be associated with diabetes and hypercholesterolemia, where respondents with higher education were more likely to have both these conditions compared to those who were uneducated. In previous studies of Bangladesh, education was found to be associated with increased weight, which could be caused due to higher sitting time and less physically strenuous jobs among those who are highly educated.[31] There is further spatial impact as more educated citizens are expected to reside in metropolitan areas, which reduces the scope of further physical activity and increases the possibility of an unbalanced diet.[38] However, opposite findings in LMICs are reported in literature, where educated individuals were considered more aware and more likely to take precautionary measures against NCDs.[39,40] These complex associations varied across sex and geographic locations.

Physical activity (PA) is considered a key lifestyle behavior associated with the onset of NCDs. Such diseases have mushroomed in urban educated sedentary class, particularly in LMICs. This study results also found similar effects as lower level of PA lead to increased prevalence of hypertension and hypercholesterolemia. Previous reviews have concluded dietary quality and PA as possible preventive measures against NCDs.[41] This also explains why BMI was found to be associated with all three studied NCDs in this study, where overweight and obese respondents were more likely to fall victim to NCDs. Given that NCDs are typically chronic, behavior-change interventions could be implemented for long-term improvements,[42] particularly targeting older urban residents who have fewer opportunities for physical activities. Although multiple policies were initiated in Bangladesh, they lack appropriate long-term planning, implementation and monitoring. Empowering individuals to make informed lifestyle choices, supported by digital platforms that enhance metabolic health and overall well-being, is essential. This requires integrating health literacy into all levels of the school system and implementing innovative clinical services of "lifestyle medicine" within advanced, multidisciplinary community healthcare models.[43]

This study used the latest available STEPS survey to assess prevalence and risk factors of hypertension, diabetes, and

hypercholesterolemia. However, there were a few limitations. First, detailed dietary information of the respondents was not included in the study models, which could have provided a comprehensive assessment of behavioral aspects of NCDs and their prevention. Second, the study is cross-sectional, thus limiting any casual interpretations. Third, detailed district or subdistrict-wise information would have provided a spatial distribution of NCDs in Bangladesh and more focused policy efforts based on geographic locations. For now, it is only limited to divisional areas. Finally, only information on whether respondents were taking any medicines for their conditions were surveyed, not type of their medication as well as length of their conditions, which concealed some important details.

5 | CONCLUSION

Bangladesh is gradually getting traction in economy and with it, urban metropolitan areas are booming, often unplanned excluding greenness. This works as a suitable petri dish for NCDs. This study analyzed the Stepwise approach to surveillance (STEPS) of 2018 in Bangladesh to evaluate three NCDs—diabetes, hypertension, and hypercholesterolemia. The nationwide prevalence of diabetes, hypertension and hypercholesterolemia were 27.3%, 9.8%, and 30.2%, respectively, which are estimated to increase over the years if no interventions are placed. Similar to other LMICs, older people and those who are overweight were more likely to suffer from NCDs. Greater education and less strenuous profession led to a higher chance of NCDs. Overall, physical activity and maintenance of weight seem to be factors driving higher rates of NCDs in Bangladesh. As a preventive measure against NCDs, an active lifestyle is to be encouraged, a holistic national approach is paramount, particularly targeting the most vulnerable cohort.

AUTHOR CONTRIBUTIONS

Raaj Kishore Biswas conceptualized the study, structured the hypothesis, drafted the manuscript, and supervised the project. Srizan Chowdhury conducted the analysis, drafted the manuscript, and critically reviewed the manuscript. Sorif Hossain conducted the analysis, conducted literature review, drafted the manuscript, and critically reviewed the manuscript. Promit Barua Chowdhury conducted the analysis, drafted the manuscript, and critically reviewed the manuscript. All authors have read and approved the final version of the manuscript. Raaj Kishore Biswas had full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

STEPS 2018 raw data are stored without personally identifiable information in WHO data repository (https://extranet.who.int/ncdsmicrodata/index.php) and the survey data used in this study are publicly available. Before accessing the data, permission was taken from the WHO program authority by the authors on November 14, 2020. Moreover, A STROBE checklist has been provided for these observational studies (see Supporting Information: STROBE_checklist file).

TRANSPARENCY STATEMENT

The lead author Sorif Hossain affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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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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