

## The socio-economic burden of expenditure for diabetes mellitus treatment: A cross sectional study

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### Abstract

**Background:** Diabetes mellitus is a chronic disorder, non-curable, only controlled by medicines and /or insulin therapy. The aim of this study was to evaluate the expenditure on diagnoses and treatment of diabetes mellitus patients with economic burden to households.

**Methodology:** We collected data by directly interacting with the pre-informed diabetic patients regarding the duration of diabetes, types of insulin therapy and oral hypoglycemic agent, cost of medicine/month and cost of blood sugar test by glucometer/month.

**Results:** A total of 254 patients were enrolled in the study of which 30.71% (n=78) belongs to upper cost family (UCF), 44.88% (n=114) belongs to middle cost family (MCF), and 24.41% (n=62) belongs to lower cost family (LCF), categorized according to their total score. While studying, it was found that the mean family income (rupees)/month of UCF, MCF and LCF are Rs. 33860.26, Rs. 9326.75 and Rs. 7551.79 respectively. The mean blood sugar test cost (rupees)/month for UCF, MCF and LCF are Rs. 377.44, Rs. 382.89 and Rs. 360.00 respectively. Whereas the mean medicine purchase cost (rupees)/month for UCF, MCF and LCF are Rs. 1004.81, Rs. 784.40 and Rs. 721.79 Respectively. The total cost (rupees)/month for sugar test and purchasing medicine that is taken from their family income are Rs. 1382.24, Rs. 1167.30 and Rs. 1081.79 for UCF, MCF and LCF respectively. We also derived that, the UCF, MCF, LCF spent 1.19%, 2.28%, 4.84% of their monthly income on blood sugar test respectively and spent 3.20%, 4.76%, 9.95% of their monthly income on medicine purchase respectively. The percentage of cost, the UCF, MCF, and LCF has spent on both the blood sugar test and medicine purchase is 4.39%, 7.04%, 14.80% respectively.

**Conclusion:** The urgent need should be arisen for better health care policies for making low or no cost blood glucose monitoring device (alternative to glucometer) with low-cost anti-diabetic medicines by Government, for diabetes management.

**Keywords:** Diabetes mellitus; UCF; MCF; LCF; Rupees

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## 1. Introduction

Diabetes Mellitus (DM) has long been considered less important to global health, but it is now one of the biggest threats to human health in the 21st century [1]. According to the International Diabetes Federation (IDF), the number of people with Type 2 Diabetes Mellitus (T2DM) worldwide increased rapidly from 463 million in 2019 to 537 million in 2021. It has also been estimated that the global burden of T2DM will further increase to more than 783 million by 2045 [2]. DM is a complex chronic metabolic disease and a major public health problem worldwide. Diabetes mellitus is classified into three types, namely, type 1, type 2 and gestational diabetes. Among them T2DM is most widely prevalent and accounts for >90% of cases. In T2DM the body does not respond properly to the insulin (insulin resistant) or body does not produce adequate insulin resulting in hyperglycemia [3]. The increase in the number of people with T2DM in India caused by unprecedented urbanization rates, leads to environmental and lifestyle changes [4]. This burden of diabetes can affect individuals, families and the healthcare system [5]. Diabetes is a costly illness due to its chronic nature and the severity of complications so, the resources need to control them [6]. Several studies in India estimated that up to 25% of a family's income could be devoted to the diabetes treatment for a low-income family with one adult suffering diabetes. The cost of diabetes treatment is affecting everyone, everywhere; it's not only causing the crisis or financial problem, but also causing pain, anxiety, discomfort of the patient and their family and generally reduces the quality of their life [7]. The cost of diabetes depends on its prevalence, the type of drug used and the presence of comorbidities, patient compliance, and medical test and the onset and progression of complications [8]. India is considered as the diabetic capital of the world, but adequate measures have not been taken to control the disease. Treatment of DM and its complications can be costly and can pose a serious obstacle to strengthening India's health system [9]. Direct medical costs for people with diabetes are generally 2 to 3 times higher than those without diabetes and 4 to 8 times higher in the presence of diabetic complications [10]. In India, the average annual direct and indirect costs associated with diabetes treatment are estimated to be Rs. 25,391(US\$ 331.69) and Rs. 4,970(US\$ 64.92) respectively. Almost a quarter of the patient's income is spent on diabetes treatment [11]. In India, diabetics alone spend 5-25% of the average Indian household's income for their treatment [12]. The aim of the study was to evaluate the expenditure on diagnoses and treatment of diabetes mellitus patients with economic burden to households.

## 2. Material and methods

### 2.1. Study design and subject

From November 2020 to March 2021, a population-based cross-section survey was carried out including the T2DM patient community of Sarathpally (Word No-23), Bidhannagar (Word No. 5), Rangamati (Word No. 24), Tantigeria (Word No. 25), Midnapur town (22° 25' 51.2004" N, 87° 19' 17.3532" E), Paschim Medinipur, West Bengal, India. The study was carried out by the declaration of Helsinki and all procedures were approved by the Ethics Committee of Raja Narendra Lal Khan Women's College (Autonomous). All participants (ages 30-99) have signed the informed consent form, prior to data collection. Individuals and pregnant women with severe comorbidities such as severe infections, stroke, myocardial infarction, major surgery, malabsorption, and history or current use of drugs that have a significant impact on glucose metabolism (glucocorticoids, oral contraceptives containing levonorgestrel or high dose estrogen, phenytoin, and high dose thiazide diuretics, etc.) were excluded from the study. We collected data by directly interacting with the diabetic patient [7]. Pre informed diabetic patient regarding duration of diabetes, types of insulin therapy and oral hypoglycemic agent, cost of medicine/month and cost of blood sugar test by glucometer/month. All data was recorded in our own-made data collection format (supplementary file 1).

### 2.2. Sample size determination

Sample numbers of participants were obtained using an expression with the following parameters: 9.1% prevalence of diabetes (P), 5% margin of error (E), and a standard normal deviation(Z) of 1.96.

$$\text{Formula: } N = \frac{z^2 p(1-p)}{E^2} [7].$$

### 2.3. Statistical analysis

The data are shown as mean  $\pm$  standard error (SE). The mean was tested by a one-way analysis of the variance model using the origin Windows version 6.1 package [7].

### 3. Results

A total of 254 patients were enrolled in the study of which 30.71% (n=78) belongs to upper cost family (UCF), 44.88% (n=114) belongs to middle cost family (MCF,) and 24.41% (n=62) belongs to lower cost family (LCF), categorized according to their total score, Table 1.

**Table 1** Sociodemographic characteristics of the participants

Sociodemographic profile	Belong to upper family cost	%	Belong to middle family cost	%	Belong to lower family cost	%
Number of participants	78	30.71	114	44.88	62	24.41
<b>Age(years)</b>						
20-44	14	17.95	22	19.30	4	6.45
45-59	30	38.46	44	38.60	28	45.16
60-74	17	21.79	36	31.58	24	38.71
75-99	17	21.79	12	10.53	6	9.68
<b>Sex</b>						
Male	51	65.38	66	57.89	38	61.29
Female	27	34.62	48	42.11	24	38.71
<b>Level of education</b>						
Illiterate	0	0.00	3	2.63	13	20.97
Primary school	0	0.00	3	2.63	31	50.00
Middle school	0	0.00	18	15.79	14	22.58
Intermediate	4	5.13	35	30.70	0	0.00
High school	2	2.56	39	34.21	4	6.45
Post high school or diploma	6	7.69	3	2.63	0	0.00
Graduate or post graduate	42	53.85	12	10.53	0	0.00
Profession or honours	24	30.77	1	0.88	0	0.00
<b>Employment status</b>						
Unemployed	0	0.00	5	4.39	18	29.03
Unskilled worker	0	0.00	3	2.63	41	66.13
Skilled worker	0	0.00	26	22.81	0	0.00
Semi-skilled worker	0	0.00	19	16.67	3	4.84
Semi-professional	0	0.00	18	15.79	0	0.00
Clerical	0	0.00	26	22.81	0	0.00
Farmer	0	0.00	17	14.91	0	0.00
Profession	74	94.87	0	0.00	0	0.00
<b>Family income per month(rupees)</b>						
1000-4999	0	0.00	1	0.88	29	46.77
5000-9999	0	0.00	6	5.26	33	53.23
10000-14999	0	0.00	28	24.56	0	0.00
15000-19999	2	2.56	40	35.09	0	0.00
20000-29999	25	32.05	26	22.81	0	0.00
30000-39999	32	41.03	9	7.89	0	0.00
>=40000	19	24.36	4	3.51	0	0.00

Duration of disease(year)						
1-4	16	20.51	26	22.81	10	16.13
5-9	16	20.51	25	21.93	12	19.35
10-14	14	17.95	30	26.32	15	24.19
15-19	17	21.79	19	16.67	11	17.74
>=20	15	19.23	14	12.28	14	22.58

Also found that the age of 17.95% UCF, 19.30% MCF, 6.45% LCF is between 20-44 years; also, in the range of 45-59 years there are 38.46% UCF, 38.60% MCF and 45.16% LCF; again 21.79% UCF, 31.58% MCF, 38.71% LCF is in the range at 60-74 years and lastly the age of 21.79% UCF, 10.53% MCF and 9.68% LCF is in between 75-99 years, Table 1.

Another data found that 65.38% male UCF, 34.62% female UCF, 57.89% male MCF, 42.11% female MCF, 61.29% male LCF and 38.71 % female LCF have been participated Table 1. We further found that 2.63%MCF, 50.0% LCF received primary education. It was also found that 15.79% MCF, 22.58 % LCF completed middle school education. Further information shows that 5.13% UCF, 30.7% MCF having intermediate qualifications and 2.56% UCF, 34.2% MCF, 6.45% LCF having higher school qualifications. Another information indicates that 7.69% UCF, 2.63% MCF accomplished post high school or diplomatic education. Some more information shows that 53.85% UCF, 10.53% MCF, 30.77% UCF, 0.88% MCF are graduate or post graduate and have profession or honours level degree. Also, it was found that 2.63% MCF and 20.97 LCF were illiterate. Our study also reflects that 4.39% MCF, 29.03% LCF are unemployed; 2.63% MCF, 66.13% LCF are unskilled worker; 2.81% MCF are skilled worker; 16.67% MCF, 4.84% LCF are semi-skilled worker; 15.79%, 22.81%, 14.91% MCF's are involved with semi-professional job, clerical job and are farmers respectively and further 94.87% UCF are involved with professional job, Table 1. Our study also concludes that the monthly family income of 0.88% MCF, 46.77% LCF lies between 1000-4999 Rs.; and of 5.26% MCF, 53.23% LCF lies between 5000-9999 Rs.; also found that 24.56% MCF's monthly family income's range is about 10000-14999 Rs.; further we have 2.56% UCF, 35.09% MFC whose monthly family income lies in between 15000-19999 Rs.; as well 32.05% UFC, 22.81% MCF have a monthly family income of range 20000-29999 Rs.; moreover, the monthly family income of 41.03% UCF, 7.89% MCF is in between 30000-39999 Rs.; and lastly we have 24.36% UCF and 3.51% MCF whose monthly family income is more than 40000 Rs., Table 1. Furthermore, we have found that the duration of diabetes for 20.51% UCF, 22.81% MCF, 16.13% LCF is 1-4 years; for 20.51%UCF,21.93% MCF, 19.35% LCF, the disease lasted for about 5-9 years; in addition, 17.95% UCF, 26.32% MCF, 24.19% LCF are suffering for almost 10-14 years; as well 21.79%UCF, 16.67% MCF, 17.74% LCF are tolerating diabetes for 15-19 years; and lastly there are 19.23% UCF, 12.28% MCF and 22.58% LCF who are agonizing diabetes for more than 20 years, Table 1.

**Table 2** Analysis of various categories with economic burden on family income for diabetes mellitus treatment of UCF, MCF and LCF

Category	Family income(rupees)/month	Cost (rupees)/month for blood sugar test from family income (Mean ± SE)	Cost (rupees)/month for medicine from family income (Mean ± SE)	Cost (rupees)/month for blood sugar test and medicine from family income (Mean ± SE)	Annual cost(rupees) for blood sugar test (Mean ± SE)	Annual cost(rupees) for purchase medicine (Mean ± SE)	Annual cost(rupees) for both blood sugar test and parches medicine (Mean ± SE)
UCF (n=78)	33860.26±926.39	377.44±13.91	1004±71.37	1382.24±74.90	4529.23±166.95	12057.69±856.39	16586.92±898.85
MCF (n=114)	19326.75±759.65	382±15.69	784.40±37.68	1167.30±45.75	4594.74±188.30	9412.84±452.10	14007.58±548.96
LCF (n=62)	7551.79±262.02	360.00±24.61	721.79±32.87	1081.79±40.54	4320.00±295.31	8661.43±394.40	12981.43±486.51

UCF- upper cost family, MCF - middle cost family, LCF- lower cost family.

While studying it was found that the family income (rupees)/month among participants are UCF, MCF and LCF are Rs. 33860.26, Rs. 9326.75 and Rs. 7551.79 respectively, Table 2; the blood sugar test cost(rupees)/month for UCF, MCF and

LCF are Rs. 377.44, Rs. 382.89 and Rs. 360.00 respectively, Table 2; the medicine purchase cost(rupees)/month for UCF, MCF and LCF are Rs. 1004.81, Rs. 784.40 and Rs. 721.79 respectively that is taken from their family income, Table 2; total cost (Rupees)/month for sugar test and purchasing medicine that is taken from their family income are Rs. 1382.24, Rs. 1167.30 and Rs. 1081.79 for UCF, MCF and LCF respectively, Table 2.

**Table 3** Percentage wise analysis of economic burden on family income for diabetes mellitus treatment of UCF, MCF and LCF

Category	% Of cost (rupees)/month for blood sugar test from family income	% Of cost (rupees)/month for medicine from family income	% Of cost (rupees)/month for blood sugar test and medicine from family income
UCF (n=78)	1.19%	3.20%	4.39%
MCF (n=114)	2.28%	4.76%	7.04%
LCF (n=62)	4.84%	9.95%	14.80%

UCF- upper cost family, MCF - middle cost family, LCF- lower cost family.

#### 4. Discussion

Diabetes mellitus is non-curable, only controlled by medicines and /or insulin therapy. Every patient mandatorily consume sulfonylurea, biguanides, DPP-IV inhibitors etc. regularly. Some patients advised to take insulin injection with regular blood glucose monitoring. So monthly recurring cost is essential to survive them beyond the household expenditure. According to the International Diabetes Federation (IDF), the average diabetes-related expenditure per diabetic in India in 2012 is estimated to be 67.98 US \$ (Rs. 4146/-, using an exchange rate of Rs. 61/ US\$) approximately. According to another study conducted in seven states out of various Indian states on 556 diabetics, the total annual average direct expenditure by patients for the treatment of diabetes estimated to be Rs 10000(US\$ 227) and Rs. 6260 (US\$ 142) in urban and rural areas, respectively. A recent study examining the burden of diabetes in 606 people attending government, private and local clinics in the Southern India, reported that the annual direct cost was the highest among those who were attending the private clinics (Rs. 19552 /-, US \$ 425) and the lowest among those who go to a public hospital (Rs. 1204 /-, US \$ 26.17) [5]. In another study, the average expenditure per visit was estimated as Rs. 912, and in a similar study conducted in Mumbai in 2017, the expenditure per visit was Rs. 298, the average for diabetes treatment. Total expenditure is reported to be Rs.853.47 per month approximately [6]. According to another study, the cost of medical care for people with diabetes is two to five times higher than the cost of medical care for people without diabetes. The average annual expenditure per patient is at least Rs. 4500(approximately US\$120) [4]. In the Northern Zone, eight studies were conducted to calculate the direct and indirect costs of diabetes at the individual / household level. The median direct cost of diabetes is estimated to be Rs. 18890/- per annum, ranging from Rs. 999/- to Rs. 109344/- [12]. Self-Monitoring Blood Glucose (SMBG) accounts for the majority of insulin and SMBG-related pharmacy costs for insulin users, and prescription test strips and consumables account for 27% of the cost of prescribing and supplying insulin (\$772 of \$2,850). The total cost of insulin usage in diabetics and the proportion of total insulin-related costs is well studied, but the economic impact of SMBG on both payers and patients is not well-understood which affects disproportionately to certain subgroups. Of particular note is that SMBG costs account for 35.8% of bolus insulin users' insulin costs (\$ 1,161 of \$ 3,244). This is probably due to the high utilization of insulin pumps in this category [13]. This study provides an assessment of the financial burden of treating complications of T2DM diabetes in Ghana. Research results suggest that complex diabetes is more common in women and the elders. The estimated total management cost for T2DM diabetes with complications is approximately US \$ 9,981, and direct management costs account for approximately 94% of total health care management. People with T2D diabetes who suffer from complications spend an average of about US\$39, and most of them have a moderate intangible cost burden. Other studies have shown that T2D diabetes is more common in older people in Canada and the USA [29,30] [14]. According to 2015 statistics, the average global annual cost per person spent on the treatment of T2DM is estimated to be 1,622.1 USD. The results of this study showed an average annual cost of US \$ 36.2 ± 42.3 per patient (2014-2016). For hospital admissions, the Singapore study calculated an average direct medical expenditure of 1,575.6 USD. Iran had an average direct cost per capita of 842.6±102 USD. The average cost of T2DM per capita in Latin America and the Caribbean was estimated to be 703 USD. In 2000, the highest intake costs were in Cuba (1,219 USD) and the lowest were in Colombia (442 USD) [15]. We used the results of a recently published report to estimate the annual cost of diabetes in our 20-year model, which reported the economic impact of diabetes if it is not prevented. The average annual burden per instance of diagnosed diabetes, according to the report, is US\$13240 [16]. In 2017, the cost of confirmed diabetes (for all ages), undiagnosed diabetes and prediabetes (adults), and gestational diabetes mellitus (mother and newborns) was predicted to be over \$404 billion. This includes a total of \$302 billion in increased medical costs and \$102 billion in lost

productivity. This annual cost reaches \$1,240 per individual in the United States [17]. The average cost per episode of inpatient care for T2DM patients was about RM 901.51 (US\$ 286.20), whereas the average cost per outpatient visit was about RM 641.02 (US\$ 203.50). Previous local studies found that the provider's cost of T2DM hospitalizations was around RM 2635.34 (USD 693.51, currency rate 1 US\$ = RM 3.80) per patient admission in 2002, which was greater than this study's findings [18]. Another local study from 2009 discovered that the average cost per diabetic admission was about RM 1951 (US\$ 514.80, currency rate 1 US\$ = RM 3.79) [18].

Our study is that the mean cost (Rupees) spent per annum due to blood sugar test from family income for UCF, MCF, LCF are Rs. 4529.23 (US\$ 59.17, Rs. 76.55/US\$), Rs. 4594.74 (US\$ 60.02) and Rs.4320 (US\$ 56.43) respectively. Mean cost (Rupees) spent per annum due to medicine purchase from family income for UCF, MCF, LCF are Rs. 12057.69(US\$ 157.51), Rs. 9412.84(US\$ 122.96) and Rs.8661.43(US\$ 113.15) respectively. Mean cost (Rupees) spent per annum due to both blood sugar test and medicine purchase from family income for UCF, MCF, LCF are Rs. 16586.92 (US\$ 216.68), Rs. 14007.58 (US\$ 182.99) and Rs. 12981.43 (US\$ 169.58) respectively, Table 2.

So, from the above-mentioned study, we derived that, from, Table 2, the UCF, MCF, LCF spent 1.19%, 2.28%, 4.84% of their monthly income on blood sugar test respectively and spent 3.20%, 4.76%, 9.95% of their monthly income on medicine purchase respectively. The percentage of cost, the UCF, MCF, LCF has spent on both the blood sugar test and medicine purchase is 4.39, 7.04, 14.80 respectively, Table 3.

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## 5. Conclusion

Diabetes mellitus is a live-long metabolic disorder and expensive ailment for the direct medical cost which economically effect on a very large proportion of people in the societies. In view of increasing global prevalence of diabetes mellitus, information of cost for treatment should be used to increase awareness among people as 'prevention is better than cure'. The urgent need should be arisen for better health care policies for making low or no cost blood glucose monitoring device (alternative to glucometer) with low-cost anti-diabetic medicines by Government, for diabetes management.

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## Compliance with ethical standards

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### *Disclosure of conflict of interest*

No conflict of interest.

### *Statement of ethical approval*

The present research work was approved by Institutional Human Ethical Committee of Belda College, Belda, Dist-Paschim Medinipur, West Bengal, India (Approval No. BC/IHEC/01/2020 dated 11.10.2020).

### *Statement of informed consent*

Informed consent was obtained from all individual participants, included in the study.

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