A Cross-sectional Study Unveiling the Enduring Cost Burden of Diabetes and Hypertension Management in Bangladesh and its Association with Lifestyle Modifications

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(Received: February 10, 2026; Accepted: May 26, 2026; Published (web): June 25, 2026)

ABSTRACT: Diabetes mellitus and hypertension constitute major non-communicable diseases in Bangladesh, contributing substantially to morbidity, mortality and economic burden, with limited evidence on medication costs and lifestyle modifications. A multi-stakeholder cross-sectional study was surveyed on 456 participants in Bangladesh, with data collected from Dhaka Medical College Hospital, selected Dhaka city pharmacy areas, professional workplaces, and online platforms using structured questionnaires. Among patients, the majority were aged 40–60 years (57.36%), female (52.83%) and from urban areas (84.53%). Hypertension was alone the most prevalent condition (30.94%), followed by diabetes (29.43%) and comorbid diabetes with hypertension (23.02%). Our study revealed that monthly medication expenses mostly ranged from BDT 1,000 to 5,000, as stated by 50.94% of patients, whilst 13.21% had costs above BDT 5,000. Chi-square analysis demonstrated significant correlations between monthly medication expenses incurred and affordability status (χ^2=11.57, p=0.040), disease condition (χ^2=48.63, p<0.001), and monthly income (χ^2=68.67, p<0.001). Statistical analysis also demonstrated that lifestyle modifications were not significantly associated with the financial cost burden of the patients. Metformin hydrochloride and amlodipine were found to be the most commonly prescribed antidiabetic and antihypertensive drugs respectively. Overall, 87.55% of patients could afford their medications. However, 12.45% of patients reported financial hardship. While lifestyle change is commonly viewed as a means to lower costs, healthcare finance, rational prescription, and control of medication prices are crucial for alleviating the economic burden of chronic illness management.

Key words: Diabetes mellitus, hypertension, medication cost burden, lifestyle modification, Bangladesh.

INTRODUCTION

Non-communicable diseases (NCDs) have emerged as the foremost public health challenge of the 21st century, responsible for approximately 71% of global mortality each year, with the overwhelming burden borne by low- and middle-income countries (LMICs).[1] In Bangladesh, NCDs accounted for 80% of all deaths in 2023 with diabetes mellitus and hypertension among the top contributors.[2] The country faces a dual burden: a significant proportion of the population falls below the poverty line while simultaneously confronting the economic consequences of chronic disease management, which require lifelong medication, regular monitoring, and substantial lifestyle adjustments.[3]

Diabetes mellitus, particularly type-2 diabetes mellitus (T2DM), is a progressive metabolic disorder characterised by impaired insulin secretion or action, leading to persistent hyperglycaemia and multi-organ complications including neuropathy, nephropathy,

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Dhaka Univ. J. Pharm. Sci. **25**(1): 39-53, 2026 (June)
DOI: https://doi.org/10.3329/dujps.v25i1.91122

retinopathy and cardiovascular disease.[4] Globally, the number of people living with diabetes is projected to rise from 537 million to 783 million by 2045.[5] In Bangladesh specifically, the diabetic population is estimated to reach 4 million by 2025, placing enormous strain on an already overstretched healthcare system.[6] On the other hand, hypertension, defined as sustained blood pressure exceeding systolic 130 and/or diastolic 80 mmHg by the American Heart Association classification, is the single most important modifiable risk factor for cardiovascular disease, stroke and renal failure worldwide.[7] The risk factors for diabetes and hypertension such as sedentary behavior, unhealthy diet, obesity, psychological stress and family history are largely overlapping and contribute to a high and growing burden of comorbidity in clinical practice.[8] The coexistence of both conditions amplifies treatment complexity and escalates monthly medication expenditure, posing a disproportionate burden on households in LMICs such as Bangladesh.[9]

Healthcare financing in Bangladesh remains predominantly out-of-pocket, with limited insurance coverage and public subsidy mechanisms.[10] Studies have estimated that the total annual per capita expenditure for T2DM management in Bangladesh is approximately US$635 in urban settings, with medication accounting for the largest share of costs.[11] For hypertensive patients, these costs are compounded by the frequent need for combination of antihypertensive therapy. Despite this evidence, no comprehensive multi-stakeholder study has simultaneously captured the cost perspectives of patients, clinicians, pharmaceutical industry professionals, pharmacy retailers and lifestyle professionals within a single study framework.

Lifestyle modification, encompassing regular physical activity, dietary adjustment, body weight control and cessation of tobacco and alcohol has been demonstrated internationally to be a cost-effective adjunct or even an alternative to pharmacotherapy in the early management of diabetes and hypertension.[12-13] However, the implementation rate of these interventions among affected patients in Bangladesh remains poorly characterised. Understanding the gap between recommended and actual lifestyle practices is essential to designing effective public health strategies.

The present study was therefore conducted using a multi-stakeholder approach to: (i) determine the most frequently prescribed and dispensed medications for diabetes and hypertension; (ii) evaluate the monthly medication expenditure burden among affected patients; (iii) assess the extent of financial hardship in relation to household income; (iv) investigate lifestyle adherence practices among patients and (v) explore stakeholder perceptions regarding the role of lifestyle modification in reducing the economic burden associated with chronic disease management in Bangladesh.

MATERIALS AND METHODS

Study design and setting. A community and hospital-based cross-sectional study with a multi-stakeholder design was conducted from January 2022 to September 2022 across Bangladesh. Data were collected through multimodal platforms both online (Google Forms) and offline from five distinct stakeholder categories. The study encompassed patients recruited from Dhaka Medical College Hospital and online communities; physicians from public and private hospitals; pharmaceutical company professionals from their respective workplaces and online; pharmacy retailers from three different areas of Dhaka city and lifestyle professionals (nutritionists, gym trainers, health content creators and psychologists) via online and hospital-based contact.

Sample size determination. Sample size was calculated using Cochran's formula for categorical data, assuming an expected proportion (p) of 0.50, a margin of error (d) of 5% and a significance level (α) of 5%, yielding a minimum sample size of 384 ($n = Z^2\alpha/2 \times p \times q / d^2$; $n = 1.96^2 \times 0.5 \times 0.5 / 0.05^2 \approx 384$). Questionnaires were distributed to approximately 2,000 potential respondents via online and offline platforms and a total of 456 valid

responses were obtained encompassing 265 patients, 72 physicians, 60 pharmaceutical company professionals, 47 pharmacy retailers and 12 lifestyle professionals.

Inclusion and exclusion criteria. Eligibility for inclusion in the study was restricted to adult patients with a confirmed diagnosis of diabetes mellitus, hypertension or both, who were currently receiving treatment or under regular follow-up for these conditions. Exclusion criteria for patients included refusal to participate and provision of incomplete questionnaire responses. Similarly, for non-patient stakeholders, only those actively engaged in the management or supply of diabetes or hypertension-related healthcare services were included. Incomplete responses were excluded across all stakeholder groups.

Data collection instruments. Five separate structured questionnaires were developed, one for each stakeholder category covering sociodemographic characteristics, disease-related information, medication use, monthly cost expenditure, lifestyle practices and opinions on cost-reduction strategies. All questionnaires were prepared in both English and Bengali to facilitate comprehension. The patient questionnaire additionally included sections on blood glucose levels, blood pressure measurements, exercise frequency, dietary habits and medication adherence. In this study, cost burden specifically refers to self-reported monthly medication expenditure and does not include consultation fees, diagnostic costs, travel expenses, food costs, or other indirect costs. Monthly cost expenditure was recorded as self-reported usual monthly medication expense using predefined cost categories rather than prescription-based exact cost calculation. All questionnaires were pilot-tested prior to full deployment. For pharmaceutical company professionals and some physicians, data were additionally collected through in-person structured interviews.

Statistical analysis. Data were entered and sorted in Microsoft Excel. Descriptive statistics, including frequency counts and percentages were computed for all categorical variables. Chi-square (χ^2) tests of independence were performed to evaluate associations between key categorical variables, including disease type, age group, monthly income, medication cost category, affordability, disease duration and exercise habit. A p-value of <0.05 was considered statistically significant.

RESULTS AND DISCUSSION

The current study assessed the economic burden, treatment practices, lifestyle adherence and stakeholder opinions on lifestyle adjustments relating diabetes mellitus and hypertension management in Bangladesh. The results shed significant light on the clinical and demographic traits of afflicted patients, drug usage habits, treatment affordability and the perceived contribution of lifestyle change to lower long-term healthcare costs.

Patients demographics. The demographic profile of patient participants is outlined in table 1. The majority of patients were aged 40-60 years (57.36%), with a smaller proportion aged above 60 years (26.04%) and between 18-40 years (16.60%). Female patients (52.83%) slightly outnumbered male patients (47.17%). Most participants resided in urban areas (84.53%), where homemakers (31.32%) and retired individuals (19.25%) comprised the largest occupational groups. With respect to monthly household income, 25.28% earned BDT 20,000-40,000 and 24.91% earned BDT 40,000-60,000. The most common family size was 4-5 members (65.28%). Concerning body weight status, 44.53% maintained a healthy weight, while 32.83% were overweight and 18.11% were obese, together representing more than half (50.94%) of the study population with excess body weight. These findings closely aligned with the Bangladesh Demographic and Health Survey 2017/18, which identified the 40-59 age group as carrying the highest NCD burden nationally and with WHO projections of escalating urban NCD prevalence across South Asian LMICs.[1,14]

Table 1. Demographic characteristics of patient participants (n=265).

Variables	Categories of Variables	Frequency (%)
Age	18-40 years	44 (16.60%)
	40-60 years	152 (57.36%)
	> 60 years	69 (26.04%)
Gender	Male	125 (47.17%)
	Female	140 (52.83%)
Area of Residence	Urban	224 (84.53%)
	Rural	41 (15.47%)
Occupation	Government employee	46 (17.36%)
	Non-government employee	53 (20.00%)
	Business	13 (4.91%)
	Student	19 (7.17%)
	Homemaker	83 (31.32%)
	Retired	51 (19.25%)
Monthly Family Income (BDT)	< 20,000	30 (11.32%)
	20,000-40,000	67 (25.28%)
	40,000-60,000	66 (24.91%)
	60,000-80,000	37 (13.96%)
	80,000-100,000	28 (10.57%)
	> 100,000	37 (13.96%)
Number of Family Members	1-3	51 (19.25%)
	4-5	173 (65.28%)
	6-7	31 (11.70%)
	> 7	10 (3.77%)
Body Weight Status	Underweight	2 (0.75%)
	Healthy weight	118 (44.53%)
	Overweight	87 (32.83%)
	Obese	48 (18.11%)
	Class 3 Obesity	4 (1.51%)
	Prefer not to say	6 (2.26%)

Professional stakeholder demographics. The majority of doctors (n = 72) were between the ages of 30 and 41 (56.94%, n = 41), followed by those between the ages of 41 and 50 (29.17%, n = 21) and above 50 (13.89%, n = 10), reflecting that early to mid-career practitioners predominate. Every responder worked in secondary or tertiary urban healthcare institutions. The majority of doctors treated 20–50 instances of diabetes mellitus (DM) and hypertension (HTN) per day (68.06%, n = 49), followed by 50–100 cases (22.22%, n = 16) and more than 100 cases (9.72%, n = 7). Internal medicine (45.83%, n = 33), cardiology (27.78%, n = 20), endocrinology (18.06%, n = 13), and general practice (8.33%, n = 6) were among their specializations. Additionally, the findings showed that doctors' experience varied by 5–10 years (43.06%, n = 31), 10-20 years (34.72%, n = 25) and >20 years (22.22%, n = 16).

The majority of pharmaceutical company personnel (n = 60) were male (65.00%, n = 39) and aged 30-45 (58.33%, n = 35). Participants worked predominantly in production/manufacturing (36.67%, n = 22), followed by marketing/business development (30.00%, n = 18), quality control/assurance (20.00%, n = 12) and regulatory affairs (13.33%, n = 8). Their organizational tenure varied from 3-7 years (45.00%, n = 27) to 7-12 years (28.33%, n = 17), with 26.67% (n = 16) having more than 12 years' experience. All participants were working at the Dhaka headquarters and worked on national antidiabetic and antihypertensive product portfolios.

The majority of pharmacy retailers (n = 47) were between the ages of 35 and 50 (55.32%, n = 26), followed by 25 and 35 (27.66%, n = 13) and above 50 (17.02%, n = 8). Male participants accounted for 78.72% of the total (n = 37). The majority of pharmacies (89.36%, n = 42) were located in

metropolitan regions, with 10.64% (n = 5) in semi-urban areas. The majority of retailers dispensed 50-200 DM and HTN prescriptions monthly (61.70%, n = 29), whereas 25.53% (n = 12) dispensed 200-500 prescriptions and 12.77% (n = 6) dispensed more than 500 prescriptions each month. The licensing tenure for retailers ranged from 5 to 15 years (59.57%, n = 28), followed by >15 years (27.66%, n = 13) and <5 years (12.77%, n = 6).

The majority of lifestyle professionals (n = 12) were between the ages of 28 and 45 (75.00%; n = 9). The group included dietitians/nutritionists (41.67%, n = 5), fitness trainers (33.33%, n = 4) and yoga or holistic health practitioners (25.00%, n = 3). The majority of the participants (83.33%, n = 10) treated urban middle-class patients with diabetes mellitus (DM) and hypertension (HTN). Professional experience varied from 3-7 years (58.33%, n = 7) to 7-10 years (25.00%, n = 3), with 16.67% (n = 2) reporting more than 10 years of experience. Services were provided through clinic-based practices (50.00%), online platforms (33.33%), or hybrid models that used both techniques (16.67%).

Distribution of disease conditions among patient participants. The most common ailment among the 265 patient participants was hypertension, which affected 82 people (30.94%), closely followed by diabetes mellitus, which was recorded in 78 people (29.43%), as illustrated in figure 1. Furthermore, 61 participants (23.02%) had both diabetes and hypertension at the same time, suggesting that the study group had a significant burden of comorbidity. In addition to diabetes and hypertension, 44 patients (16.60%) reported having other conditions. These results show that among the responders, chronic non-communicable illnesses and related comorbidities were rather common.

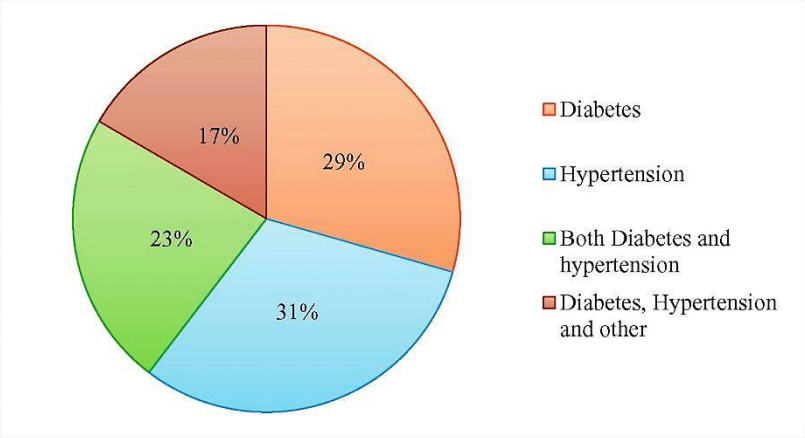

Figure 1. Distribution of diseases among patients.

Drugs commonly prescribed for diabetes and hypertension. Among the prescribed antidiabetic medications, metformin hydrochloride was the most frequently utilized agent, prescribed by 77.05% of doctors, followed by insulin, prescribed by 63.93% of doctors. Combination therapy comprising linagliptin and metformin hydrochloride was prescribed by 27.87% of doctors, with gliclazide prescribed by 22.95% of doctors, linagliptin monotherapy by 19.67% of doctors and the metformin hydrochloride–sitagliptin combination by 19.67% of doctors as shown in figure 2.

Many antihypertensive drugs are available in the market so the distribution is very widespread but according to 73.13% of the doctors, amlodipine is the most commonly prescribed antihypertensive medicine followed by Bisoprolol + Hydrochlorothiazide (43.28%) and Losartan Potassium (40.30%), as depicted in figure 3. Combination therapy of Amlodipine + Olmesartan Medoxomil accounted for 35.82%, while Hydrochlorothiazide + Losartan Potassium was prescribed in 31.34% of cases. Atenolol (26.87%) and Ramipril (23.88%) were also frequently prescribed. Nebivolol showed the lowest prescription frequency (1.49%).

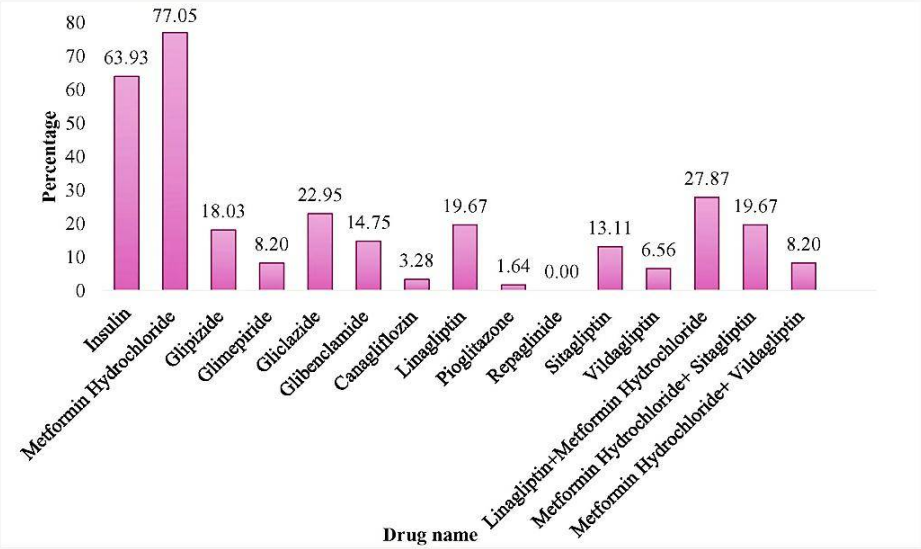

Figure 2. Antidiabetic drugs commonly prescribed by the doctors.

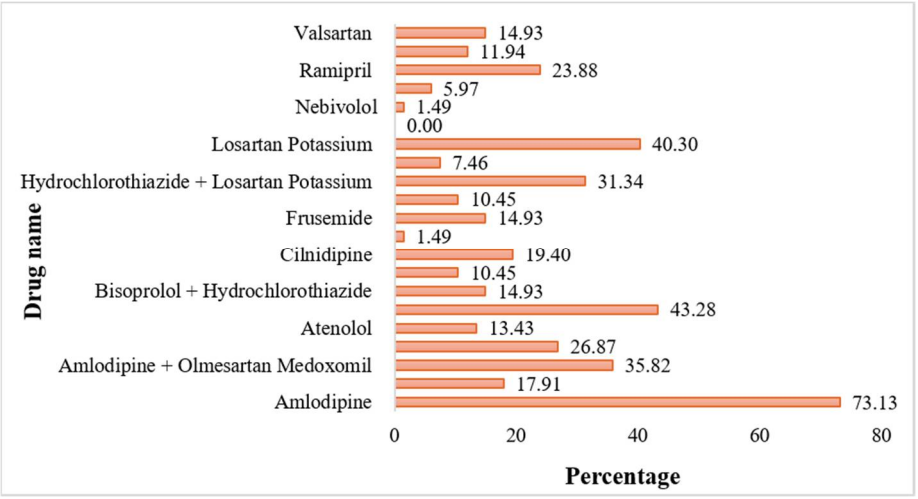

Figure 3. Antihypertensive drugs commonly prescribed by the doctors.

Drugs commonly dispensed by pharmacies. Among the antidiabetic medications most frequently dispensed by pharmacies, Metformin Hydrochloride was the most commonly dispensed drug (78.72%), followed by Linagliptin (51.06%). Combination therapy of Linagliptin + Metformin Hydrochloride and Sitagliptin each accounted for 42.55%, while Gliclazide represented 40.43% of dispensed medications. Insulin (38.30%), Glimepiride (31.91%) and Metformin Hydrochloride + Sitagliptin (29.79%) were also commonly dispensed, as shown in table 2. Repaglinide showed the lowest dispensing frequency (4.26%) among the listed antidiabetic agents.

Among the antihypertensive medications dispensed by pharmacies, Amlodipine was the most commonly dispensed drug (68.09%), followed by Losartan Potassium (51.06%). Combination therapy of Amlodipine + Olmesartan Medoxomil accounted for 48.94%, while Olmesartan Medoxomil and Bisoprolol each represented 46.81% of dispensed medications. Amlodipine + Atenolol was dispensed in 42.55% of cases, followed by Bisoprolol + Hydrochlorothiazide (36.17%). Other frequently dispensed agents included Amlodipine + Valsartan

and Atenolol (31.91% each) and Telmisartan (29.79%). Metoprolol Tartrate and Lisinopril showed the lowest dispensing frequency (4.26%) among the listed antihypertensive medications.

Table 2. Frequency distribution of antidiabetic and antihypertensive drugs dispensed by pharmacies.

Antihypertensive Drugs	Frequency (%)	Antidiabetic Drugs	Frequency (%)
Amlodipine	68.09	Metformin Hydrochloride	78.72
Losartan Potassium	51.06	Linagliptin	51.06
Amlodipine + Olmesartan Medoxomil	48.94	Linagliptin + Metformin Hydrochloride	42.55
Olmesartan Medoxomil	46.81	Sitagliptin	42.55
Bisoprolol	46.81	Gliclazide	40.43
Amlodipine + Atenolol	42.55	Insulin	38.30
Bisoprolol + Hydrochlorothiazide	36.17	Glimepiride	31.91
Amlodipine + Valsartan	31.91	Metformin Hydrochloride + Sitagliptin	29.79
Atenolol	31.91	Glipizide	27.66
Telmisartan	29.79	Metformin Hydrochloride + Vildagliptin	19.15
Hydrochlorothiazide + Losartan Potassium	25.53	Vildagliptin	12.77
Carvedilol	25.53	Glibenclamide	12.77
Ramipril	23.40	Pioglitazone	10.64
Valsartan	21.28	Canagliflozin	8.51
Nebivolol	17.02	Repaglinide	4.26
Frusemide	17.02		
Frusemide + Spironolactone	14.89		
Cilnidipine	14.89		
Diltiazem Hydrochloride	12.77		
Metoprolol Tartrate	4.26		
Lisinopril	4.26		

Monthly medication expenditure and self-reported cost burden. Approximately half of the patients (50.94%) reported monthly medication expenditures between BDT 1,000-5,000, while 35.85% spent less than BDT 1,000 per month. In contrast, 13.21% of participants incurred treatment costs exceeding BDT 5,000 monthly. Most physicians (68.85%) reported that the monthly treatment expenditure for diabetic patients was within 1-5 thousand taka, as shown in figure 4.

For hypertensive patients, 60.29% of physicians estimated the expenditure to be within 5-10 thousand taka, while 38.24% reported costs below 1 thousand taka. In cases of combined diabetes and hypertension, 68.06% of physicians identified 1-5 thousand taka as the most common expenditure category, although higher expenditure ranges of 5-10 thousand taka (16.67%) and 10-15 thousand taka (4.17%) were also reported.

Similarly, the majority of pharmaceutical company professionals (86.67%) and retailers (89.36%) perceived that the monthly expenditure for antidiabetic and antihypertensive medications generally remained within the 1-5 thousand taka range, as shown in figure 4.

Among participants earning 20,000-40,000 BDT, 14.34% (n=38) spent 1,000-5,000 BDT monthly compared with 8.68% (n=23) spending less than 1,000 BDT. Similarly, in the 40,000-60,000 BDT income group, 13.21% (n=35) spent 1,000-5,000 BDT, while 9.43% (n=25) spent less than 1,000 BDT on medication, as shown in figure 5.

Among participants earning 60,000-80,000 BDT, 7.55% (n=20) reported expenditures of 1,000-5,000 BDT compared with 4.91% (n=13) spending less than 1,000 BDT. In contrast, participants with incomes above 1 lakh BDT showed relatively higher medication expenditures, where 3.02% (n=8) spent 5,000–10,000 BDT and 2.64% (n=7) spent 10,000-15,000 BDT monthly. Very high medication expenditures (15,000-20,000 BDT and >20,000 BDT) were observed only among participants earning more than 1 lakh BDT, each representing 0.38% (n=1) of the total study population.

The association between monthly expenses and financial sustainability was explored in figure 6. Data suggests an inverse relation; as monthly expenditures rise, the affordability rate among patients declines sharply. This trend underscores the vulnerability of lower-income groups to price fluctuations in the pharmaceutical market.

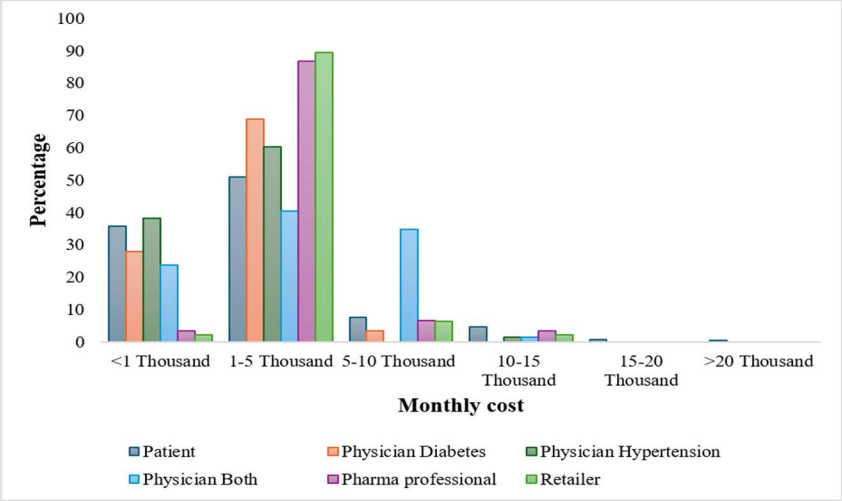

Figure 4. Monthly cost of medicines according to different stakeholders.

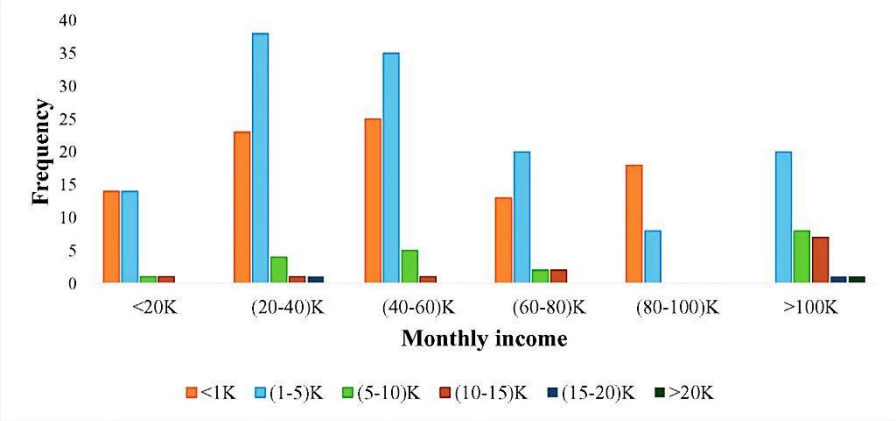

Figure 5. Distribution of monthly medication expenditure across different monthly income groups among patients.

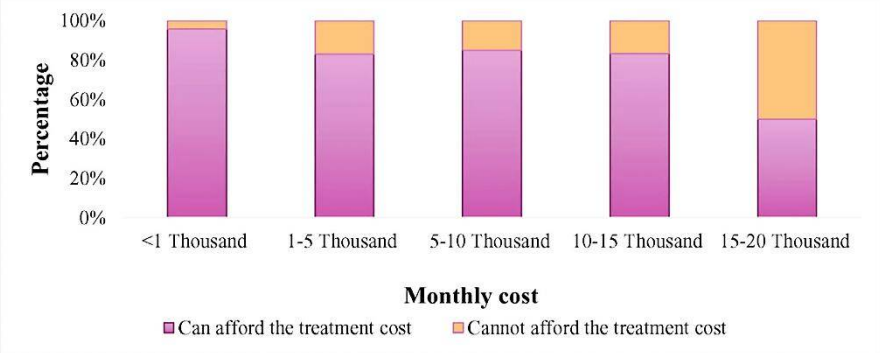

Figure 6. Association between monthly medication expenditure and treatment affordability among patients

The majority of patients across all disease categories reported low monthly drug expenditure, predominantly within the 1-5 thousand range. Specifically, 14.72% of diabetes patients, 10.57% of hypertension patients, 15.09% of patients with both conditions and 10.57% of patients with multiple comorbidities fell into this category, as shown in table 3. The <1 thousand expenditure group was also notable, particularly among hypertension patients (18.87%) and diabetes patients (9.43%). Overall, very few patients reported higher medication costs, with expenditures ≥10 thousand observed only in a small fraction of participants, including diabetes (1.89%), hypertension (0.38%), both conditions (0.75%), and multiple diseases (up to 1.51-0.38%).

The distribution of monthly medication expenditure according to affordability status, disease conditions, monthly income, rich food intake frequency, disease management practices and exercise duration among the study participants shown in table 4. Most participants reported being able to afford their treatment costs (n = 232, 87.5%), while 33 participants (12.5%) indicated difficulty affording treatment. Regarding rich food intake, the largest proportion consumed rich foods once in several months (n = 80, 30.2%), followed by 2-3 times per month (n = 77, 29.1%), once per month (n = 63, 23.8%) and every week (n = 45, 17.0%).

Table 3. Distribution of monthly medication expenditure according to disease condition among patients.

Disease Condition	<1 thousand (%)	1-5 thousand (%)	5-10 thousand (%)	10-15 thousand (%)	15-20 thousand (%)	>20 thousand (%)
Diabetes	9.43	14.72	3.02	1.89	0.38	–
Hypertension	18.87	10.57	1.13	0.38	–	–
Both Diabetes and Hypertension	5.66	15.09	1.51	0.75	–	–
Diabetes, Hypertension and Other Diseases	1.89	10.57	1.89	1.51	0.38	0.38

Table 4. Frequency distribution of monthly medication expenditure according to socioeconomic characteristics, disease conditions, lifestyle factors, and disease management practices.

Variable	Category	<1 thousand	1-5 thousand	5-10 thousand	10-15 thousand	15-20 thousand	>20 thousand
Affordability Status	Can afford treatment cost	91	112	17	10	1	1
	Cannot afford treatment cost	4	23	3	2	1	0
Disease Condition	Diabetes	25	39	8	5	1	0
	Hypertension	50	28	3	1	0	0
	Both diabetes and hypertension	15	40	4	2	0	0
	Diabetes, hypertension and other comorbidities	5	28	5	4	1	1
Monthly Income (BDT)	<20,000	14	14	1	1	0	0
	20,000–40,000	23	38	4	1	1	0
	40,000–60,000	25	35	5	1	0	0
	60,000–80,000	13	20	2	2	0	0
	80,000–100,000	18	8	0	0	0	0
	>100,000	0	20	8	7	1	1
Rich Food Intake Frequency	Every week	19	16	5	4	1	0
	2-3 times/month	27	41	4	5	0	0
	Once/month	21	32	7	2	1	0
	Once in several months	28	46	4	1	0	1
Disease Management Practice	Taking regular medications	75	130	19	12	2	1
	Regulating food intake	58	80	11	7	1	1
	Performing daily exercise	40	50	10	2	1	0
	Trying home remedies	18	18	4	1	0	0
	Sleeping adequately	27	42	6	3	1	1
Exercise Duration	Not at all	17	22	5	5	0	0
	<30 min	21	41	5	2	2	1
	30-75 min	26	37	3	4	0	0
	75-150 min	10	12	4	0	0	0
	>150 min	21	23	3	1	0	0

In terms of exercise duration, 72 participants (27.2%) exercised for less than 30 min, 70 (26.4%) for 30-75 min, 49 (18.5%) did not exercise, 48 (18.1%) exercised for more than 150 min, and 26 (9.8%) for 75-150 min. Regarding disease management practices, regular medication use was the most frequently reported strategy (n = 239, 90.2%), followed by regulating food intake (n = 158, 59.6%), daily exercise (n = 103, 38.9%), adequate sleep (n = 80, 30.2%) and home remedies (n = 41, 15.5%). Multiple responses were permitted for disease management practices.

Chi-square tests of independence revealed significant associations between several factors and monthly medication expenditure. Treatment cost categories were significantly linked to patients' affordability status ($\chi^2 = 11.57$, df = 5, $p \approx 0.04$), with reduced affordability in higher-cost groups, as illustrated in table 5. Disease type showed a strong association ($\chi^2 = 48.63$, df = 15, $p < 0.001$), driven by elevated costs in patients with comorbidities (e.g., diabetes and hypertension) which may be due to polypharmacy, compared to lower costs for isolated hypertension treated with affordable generics. Monthly income was highly associated with expenditure ($\chi^2 = 68.67$, df = 25, $p < 0.001$), with lower-income groups concentrated in low-expenditure categories and higher-income groups showing broader spending distributions.

Table 5. Association between monthly medication expenditure and selected sociodemographic, lifestyle, and disease-related variables among patients.

Statistical parameter	Affordability status	Disease condition	Monthly income	Exercise duration	Rich food intake frequency	Disease management practices
χ^2 Value	11.57	48.63	68.67	20.69	16.63	8.66
df	5	15	25	20	15	20
p-value	0.040	<0.001	<0.001	0.415	0.340	0.987

Note: χ^2 = Chi-square value; df = Degrees of freedom. A p-value of <0.05 was considered statistically significant.

Relationship between lifestyle modifications, disease management behaviors and monthly medication expenditure among patients. The distribution of monthly medication expenditure according to self-reported exercise duration demonstrated that the majority of participants across all exercise categories reported spending within the 1-5 thousand taka range. Participants engaging in 30-75 min of exercise showed the highest proportion of expenditure below 1 thousand taka (9.81%), followed by those exercising for less than 30 min and more than 150 min (7.92% each). Expenditure within the 1-5 thousand taka category was most prominent among participants exercising less than 30 min (15.47%) and 30-75 min (13.96%). Higher medication expenditure categories were comparatively less frequent across all groups. Participants who did not perform any exercise demonstrated relatively greater representation within the 10-15 thousand taka expenditure category (1.89%) compared to other exercise groups.

Participants consuming rich food once in several months showed the highest proportion in this category (17.36%), followed by those consuming rich food 2-3 times per month (15.47%). Expenditure below 1 thousand taka was also common, particularly among participants consuming rich food once in several months (10.57%) and 2-3 times monthly (10.19%). Higher expenditure categories (>10 thousand taka) were comparatively uncommon across all groups, with only 1.51% of weekly rich food consumers reporting expenditure within the 10-15 thousand taka range.

In contrast, no statistically significant association was observed between exercise duration and monthly medication expenditure (χ^2 = 20.69, df = 20, p = 0.415), nor between frequency of rich food intake and medication expenditure (χ^2 = 16.63, df = 15, p = 0.340), as depicted in table 4. Although a substantial proportion of respondents perceived regular physical activity as a potential strategy for reducing treatment costs, the expenditure pattern remained relatively

consistent across different exercise categories. This finding may reflect the chronic and progressive nature of diseases such as diabetes and hypertension, where medication requirements are primarily determined by clinical necessity rather than short-term lifestyle modifications.

Similarly, dietary habits showed no significant influence on medication expenditure following disease onset and diagnosis. While unhealthy dietary practices are recognized contributors to the development and progression of chronic non-communicable diseases, their impact on immediate pharmaceutical expenditure appears limited once long-term pharmacotherapy has been initiated. The relatively uniform expenditure pattern across lifestyle categories suggests that disease severity, presence of comorbidities, treatment complexity and prescribing patterns exert a greater influence on medication costs than behavioral factors alone.

No statistically significant association was observed between disease management practices and monthly medication expenditure ($\chi^2 = 8.66$, df = 20, p = 0.987). Taking regular medications was the most frequently reported disease management strategy, with the majority of participants spending within the 1-5 thousand taka category (49.06%), followed by <1 thousand taka (28.30%). Similarly, participants who regulated food intake were predominantly distributed within the 1-5 thousand taka (30.19%) and <1 thousand taka (21.89%) expenditure categories. Among respondents performing daily exercise, 18.87% reported monthly medication expenditure within 1-5 thousand taka, while 15.09% spent below 1 thousand taka. Participants relying on home remedies demonstrated comparatively lower proportions across all expenditure categories, mainly within <1 thousand taka (6.79%) and 1-5 thousand taka (6.79%). Likewise, respondents reporting adequate sleep were primarily concentrated within the 1-5 thousand taka (15.85%) and <1 thousand taka (10.19%) expenditure groups. Overall, medication expenditure patterns remained relatively similar across different disease management practices, suggesting that treatment costs are more strongly determined by disease complexity and therapeutic requirements than by self-management behaviors alone.

Comparative evaluation of stakeholder perceptions on chronic disease risk factors and patient management practices. Perceptions regarding common risk factors for chronic diseases varied considerably among patients, physicians, and pharmaceutical company professionals. Family history was identified as the most prominent risk factor by physicians (92.75%) and company professionals (91.67%), while 62.64% of patients also recognized it as an important contributing factor. Obesity and unhealthy diet were highly emphasized by physicians (88.41% and 47.83%, respectively) and company professionals (95.00% and 91.67%, respectively), whereas comparatively lower proportions of patients identified these factors (25.66% and 26.42%, respectively). Similarly, physical inactivity and mental stress were frequently acknowledged by physicians (79.71% and 71.01%) and company professionals (81.67% and 76.67%), while among patients, mental stress was relatively more recognized (54.72%) than other lifestyle-related factors, as illustrated in figure 7.

The effect of other diseases and the influence of drugs, tobacco, or alcohol were also more commonly reported by company professionals (51.67% and 45.00%, respectively) and physicians (28.99 and 31.88%, respectively) compared to patients. Pregnancy as a contributing factor was identified by 33.33% of physicians and 28.33% of company professionals, whereas only 5.28% of patients reported it. Environmental pollution was comparatively less recognized across all stakeholder groups.

Overall, the findings indicate substantial differences in awareness and perception of chronic disease risk factors among stakeholders. Physicians and pharmaceutical company professionals demonstrated greater recognition of clinically established and modifiable lifestyle-related risk factors compared to patients, possibly reflecting differences in professional knowledge and health

literacy. In contrast, patients appeared to place relatively greater emphasis on hereditary factors and mental stress. These findings highlight the need for strengthened public health education and awareness programs focusing on modifiable behavioral risk factors such as obesity, unhealthy diet, and physical inactivity to improve preventive disease management practices among the general population.

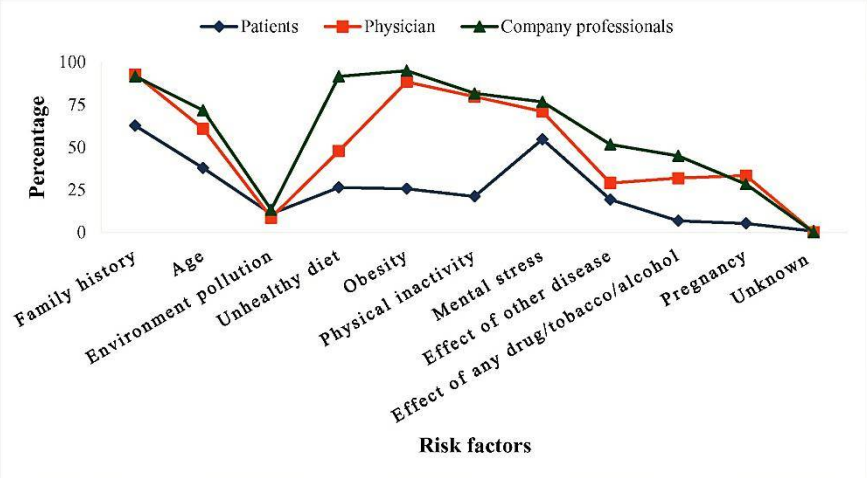

Figure 7. Comparative perceptions of patients, physicians, and company professionals regarding chronic disease risk factors.

Perceptions regarding important disease management strategies varied among patients, physicians, pharmaceutical company professionals and retailers. Taking regular medications was identified as the most important management approach across all stakeholder groups, particularly among patients (98.49%), retailers (95.74%) and physicians (93.06%), as illustrated in figure 8. Regulation of food intake was also widely recognized, especially by retailers (72.34%) and company professionals (71.67%). Performing daily exercise was strongly emphasized by physicians (88.89%), company professionals (93.33%) and retailers (89.36%), whereas comparatively fewer patients (39.25%) considered it an important management strategy. Adequate sleep was more frequently acknowledged by physicians (69.44%) and retailers (55.32%) than by patients (30.19%). Similarly, meditation or yoga and smoking cessation were considerably more recognized among healthcare-related stakeholders than patients. In particular, stopping smoking and tobacco use was reported by 70.83% of physicians, 68.33% of company professionals and 65.96% of retailers, compared to only 6.42% of patients.

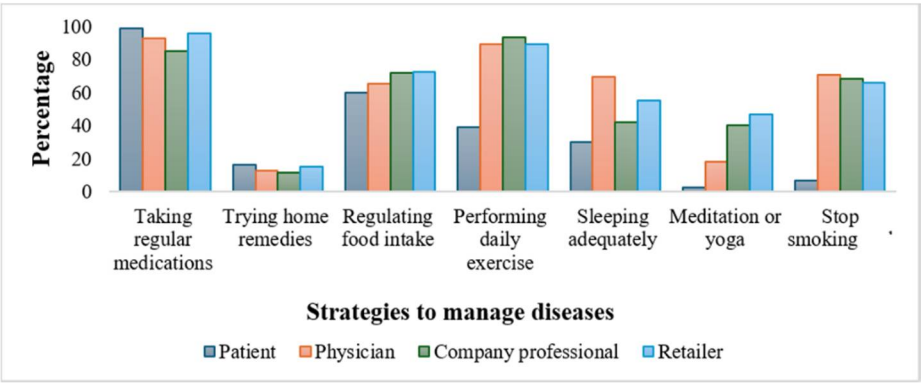

Figure 8. Disease management strategies for patients according to different stakeholders.

Perceptions regarding strategies for reducing treatment costs differed among patients, physicians, company professionals, retailers and lifestyle professionals, as illustrated in figure 9. Healthy diet was one of the most frequently recommended approaches, particularly among lifestyle professionals (100.00%) and company professionals (88.33%), while 73.21% of patients also recognized its importance. Exercise and controlling body weight were similarly emphasized across stakeholder groups, especially by lifestyle professionals (100.00% each), company professionals (75.00% and 76.67%, respectively), and patients (63.40% and 62.26%, respectively). Giving up smoking or tobacco use was strongly acknowledged by physicians (66.67%), company professionals (70.00%), and retailers (55.32%), whereas only 27.17% of patients identified it as an important cost-reducing measure. Government incentives were also widely recognized, particularly among retailers (76.60%), physicians (56.94%) and company professionals (55.00%). In contrast, fewer respondents supported buying cheaper medicines, using home remedies, or insurance-based approaches as major strategies for reducing treatment expenditure.

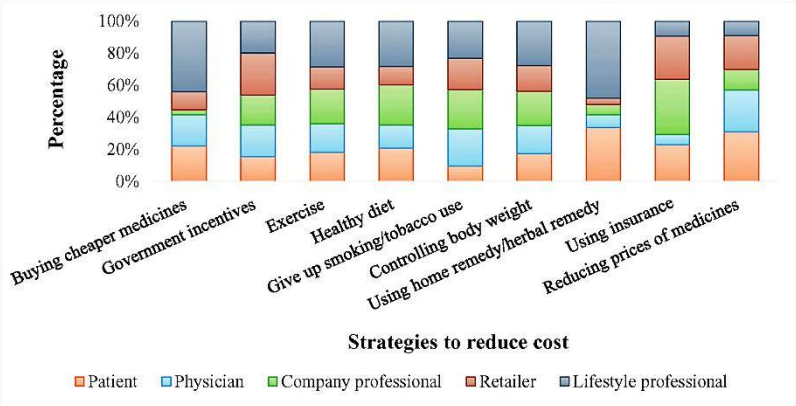

Figure 9. Stakeholder perceptions regarding strategies for reducing the treatment cost burden of chronic diseases.

The findings of the present study are also supported by previous national and international evidence regarding the economic burden of chronic disease management. Islam *et al*. (2017) reported that annual per capita healthcare expenditure for diabetes in Bangladesh ranged from US$ 218 to US$ 635 in urban settings, with medication costs constituting the largest component of total expenditure. This observation is consistent with the findings of the present study, where the majority of patients (50.94%) reported monthly medication expenditure within the BDT 1,000–5,000 range which highlights the substantial contribution of medication costs to the overall economic burden of diabetes and hypertension management.[11] Similarly, previous studies conducted in Bangladesh have demonstrated that out-of-pocket healthcare expenditure disproportionately affects lower-income households. Mahumud *et al*. (2017) and Rahman *et al*. (2025) reported that the financial burden of chronic disease management is substantially greater among economically disadvantaged populations, often limiting access to essential healthcare services.[10,15] Previous research has also highlighted persistent affordability challenges associated with long-term treatment of chronic diseases, particularly in low- and middle-income countries where healthcare financing largely depends on direct household expenditure. Consistent with these findings, the present study identified a significant association between medication expenditure and treatment affordability, underscoring the need for affordable medicine policies, financial protection mechanisms and cost-reduction strategies to improve treatment adherence and long-term disease management.[16]

Overall, the findings suggest that most stakeholders perceived lifestyle modification and supportive healthcare policies as more effective long-term strategies for reducing the treatment cost burden of chronic diseases than short-term economic alternatives. Although lifestyle interventions remain fundamental for disease prevention, disease control, and overall health improvement, reducing the financial burden associated with chronic disease management in Bangladesh may require greater emphasis on healthcare financing strategies, rational prescribing practices and effective medication price regulation policies. Despite the majority of patients reporting their treatment costs as manageable, a considerable proportion of low-income individuals and patients with long-standing chronic conditions remained financially vulnerable. Furthermore, inadequate lifestyle adherence and suboptimal disease management observed among a substantial segment of participants underscore the continuing need for integrated public health interventions and sustainable policy-level support.

LIMITATIONS

Despite using a multi-stakeholder approach to address various aspects of managing diabetes and hypertension, this study has a number of limitations. First, the cross-sectional design makes it more difficult to determine if treatment expense burden and lifestyle adherence are causally related. Second, the study used participant self-reported replies, which could be skewed by subjective interpretation, recollection bias, and reporting bias. Third, despite the fact that participants were drawn from a variety of stakeholder categories, the sample size was somewhat small and might not accurately reflect Bangladesh's overall population, especially for lifestyle professionals. Furthermore, the majority of respondents were from metropolitan areas, which may restrict the findings' applicability to rural populations where healthcare affordability and accessibility may vary significantly.

CONCLUSION

This multi-stakeholder cross-sectional study demonstrated that diabetes mellitus and hypertension imposed a substantial but variably distributed economic burden on patients in Bangladesh. Although the majority of participants reported that their monthly medication expenditure remained within an affordable range (primarily BDT 1,000-5,000), financially vulnerable low-income patients continued to experience significant affordability challenges. The study further revealed inadequate adherence to recommended lifestyle practices, including regular exercise, dietary monitoring and weight control, despite broad stakeholder consensus regarding their importance in long-term disease management. Poor lifestyle adherence indicated the need for stronger patient education and behavioral intervention programs. Therefore, the findings of the present study collectively suggest that effective chronic disease management in Bangladesh requires an integrated strategy combining affordable pharmacotherapy, lifestyle modification counselling, public awareness initiatives and targeted government support for economically vulnerable populations. Strengthening preventive healthcare policies and promoting evidence-based lifestyle interventions may substantially reduce both disease burden and long-term healthcare expenditure in Bangladesh.

ACKNOWLEDGEMENTS

The authors acknowledge all participants across different stakeholder groups for their valuable time and contributions.

DISCLOSURE STATEMENT

The authors declare that there is no conflict of interest.

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