

ECONOMIC BURDEN OF TYPE 2 DIABETES MELLITUS ON PATIENTS ATTENDING AL-MUSTANSIRIYA UNIVERSITY NATIONAL DIABETES CENTER AND ON THEIR FAMILIES –2023

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ABSTRACT

Background: Diabetes mellitus in Iraq is a major health problem in all socioeconomic classes and is well recognized as a significant economic burden to diabetic patients and their families, in addition to the burden on the country's resources due to its long-term course and complications. **Objectives of the study:** To assess the economic burden of Type 2 Diabetes Mellitus on patients attending Al-Mustansiriya University National Diabetes Center and on their families, and to explore the factors associated with the economic burden of the disease. **Patients and Methods:** A cross-sectional study was conducted at Al-Mustansiriya University National Diabetes Center. 397 patients with type 2 diabetes were interviewed. Data regarding sociodemographic characteristics, characteristics of the disease, and cost of illness were obtained. **Results:** The median annual expenditure of diabetes care was about 590,000 ID (about USD 390) per patient. the direct medical cost was the largest contributor accounting for 96.1% of the total cost (medications represent the highest median and total cost), followed by the direct non-medical cost which only represented 3.2%. While the indirect cost represented 0.7% of the total cost. The indirect cost included the loss of income of subjects or their caregivers due to absence from work. **Conclusion:** Diabetes has a significant financial burden on diabetics and their families, especially those who take treatment from private sources, and the complications of diabetes increase the financial burden on the patients as they increase.

KEYWORDS: A cross-sectional study was conducted at Al-Mustansiriya University National Diabetes Center.

INTRODUCTION

Diabetes mellitus (DM) is a chronic heterogeneous metabolic disease with a complicated pathogenesis. It is characterized by hyperglycemia, which results from abnormalities in insulin secretion, insulin action, or both. Hyperglycemia manifests in various forms and is associated with carbohydrate, fat, and protein metabolic dysfunctions. Long-term hyperglycemia often leads to various microvascular and macrovascular diabetic complications, which are mainly responsible for diabetes-associated morbidity and mortality.^[1]

Type 2 DM, also known as non-insulin-dependent diabetes mellitus (NIDDM), constitutes about 90–95% of all cases of diabetes. This type of diabetes is characterized by insulin resistance and β -cell dysfunction. Insulin resistance leads to a decreased response or decreased sensitivity of cells in the peripheral tissues toward insulin.^{[2][3]}

DM has increased significantly around the world and is expected to affect 628 million in 2045. Undiagnosed type 2 diabetes may affect 24% - 62% of the people with diabetes; while the prevalence of prediabetes is estimated to be 470 million cases by 2030.^[21]

it is one of the top 10 killers in the world. Together with cardiovascular diseases, cancer, and respiratory diseases, these conditions account for over 80% of all premature non-communicable disease (NCD) deaths.^[23] Excluding the mortality risks related to the COVID-19 pandemic, about 6.7 million adults between the ages of 20–and 79 are estimated to have died as a result of diabetes or its consequences in 2021. This is equivalent to 12.2% of global deaths from all causes in this age group.^[2]

The presence of diabetes is linked to higher rates of mortality from infections, cardiovascular disease, stroke, chronic kidney disease, chronic liver disease, and

cancer.^[24] In addition, despite improvements that have been made in promoting population health and extending life expectancy, diabetes still has the second biggest negative overall effect on lowering health-adjusted life expectancy globally.^[25]

According to the International Diabetic Federation (IDF), it is expected that diabetes cases will reach 643 million in 2030 and 783 million in 2045. In the Middle East & North Africa (MENA), approximately 95 million people will be diabetics in 2030, and that number is projected to increase to 136 million in 2045.^[2]

According to the EMRO report 2023, non-communicable diseases (NCDs) are the leading cause of morbidity and death in Iraq, and it is estimated that 14% of Iraqis have diabetes, which accounts for an estimated 4% of total deaths.^[26]

According to the Iraqi STEP Wise Survey 2015, Self-reported diabetes in Iraq was 7.8%, and most of them were on Insulin therapy. Laboratory investigations indicated a higher prevalence of diabetes/ hyperglycemia (13.9%), and a sharp increase in the prevalence was noted after the age of 40 years. Self-reported diabetes was higher among women (8.7%) than men (6.7%).^[27]

Economic Burden of Diabetes Mellitus

Studies on the “cost of illness” (COI) examine the effects of a disease on individuals, communities, and countries from various angles. COI research aims to discover and calculate direct and indirect costs related to a certain condition. The output calculates the societal financial costs associated with a specific disease. It is widely accepted that calculating the overall financial burden of an illness is an important tool for creating national and global health strategies.^[30]

Direct health expenditures due to diabetes are already close to one trillion USD and will exceed this figure by 2030.^[2] Several studies have reported on the cost of diabetes, with a wide variation of cost per patient per year depending on the country. Research published in March 2018, by the American Diabetes Association (ADA), revealed that the total cost of diagnosed diabetes in the US increased to \$327 billion in 2017 from \$245 billion in 2012 when the cost was last examined.^[31]

According to a systematic review conducted in Africa in 2016, the yearly national direct expenses of diabetes varied between African countries, ranging from 3.5 billion USD to 4.5 billion USD per year.^[32] In Turkey, a 2014 study on the direct medical costs of Type 2 Diabetes Mellitus and its Complications found that the cost of Type 2 diabetes among diagnosed patients was between 11.4 and 12.9 billion Turkish Lira, and cardiovascular complications made up the largest share of overall medical costs (between 24.3% and 32.6%).^[33]

Regarding the Middle East, a study done in Bahrain in

2015 showed that the total direct medical cost of T2DM was 104.7 million Bahraini dinars (BHD), or 277.9 million USD, and the average unit cost per person with type 2 diabetes (1162 BHD, or 3084 USD) was about three times greater than for a person without the condition (372 BHD, or 987 USD). The indirect cost due to absenteeism was 1.23 million BHD (3.26 million USD).^[34]

On the other hand, a study conducted in Kuwait in 2018 found that drug costs for treating diabetes and its complications accounted for 22.8% of Kuwait’s drug budget for that year. Comorbidities and complications added 44.7% to the average drug cost per diabetes patient.^[35]

Another example is a study done in Saudi Arabia in 2014 which revealed that the cost of diabetes is about 17 billion Riyals and anticipated that if those who are undiagnosed joined the treatment pool, the future cost would rise to 27 billion Riyals.^[36]

Unfortunately, the only data available on the COI of diabetes in Iraq is a publication from the IDF Diabetes Atlas, which provided the following estimates: Total diabetes-related health expenditure (in USD million) was approximately 1710 in 2021 and it is projected to reach 2194 in 2030, and 3180 in 2045. While diabetes-related health expenditure per person (in USD) was approximately 850 in 2021, and it is expected to increase to 1090 in 2030 and 1580 in 2045.^[14]

OBJECTIVES OF THE STUDY

1. To assess the economic burden of Type 2 Diabetes Mellitus on patients attending Al-Mustansiriya University National Diabetes Center and on their families in 2023.
2. To explore the factors associated with the economic burden of the disease.

PATIENTS AND METHODS

Study design: a cross-sectional study.

Study setting: This study was conducted at Al-Mustansiriya University National Diabetes Center. This center is a governmental institution located in Baghdad that provides health education and medical services for diabetic patients, in addition to conducting scientific research on diabetes and its complications and methods of prevention and treatment. The data were collected in a 5-month duration (from 1st March to 31st July 2023).

Study Population: The study included all patients with type 2 diabetes attending the center at the time of study during the data collection time with a minimum one-year duration of diagnosis.

Sampling Technique: A convenience sampling method was applied. Critically ill patients, pregnant women, patients with other types of DM, and those who refused

to complete the questionnaire were excluded. Sample size estimation: the minimum sample size was estimated to be 385, and it was calculated according to the formula $(n = z^2pq/d^2)^{[37]}$, where $z = 1.96$, $p = 50\%$, $q = 1 - p$, $d = 0.05$.

Data collection tool: Data were collected via direct face-to-face interviews. A structured questionnaire in Arabic was developed for data collection and reviewed by experts. The validity was ensured by a pilot study.

Statistical analysis: The data was collected on paper then entered into Excel 2016 and analyzed by Statistical Packages for Social Sciences (SPSS ver.26). The numerical data were tested for their normality by using the Shapiro-Wilk test, then and after the costs (the main dependent variable) appeared to be not normally distributed, so we used the Kruskal Wallis and Mann-Whitney U nonparametric tests for the univariate analysis to test the cost differences according to the independent variable, then the variables that were hypothesized to affect the cost and the univariate analysis P-value of 0.1 or less were fitted in a quantile multivariate regression model (0.5 for the median) to find the most effective factor on the cost. The categorical data were represented using counts and percentages. A P-

value of less than 0.05 is considered significant.

RESULTS

The recent study included 397 diabetic patients, most of them were older than 40 years with mean age of 56.4 (± 9.9) years and ranged from 30 to 76 years. About half of them (51.1%) were males, and more than one-fourth of the sample were illiterate or could just read and write, while 31% had higher academic degrees. Unemployed or housewives comprised 43.6% followed by retired at 24.4%, then self-employers at 17.4%.

Regarding monthly income, 57.5% of the studied persons have no or low income, while only 1.3% of them have income of more than one million. The majority (87.7%) of patients' families in the current study earn a low to medium monthly income (500,000 to 2,000,000 Iraqi dinars).

The crowding index of the participants showed that 63.7% of them lived in highly crowded houses, with more than two percent residing in the same room, and only 5 (1.3%) had a low index. About one-third (32.5%) of the women are of low socioeconomic status and 30.7% of the participants are of high socioeconomic status. As shown in Table 1.

Table 1: Socio-demographic characteristics of the study participants.

Variables	Count	%	
Age groups	≤ 40 years	21	5.3
	41 - 59 years	186	46.9
	60+ Years	190	47.9
Sex	Male	203	51.1
	Female	194	48.9
Education level	Illiterate/ read & write	109	27.5
	Primary school	94	23.7
	Secondary school	71	17.9
	University or more	123	31.0
Occupation	Governmental employee	42	10.6
	Private employee	16	4.0
	Self-employer	69	17.4
	Unemployed/ Housewife	173	43.6
	Retired	97	24.4
Person monthly income group ^[40]	No income	138	34.8
	≤500,000 IDs	90	22.7
	>500,000 to 1,000,000 IDs	164	41.3
	>1,000,000 IDs	5	1.3
Crowding index	<1	5	1.3
	1-2	139	35
	>2	253	63.7
Socioeconomic status ^[41]	Low	129	32.5
	Moderate	146	36.8
	High	122	30.7
House	Owned	336	84.6
	Rented	61	15.4
Number of thebedrooms	1	105	26.4
	2	177	44.6
	3	80	20.2
	>3	35	8.8

IDs= Iraqi Dinars

About two out of every ten people in the studied sample were diagnosed with type 2 diabetes mellitus within the last five years, while 30.5% were diagnosed before 10 years. More than three-fourths of them (77.1%) have a family history of diabetes. Oral hypoglycemic medications are the exclusive treatment for 70.5% of the patients, on the other hand, insulin is the exclusive treatment for 12.8%. The main source of the treatment was private while 19.4% were from governmental sources (like primary healthcare centers, hospitals, tertiary clinics, and public medical clinics as 23.7% of the sample had registered there) the rest received their treatment from both sources.

About two-thirds (67.5%) of the patients had high ($\geq 8\%$) Last HbA1c and only 5.8% had $< 7\%$ level. One-fourth of the patients have hypertension as a comorbid disease, hyperlipidemia also presented in 5.5% and 1 % had cardiac disease, on the other hand; 52.4% did not have any other diseases besides diabetes. While only 4.5% of the current study sample was previously hospitalized, 41.1% visited private clinics regularly. Glucometers are owned by 88.7% of the patients. Regular daily self-checking of glucose level was done more than twice in 5% of the patients while 53.7% of them were found to check one to two times. Although more than half of the patients had no complications, 34.8% had eye problems, and 31.5% had neuropathy, in addition, 24.4% had more than one complication, as shown in Table 2.

Table 2: General characteristics of Diabetes Mellitus disease among the study participants.

Variables	Count	%	
Diagnosis duration	1 - 5 years	86	21.7
	6 - 10 years	190	47.9
	> 10 years	121	30.5
Family history of T2DM	Yes	306	77.1
	No	91	22.9
Treatment	Oral	280	70.5
	Insulin	51	12.8
	Oral + insulin	66	16.6
Source of treatment	Governmental	77	19.4
	Private source	258	65.0
	Both	62	15.6
Comorbidities	None	208	52.4
	Hypertension	99	24.9
	Hyperlipidaemia	22	5.5
	Cardiac diseases	4	1.0
	More than one	64	16.1
Public Clinics registry	Yes	94	23.7
	No	303	76.3
Last HbA1c result	≤ 6.9	23	5.8
	7 - 7.9	106	26.7
	≥ 8	268	67.5
Hospitalization	Yes	20	4.5
	No	379	95.5
Private clinic visits	Yes	159	41.1
	No	238	59.9
Own a glucometer	Yes	352	88.7
	No	45	11.3
Times of check	Not checking	59	14.9
	<1 time per day	105	26.4
	1 - 2 times per day	213	53.7
	>2 times per day	20	5.0
Medications Incompliance due to cost	Yes	133	33.5
	No	264	66.5
Complications	None	208	52.4
	Eye	138	34.8
	Neuropathy	125	31.5
	Impotence	23	11.3
	Diabetic foot	20	5

All levels of the costs are illustrated in Table 3, showing that the highest cost was the direct medical cost, with

96.1% of the total costs on the patients in the current study (medications represent the highest median and total cost), and the direct non-medical cost only represented

3.2%. While the indirect cost represented 0.7% of the total cost of the disease to the participants.

Table 3: The values of total direct and indirect costs in Iraqi Dinars related to diabetes in patients attending Al-Mustansiryah University National Diabetes Centre and their families, 2023.

Types of cost	Median (X 1000 IDs)	IQR (X 1000 IDs)	Percent of totalcost (%)
Hospitalization	13	(9 - 15)	0.3
Clinic visits	60	(50 - 100)	5.4
Medications	465	(120 - 640)	72.2
Laboratory tests	35	(0 - 60)	6.6
Glucometer sticks	30	(0 - 120)	11.5
Direct medical cost	542	(160 - 850)	96.1
Transportation	0	(0 - 20)	2.3
Diet	0	(0 - 10)	0.9
Direct non-medical cost	0	(0 - 30)	3.2
Direct cost	560	(180 - 860)	99.3
Monthly income loss for the person's absence from work	50	(0 - 100)	0.7
Indirect cost	50	(0 - 100)	0.7
Total cost	590	(180 - 860)	100.0

IDs= Iraqi Dinars, IQR: Inter-quartile range (25th – 75th centiles)

In the end, we fitted the probable factors that could affect the median cost in the quartile model which revealed that; the cost of diabetes treatment was inversely associated with the monthly income of the patients and it appeared that those with no income significantly spent higher compared to <=500000 ID group by 278900 ID (P<0.001), >500000-1000000 ID group by 168900 ID (P<0.001), and >1000000 ID group by 296900 ID (P=0.015). In contrast, the cost increases with the socioeconomic levels of the patients, those with a high level spend 193400 Iraqi dinars and the median level spend 154900 Iraqi dinars more than those in the low level (P<0.001). Compared to those who were diagnosed within five years, the median cost was significantly higher by 114600 Iraqi dinars (P=0.002) among those diagnosed 5 to 10 years and 169400 Iraqi dinars (P<0.001) among those diagnosed before 10 years.

Patients with hyperlipidemia showed a significantly higher cost compared to those without any comorbidities by 161100 Iraqi dinars (P=0.011). Patients who complained of more than two complications spent 320000 ID higher than those without complications (P<0.001). The median annual cost of those getting their therapy from the pharmacies or both pharmacies and the government was higher than those getting their treatment from governmental sources only by 510000 and 224900 Iraqi dinars (P<0.001) for both respectively. While the treatment did not affect the total cost significantly. So, the factors that affect the total cost of diabetes mellitus among the study group were the monthly income, socioeconomic status, years since the diagnosis of diabetes, treatment source, complications of diabetes, and the presence of comorbidities, especially hyperlipidemia.

Table 4: Quantile (Median) regression analysis of total cost.

Variables	Unadjusted Coefficient	P-value	95% CI		Adjusted Coefficient	P-value	95% CI	
			Lower Bound	Upper Bound			Lower Bound	Upper Bound
Age groups								
<40 years	Ref.							
41 - 59 years	-90	0.512	-359.4	179.4				
60+ Years	90	0.511	-179.1	359.1				
Person income per month								
No income	Ref.				Ref.			
<=500000 ID	-576	<0.001*	-689.0	-463.0	-278.9	<0.001*	-354.4	-203.3
>500000-1000000 ID	-30	0.541	-126.3	66.3	-168.9	<0.001*	-256.7	-81.0
>1000000 ID	-470	0.015*	-849.6	-90.4	-296.9	0.015*	-536.4	-57.3
Socioeconomic status								
Low	Ref.				Ref.			
Moderate	340	<0.001*	191.3	488.7	154.9	<0.001*	82.0	227.8
High	260	0.001*	104.6	415.4	193.4	<0.001*	96.1	290.8

Years from diagnosis								
<= 5 years	Ref.				Ref.			
6 - 10 years	190	0.025*	23.5	356.5	114.6	0.002*	44.0	185.1
> 10 years	250	0.007*	69.4	430.6	169.4	<0.001*	90.9	248.0
Comorbidities								
None	Ref.				Ref.			
Hypertension	130	0.1	-25.2	285.2	44.6	0.187	-21.8	110.9
Hyperlipidemia	212	0.144	-72.9	496.9	161.1	0.011*	37.5	284.8
Cardiac diseases	-390	0.233	-1032	252	-58.6	0.663	-322.6	205.4
More than one	310	0.001*	128.4	491.6	30	0.495	-56.4	116.4
Complications								
None	Ref.				Ref.			
One or two	80	0.29	-68.5	228.5	11.4	0.714	-49.7	72.6
Three or more	520	0.001*	206.5	833.5	320	<0.001*	194.0	446.0
Treatment								
Oral	Ref.				Ref.			
Insulin	-540	<0.001*	-706.7	-373.3	-65.4	0.2	-165.6	34.8
Oral + insulin	-146	0.056	-295.8	3.8	-19.4	0.659	-105.9	67.1
Source of the medications								
Governmental	Ref.				Ref.			
Pharmacy	640	<0.001*	561.7	718.3	510	<0.001*	423.9	596.1
Both	462	<0.001*	359.2	564.8	224.9	<0.001*	117.7	332.0

*Significant at 0.05 level, Ref. = Reference group, ID=Iraqi dinars, CI=Confidence interval

DISCUSSION

Diabetes is a major global threat and has become a major global economic burden in recent years. Diabetes is also an increasing economic threat in Iraq, yet studies on an adequate estimation of COI for T2DM and its key drivers are limited in Iraq.

The calculation of diabetes-related costs has gained importance as the prevalence of this disorder increases with every passing day. The key finding of this study was the median annual cost of T2DM patients which was about 590,000 ID (about USD 390). For comparison, in Nepal in 2010, the total cost incurred in the treatment and care of DM per month was about USD 40, and per annum was USD 445. Regarding South India, a study done in 2012 determined the average cost of DM for six months to be approximately USD 314.^[43]

Ghana had an average monthly healthcare management cost for diabetes mellitus in 2016 of about USD 39^[44], whereas Bangladesh had an average annual cost per patient in 2017 of about USD 865^[39], Indonesia had an average annual cost of USD 1208 in 2019.^[38], and Pakistan had an annual total cost of diabetes care about USD 740 in 2022.^[30]

In our study, the direct medical cost was the largest contributor accounting for 96.1% of the total cost (medications represent the highest median and total cost), followed by the direct non-medical cost which only represented 3.2%. While the indirect cost represented 0.7% of the total cost. The indirect cost included the loss of income of subjects or their caregivers due to absence from work.

Direct costs are frequently higher than indirect costs, for example in South India in 2012, Out of a total cost of USD 314.15, the average total direct medical cost was USD 290.04 (92%), the average direct non-medical cost was USD 3.75 (1%) and the average total indirect cost was USD 20.34 (6.5%).^[43] The same in Indonesia in 2019, the direct cost had the largest share of the overall cost (87.95%) with medicine cost as the major contributor followed by general practitioners' visits^[38], and in Pakistan in 2022, amongst the annual total cost of USD 740.1, the share of the direct cost was USD 646.7 (87%), and the indirect cost was USD 93.65 (13%).^[30]

Finally, a median regression analysis showed that the cost of diabetes substantially increased with the presence of comorbidities, especially hyperlipidemia, this finding was in line with other COI studies worldwide which concluded that the cost was positively correlated with the increased number of comorbidities.^[30,35,38,39,43,45] However, the presence of complications of DM did not affect the total cost significantly in this study, contrary to other studies worldwide. Maybe this is because patients with advanced or deteriorating illnesses do not go to government centers due to a lack of some medicines.

Another factor that significantly affected the cost in our study is the type of treatment. Patients taking oral hypoglycemic drugs alone had the highest median annual cost compared with those who were taking insulin or mixed therapy, this finding is counter to a study in the United Arab Emirates where the costs were higher for patients treated with insulin compared to those treated with oral hypoglycemic agents or with diet control only^[45], this finding may be because insulin is available in Iraqi governmental centers, unlike oral hypoglycemic

drugs.

Not only the type, but the source of treatment also affected the cost, the median annual cost of those getting their therapy from private sources or both private sources and the government was much higher than those getting their treatment from governmental sources only.

The duration of diabetes also accelerates cost, patients with a disease duration of 10 years or more have significantly higher costs in comparison to those diagnosed within the last five years, this finding is supported by other COI studies worldwide.^[30,37,39,43–45] Likewise, cost increased for patients who had poor glycemic control compared to good control, as the patients with Last HbA1c levels of more than 8% have a higher median cost compared to those with less than 7%, similar results were reported in previous studies.^[30,38]

In conclusion, Diabetes poses a significant financial burden on diabetics and their families, especially those who take treatment from private sources, the complications of diabetes increase the financial burden on the patients as they increase, and the highest cost is the direct medical cost.

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