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Out-of-pocket expenditure among patients with diabetes in Bangladesh: A nation-wide population-based study

Zakir Hossain [a], Moriam Khanam [b], Abdur Razzaque Sarker [a,c,d,*]

[a] Population Studies Division, Bangladesh Institute of Development Studies (BIDS), Dhaka, Bangladesh
[b] Institute of Health Economics, University of Dhaka, Dhaka, Bangladesh
[c] Institute of Applied Health Research, University of Birmingham, United Kingdom
[d] Melbourne School of Population and Global Health, University of Melbourne, Melbourne, Australia

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ABSTRACT

Background and objectives: Diabetes has become one of the fastest growing public health emergencies worldwide. The objective of this study was to estimate the average annual out-of-pocket cost of diabetes treatment as well as to find out the catastrophic health expenditure (CHE) and their determinants in Bangladeshi context.
Data and methods: The study utilised data from the most recent nationally representative Household Income and Expenditure Survey 2016–2017. The incidence of CHE was estimated by applying 10% and 25% of the annual total household expenditure threshold levels. The factors associated with CHE was presented as adjusted odds ratio with 95% confidence intervals.
Results: The annual average out-of-pocket cost per diabetes patient was US$ 323 (BDT 25,473). The cost of medication was the main cost driver contributed for 75.43% of the total out-of-pocket cost. The incidence of CHE was 14.34%, and 5.86% of the study households for 10% and 25% of the threshold levels, respectively. The patient aged more than 60 (AOR: 4.89; CI 0.82 to 28.95), uneducated (AOR: 1.83; CI 0.25 to 2.12), comorbid condition (AOR: 1.62; CI 0.94 to 2.79), small household size (AOR: 3.20; CI 0.58 to 17.51), rural resident (AOR: 1.85; CI 0.46 to 1.57), poorest asset quintile (AOR: 4.06; CI 1.43 to 13.87) and private facility type (AOR: 8.16; CI 3.46 to 19.;25) were significantly associated with the incidence of CHE due to diabetes treatment.
Conclusions: There are considerable out-of-pocket costs needed for diabetes care in Bangladesh. The evidence of catastrophic expenditure suggests the urgent need to improve financial risk protection to ensure access to care.

1. Introduction

Diabetes has become one of the fastest growing global public health emergencies in the 21st century. Diabetes -a chronic disease that lasts a lifetime- has spread widely and is among the most common non-communicable diseases in both high-income countries and low- and middle-income countries (LMICs) [1]. Several studies have indicated that, the fastest increases in the number of people living with diabetes will be observed in the low- and middle-income countries [2,3]. It was estimated that, about two-thirds of all the people living with diabetes was from LMICs including Bangladesh [4]. Diabetes imposes a wide range of burden on patients, families, communities and national healthcare systems. Further, a large number of people are undiagnosed with diabetes, particularly in many LMICs which leads to underestimation of the actual burden of the disease. According to a global report on diabetes, 1 in 2 people with diabetes were undiagnosed [5]. South-east Asian Region is experiencing an increase in the diabetes-related mortality and morbidity and number of diabetes patients in that region is likely to be increased from 72.1 million in 2013 to 123 million by 2035 [4].

Bangladesh has the second highest prevalence of diabetes among adults [4]. The latest data indicated that, the prevalence of diabetes and prediabetes were 10% and 15% of the total adult population, respectively with a significant difference between rural and urban areas in Bangladesh [6]. The number of diabetes patient is increasing rapidly in Bangladesh which has reached around 8.4 million, posing a big

* Corresponding author at: Health Economics and Financing Research, Population Studies Division, Bangladesh Institute of Development Studies (BIDS), Agargaon, Dhaka 1207, Bangladesh.
E-mail addresses: hossainmdzakir1@gmail.com (Z. Hossain), moriam.ihe@du.ac.bd (M. Khanam), razzaque.sarker@gmail.com, razzaque@bids.org.bd (A. Razzaque Sarker).

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challenge to the health system [7]. Studies documented that diabetes patient often suffers from life-threatening diseases/complications, poor health status, various form of disabilities, high out-of-pocket cost which cause undue financial and mental stress on households [8,9]. Along with the health burden of disease, the economic impact on household-level is significant [10]. An earlier study indicated that the average annual out-of-pocket cost of diabetes was about US$ 865 in Bangladesh [11]. Further, indirect-costs of diabetes such as reduced labor force, absenteeism, and presenteeism has significant effects on societal productivity [12]. Various studies documented the direct cost of diabetes treatment as considerable which is often increasing over time [13].

Bangladesh uses a combination of various healthcare financing sources, including out-of-pocket (OOP) cost, general revenue taxation, donation of development partners' and a small component of private and public-run insurance schemes [14]. Above them, OOP cost is one of the lion-share for healthcare financing in Bangladesh which is increasing alarmingly [14]. As a consequence, approximately 16% of the households face catastrophic health expenditures and almost 5 million people fall into poverty every year for excess healthcare costs [9]. Out-of-pocket cost is defined as the expenditure incurred by households at the time of receiving diabetes care services. Although a small fee is required to access public health facilities in Bangladesh, a large OOP cost are required in private facilities, which has often become challenging for low-income people [15]. There are several studies on catastrophic health expenditure (CHE) and its determinants in Bangladesh, however, none of those focused on the CHE due to diabetes only [9,16]. Although some studies estimated the treatment costs for diabetes, but none of those used nationally representative dataset [11,17]. Therefore, the aim of this study was to estimate the average annual out-of-pocket cost of diabetes treatment as well as to find out the catastrophic health expenditure (CHE) and their determinants in Bangladeshi context. The findings of this study will provide an up-to-date information on the out-of-pocket cost incurred by people with diabetes. In addition, it will play an important role in the planning of health care needs for diabetes management in Bangladesh and elsewhere with similar socioeconomic conditions.

2. Materials and methods

2.1. Study population and data source

The study utilised data from the most recent nationally representative Household Income and Expenditure Survey (HIES) 2016–2017. The survey followed a two-stage stratified random sampling technique to cover the entire population by taking a nationally representative sample which was carried out from April 2016 to March 2017 under the authority of Bangladesh Bureau of Statistics (BBS) [18]. The HIES is a vital source of records of data used in this study, including the income, expenditure, assets of the households and healthcare costs incurred by the households for different diseases including diabetes. All the missing data were excluded from the analysis to avoid any inconsistencies in the results. Households with diabetes patients were considered as the population of this study. A total of 11,520 individuals including 2,887 diabetes patients from 2,664 households' data were encircled in this analysis after excluding missing and inconsistent information from the main data set.

2.2. Incidence of catastrophic health expenditure

One of the most frequently used and established definition for the estimation of CHE is dividing OOP health expenditure by the annual total household expenditure (THE). OOP cost includes any payment related to medical fees, purchases of medicines (prescribed or not), user fees for public care and payments for equipment and diagnostic tests. There is no single recognized threshold to consider CHE estimation. In this analysis, a 10% threshold of THE was used to determine CHE in Bangladesh [9]. If a household's OOP healthcare expenditure was more than 10% of THE then this was measured as a CHE incidence for that household. Two dummy variables were created for the threshold and recoded as "yes" if the household healthcare expenditure was more than the threshold and "no" otherwise. In addition, the incidence of CHE was estimated by varying the threshold between 5% and 25%, as recommended by O'Donnell *et al.* [19]. Respondents were requested to provide information related to the cost of illness for diabetes within one year preceding to the survey. Data on the facility type, expenditures due to diabetes treatment and mode of financing the cost of treatment were also collected from the respondents.

2.3. Distress financing for financial difficulties due to diabetes

Another outcome variable was the distress financing due to OOP health expenditure for diabetes treatment. Distress financing was defined as the funding for out-of-pocket health expenditure by selling household assets/lands, borrowing money from lender/banks/friends/relatives, and by receiving assistance from friends/relatives. If a household incurred OOP health expenditure and managed money from any of these sources then a dummy variable was coded "yes" as a measure of distress financing, and "no" contrastingly. The incidence of distress financing was then calculated for diabetes treatment.

2.4. Explanatory variables

A number of explanatory variables were included in this study based on the availability of the information on the study dataset and previously published similar studies. The series of explanatory variables were as follows: age, gender, marital, educational and comorbidity status of the patients; educational status of the household head; religion of the household; number of earners; household size; presence of under 5 children and older person (aged 60 or more) in the households; place of residence; administrative division and asset quintile of the households. Patients' age was categorised into five groups with irregular intervals to get a better view over the young adults and the elderly citizens: 'less than 18 years', '18 to 35 years', '36 to 49 years', '50 to 60 years' and 'more than 60 years. Gender of the patients was categorised as 'male' and 'female'. Marital status of the patients was classified into 'married', 'widow/widower/separated' and 'unmarried'. Educational status of the patients and household heads were reported by the study participants and categorised as 'no formal education', 'up to primary education', 'secondary education', 'higher secondary education' and 'higher education'. Comorbidity status of the patients, presence of under 5 children and older person (aged 60 or more) in the households were categorised as 'yes' and 'no'. The administrative division was categorised into eight groups (Dhaka, Chattogram, Khulna, Rajshahi, Barishal, Rangpur, Sylhet and Mymensingh). A composite score named the 'asset quintile' was calculated using principal component analysis and categorised these households into the 'poorest', 'poorer', 'middle', 'richer' and 'richest' quintiles.

2.5. Statistical analysis

This study utilized descriptive statistics and logistic regression analysis. The categorical data were presented as frequency and percentages, while the continuous data were presented as mean (standard deviation, SD) and median. The study variables' level of significance was established using inferential statistics (Mann–Whitney *U* test and Kruskal–Wallis tests). Proportion, frequencies, rates and ratio, was presented with a standard deviation in local currency, i.e., Bangladeshi Taka (BDT) and US dollars (US$) using the exchange rate (US$1 = 78.87 BDT) during the survey period. The OOP cost of diabetes treatment was firstly categorized as 'Direct medical' and 'Direct non-medical' cost. Secondly, 'medication cost', 'investigation cost', 'consultation fee', 'operational cost' and 'bed fee' were considered as the direct medical cost while

'transportation cost', 'informal payment', 'necessary things cost' and 'others cost' were included in the direct non-medical cost category. And thirdly, 'direct medical cost' and 'direct non-medical cost' were added up to calculate the total OOP cost of the diabetes treatment. The predictors of CHE owing to OOP health expenditure was investigated using multivariable logistic regression model, with the results provided as odds ratios (i.e., exponential form of regression coefficient, OR = exp (beta)) and 95% confidence intervals. The regression model can be expressed as-

$$logit(Yi) = \alpha + \beta 1X1i + \beta 2X2i + ... + \in i$$

Where, Yi is the dichotomous outcome variables (i.e., CHE) with value '0′ if household did not experience CHE and '1′ if household faced CHE; α is the constant; β1, β2…. are the regression coefficients for the corresponding explanatory variables; X1i, X2i…. denote explanatory variables; and ∈i is the error term. Explanatory variables that were found statistically significant at the significance level of 0.05 during the bivariate analysis were included in our regression models to observe the multi-collinearity among the significant variables. The dependent variable was expressed as binary, and it was represented as '1′ for the existence of CHE, while '0′ was represented for the non-existence of CHE among the study households due to diabetes treatment. In the multivariable logistic regression model, results were presented as adjusted OR (AOR) with 95% CIs. Results were considered to be statistically significant at 5% α level (p less than 0·05). The Variance Inflation Factor (VIF) was assessed to observe the multi-collinearity problems. The data was analysed using a spreadsheet in Microsoft Excel and Stata/SE 14.0 (Stata Corp., College Station, TX, USA).

3. Results

3.1. Background characteristics of the study participants

A total of 2,887 diabetes patients from 2,664 households were included in the study (Table 1). The highest percentage of respondents (32.42%) belonged to 50–60-year-old age group followed by the 36–49-year-old (30.41%) and the average age of the patients was found 52.48 years while about 55.87% respondents were female. About 54% household heads had completed secondary-level education while about 23% of the study household heads did not have any formal education. About 46% of the study households were belonged to the urban community and the highest number of participants (21%) were drawn from Dhaka division and the lowest number of participants (3.53%) were drawn from Mymensingh division. The annual mean income and mean expenditure were about US$ 4498 and US$ 4344 for the study households, respectively. We observed a gradual increase in the monthly income of the households as per the upgradation of the asset quintile from poorest to richest and it was US$ 176 for the poorest households and US$ 790 for the richest households.

3.2. Average OOP cost of diabetes

The overall household OOP cost per-patient per annum is described in Table 2. The annual average OOP cost per diabetes patient was US$ 323. The cost of medication (US$ 244) and investigation (US$ 42) were the main cost drivers for the direct cost of diabetes management whereas medication and investigation cost contributed for 75.43% and 13.03% of the total out-of-pocket cost respectively. Moreover, the consultation (US$ 13) and operational costs (US$ 3) also had a high share of the direct cost for the treatment of diabetes patients annually. The average total direct medical cost was US$ 308 which contributed 95.25% of the total out-of-pocket cost of illness. The median and IQR values are provided in supplementary materials (Sup2).

Table 1
Background information of the study participants.

Variables	Frequency (N)	Percentage (%)
Age of the patients		
Less than 18 years	25	0.87
18 to 35 years	277	9.59
36 to 49 years	878	30.41
50 to 60 years	936	32.42
More than 60 years	771	26.71
Average age of the patients (Frequency Mean)	2887	52.48
Gender of the patients		
Female	1613	55.87
Male	1274	44.13
Marital status of the patients		
Married	2428	84.10
Widow/Widower/Separated	408	14.13
Unmarried	51	1.77
Educational status of the patients		
No formal education	667	23.10
Up to primary education	688	23.83
Secondary education	1048	36.30
Higher secondary education	273	9.46
Higher education	211	7.31
Comorbidity status of the patients		
No	1307	45.27
Yes	1580	54.73
Educational status of the household head		
No formal education	622	23.35
Up to primary education	628	23.57
Secondary education	965	36.22
Higher secondary education	258	9.68
Higher education	191	7.17
Religion of the household		
Islam	2372	89.04
Hinduism	271	10.17
Christianity	9	0.34
Buddhism	12	0.45
Number of earners		
No earner	371	13.93
One earner	1538	57.73
Two earners	584	21.92
Three and more earners	171	6.42
Household size		
Less than 3 members	390	14.64
3–4 members	1191	44.71
5–6 members	832	31.23
7 and more members	251	9.42
Presence of under 5 children in the household		
No	2042	76.65
Yes	622	23.35
Presence of older person (aged 60 or more) in the household		
No	1368	51.35
Yes	1296	48.65
Place of residence		
Urban	1233	46.28
Rural	1431	53.72
Administrative division		
Dhaka	563	21.13
Chattogram	503	18.88
Khulna	500	18.77
Rajshahi	348	13.06
Barishal	307	11.52
Rangpur	212	7.96
Sylhet	137	5.14
Mymensingh	94	3.53
Asset quintile		
Poorest	752	28.23
Poorer	393	14.75
Middle	454	17.04
Richer	541	20.31
Richest	524	19.67
Household monthly income by asset quintile BDT (US$)		
Poorest	13,869 (176)	22,150 (281)

(continued on next page)

Table 1 (*continued*)

Variables	Frequency (N)	Percentage (%)
Poorer	17,274 (219)	32,391 (411)
Middle	24,313 (308)	37,680 (478)
Richer	33,422 (424)	54,295 (688)
Richest	62,309 (790)	96,770 (1227)
Income quintile		
Poorest	533	20.01
Poorer	538	20.20
Middle	548	20.57
Richer	513	19.26
Richest	532	19.97
Annual income of the household (Mean SD) BDT (US$)	354,742 (4,498)	687,989 (8,723)
Annual income of the household (Median IQR) BDT (US$)	160,000 (2,029)	387,868 (4,918)
Annual expenditure of the household (Mean SD) BDT (US$)	342,642 (4,344)	342,000 (4,336)
Annual expenditure of the household (Median IQR) BDT (US$)	244,794 (3,104)	279,504 (3,544)

3.3. Catastrophic health expenditure (CHE)

Table 3 illustrates the CHE due to diabetes treatment using different threshold levels. We observed that about 14.34% of households faced catastrophic health expenditure due to diabetes considering 10% of the total household expenditure threshold level. CHE was observed high among the households with patients older than 60 years (21%) and male patients (21%). The households with diabetes patients with comorbid condition confronted CHE much more (16%) than the counterparts. As anticipated, the incidence of CHE was greatest among no-earner households (27%) compared to other categories. The patients from small households (23%) and households having older person (16%) faced CHE more than counterpart. The CHE burden was higher in rural households (17%) and households belonged to the Barishal division (19.5%) suffered CHE more than other administrative divisions. The highest percentage of CHE (22%) was observed among the patients who utilized private healthcare facilities. In terms of wealth status, poorest households (18%) suffered more than richest households (8%).

3.4. Factors associated with the incidence of CHE

Table 4 shows the factors associated with the incidence of CHE due to diabetes treatment. We observed that the age, educational status and comorbidity status of the patients, number of earners, household size, presence of older person (aged 60 or more), place of residence, administrative division, wealth status and sources of care were significantly associated with the incidence of CHE due to diabetes. The incidence of CHE was 2.28 times (CI 0.73 to 7.15; $p \leq 0.01$) and 4.89 times (CI 0.82 to 28.95; $p \leq 0.01$) higher among the older patients aged more than 60 years compared to the patients aged less than 18 years. Households having uneducated patients had a greater risk of CHE (AOR: 1.86; CI 0.28 to 2.69; $p \leq 0.05$) compared to the higher educated patients. Diabetes patients with comorbid condition were 1.80 times (CI 1.12 to 2.89; $p \leq 0.01$) more likely to suffer from CHE regarding 10% threshold level while it was 1.62 times higher (CI 0.94 to 2.79; $p \leq 0.01$) for 25% threshold level compared to the counterparts. Diabetes patients from small households and households having no earner were vulnerable for CHE than the large households and households having three or more earners, respectively. Rural households (AOR: 1.31; CI 0.79 to 2.18; $p \leq 0.05$) and households having older persons (AOR: 1.46; CI 0.70 to 3.06; $p \leq 0.01$) were more prone to expose CHE for diabetes. The risk of CHE was significantly higher among the households located in Chattogram, Barishal and Rangpur division compared to the Dhaka division. The poorest households faced CHE 4.45 times higher (CI 1.60 to 10.25; $p \leq 0.001$) than the richest households. Diabetes patients who sought treatment from public facility and private facility were at greater risk of facing CHE compared to patients who sought treatment from pharmacy while it was 3.37 times (CI 1.70 to 6.69; $p \leq 0.001$) and 3.40 times (CI 1.78 to 6.46; $p \leq 0.001$) higher for 10% CHE threshold level and 5.09 times (CI 2.31 to 11.19; $p \leq 0.001$) and 8.16 times (CI 3.46 to 19.25; $p \leq 0.001$) higher for 25% CHE threshold level, respectively.

3.5. Coping strategies and distress financing

The Fig. 1 represents the coping mechanisms and distress financing for diabetes treatment. Most of the households relied on regular income (43.1%) and savings (29.7%) during diabetes treatment. However, about 12.1% households had to borrow money while 9.5% and 5.6% of the households had to seek help from friends and relatives and selling assets, respectively. We observed that about 27.2% of the households faced distressed financing due to diabetes treatment in Bangladesh.

4. Discussion

Ensuring financial risk protection is a key to achieving Universal Health Coverage (UHC) by 2030 for many low- and middle-income

Table 2
Average annual OOP cost of diabetes treatment per episode.

Cost	Parameter	Cost of treatment (Only Diabetes)		Cost of treatment (Diabetes with comorbidity)		Cost of treatment (Diabetes with & without comorbidity)		Proportion of total cost
		Mean BDT (US $)	SD BDT (US$)	Mean BDT (US $)	SD BDT (US$)	Mean BDT (US $)	SD BDT (US$)	
Direct Medical	Medicine cost	15,528 (196.9)	37,926 (480.9)	22,264 (282.3)	48,806 (618.8)	19,215 (243.6)	44,333 (562.1)	75.43
	Investigation cost	2553 (32.4)	10,033 (127.2)	3950 (50.1)	16,496 (209.2)	3318 (42.1)	13,962 (177)	13.03
	Consultation fee	787 (10)	3847 (48.8)	1199 (15.2)	6985 (88.6)	1013 (12.8)	5782 (73.3)	3.98
	Bed fee	61 (0.8)	521 (6.6)	320 (4.1)	2705 (34.3)	203 (2.6)	2036 (25.8)	0.80
	Operational cost	136 (1.7)	1734 (22)	828 (10.5)	13,112 (166.2)	515 (6.5)	9775 (123.9)	2.02
Total Direct Medical Cost		19,065 (241.7)	44,883 (569.1)	28,563 (362.2)	62,425 (791.5)	24,263 (307.6)	55,372 (702.1)	95.25
Direct Non-Medical	Transport cost	714 (9.1)	3434 (43.5)	1065 (13.5)	4988 (63.2)	906 (11.5)	4357 (55.2)	3.56
	Informal payment	46 (0.6)	436 (5.5)	173 (2.2)	1016 (12.9)	115 (1.5)	809 (10.3)	0.45
	Necessary things cost	42 (0.5)	514 (6.5)	93 (1.2)	785 (10)	70 (0.9)	677 (8.6)	0.28
	Others cost	64 (0.8)	1031 (13.1)	162 (2.1)	3138 (39.8)	118 (1.5)	2423 (30.7)	0.46
Total Direct Non-Medical Cost		867 (11)	4048 (51.3)	1493 (18.9)	6422 (81.4)	1210 (15.3)	5485 (69.5)	4.75
Total out-of-pocket (OOP) Cost		19,932 (252.7)	46,989 (595.8)	30,056 (381.1)	66,385 (841.7)	25,473 (323)	58,615 (743.2)	100.00

Table 3
Catastrophic healthcare expenditure (CHE) due to treatment of Diabetes.

Variables	05% of Total Expenditure Threshold	10% of Total Expenditure Threshold	15% of Total Expenditure Threshold	25% of Total Expenditure Threshold
Age of the patients				
Less than 18 years	–	–	–	–
18 to 35 years	10.11	5.42	4.33	2.53
36 to 49 years	17.20	8.66	5.24	2.39
50 to 60 years	23.08	14.00	9.29	5.98
More than 60	31.78	20.75	14.40	9.34
P-value	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Gender of the patients				
Female	9.86	6.82	4.84	2.85
Male	37.76	21.35	13.97	8.63
P-value	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Marital status of the patients				
Married	21.87	12.44	8.11	5.02
Widow/ Widower/ Separated	26.23	19.12	13.79	8.09
Unmarried	3.92	3.92	3.92	1.96
P-value	*0.001*	*<0.001*	*<0.001*	*0.022*
Educational status of the patients				
No formal education	24.44	16.94	12.14	7.95
Up to primary	23.55	13.66	9.16	5.23
Secondary	21.56	12.31	7.92	4.68
Higher secondary	19.05	9.52	6.23	4.03
Higher education	17.54	9.48	5.69	3.32
P-value	*0.129*	*0.005*	*0.005*	*0.015*
Comorbidity status of the patients				
No	18.06	9.95	6.43	3.75
Yes	25.57	15.95	10.89	6.77
P-value	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Educational status of the household head				
No formal education	26.21	18.17	13.02	8.52
Up to primary	25.80	14.97	10.03	5.73
Secondary	23.42	13.37	8.60	5.08
Higher secondary	20.16	10.08	6.59	4.26
Higher education	19.37	10.47	6.28	3.66
P-value	*0.122*	*0.006*	*0.005*	*0.018*
Religion of the household				
Islam	22.54	13.55	9.03	5.68
Hinduism	18.71	10.54	7.48	3.06
Christianity	27.27	9.09	9.09	–
Buddhism	23.08	15.38	7.69	7.69
P-value	*0.491*	*0.515*	*0.848*	*0.230*
Number of earners				
No earner	38.81	27.22	19.14	12.40
One earner	23.54	13.13	8.71	5.14
Two earners	17.29	10.96	7.02	4.45
Three and more earners	19.30	8.77	5.85	2.92
P-value	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Household size				
Less than 3 members	33.85	23.08	13.08	10.87
3–4 members	23.93	12.43	8.06	4.95
5–6 members	15.99	9.13	6.01	3.37
7 and more members	20.32	11.55	7.97	4.38
P-value	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Presence of under 5 children in the household				
No	23.10	15.92	10.77	6.51
Yes	25.00	9.16	5.79	3.70
P-value	*0.251*	*<0.001*	*<0.001*	*0.009*
Presence of older person (aged 60 or more) in the household				
No	17.36	12.57	7.82	4.46
Yes	26.05	16.20	11.50	7.33
P-value	*<0.001*	*0.008*	*0.001*	*0.002*
Place of residence				
Urban	22.14	11.68	7.54	4.79
Rural	25.65	16.63	11.39	6.78
P-value	*0.035*	*<0.001*	*0.001*	*0.029*
Administrative division				
Dhaka	18.83	10.30	7.28	4.26
Chattogram	27.83	16.30	10.14	5.96
Khulna	20.20	11.80	7.80	4.80
Rajshahi	24.43	14.37	10.34	6.32
Barishal	30.94	19.54	13.68	8.47
Rangpur	26.89	17.45	11.32	7.55
Sylhet	21.90	13.87	8.03	3.65
Mymensingh	27.66	18.09	12.77	9.57
P-value	*<0.001*	*0.003*	*0.054*	*0.094*
Facility type				
Public facility	26.83	15.19	11.23	7.11
Private facility	36.59	22.41	16.59	10.31
Pharmacy	19.31	13.09	8.41	4.51
Other facility	13.33	6.67	2.22	1.51
P-value	*<0.001*	*0.004*	*<0.001*	*<0.001*
Asset quintile				
Poorest	26.33	18.09	13.30	8.78
Poorer	27.99	17.81	12.72	8.40
Middle	25.11	14.98	10.13	5.73
Richer	20.33	12.01	7.02	3.33
Richest	20.61	8.21	4.20	2.48
P-value	*0.010*	*<0.001*	*<0.001*	*<0.001*
Overall	24.02	14.34	9.61	5.86

countries, including Bangladesh. Using the latest available Household Income and Expenditure Survey dataset of Bangladesh, this study estimated the average annual out-of-pocket cost of treatment for diabetes, which is one of the major public health concerns among NCDs. It has also identified the associated CHE and their determinants in the context of Bangladesh. To the best of our knowledge, this is the first nationally representative study in Bangladesh which measured the out-of-pocket costs, incidence of CHE and the associated factors of CHE for the treatment of diabetes.

The findings showed that the annual average OOP cost per diabetes patient was BDT US$ 323. Our estimated cost is lower than the estimated costs in a study in Pakistan (US$ 646.7) and slightly lower cost than in India (US$ 380) [20,21]. A study in Bangladesh, estimated the average annual direct costs of diabetes as US$ 781.7, which is more than double of our estimated costs [11]. A global systematic review found that the annual direct costs of diabetes per person ranged from US$ 242 in Mexico to US$ 11,917 in the USA [22,23]. Another systematic review of cost-of-illness studies from South Asia identified that the range of total

Table 4
Factors associated with CHE due to the treatment of Diabetes.

Variables	CHE using 10% of Total Expenditure AOR (Lower CI, Upper CI)	CHE using 25% of Total Expenditure AOR (Lower CI, Upper CI)
Age of the patients		
Less than 18 years (ref.)		
18 to 35 years	–	–
36 to 49 years	1.16 (0.37, 3.67)	2.37 (0.40, 13.94)
50 to 60 years	2.11 (0.59, 7.54)	6.17* (1.07, 35.42)
More than 60	2.28** (0.73, 7.15)	4.89** (0.82, 28.95)
Gender of the patients		
Female	1.55 (0.83, 2.89)	1.20 (0.58, 2.48)
Male (ref.)		
Educational status of the patients		
No formal education	1.86* (0.28, 2.69)	1.83* (0.25, 2.12)
Up to primary	1.86 (0.31, 2.38)	1.73 (0.28, 2.51)
Secondary	1.83 (0.25, 2.74)	1.72 (0.26, 2.02)
Higher secondary	1.04 (0.35, 3.08)	1.66 (0.18, 2.39)
Higher education (ref.)		
Comorbidity status of the patients		
No (ref.)		
Yes	1.80** (1.12, 2.89)	1.62** (0.94, 2.79)
Number of earners		
No earner	2.14** (0.60, 7.62)	1.68** (0.33, 8.58)
One earner	1.57 (0.45, 5.45)	1.52 (0.35, 6.66)
Two earners	1.24 (0.31, 4.87)	1.52 (0.36, 6.49)
Three and more earners (ref.)		
Household size		
Less than 3 members	2.98* (0.89, 10.01)	3.20* (0.58, 17.51)
3–4 members	1.18 (0.41, 3.38)	1.79 (0.37, 8.58)
5–6 members	0.81 (0.31, 2.16)	1.19 (0.29, 4.84)
7 and more members (ref.)		
Presence of under 5 children in the household		
No	1.20 (0.58, 2.50)	1.12 (0.48, 2.59)
Yes (ref.)		
Presence of older person (aged 60 or more) in the household		
No (ref.)		
Yes	1.46** (0.70, 3.06)	1.39* (0.60, 3.18)
Place of residence		
Urban (ref.)		
Rural	1.31* (0.79, 2.18)	1.85* (0.46, 1.57)
Administrative division		
Dhaka (ref.)		
Chattogram	1.35* (0.61, 2.96)	1.79* (0.32, 1.91)
Khulna	0.81 (0.39, 1.69)	0.58 (0.25, 1.35)
Rajshahi	0.76 (0.34, 1.69)	0.62 (0.24, 1.57)
Barishal	3.18** (1.15, 8.83)	1.89* (0.61, 5.84)
Rangpur	2.84** (1.11, 7.26)	1.72** (0.66, 4.47)
Sylhet	1.37 (0.39, 4.76)	1.26 (0.11, 3.94)
Mymensingh	1.23 (0.30, 5.03)	1.10 (0.31, 3.88)
Asset quintile		
Poorest	4.45*** (1.60, 10.25)	4.06** (1.43, 13.87)
Poorer	2.92 (0.73, 5.03)	1.97** (0.66, 5.86)
Middle	2.65** (1.09, 6.44)	1.94 (0.30, 2.98)
Richer	1.11 (0.88, 5.06)	1.59 (0.52, 4.87)
Richest (ref.)		
Facility type		
Public facility	3.37*** (1.70, 6.69)	5.09*** (2.31, 11.19)
Private facility	3.40*** (1.78, 6.46)	8.16*** (3.46, 19.25)
Pharmacy (ref.)		
Other facility	0.40 (0.09, 1.84)	0.58 (0.06, 5.60)
Constant	0.01*** (0.00, 0.13)	0.00*** (0.00, 0.05)
N	418	352
Wald chi2(33)	70.87	66.31
Prob > chi2	0.000	0.000
Pseudo R2	0.1724	0.1874
Log pseudolikelihood	−237.70	−181.06
Mean VIF	4.29	4.18

* *p less than 0.05,* ***p less than 0.02,* ****p less than 0.01.*

annual costs for diabetes treatment was from US$ 483 to US$ 2637 per patient, which is more than the costs we found in our study [23,24]. We found the cost of medication contributed for 75.43% of the total cost. Other studies in Bangladesh, Pakistan and Brazil identified the costs of medication as one of the major contributing factors of the treatment costs of diabetes as well [11,20,25]. The variations in diabetes treatment costs across different settings could be due to the differences in the contextual factors (e.g., health system, economy), differences in estimation methods as well as the differences in assessment periods.

The incidence of CHE due to diabetes treatment were observed for 14.34%, and 5.86% of the study households for 10% and 25% of the total household expenditure threshold levels, respectively. A recent study indicated the incidence of CHE as 26.1% (at 10% threshold) and 21.5% (at 25% of threshold) due to hospitalization for various communicable and non-communicable diseases in Bangladesh [26]. The incidence of CHE due to diabetes treatment has previously been calculated in various settings. For instance, a study in South Africa identified 25% incidence of CHE using the 10% threshold [27]. Further, a study in Brazil identified the prevalence of CHE as 17.9% and 7.5%, for expenditures corresponding to 10% and 25% threshold, respectively [25]. Another study in Korea identified the CHE as 20.4% at 10% threshold level in 2013, which is higher than our finding [28]. A global analysis of surveys from 86 countries showed that the CHE incurred for diabetes treatment ranged from less than 1% of households in high income settings to 13% in low- and middle-income countries, which is lower than our estimated incidence of CHE [23].

This study identified that the age of the patients had a positive association with the incidence of CHE. Countries like Bhutan and China also found that the probability of CHE is higher for people with older age [29,30]. This finding is intuitive and can be explained by the fact that the aged people with diabetes usually face different types of diabetes related complications. In addition, the risks of suffering from other chronic conditions are high among the elderly [31]. Older people require more frequent spending, and most expenditures are related to medicines and consultation [25]. Like earlier studies we found that the households that had a diabetes patient with comorbidities had higher odds of experiencing CHE compared to their counterparts [25,29]. This result may be explained by the fact that individuals with comorbidities needs more healthcare services [25].

This study also found that diabetes patients with higher educational qualifications had lower probability of CHE than those with no education. This result is consistent with findings from another study in China which showed that diabetes patients with lower educational qualification had greater odds of incurring CHE [29]. This may be due to the fact that the educated people have higher earning capacities and therefore their total expenditure is higher as well, which prevents their households from falling into the incidence of CHE. However, such findings were not always common [32]. We identified that diabetes patients from small households had greater likelihood of bearing CHE. The results of this study are consistent with findings from other studies indicated that household number has a negative influence on the risks of experiencing CHE due to diabetes treatment [32,33]. In Bangladesh, both public and private health insurance coverage are rare, therefore most of the households depend on OOP payment for mitigating healthcare expenses while regular income was the lion share for coping strategies during treatment care [34]. Indeed, a large household has multiple earning member and hence a higher total income and expenditure [35]. Therefore, households having no earner were at higher risk of experiencing CHE which was observed in this study. Like earlier study we found that the presence of older person in the households was a predictor of CHE [36]. This might be due to the fact that older people are prone to various chronic conditions and high treatment costs and thus incurred additional financial burden to the same households [35]. In line with other studies in various settings, we also observed that households belonging to the poorest groups had greater risks of experiencing CHE [27,29]. As the poorest households had lower expenditure level due to lower

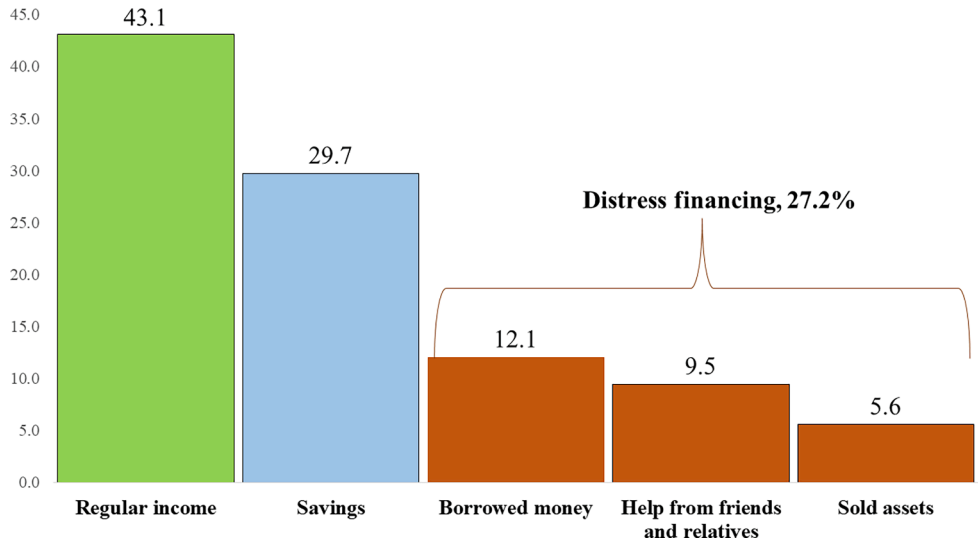

Fig. 1. Coping strategies during treatment (%).

spending capacity, any out-of-pocket spending for treatment constituted a large proportion of their total expenditure [35]. Although richer households spend more on treatment, the impact on the budget is greater for the poorer households [30].

Like other settings in Bhutan and China, we found that the rural households were more prone to CHE [30,37]. The current study also found that the risk of CHE due to diabetes treatment in Chattogram, Barishal and Rangpur division was significantly higher than Dhaka division [35]. Although, there are no significant differences in socio-economic characteristics across different regions, Chattogram and Barishal divisions located in the coastal regions and the cost of transportation was relatively higher than other regions [6,26,38]. We observed that the diabetes patients who sought treatment from private facilities were at greater risk of facing CHE. This finding is in line with another study in Bangladesh which identified that treatment from public or private facilities increased the odds of incurring catastrophic heath expenditure for different diseases [35]. Sheikh et al. also identified that patients who sought treatment from private facilities are at greater risks of experiencing CHE [26]. The reasoning behind this might be that, private hospitals have high price of treatment. Although the consultation fee is low in the public facilities, households might have made high out-of-pocket payments to purchase certain medical care items and use investigation services from the private market [35]. Our findings also showed that about 27% of the households faced distress financing as they had to borrow money, seek help from friends and relatives or sell assets for bearing the treatment cost of diabetes. A recent study in Bangladeshi context found that 58% households faced distress financing on hospitalization for various communicable and noncommunicable diseases in Bangladesh [26]. This percentage is more than double of our finding as we only consider the treatment of diabetes and their study considered hospitalization costs only. Still, our percentage is high and indicates that achieving UHC would be difficult without mitigating financial distress for the treatment of diabetes.

This study has several limitations. Firstly, data on health service utilization, treatment costs and household expenditure were self-reported information. Therefore, there is a possibility of recall bias and under-reporting or over-reporting bias in this study. Secondly, as we used cross sectional dataset for conducting this study, causal relationship between CHE and other factors may not be inferred. Thirdly, this study is unable to sort out the health-related quality of life of diabetes patient and variation of OOP cost across disease severity as only partial information on diagnoses data were available. Fourthly, this study could not analyze medicines prices as a factor affecting medicines expenditure as information on medicine prices was not collected as part of the survey. Further, the reasons for choosing specific sources of distress financing were not possible to sort out due to lack of data in our study dataset. Despite these limitations, this study used a nationally representative dataset, the study findings can be generalized in the context of Bangladesh. This study provides significant insights into the challenges of the health system of Bangladesh. Policies should be designed to reduce the out-of-pocket costs for diabetes treatment especially for the vulnerable groups like the elderly, those who are with low socio-economic status and who lives in the rural areas.

5. Conclusion

The annual average OOP cost per diabetes patient was US$ 323. As consequences, about 14.34% of households faced catastrophic health expenditure in Bangladesh. The evidence of catastrophic expenditure suggests that diabetes services are unaffordable particularly for low-income households and illustrate the urgent need to improve financial risk protection to ensure access to care. These results will also be utilized to evaluate current treatment of patients with diabetes and determine the most cost-effective interventions for tackling the health and economic burden due to diabetes in Bangladesh.

Ethics approval.

The study analysed a publicly available BBS- HIES 2016 data set. The electronic datasets can be downloaded from the BBS website through the following link: https://data.bbs.gov.bd/index.php/catalog/HIES.

Consent to participate.

According to the HIES-2016, written informed consent was obtained from women enrolled in the survey according to the guidelines laid down in the Declaration of Helsinki.

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CRediT authorship contribution statement

Zakir Hossain: Writing – review & editing, Writing – original draft, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation. **Moriam Khanam:** Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Project administration, Methodology, Investigation. **Abdur Razzaque Sarker:** Writing – original draft, Data curation, Formal analysis, Conceptualization, Visualization, Formal analysis.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.hpopen.2023.100102.

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