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Out-of-pocket cost and financial catastrophe of patients with cancer: the alarming cost-of-illness in Bangladesh

Abdur Razzaque Sarker[1,2*], Rasedul Islam[1] and An Tran-Duy[2]

Abstract

Background Out-of-pocket (OOP) cost of cancer treatment has increased substantially globally. In low- and middle-income countries, many patients face financial distress due to cancer. For patients with cancers in Bangladesh, this study aimed to (1) estimate the annual OOP cost of cancers from households' perspective, (2) assess the coping strategies and financial distress, and (3) examine factors associated with OOP cost.

Methods We used data from a cross-sectional hospital-based survey conducted in three randomly selected hospitals in Bangladesh. A bottom-up micro-costing approach was used to estimate the OOP cost components. We used the logistic regression model and the generalized linear model to examine the determinants of distress financing and OOP cost, respectively.

Results The average annual OOP cost per cancer patient was US$ 6,504 (range, US$ 959 – 29,681), which was greater than 2 times the average annual household income. About 90% of households faced distress financing due to cancer. Having at least one comorbid condition, cancer stage 2 or higher, households having no elderly people, or having treatment abroad was significantly associated with a higher OOP cost compared to those without the condition.

Conclusion OOP cost of cancer treatment and the proportions of patients with distress financing and financial catastrophe are alarmingly high in Bangladesh. Earlier cancer diagnosis and implementation of Government financial health protection schemes are crucial and urgent to alleviate the enormous economic burden and ensure equitable access to care for the patients.

Keywords Economic burden, Cancer, Financial distress, Out of pocket, Bangladesh

*Correspondence:
Abdur Razzaque Sarker
razzaque.sarker@gmail.com; razzaque@bids.org.bd
[1]Health Economic and Financing Research, Population Studies Division, Bangladesh Institute of Development Studies (BIDS), Dhaka 1212, Bangladesh
[2]Centre for Health Policy, Melbourne School of Population and Global Health, University of Melbourne, Melbourne, VIC 3053, Australia

Introduction

Cancer is an overwhelming global public health issue worldwide. Globally, about 19.3 million people were newly diagnosed with cancer in 2020 and this number was projected to reach 21.6 million in 2030 [1]. Cancer incidence rises dramatically with age and is often called a disease of aging. For example, gastrointestinal cancer is widespread among older people which leads to massive hospitalizations and intensive treatment. Not only is cancer highly prevalent in old people, every year about 400,000 children and adolescents also develop various cancers globally [2]. While more than 80% of children with cancer are cured in high-income countries, this figure is less than 30% in low- and middle-income countries (LMICs) [2, 3]. Prevention of cancer is crucial to reduce the health and economic burden of cancer as up to 50% of all cancer cases are preventable [4].

Cancer is particularly an overwhelming public health problem in Bangladesh [5, 6]. The prevalence of cancer in Bangladesh is about 0.71 per 1000 population, with approximately 0.2 million patients newly diagnosed with cancer each year [7, 8]. In 2020, about 156,775 individuals were newly diagnosed with cancer and about 108,990 people died due to various cancers in Bangladesh [9]. In 2005 cancer caused about 7.5% of total deaths in Bangladesh, which was projected to increase to approximately 13% in 2030 [10, 11]. However, there is no national central cancer registry in Bangladesh and therefore the national burden of cancer is still unknown [9]. Although a large number of people suffer from cancers annually, only about 50,000 regularly go for treatment in Bangladesh, which indicates the vulnerability of the people who do not receive any treatment [12]. Indeed, the financial burden of cancer is enormous on individuals and their families/caregivers [13].

Cancers have a negative impact on people's health and life and on economies around the world. From an economic perspective, the ever-increasing number of patients and the severity of illness have imposed significant direct and indirect costs on patients, the health system and the government. Recent data indicated that globally the economic cost of cancers from 2020 to 2050 was 25.2 trillion international dollars [14]. A study observed that the economic cost of cancer was €126 (US$168) billion among the 27 countries of the European Union, of which lung cancer constituted the highest cost (€18·8 billion or US 25 billion), followed by breast cancer (€15·0 billion or US$19.95 billion) [15]. A recent study observed that the economic burden of cancer in Spain was about €9,016 (US$10,820) million in 2009 [16]. The economic cost of cancer is massive in the USA and almost US$208 billion was spent in the U.S. on cancer-related health care in 2020 [17]. Another study indicated that the economic cost of cancer was 1.4 trillion international dollars in India [14]. These costs of cancer care are likely to increase, as more people require treatments. It was observed that, the cancer patient often spent up to US$7,500 annually for treatment related activities in Bangladesh [18]. Another study in rural Bangladesh observed that about 12% of households fell into poverty due to payment for cancer care [19].

Bangladesh uses a combination of different healthcare financing strategies, including general revenue taxation, out-of-pocket (OOP) payments, development partners' contributions and others including insurance [20]. OOP health expenditure constitutes a large share (68.5%) of total healthcare expenditure in Bangladesh [21]. Reliance on OOP cost results in two divergences on households; firstly, it often leads to the catastrophic healthcare expenditure on households [22], and secondly, the inability to pay for adequate healthcare at the point of service by low-income people results in unmet need of care [23]. OOP issues often lead low-income people to seeking healthcare from untrained healthcare providers which in many cases results in adverse effects on health or inadequacy of treatment care [24]. Although the costs of cancer have been reported in different countries around the world [15, 16, 25–28], to the best of our knowledge, there has been limited or no research focusing on the OOP cost, economic burden and factors associated with OOP cost of cancer treatment in Bangladesh [13, 19]. Assessing OOP cost associated with different stages of cancer, which is rarely available in the Bangladesh context, can help to estimate the impact of early treatment of cancer on reducing economic burden of the patients. The aim of this study was to (1) estimate the annual OOP cost of cancers from households' points of view, (2) assess the coping strategies and financial distress, and (3) examine factors, including cancer stages, associated with OOP cost in Bangladesh. Examining the economic dimensions of cancer through this research will provide important evidence for making socioeconomic policies related to cancer, and provide a method for OOP cost assessment in other non-communicable diseases (NCDs) in Bangladesh.

Methods

Study design and population

A cross-sectional hospital-based survey was conducted between November 2022 and January 2023. We adopted an incidence-based approach for estimating the OOP cost of illness [29, 30]. Cancer patients who were confirmed by a registered physician in the selected health facilities were considered for sampling. This study was conducted in three randomly selected hospitals: the National Institute of Cancer Research & Hospital (public hospital), the Bangladesh Medical College and Hospital (private hospital), and the Ahsania Mission Cancer and General

Hospital (NGO hospital). In this regard, a complete list of the hospitals in Dhaka was listed and stratified into three categories (public, private and NGO). Then, one hospital from each stratum was randomly selected using statistical software. Although treatment costs at public hospitals are lower compared to private hospitals and hospitals financed by NGOs, cancer patients frequently visit both private and NGO-based hospitals in Bangladesh. The sample size was calculated using the following formula [31, 32]:

$$n = \frac{Z^2_{1-\frac{\alpha}{2}} P(1-P)}{d^2}$$

Where $Z_{1-\frac{\alpha}{2}} = 1.96$ was the statistic for 5% level of significance, P was the expected proportion of the population with a specific characteristic, and d = 5% was the precision level. In this study, we considered an expected proportion (P) of 50% for the maximum variability of the sample [32]. Considering a 15% non-response rate, a sample size of 441 patients was required for this study. A total of rounded 450 patients (150 cases from each of the 3 randomly selected hospitals) were aimed to be included in this study. In the recruitment, a list of patients who received cancer treatment was collected from each participating hospital and each patient was assigned a unique identifying number. Then, the patients were randomly selected and invited for the interview. Upon receiving the consent of the respondents, the data were collected, separately for patients from each hospital based on the unique identifying numbers. During the data collection period, the data were collected face-to-face from the patients. In case of a non-response or unavailability of any selected patients, we replaced them with other patients from the list selected by random nature. The quantitative approach was used to quantify the annual OOP cost and its determinants. A structured paper-based survey questionnaire was developed based on the national household income and expenditure survey, a validated tool in Bangladesh [33]. The final questionnaire was developed following a pilot survey of 30 cancer patients to refine the wording and comprehension.

OOP cost estimation

OOP cost is defined as the expenses incurred by patients or households at the time of receiving any healthcare services, including cost-sharing and informal payments (e.g., tips and under-the-table payments) but excluding insurance premiums and any reimbursements from the third-party payers [34]. 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. A bottom-up micro-costing approach was used where all relevant OOP cost components, including both direct medical and non-medical expenses, were identified and valued at the most detailed level [35]. Direct medical expenses included costs associated with healthcare resource use during treatment, such as medicine, diagnosis, registration fees, and others. The direct non-medical OOP cost included transportation, lodging, food items, informal payment, and payment for helping the patients during treatment.

Variables

The primary outcome variable was the annual OOP cost of cancer. The secondary outcome was the distress financing, a binary indicator of whether or not the patients relied on sale of household assets, borrowings from banks and other lenders, and/or money contributions from relatives and friends to pay for OOP cost of cancer treatment [34, 39]. Ages of the patients were categorized into four groups (younger than 5, 5–19, 20–59, and 60 and above). Patients' educational levels were classified as 'no education', 'primary level' (grades 1–5), 'secondary' (grades 6–10), 'higher secondary' (grades 11–12), and 'higher education' (Bachelor or postgraduate). Household size was a categorical variable based on the number of household members and expressed as 'small' (smaller than four members), 'medium' (four to six members), and 'large' (more than six members). Other explanatory variables included treatment type (chemotherapy only or combination of surgical treatment and chemotherapy), patients having at least one co-morbidity (yes or no), seeking care from abroad (yes or no), having older people in the household (yes or no), stage of cancers (stage 1, 2, 3 or 4), and wealth index. The wealth index, a composite score, was constructed from the asset vector of the household. Each household's durable asset (e.g., housing materials, toilet or latrine access, phone/tv ownership etc.) were dichotomized ('yes' if present and 'no' if not). Principal component analysis (PCA) was performed using the ownership of durable assets of households to calculate the wealth score [36]. The constructed wealth score values were then assigned to individuals based on variables included in the model. The wealth score was divided into five groups based on overall asset ownership: poorest (Q1: lowest 20%), poorer (Q2), middle (Q3), richer (Q4), and richest (Q5: top 20%).

Statistical analysis

The data was analyzed using Stata/SE 15.0 (StataCorp., College Station, TX, USA). Descriptive statistics were applied for the primary outcome and the explanatory variables described in the previous section. Costs were converted to 2023 US Dollars (US$) using the Consumer Price Index (CPI) to adjust for inflation. The household cost burden was measured by the percentage of total household earnings that was consumed by the cancer

treatment [27]. OOP cost was considered as catastrophic if it exceeded 25% of the household's income [37]. We used the generalized linear model (GLM) with a log link and γ distribution to assess the associations between the explanatory variables and annual OOP cost, and the logistic regression model for distress financing. Significant associations in the models were determined at the 5% alpha level ($p < 0.05$). As in previous studies, a one-way sensitivity analysis was conducted to examine the effect of increasing and decreasing each cost component by 20% on the change in the average total annual OOP cost [29, 38].

Results

Characteristics of study participants

Characteristics of 450 participants in the survey are presented in Table 1. The average age was around 47 years, with the majority of patients (60.7%) falling in the age group of 20–59 years. 56% of the participants were female, and most households (70.67%) had a single earner. The average and median annual household income of the patient was about US$2,996 (SD, 2379) and US$2,617, respectively. Most participants (83%) had cancer stages 2 and 3, and more than a half (63%) had at least one comorbid condition. Breast cancer constituted the highest percentage (16%) of all patients, followed by cervical cancer (11.11%), lung cancer (8.89%), throat cancer (7.33%), and blood cancer (6.22%) (Supplementary Table S1). Most of the patients received treatment in the country, and only 5% of the patient received treatment from abroad.

Annual OOP cost components

Table 2 shows descriptive statistics, based on the number of patients who actually incurred costs, of the annual OOP cost components of cancer treatment from households' perspective. The average total annual OOP cost per cancer patient was US$6,504 (SD, 4,988; range, US$959 to US$29,681). Direct medical costs (US$5,427) and direct non-medical costs (US$1,077) constituted 83% and 17% of the total OOP cost, respectively (see detail in Supplementary Table S2). Among all components of the OOP cost except for costs related to treatment abroad, the average annual medicine cost was recorded as the highest cost (US$1,961) followed by diagnostic cost (US$1,730) and bed fee (US$610). Regarding average annual direct non-medical costs, US$292, US$238 and US$229 were spent for the accommodation, transportation and food cost, respectively. Further, US$337 was spent for their caregivers' purposes. During the survey, we observed that a total of 23 patients received the treatment abroad, of which each spent US$5,988 and US$1,900 for direct medical and non-medical purposes.

Annual OOP cost across background characteristics

Descriptive statistics of OOP costs of cancer across patients in each level of a categorical variable is shown in Table 3. Considering the patients' age group, the average total annual OOP costs ranged from US$4,256 for patients up to 5 years old to US$6,581 for those above 60 years old. Female patients spent more for OOP cost compared to males (US$6,710 vs. US$6,241). Regarding education level, the highest average annual OOP cost was observed among patients with a higher education (US$10,524). Small-size households consisted of 3 members or fewer spent more (US$6,954) compared to households with more members, and households with no elderly spent more than households with elderly (US$7,018 vs. US$6,021). The average annual OOP cost was lower in public settings (US$3,829) than in the private healthcare facilities (US$7,795) and in hospitals financed by NGOs (US$7,889) (Supplementary Table S3). The highest annual OOP cost incurred for treatment of gastrointestinal cancers, including esophageal cancer, colorectal cancer, colon cancer, and others (US$7,660), followed by blood and lymphatic cancers (US$7,327) (Supplementary Table S4). The average annual OOP cost of patients seeking care from abroad (US$15,183) was more than twice that of those treated domestically (US$6,036). Patients at the end stage of cancer spent more (US$8,309) than the patient at the early stage of cancer (US$3,932). We found that patients who belonged to the richest (5-*th*) quintile spent about double (US$9,126) that of the poorest group (US$4,500).

Households cost burden, coping strategies and financial distress

The economic burden of cancer treatment is presented in Table 4. The OOP expenditure as a proportion of a household's annual income differed significantly among the income groups ($p < 0.001$). The average annual OOP expenditure of cancer was 217% of the average annual household income. Notably, the average annual OOP cost of patients in the poorest (1-*st*) quintile was nearly three times the average annual household income, while the richest (5-*th*) quintile spent about 157% of the annual household income. Considering a catastrophic health expenditure (CHE) threshold of 25%, all households suffered from CHE due to cancer. We observed the significant gap between annual income and annual OOP expenditure of cancers, indicating that households often rely on other financing mechanisms, including household income (Fig. 1).

Figure 1 demonstrates the coping strategies during cancer treatment, expressed as percents of the households who used a specific strategy during treatment. The most common coping strategies were borrowing money (78%), using regular income (65%), using savings (56%),

Table 1 Characteristics of the study participants

Attributes	*n* (%)	95%CI
Age of the patients		
Up to 5 years	8 (1.8)	[0.9, 3.5]
5–19 years	33 (7.3)	[5.2, 10.1]
20–59	273 (60.7)	[56.0, 65.0]
Above 60 years	136 (30.2)	[26.1, 34.6]
Gender of the patient		
Female	252 (56)	[51.3, 60.5]
Male	198 (44)	[39.4, 48.6]
Educational status of patient		
No education	72 (16)	[12.8, 19.7]
Up to primary	148 (32. 9)	[28.6, 37.3]
Secondary	164 (36.4)	[32.1, 41.0]
Higher Secondary	46 (10.2)	[7.7, 13.3]
Higher Study	20 (4.4)	[2.8, 6.8]
Education Status of Household head		
No education	62 (13.8)	[10.8, 17.3]
Up to primary	96 (21.3)	[17.7, 25.3]
Secondary	168 (37.3)	[32.9, 41.9]
Higher Secondary	55 (12.2)	[9.4, 15.6]
Higher Study	69 (15.3)	[12.2, 18.9]
Patient's marital status		
Married	343 (76.2)	[72.5, 79.9]
Other	13 (2.9)	[1.6, 4.9]
Separated	7 (1.6)	[0.7, 3.2]
Unmarried	45 (10)	[7.5, 13.1]
Widow/widower	42 (9.3)	[6.9, 12.4]
No of earners in Household		
No earner	8 (1.8)	[0.8, 3.5]
Single earner	318 (70.7)	[66.2, 74.7]
Multiple earners	124 (27.6)	[23.6, 31.8]
Household size		
1–3 members	46 (10.2)	[7.7, 13.3]
4–6 members	318 (70.7)	[66.2, 74.7]
More than 6 members	86 (19.1)	[15.73, 23.02]
Household has elderly person(s) (60 + years)		
No	218 (48.4)	[43.8, 53.0]
Yes	232 (51.6)	[46.9, 56.1]
Patient's comorbidity status		
No	165 (36.7)	[32.3, 41.2]
Yes	285 (63.3)	[58.7, 67.6]
Stage of cancer		
Stage 1	38 (8.4)	[6.2, 11.1]
Stage 2	213 (47.3)	[42.7, 51.9]
Stage 3	162 (36)	[31.6, 40.5]
Stage 4	37 (8.2)	[6.0, 11.1]
Type of treatment		
Both Surgical treatment and Chemotherapy	259 (57.6)	[52.9, 62.0]
Only Chemotherapy	191 (42.4)	[37.9, 47.0]
Treatment from abroad		
No	427 (94.9)	[92.4, 96.5]
Yes	23 (5.1)	[3.4, 7.5]
Wealth index		
Poorest (Lowest 20%)	91 (20.2)	[16.7, 242]

Table 1 (continued)

Attributes	*n* (%)	95%CI
Poorer	89 (19.8)	[16.3, 23.7]
Middle	90 (20)	[16.5, 23.9]
Richer	96 (21.3)	[17.7, 25.3]
Richest (Upper 20%)	84 (18.7)	[15.3, 22.5]

Table 2 Average annual out-of-pocket (OOP) cost across cost components (US$)

Type of cost	Cost components	Overall						
		Mean	SD	Minimum	Maximum	Median	5th Percentile	95th Percentile
Direct medical	Registration fee (*n* = 450)	22	16	1	59	18	2	59
	Consultation fee (*n* = 424)	342	335	24	1,781	237	30	1,069
	Medicine Cost (*n* = 450)	1,961	1,662	356	11,872	1,543	475	4,274
	Diagnostic Cost (*n* = 450)	1,730	1,336	237	10,091	1,187	416	4,155
	Bed fee (*n* = 430)	610	645	59	4,155	356	71	1,781
	Medical Equipment Cost (*n* = 450)	502	450	24	2,374	356	59	1,425
	Direct medical cost abroad (*n* = 23)	5,988	5,420	1,781	21,370	4,155	1,781	20,183
Total direct medical cost (*n* = 450)		**5,427**	**4,459**	**737**	**26,932**	**4,051**	**1,414**	**14,733**
Direct non-medical	Transportation Cost (*n* = 450)	238	194	36	1,781	178	59	594
	Food cost (*n* = 450)	229	167	18	1,187	178	59	594
	Informal payment (*n* = 376)	24	16	2	107	21	6	59
	Caregiver expenditure (*n* = 441)	337	204	24	10,69	297	59	712
	Accommodation cost (*n* = 204)	292	210	36	1,425	237	83	712
	Other cost (*n* = 450)	31	41	6	594	24	6	83
	Direct non-medical cost abroad (*n* = 23)	1,900	1,036	594	4,749	1187	950	3562
Total direct non-medical cost (*n* = 450)		**1,077**	**719**	**148**	**4,874**	**902**	**291**	**2,582**
Total OOP cost (*n* = 450)		**6,504**	**4,988**	**959**	**29,681**	**4,927**	**1,935**	**16,799**

selling assets (40%) and receiving donations from friends and relatives (27%).

Factors associated with average annual OOP cost

After adjusting the OOP cost for the demographic and clinical variables using the GLM model, we observed that having at least one comorbid condition, cancer stage 2 or higher, households having no elderly people, receiving both surgical treatment and chemotherapy, having treatment abroad or wealthier were significantly associated with a higher average annual OOP cost compared to the references. For instance, the average annual OOP cost in patients with at least one comorbid condition was 1.42 times (95% CI 1.22–1.66) that of those who had no comorbidities. Average annual OOP costs of patients with cancer stages 2, 3 and 4 were 1.56 times (95% CI 1.24–1.94), 1.69 times (95% CI 1.35–2.13), and 1.91 times (95% CI 1.42–2.55) that of those in cancer stage 1. The households who had no elderly persons (aged 60+) spent 19% more on treatment costs compared to their counterparts. Patients who received treatment abroad had the strongest relative effect on the annual healthcare expenditure with a mean ratio of 1.92 (95% CI, 1.45–2.53) compared to patients who were treated domestically. We observed that the richer (4-*th* quintile) and wealthiest (5-*th* quintile) households spent annually 54% (95% CI, 1.26–1.87) and 70% (95% CI, 1.37–2.09), respectively, higher OOP cost compared to the poorest households.

From the marginal effect analysis, we observed that treatment abroad was the most expensive scenario with an incremental average annual OOP cost of US$5,638 (95% CI US$2,467–US$8,810) compared to patients treated domestically. Patients belonging to the richest and richer households had an incremental average annual OOP cost of US$3,353 (95% CI US$1,949–US$4,758) and US$2602 (95% CI, US$1,403–US$3,802) compared to the poorest households (Table 5). Patients with at least one comorbid condition had significantly higher incremental average cost of US$2,184 (95% CI US$1,247-US$3,122) compared to the patients without the condition. Patients with cancer stages 4 and 3 had incremental average annual OOP costs of US$3,717 (95% CI, US$1,910–US$5,524) and US$2,853 (95% CI, US$1,617–US$3,945), respectively, compared to the patients with cancer stage 1.

Factors associated with distress financing of cancer treatment

We observed that 89.6% of the households faced distress financing due to cancer in Bangladesh (Supplementary Figure S1). Statistically significant determinants of distress health financing included age and educational status

Table 3 Distribution of the average total annual OOP cost across background characteristics (US$)

Indicators	OOP Cost (US$)				
	Mean	SD	Minimum	Maximum	Median
Age of the patients					
Up to 5 years	4,256	1,670	2,416	7,159	3,907
5–19 years	5,575	3,837	2,042	17,892	4,117
20–59	6,644	5,227	1,128	29,681	5,135
Above 60 years	6,581	4,851	959	23,804	4,945
Gender of the patient					
Female	6,710	4,976	1,128	29,681	5,405
Male	6,241	5,004	959	27,912	4,761
Educational status					
No education	5,693	3,678	1,258	23,745	4,811
Up to primary	5,685	4,157	1,128	26,119	4,197
Secondary	6,761	5,102	959	28,861	5,319
Higher Secondary	7,747	5,944	1,140	29,681	5,998
Higher Education	10,524	8,232	1,371	28,619	6,922
Household size					
1–3 members	6,954	5,830	1,371	27,912	5,733
4–6 members	6,565	4,987	959	29,681	5,111
More than 6 members	6,036	4,513	1,140	26,119	4,194
Patient's comorbidity status					
No	5,264	3,575	1,140	23,745	4,161
Yes	7,243	5,541	959	29,681	5,483
Stage of cancer					
Stage 1	3,932	2,443	959	9,676	3,918
Stage 2	6,339	4,250	1,217	26,119	5,147
Stage 3	6,912	5,726	1,537	29,681	4,861
Stage 4	8,309	6,324	1,352	23,804	5,883
Type of treatment					
Only chemotherapy	5,973	4,457	959	27,912	4,814
Both chemotherapy and surgery	6,896	5,321	1,231	29,681	5,099
Seeking care from abroad					
No	6,036	4,428	959	29,681	4,808
Yes	15,183	6,718	4,529	28,619	14,912
Household has elderly person(s) (60 + years)					
No	7,018	5,197	1,140	28,861	5,785
Yes	6,021	4,745	959	29,681	4,206
Wealth index					
Poorest	4,500	3,295	1,128	23,745	3,609
Poorer	5,301	3,930	959	28,861	4,152
Middle	5,835	3,640	1,217	17,553	4,861
Richer	7,851	5,607	1,231	26,119	6,001
Richest	9,126	6,385	1,140	29,681	7,221
Across all patients	**6,504**	**4,988**	**959**	**29,681**	**4,927**

of the patients, stages of cancer, type of treatment and wealth quintiles (Supplementary Table S5). Patients aged 20 years and above were more likely to expect distress financing compared to younger patients. The likelihoods of experiencing distress health financing were 37.53, 16.34, 7.95 and 12.8 times for those patients who had no education, primary level education, secondary level education and higher secondary level education, respectively. The patient who received both surgery and chemotherapy increase the likelihood of distress financing by 6.27 times. Patient belonged to the resource constrained households were more prone to distress financing. For instance, the likelihoods of experiencing distress health financing were 141 and 63 times higher for the poor and poorest wealth quintiles, respectively.

Table 4 Economic burden (US$) across income quintiles

Income group	Average Annual income	Average total OOP cost	Diff	OOP as % of Household Income
Poorest quintile	1,540	4,500	-2,960	292
2nd quintile	1,908	5,301	-3,393	278
3rd quintile	2,682	5,835	-3,153	218
4th quintile	3,220	7,851	-4,631	244
Richest quintile	5,806	9,126	-3,320	157
Overall	2,996	6,504	-3,508	217
Richest-poorest ratio	3.77	2.03		
Richest-poorest difference	4,266	4,626		

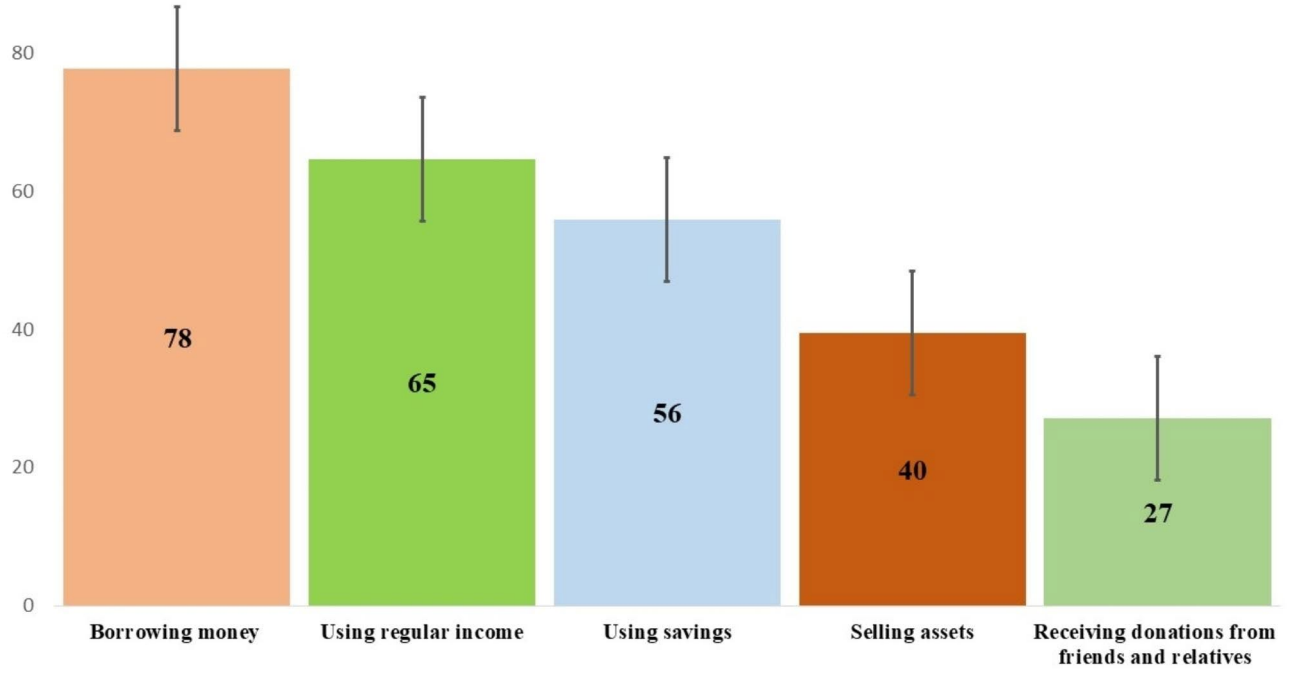

Fig. 1 Coping strategies of households (%) for out-of-pocket costs during cancer treatment. The error bars represent 95% confidence intervals

Sensitivity analysis

The tornado diagram represents the results from the sensitivity analysis (Fig. 2). Changes in medicine and diagnostic costs had the greatest impact on the average total annual OOP cost, as opposed to the smallest effect of changes in registration fee and informal payments. Increasing the medicine cost or diagnostic cost by 20% resulted in an increase of US$391 or US$345, respectively, in the average total annual OOP cost. A 20% change in in other cost components led to changes of smaller than US$116 in the average total annual OOP.

Discussion

Cancer is a global public health concern and considered as one of the leading causes of mortalities and hospitalizations. The health and economic burdens of cancer are exacerbated in resource-poor countries like Bangladesh due to large population, limited diagnostic facilities, high treatment costs and reliance on OOP costs for health care. Bangladesh is going through an epidemiological transition from decreasing prevalence of communicable diseases to growing levels of non-communicable diseases [19, 39]. Further, life expectancy of the general population has also been increasing (67.7 years in 2010 and 72.3 years in 2021), which adds more challenges to the health care system in Bangladesh [40]. Although the economic impact of cancer on households is a global phenomenon, magnitude of this impact in the Bangladesh context has rarely been quantified. This is the first study in Bangladesh that estimated the annual OOP cost of cancer and financial hardship due to treatment of cancer, and assessed factors associated with these variables.

Our study indicated that the average total OOP cost of cancer in Bangladesh (US$6,504 per year or US$542 per month) is considerably higher than in many other countries such as USA (US$300 per month), Canada (US$112 per month), Sri Lanka (US$29 per month), Ireland (US$24 per month) and UK (US$40 per month) [28, 41–44]. The treatment cost of cancer is generally high and without insurance coverage, families need to rely on

Table 5 Results from the multivariable generalized linear model for total annual OOP expenditure among cancer patients

Indicators	Mean Ratio [a] (95% CI)	Mean Difference [b] (95% CI)
Age of the patients		
Up to 5 years (ref)		
5–19 years	0.97 (0.58, 1.63)	-211 (4351, 3929)
20–59	0.79 (0.49, 1.29)	-1630 (-5499, 2240)
Above 60 years	0.80 (0.48, 1.32)	-1584 (-5553, 2385)
Gender of the patient		
Female (ref)		
Male	0.97 (0.84, 1.11)	-186 (-1061, 688)
Educational status		
No education (ref)		
Up to primary	0.98 (0.81, 1.18)	-117 (-1244, 1009)
Secondary	1.16 (0.95, 1.41)	968 (-277, 2213)
Higher Secondary	1.25 (0.97, 1.61)	1510 (-220, 3240)
Higher Education	1.20 (0.84, 1.70)	1201 (-1190, 3592)
Household size		
1–3 members(ref)		
4–6 members	0.97 (0.79, 1.18)	-184 (-1508, 1140)
More than 6 members	0.94 (0.74, 1.19)	-362 (-1916, 1192)
Comorbidity status		
No (ref)		
Yes	1.42** (1.22, 1.66)	2185** (1247, 3122)
Seeking care from abroad		
No (ref)		
Yes	1.92** (1.45, 2.53)	5638** (2467, 8810)
Stage of cancer		
Stage 1 (ref)		
Stage 2	1.56** (1.24, 1.94)	2271** (1264, 3279)
Stage 3	1.69** (1.35, 2.13)	2853** (1761, 3945)
Stage 4	1.91** (1.42, 2.55)	3717** (1910, 5524)
Type of treatment		
Only chemotherapy (ref)		
Both chemotherapy and surgery	1.11 (0.98, 1.24)	650 (-110, 1411)
Household has elderly person(s) (60 + years)		
Yes (ref)		
No	1.19* (1.03, 1.38)	1181* (218, 2144)
Wealth index		
Poorest (ref)		
Poorer	1.21* (1.00, 1.46)	1025* (36, 2013)
Middle	1.26* (1.04, 1.51)	1219* (208, 2231)
Richer	1.54** (1.26, 1.87)	2603** (1403, 3802)
Richest	1.7** (1.37, 2.09)	3353** (1949, 4758)
Constant	2,306** (1383, 3844)	

[a] Values are the exponential form of the β coefficients for a covariate, which represents the multiplier factor for the outcome when the covariate changes from the reference level to another level

[b] Values are the average marginal effect, holding all other covariates at the average values. ** $p < 0.001$, * p<. 05

OOP costs for cancer treatments [45]. The variation in the OOP costs of cancer across countries is attributed to the differences in the structure of the healthcare systems. For instance, in publicly funded healthcare systems, the monthly OOP costs of cancer patients ranged from US$15 to US$400 in Canada and from US$58 to US$438 in Australia [44]. In contrast, the average monthly OOP cost of cancer care was US$1,093 in a tertiary hospital in Pakistan [46]. A nation-wide study conducted in India observed that the average annual OOP costs per cancer patient were US$1,716 and US$4,978 for the public and the private sectors, respectively [47, 48]. In Bangladesh, the share of OOP cost to the total health care expenditure has been steadily increasing from 55.9% in 1997 to

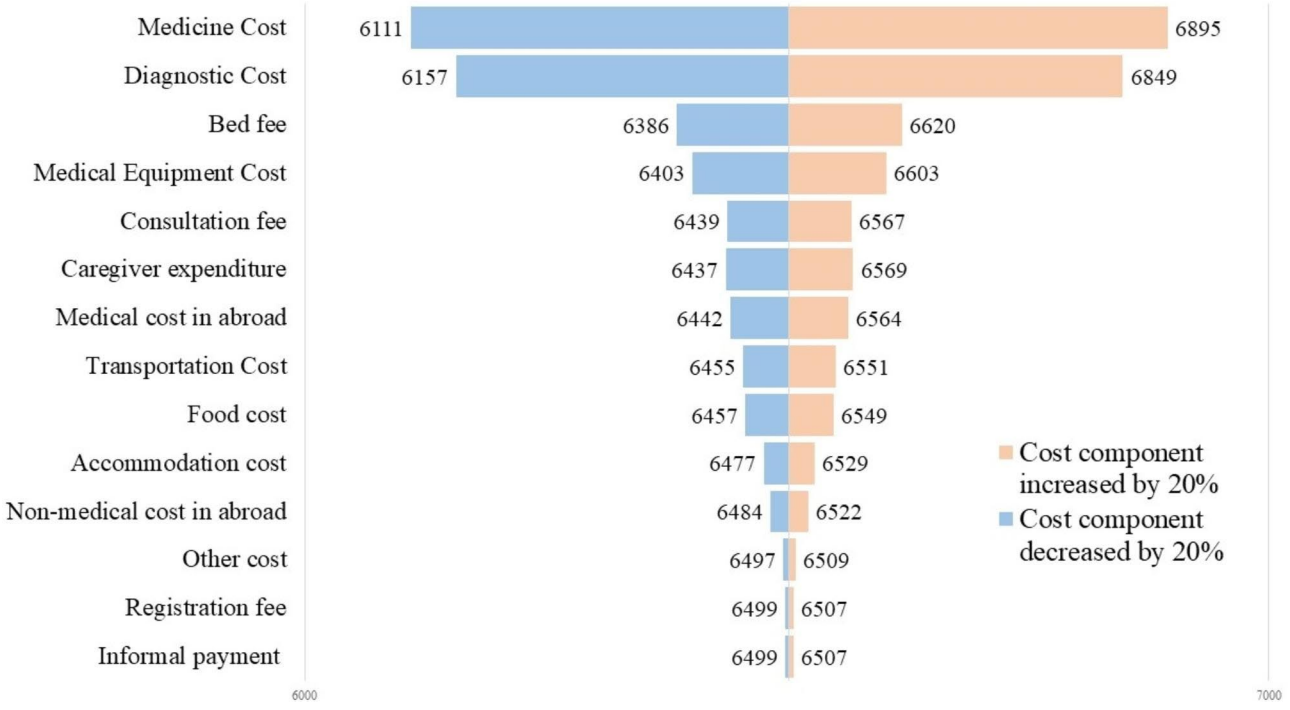

Fig. 2 Tornado plot of the effect of changing 20% of each cost components on the total annual OOP cost

68.5% in 2020 according to the latest Bangladesh National Health Account [49]. The high share of OOP cost to the total healthcare expenditure was also observed in the South-East Asia Region (SEAR) [50]. Compared to Bangladesh, the share of OOP cost was lower in Pakistan (57.50%), Nepal (51.30%) and India (49.80%) according to the Global Health Expenditure dataset [51]. As a consequence, every year approximately 14% of the households' face CHE and, alarmingly, almost 5 million people fall into poverty due to CHE in Bangladesh [22, 52]. Although inclusive policies are available for achieving universal healthcare coverage in Bangladesh, the OOP cost in Bangladesh is regressive, i.e., the poorer households use a greater share of their income for accessing healthcare services, that we also observed in our study [53].

This study also indicated that the medicine cost and diagnostic cost were the two major cost drivers during cancer treatment. This was also observed in many other countries as surgery, chemotherapy and medications are essential and costly for treating a cancer patient [28, 42, 48]. The OOP cost of medications is one of the major components of the NCDs cost in many countries like Bangladesh, Pakistan and Brazil [54–56]. According to the latest report from the Bangladesh National Health Accounts, almost 68% of total OOP cost was spent on purchasing medicines and 12% for diagnostic tests [49]; for cancer these were 30% and 27%, respectively, as observed in our study. Lack of social protection and health insurance coverage leads to the medical financial hardship and prevents many people from receiving optimal cancer care [41]. In line with previous studies, we also observed that OOP expenditure was significantly associated with the co-morbidity status of the patient [57]. Patients with comorbid conditions have a higher risk of treatment complexities and need more healthcare services [55]. In the absence of national health protection schemes, patients with comorbidities therefore incur higher OOP cost and their families face a higher risk of CHE [58].

Our study also confirms that the OOP cost significantly increases with increasing severity of cancer. This can be explained by the fact that advanced stages of cancer required more treatment care [59]. Various studies indicated that early treatment of cancer often significantly improves clinical outcomes and reduces cost of treatment [60, 61]. Research has shown that more than half of all cancers are preventable as many risk factors for cancers, such as smoking, obesity, and physical inactivity, are modifiable [62]. Given the serious consequences of cancer, it is essential to improve the risk factors of cancer and ensure affordable cancer care to all patients. Lack of awareness and negligence may increase health and economic burden to the family and society. For instance, the prevalence of breast cancer has increased tremendously but early diagnosis and treatment were relatively poor in Bangladesh, which put many households on health and financial risks [63]. Therefore, community-based programs such as increasing general awareness regarding

cancer symptoms, causes and preventive measures should be strengthened. The current study indicated that patients who were treated abroad incurred a substantial annual OOP cost (US$5,178 higher compared to those treated domestically). Bangladesh health system consists of three primary care tiers: Upazila Health Complexes at the sub-district level, Union Health and Family Welfare Centers at the union level, and Community Clinics at the village level, supported by District Hospitals for secondary care and tertiary hospitals in urban centers [64]. This structure, in conjunction with the pro-poor policy initiatives, has significantly enhanced access to cancer care services, improved financial affordability, and reduced health inequities, thereby contributing to the goal of universal health coverage. Despite the availability of this important healthcare support, a small proportion of patients go abroad for better medical treatment annually. Many neighboring countries such as India, Thailand and Singapore have less waiting-time for surgery, better-trained doctors, and higher-quality medical facilities, which attract an increasing outbound medical travel from Bangladesh [65, 66].

In line with earlier studies in India and Pakistan, we also observed that the richer cancer patients spent more for cancer treatment than poorer patients [46, 47]. Regardless of the wealth status, most of the households (90%) in Bangladesh faced financial hardship due to OOP cost. In India, one study reported that more than 50% of cancer patients faced financial distress during treatment [47]. A financing incidence analysis indicated that the current healthcare financing strategy in Bangladesh is regressive. In contrast, many other Asian countries including Thailand, Malaysia and Sri Lanka found a progressive financing system [67]. The OOP cost of treatment can have a devastating impact on households [45, 68]. In line with other studies in various settings, we also observed that households belonging to the poorest groups had greater risks of experiencing CHE [69, 70]. As the poorest households had lower expenditure levels due to lower spending capacity, any OOP spending for treatment constituted a large proportion of their total expenditure [71]. Although better-off households spend more on treatment, the impact on the budget is greater for the poorer households [72]. To mitigate the OOP costs of treatment, many resource-poor households may make a tradeoff between healthcare and livelihoods [73]. The reliance on OOP cost often forced patients, particularly those in the poorer segments, to choose harder coping mechanisms such as borrowing money, receiving assistance from relatives and even selling asset selling or getting a mortgage [74]. However, many households still do not have adequate opportunities to access the cancer care services because they cannot afford to pay [75, 76]. Therefore, policy initiatives aimed at supporting the economically disadvantaged people are essential to achieving the objective of universal health coverage [77].

Our results are subject to limitations. Firstly, this study is based on cross-sectional survey data that do not capture the time trend of OOP costs. Secondly, the survey was restricted in only three hospitals in Dhaka; therefore, our study sample may not be representative of the Bangladeshi population. However, due to the nature of pluralistic healthcare system in Bangladesh, cancer patients often visit multiple providers to seek treatment, in which could increase their OOP costs [11, 12]. Thirdly, we did not capture the indirect costs of cancer such as income loss, cost of informal caregivers and absenteeism, which may significantly contribute to the total cost of illness [78]. Lastly, our study focused on the association and not the causal relationship between socio-demographic and clinical variables and the OOP cost. Although generalizability may be limited, our study indicates that the financial burden of cancer care is overwhelming in Bangladesh.

Conclusion

Our study showed that the annual average OOP cost per cancer patient in Bangladesh was substantially higher than that in many developed countries. In most of the households, the annual average OOP cost of cancer care far exceeded the annual household income, and a large proportion of households faced catastrophic financial burden. Patients with the cancer stage 4 incurred more than twice the OOP cost of the patients with the cancer stage 1. The findings from this study can be used to inform policies and decisions to ensure that the financial burden due to cancer is accounted for when setting priorities to sustain the cancer care system. In addition, financial support programs for mitigating treatment cost could be initiated with a special focus on households who are in difficult and challenging situations. Further, early detection and treatment of cancer are crucial and urgent to reduce both health and economic burden for cancer patients.

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

Supplementary Material 5

Supplementary Material 6

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Author contributions
Study concept and design: ARS and AT-D. Acquisition of data: ARS and RI. Analysis and interpretation: ARS, RI and AT-D. Manuscript drafting: ARS. Critical revision of the manuscript: ARS, RI and AT-D. Critical review and editing: AT-D.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval
All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. This study was approved by the Institutional Review Board of the Bangladesh Institute of Development Studies (BIDS) under the protocol number PSD/EBCB/07.10/20. All methods were carried out in accordance with relevant guidelines and regulations.

Consent to participant
Informed written consent was obtained from all participants to use their data to further the understanding of OOP cost.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. UICC. Cancer control advocacy. Promoting cancer in global health and development agendas. https://www.uicc.org/what-we-do/advocacy. Accessed 8 Mar 2022.
2. WHO. CureAll framework: WHO global initiative for childhood cancer: increasing access, advancing quality, saving lives. Switzerland; 2021.
3. Lam CG, Howard SC, Bouffet E, Pritchard-Jones K. Science and health for all children with cancer. Science. 2019;363:1182-1186
4. WHO. Preventing cancer. 30–50% of cancers could be prevented. 2023.
5. Rahman MM, Opo FADM, Asiri AM. Comprehensive studies of different Cancer diseases among Less-Developed countries. Healthcare. 2022;10(3):424.
6. Alam NE, Islam MS, Rayyan F, Ifa HN, Khabir MIU, Chowdhury K, et al. Lack of knowledge is the leading key for the growing cervical cancer incidents in Bangladesh: a population based, cross-sectional study. PLOS Global Public Health. 2022;2:e0000149.
7. BBS. Bangladesh bureau of statistics. Health and morbidity status survey– 2012. Dhaka, Bangladesh; 2013.
8. Hussain SMA. Comprehensive update on cancer scenario of Bangladesh. South Asian J Cancer. 2013;02:279–84.
9. Globocan. Bangladesh - Global Cancer Observatory. International Agency for Research on Cancer. 2020. https://gco.iarc.fr/today/data/factsheets/populations/50-bangladesh-fact-sheets.pdf. Accessed 9 Mar 2022.
10. WHO. Non communicable diseases country profile, 2018. Switzerland: Geneva; 2018.
11. Hussain SA, Sullivan R. Cancer control in Bangladesh. Jpn J Clin Oncol. 2013;43(12):1159–69.
12. Kamrul Hasan. World Cancer day: burden of treatment cost too high for most patients. Dhaka Tribune. 2022;4:01–16.
13. Abdul Hamid S, Habibullah Talukder M, Tasnim A. Ihsan- Ul- Kabir M. Financing Cancer care in Bangladesh: an alternative route. Int J Social Administrative Sci. 2021;6:1–7.
14. Chen S, Cao Z, Prettner K, Kuhn M, Yang J, Jiao L, et al. Estimates and projections of the global economic cost of 29 cancers in 204 countries and territories from 2020 to 2050. JAMA Oncol. 2023;9:465–72.
15. Luengo-Fernandez R, Leal J, Gray A, Sullivan R. Economic burden of cancer across the European union: a population-based cost analysis. Lancet Oncol. 2013;14(2):1165–74.
16. Andrade P, Sacristan A, Dilla J. T. The economic burden of Cancer in Spain: a literature review. Health Econ Outcome Res. 2017;03:1–8.
17. Cancer Action Network. The Costs of Cancer. New York; 2020.
18. Daily Prothom Alo. Cancer treatment: big concerns and big costs. World Cancer Day- Bangladesh; 2021.
19. Hamid SA, Ahsan SM, Begum A. Disease-specific impoverishment impact of out-of-pocket payments for health care: evidence from rural Bangladesh. Appl Health Econ Health Policy. 2014;12:421–33 https://doi.org/10.1007/s40258-014-0100-2
20. MOHFW. Bangladesh National health accounts 1997–2015: preliminary results. Bangladesh: Dhaka; 2015.
21. Health Economics Unit and Ministry of Health and Family Welfare. Angladesh National health accounts 1997–2015: preliminary results. Dhaka, Bangladesh; 2015.
22. Van Doorslaer E, O'Donnell O, Rannan-Eliya RP, Somanathan A, Adhikari SR, Garg CC, et al. Catastrophic payments for health care in Asia. Health Econ. 2007;16:1159–84.
23. Hwang SW, Ueng JJM, Chiu S, Kiss A, Tolomiczenko G, Cowan L, et al. Universal health insurance and health care access for homeless persons. Am J Public Health. 2010;100:1454–61.
24. Donnell OO. Access to health care in developing countries: breaking down demand side barriers. Cad Saude Publica. 2007;23:2820–34.
25. Yabroff KR, Lund J, Kepka D, Mariotto A. Economic burden of cancer in the united States: estimates, projections, and future research. Cancer Epidemiol Biomarkers Prev. 2011;20(10):2006–14.
26. Rajpal S, Kumar A, Joe W. Economic burden of cancer in India: evidence from cross-sectional nationally representative household survey, 2014. PLoS ONE. 2018;13:1–17.
27. de Oliveira C, Weir S, Rangrej J, Krahn MD, Mittmann N, Hoch JS, et al. The economic burden of cancer care in Canada: a population-based cost study. CMAJ Open. 2018;6:E1–10.
28. Amarasinghe H, Jayasinghe RD, Dharmagunawardene D, Attygalla M, Scuffham PA, Johnson N, et al. Economic burden of managing oral cancer patients in Sri Lanka: A cross-sectional hospital-based costing study. BMJ Open. 2019;9:e027661.
29. Sarker AR, Islam Z, Khan IA, Saha A, Chowdhury F, Khan AI, et al. Cost of illness for cholera in a high risk urban area in Bangladesh: an analysis from household perspective. BMC Infect Dis. 2013;13:518.
30. Bhuiyan MU, Luby SP, Alamgir NI, Homaira N, Mamun AA, Khan JAM, et al. Economic burden of influenza-associated hospitalizations and outpatient visits in Bangladesh during 2010. Influenza Other Respir Viruses. 2014;8(4):406–13. https://doi.org/10.1111/irv.12254
31. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med. 2013;35(2):121–26.
32. Naing L, Winn T, Rusli BN. Practical issues in calculating the sample size for prevalence studies. Archives Orofac Sci. 2006;1:9–24.
33. Mahumud RA, Sarker AR, Sultana M, Islam Z, Khan J, Morton A. Distribution and determinants of out-of-pocket healthcare expenditures in Bangladesh. J Prev Med Public Health. 2017;50:91–99.
34. WHO. Tracking Universal Health Coverage: 2017 Global Monitoring Report. 2017.
35. Drummond MF, Sculpher MJ, Torrance GG, O'Brien BJ, Stoddart G. l. Method for the economic evaluation of healthcare programs. Third. New York: Oxford University Press; 2005.
36. Kakwani N, Wagstaff A, van Doorslaer E. Socioeconomic inequalities in health: measurement, computation, and statistical inference. J Econom. 1977;77:87–103.
37. O'Donnell O, van Doorslaer E, Wagstaff A, Lindelow M, O'Donnell O, van Doorslaer E et al. Analyzing Health Equity Using Household Survey Data. A Guide to Techniques and Their Implementation. Washington, D.C., USA; 2008.

38. Sarker AR, Sultana M, Mahumud RA, Ali N, Huda TM, Salim uzzaman M, et al. Economic costs of hospitalized diarrheal disease in Bangladesh: a societal perspective. Glob Health Res Policy. 2018;3(1):2–12.
39. Sarker AR, Khanam M. Socio-economic inequalities in diabetes and prediabetes among Bangladeshi adults. Diabetol Int. 2021;13:421–35. https://doi.org/10.1007/s13340-021-00556-9
40. Rahman MS. Aging and negligence in Bangladesh. J Gerontol Geriatr Res. 2017;06:10–1.
41. Alzehr A, Hulme C, Spencer A, Morgan-Trimmer S. The economic impact of cancer diagnosis to individuals and their families: a systematic review. Support Care Cancer. 2022;30:6385–6404
42. Marti J, Hall PS, Hamilton P, Hulme CT, Jones H, Velikova G, et al. The economic burden of cancer in the UK: A study of survivors treated with curative intent. Psycho-Oncology. 2016;25(1):77–83.
43. Ó Céilleachair A, Hanly P, Skally M, O'Leary E, O'Neill C, Fitzpatrick P, et al. Counting the cost of cancer: out-of-pocket payments made by colorectal cancer survivors. Support Care Cancer. 2017;25(9):2733–41.
44. Iragorri N, de Oliveira C, Fitzgerald N, Essue B. The out-of-pocket cost burden of cancer care—a systematic literature review. Curr Oncol. 2021;28(2):1216–48.
45. Johnson EM, Ross DB. The cost of cancer: the association of financial and Cancer-Related stress on maladaptive coping styles in families with a Cancer diagnosis. Contemp Fam Ther. 2021;20:1–10. https://doi.org/10.1007/s10591-021-09595-5
46. Zaidi AA, Ansari TZ, Khan A. The financial burden of cancer: Estimates from patients undergoing cancer care in a tertiary care hospital. Int J Equity Health. 2012;11(60):2–6.
47. Rajpal S, Kumar A, Joe W. Economic burden of cancer in India: evidence from cross-sectional nationally representative household survey, 2014. PLoS One. 2018;13:e0193320.
48. Pisu M, Azuero A, Meneses K, Burkhardt J, McNees P. Out of pocket cost comparison between Caucasian and minority breast cancer survivors in the breast Cancer education intervention (BCEI). Breast Cancer Res Treat. 2011;127(2):521–9.
49. MOHFW. Bangladesh National health accounts 1997–2020. Bangladesh: Dhaka; 2022.
50. World Health Organization and International Bank for Reconstruction and Development. / The World Bank. Tracking universal health coverage 2023 global monitoring report. 2023.
51. WHO. Global Health Expenditure Dataset. 2021. Global Health Expenditure Dataset. 2024. https://apps.who.int/nha/database/DocumentationCentre/Index/en. Accessed 19 Jun 2024.
52. Khan JAM, Ahmed S, Evans TG. Catastrophic healthcare expenditure and poverty related to out-of-pocket payments for healthcare in Bangladesh- A N Estimation of financial risk protection of universal health coverage. Health Policy Plan. 2017;32:1102–10.
53. Sarker AR, Sultana M, Alam K, Ali N, Sheikh N, Akram R, et al. Households' out-of-pocket expenditure for healthcare in Bangladesh: A health financing incidence analysis. Int J Health Plann Manage. 2021;36(6):2106–17.
54. Butt MD, Ong SC, Wahab MU, Rasool MF, Saleem F, Hashmi A, et al. Cost of Illness Analysis of Type 2 Diabetes Mellitus: the Findings from a Lower-Middle Income Country. 2022;19(19):12611.
55. Bernardes GM, Lima-costa F, Saulo H, Fernandez RN. Catastrophic health expenditure and Multimorbidity among older adults in Brazil. 2020;54(125):1–11.
56. Afroz A, Alam K, Ali L, Karim A, Alramadan MJ, Habib SH, et al. Type 2 diabetes mellitus in Bangladesh: a prevalence based cost-of-illness study. BMC Health Serv Res. 2019;19(1):601.
57. Shah CH, Onukwugha E, Zafari Z, Villalonga-Olives E, Park Jeun, Slejko JF. Economic burden of comorbidities among COPD patients hospitalized for acute exacerbations: an analysis of a commercially insured population. Expert Rev Pharmacoecon Outcomes Res. 2022;22(4):683–90.
58. Sheikh N, Sarker AR, Sultana M, Mahumud RA, Ahmed S, Islam MT, et al. Disease-specific distress healthcare financing and catastrophic out-of-pocket expenditure for hospitalization in Bangladesh. Int J Equity Health. 2022;21:114.
59. McGarvey N, Gitlin M, Fadli E, Chung KC. Increased healthcare costs by later stage cancer diagnosis. BMC Health Serv Res. 2022;22(1):1155.
60. Kakushadze Z, Raghubanshi R, Yu W. Estimating cost savings from early cancer diagnosis. Data (Basel). 2017;2(3):30.
61. Ibarrondo O, Lizeaga G, Martínez-Llorente JM, Larrañaga I, Soto-Gordoa M, Álvarez-López I. Health care costs of breast, prostate, colorectal and lung cancer care by clinical stage and cost component. Gac Sanit. 2022;36(3):246–52.
62. Colditz GA, Wolin KY, Gehlert S. Applying what we know to accelerate cancer prevention. Sci Transl Med. 2012;36(3):4.
63. Alam NE, Islam MS, Ullah H, Molla MT, Shifat SK, Akter S et al. Evaluation of knowledge, awareness and attitudes towards breast cancer risk factors and early detection among females in Bangladesh: A hospital based cross-sectional study. PLoS One. 2021;16(9):e0257271.
64. MOHFW. Bangladesh health bulletin 2015. Dhaka, Bangladesh; 2015.
65. Zakaria M, Islam MA, Islam MK, Begum A, Poly NA, Cheng F et al. Determinants of Bangladeshi patients' decision-making process and satisfaction toward medical tourism in India. Front Public Health. 2023;11;1–11.
66. Ali MM, Medhekar A. Healthcare Quality of Bangladesh and Outbound Medical Travel to Thailand. Econ Reg. 2018;14(2):575–88.
67. Asante A, Price J, Hayen A, Jan S, Wiseman V. Equity in health care financing in low-and middle-income countries: A systematic review of evidence from studies using benefit and financing incidence analyses. PLoS ONE. 2016;11:1–20.
68. Cagle JG, Carr DC, Hong S, Zimmerman S. Financial burden among US households affected by cancer at the end of life. Psychooncology. 2016;25(8):919–26. https://doi.org/10.1002/pon.3933
69. Fu Y, Chen M, Si L. Multimorbidity and catastrophic health expenditure among patients with diabetes in China: a nationwide population- based study. Front Public Health. 2022;10:8–11.
70. Mutyambizi C, Pavlova M, Hongoro C, Booysen F, Groot W. Incidence, socio-economic inequalities and determinants of catastrophic health expenditure and impoverishment for diabetes care in South Africa: a study at two public hospitals in Tshwane. Int J Equity Health. 2019;3:1–15.
71. Ahmed S. Assessing the incidence of catastrophic health expenditure and impoverishment from out-of-pocket payments and their determinants in Bangladesh: evidence from the nationwide Household Income and Expenditure Survey 2016. Int Health. 2022;14(1):84–96.
72. Sharma J. Catastrophic health care expenditure and impoverishment in Bhutan. Health Policy Plan. 2023;38(2):228–238.
73. Mphande FA, Poverty. Health and Livelihoods. In: Infectious Diseases and Rural Livelihood in Developing Countries. 2016.
74. Rahaman HZ, Choudhury LA. Social safety Nets in Bangladesh. Dhaka, Bangladesh: Power and Participation Research Centre (PPRC); 2012.
75. Leighl NB, Nirmalakumar S, Ezeife DA, Gyawali B. An arm and a leg: the rising cost of Cancer drugs and impact on access. American society of clinical oncology educational book. 2021. https://doi.org/10.1200/edbk_100028
76. Smith SK, Nicolla J, Zafar SY. Bridging the gap between financial distress and available resources for patients with cancer: A qualitative study. J Oncol Pract. 2014;10(5):e368–72.
77. MoHFW. Expanding social protection for health: towards universal coverage health care financing strategy 2012–2032. Bangladesh: Dhaka; 2012.
78. Balfe M, Butow P, O'Sullivan E, Gooberman-Hill R, Timmons A, Sharp L. The financial impact of head and neck cancer caregiving: a qualitative study. Psycho-Oncology. 2016;25(12):1441–47.

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