



Direct Financial Cost of Diabetes Mellitus among Adult Sudanese Patients in Khartoum State 2016-2017

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Authors' contributions

This work was carried out in collaboration between all authors. Author ME designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author ZS is the corresponding author and supervisor of the work. Author ZS also approved the protocol, managed the analyses of the study and literature searches. Author ZS revised the final manuscript for intellectual content and approved it. Author SIA co-supervisor of the work had substantial contribution to the acquisition and interpretation of data. All authors read and approved the final manuscript.

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ABSTRACT

Background: Diabetes mellitus is a chronic disease with devastating short and long-term complications that affect productivity. The corner stone for diabetes care is tight glycemic control with regular follow up. To achieve this care, medications and other health care services must be available and affordable.

Objective: To estimate the direct cost of diabetes mellitus care among adult patients in Khartoum state.

Methods: Cross-sectional study using multi-stage sampling technique to select the facilities proportional to population size. Patients were interviewed using questionnaire.

Results: The total annual cost of Diabetes was estimated to be 3820 Sudanese pound (SDG) per person. Hospitalizations fees accounted for the major portion of the cost. Forty-seven percent of the

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patients were admitted with diabetes related problems during the previous year. One in four of the diabetic patients had no sufficient supply of medications.

Conclusion: The total annual cost was significantly lower among those with regular follow up visits than those with irregular visits ($P < 0.03$). Emphasis should be put on providing affordable and available health services and medication especially at PHC level.

Keywords: Diabetes mellitus; direct cost; Sudan; Khartoum.

1. INTRODUCTION

Diabetes mellitus: A metabolic disorder of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, action, or both [1]. Direct cost is related to health care costs of detection, treatment, prevention and rehabilitation, this includes hospitalization, outpatient visits and cost of travelling to diabetes clinics, medication supplies such as insulin, syringes, tablets, blood and urine monitoring equipment [2]. Indirect cost is linked to loss of productivity due to premature death, short-term illness and permanent disability [3]. Diabetes treatment cost is not just a load on families but also on governments. The cost of treating diabetes mellitus and its complications is high, for example it was USD 91.8 billion in the United States in 2002 [4]. In a large study-conducted in eight European countries-aiming to reach an estimation of the cost of Type II diabetes management in Europe, they found that the average cost per patient was 2834 EUR per year. Hospital admission accounted for the greatest proportion of the total cost, while the medications constitute only 7 % of the total cost. The hospitalization rate among the involved population was 13 % [5].

In a study done in USA the cost estimates ranged from \$79.1 billion based on attributable risk to \$88.8 billion based on the two-part regression model [6].

In a study conducted in Johannesburg comparing hospitalization among patients with diabetes and others without diabetes, the authors found that, among those with diabetes, the average admission rate was higher, length of hospital stay was longer and the average hospitalization costs per patient were significantly higher [7].

A Study conducted in Cameroon estimated the direct cost of treating a patient with diabetes to be US\$489 with 56% spent on hospital admissions as cited by Jean-Claude Mbanya and Dora Mbanya [8].

A population based on prevalence study conducted in Northern state of the Sudan, recommended a further resource-based estimation of diabetes cost to prioritize and manage available assets for diabetes care [9].

In a study that conducted in India-specifically in Bangalore area- Rayappa, et al. disclosed that: the average direct cost of diabetes was about 399 US\$ per patient per year. The surgical intervention for limb complication reported the highest frequency 30 of the 53 (56.6%) respondents-those who underwent surgery in relation to diabetes complications 2,8. The survey showed that the care of diabetes may consume up to 25% of the annual family income thus raising the notion that a considerable portion of the burden of the disease will be on the family members of diabetic patients [10].

Enrique Villareal-Rios et al stated that the average annual cost per diabetic patient was \$708 USD as cited by Wan Norlida Ibrahim in the Malaysian Journal of Public Health Medicine 2010 [11].

A cross sectional study conducted in the year 2000 in Khartoum state estimated that about 7.4% of patients did not have enough supply of medications due to unaffordability and another 10.5% due to unavailability [12], while in 2007 another study on the diabetes cost estimated the annual median direct cost of diabetes care to be USD 175 and the average total expenditure on the diabetes was significantly higher among those utilizing the private sector for diabetes care [13].

A project done in Mali to estimate the Diabetes cost has found that: indirect cost was larger than direct cost (61% vs 39%) respectively and the most significant component of direct cost was laboratory tests (19%), then that was compared with the costs in Brazil and USA where most of the direct cost is related to medication and hospital inpatient care respectively [14].

Diabetes- by being one of the most important non-communicable diseases – had received much attention over time in order to achieve

better understanding of its economic burden so, the number of cost-of diabetes studies undertaken is relatively large in developed countries but in Sudan-where we really in need for such studies- up to my Knowledge they are few.

African countries have the highest percentages (62%) of undiagnosed people, who carry a high risk of developing complications – an area that needs further studies” as stated by World diabetes federation [15].

Study done in Europe to investigate the distribution of cost of resources use has defined the hospitalization costs as the sum of costs of all admissions to hospital based on length of stay [16].

1.1 General Objective

To estimate the direct cost of Diabetes Mellitus care among adult Sudanese patients in Khartoum State in the year 2016-2017.

1.2 Specific Objectives

- To calculate the direct cost of diabetes in relation to medication, insurance and ambulatory services in Sudanese pound (SDG)/ year.
- To identify of pattern of hospitalization, and co-morbidities of the disease.
- To assess the effect of Glycemic control on the cost.

2. METHODS

A cross-sectional facility-based study conducted in Khartoum State, which interviewed a total of 120 Sudanese patients aged more than 18 years attending Khartoum State Diabetes units at primary health centers, Soba teaching hospital and Private centers.

Newly diagnosed, severely ill or patients who refused to participate were excluded.

2.1 Selection of Diabetes Care Facilities and Patients

Public “state” hospitals with diabetes referred clinics were represented by the main clinic of Soba Teaching Hospital, while private Diabetes facilities were represented by choosing two facilities by simple random sampling. On the other hand, primary health care centers

implementing Diabetes mini clinics were represented by choosing one center from each locality by simple random sampling. Then probability proportional to size sampling was used to determine the number of patients included from each facility and the eligible number of the participants was 120.

2.2 Data Collection

Pre-tested structured questionnaire that was developed and validated by the International Diabetes Federation (IDF), was used to collect data. The respondents were asked about: socio-demographics characteristics, diabetes control, medications, visits to clinic, hospital admissions, and investigations. The cost was calculated by adding the estimated cost in SDGs/year of the following items: Medications, visits to clinics, hospitalizations and investigations. Information was also gathered regarding: Monthly income, insurance status and other financial resources used to meet the cost i.e. family members and friends support.

Regarding medications cost for patient on insulin, it was estimated by asking about the daily insulin regimen and adjustments were done if that was not the usual regimen, then we multiplied by 365 to obtain the annual insulin amount which was then multiplied by the cost of insulin unites purchased during that time. For oral hypoglycemic drug cost was estimated by directly asking respondents about the cost of one month and multiply by 12 to get the cost of one year and it was cross checked with current cost according to whether the patient is buying his medications from private or public facility.

Clinical visits cost was estimated by asking about total cost per visit including transportation to and from the facility, and multiply it by frequency of visits then adjustments were made if respondent did not report regular visits, to get the cost of one year. On the other hand, hospital admissions cost was estimated by directly asking about the total amount of service payment.

Investigations cost was estimated by asking about the frequency of performing: HbA1c, lipid profile, renal function test during the last 6 months and urine tests, and multiply by 2 to get one-year lab utilization then cost was cross checked with current cost according to whether the patient is utilizing private or public lab. Data was collected by the Principal investigator to reduce the bias.

2.3 Consent

Written consent was taken from Khartoum State Ministry of Health. Consent was taken from every patient after explaining research purpose, benefits and their rights.

2.4 Ethical Consideration

Ethical approval was secured from the Department of Community Medicine Ethical Committee.

3. RESULTS

Out of a total of 120 Sudanese Diabetic patients who were interviewed adequate information was obtained from 117 with a response rate of 97.5%. Mean disease duration since diagnosis was 12±7 years. Fifty-nine (50.4%) were employed. Mean monthly income was 1175 SDG/year (range 10,000-240,000).

3.1 Health Utilization Pattern and Diabetes Control

Fifty-one patients (43.6%) were on insulin and 66 (56.4%) were on oral hypoglycemic agents. Seventy-one patients (60%) had regular follow up visits to a health practitioner, 83% of them had medical insurance. We believe that this difference is due to the link

between the PHC clinic visits and the supplementation with the monthly requirements of supported medications at lower level of care.

The estimated mean annual cost of diabetes care was SDG 12193 (range 137000-193600). The mean annual cost of diabetes care among those above 55 years was higher than those below 55 [Fig. 1]. The mean annual cost for insured patients was significantly lower than that of the non-insured ($p < 0.01$) (Table 2). The total annual cost was significantly lower among those with regular follow up visits than those with irregular visits ($P < 0.03$).

The median annual cost was calculated to avoid the effect of outliers and it was 3,820 SDGs/year= (238.75USD). Which is higher than the estimate of the previous study done by Elrayah-Eliadarous, H (175USD). It is estimated that the out of pocket expenditure exceeds 75% according to the national Health strategy/Federal ministry of Health in 2007 as cited by Elrayah-Eliadarous, H [13].

Concerning pattern of hospitalization Fifty-five (47%) of patients stated that they had been admitted to hospital at least once during the previous year in an event that is related to diabetes and its complications. The average admission rate was 2 times per year, the average stay was 6 days per admission during the previous year.

Table 1. Participants' characteristics

Sex	Male	48	(41%)
	Females	69	(59%)
Age	Above 55	67	57.3%
	Below 55	50	42.7%
Insurance status	Insured	59	50.4%
	Not insured	58	49.6%
Occupation	Unemployed	58	(49.6%)
	Farmer	6	(5.1%)
	Merchant	2	(1.7%)
	Employer	19	(16.2%)
	Others	20	(17.1%)
	Retired	12	(10.3%)
Medication	Insulin	51	(43.6%)
	Oral hypoglycemic	66	(56.4%)
Regular follow up visits	Yes	71	(60%)
	No	46	(40%)
Glycemic control using HbA1c	Satisfactory	17	42.5%
	Poor	23	57.5%

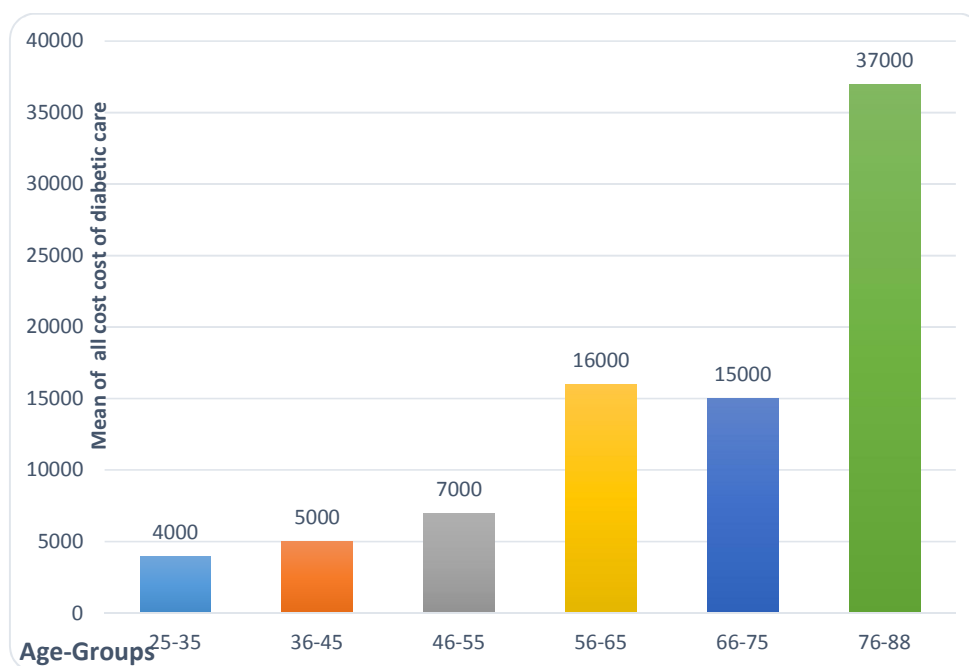


Fig. 1. Mean annual cost among different age groups

Pearson correlation test was done to show the positive correlation between the age and cost with P value (0.024)

The cost of hospital admission was the highest among other diabetes care services in both the private and the public sectors. It accounts for up to 71% of the overall cost. HbA1c test-the gold standard method that used to indicate glycemic control-pattern, was performed by 40 patients (34%) of the total sample. Among whom it was satisfactory in (17 patients) 42.5%of cases. Which constitutes 14% of the total sample.

46(84%) of those admitted to hospitals stated that the fees of hospital were paid by a family member, while the rest stated that they had paid the fees by themselves. In the public sectors the highest cost of the ambulatory service was the fees of Follow up visits in contradistinction to the public sector in which the medications cost was the highest [Fig. 2].

(Table 3) shows the complications in different body organs. Study subjects exhibited more than one complication. The macro vascular complications (Limb and Heart) and microvascular (Eye and Kidney). The most common surgical intervention was eye surgery followed by Limb surgery.

Table 2. Annual cost in SDG with regard to insurance status

Statistic	With medical insurance	With no medical insurance
Mean per person	3220	21321
Minimum	137	420
Maximum	33492	193600

Table 3. Pattern of hospitalization in relation to organ involvement

Body organ	Limb	Heart	Eye	Kidney
No. patients (multiple responses)	72	20	64	10
Percentage	61.0	17.1	54.7	8.5
Hospitalization	34.0	11.0	39.0	4.0
Medical	25.0	2.0	5.0	5.0
Surgical part	3.0	0.0	6.0	0.0
Both (medical and surgical)	28.0	10.0	32.0	2.0

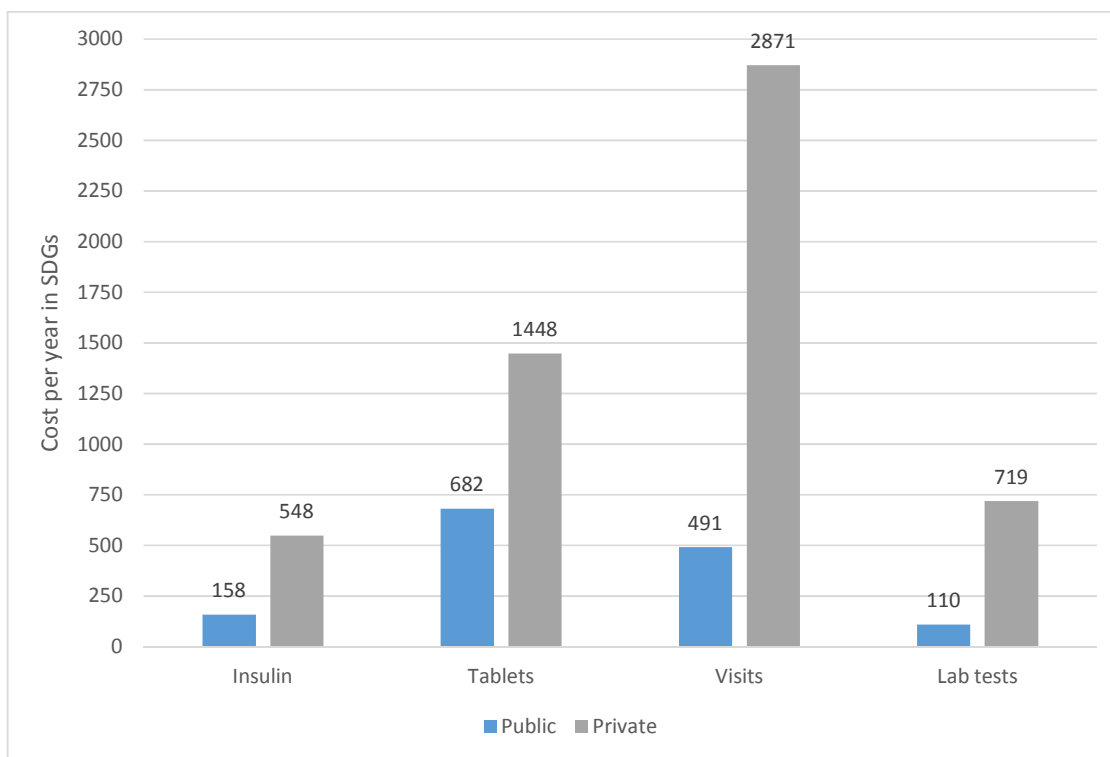


Fig. 2. Total cost break down in private VS. Public sectors
The cost of diabetes services in private sector is more than the public sector
(T- test with (P value 0.00)

4. DISCUSSION

The study focused on the direct financial cost of diabetes and ignored other aspects [or costs] of the disease. Nonetheless, we believe that indirect cost may be as large as the direct cost or even greater.

This research work aimed at studying the direct financial cost of Diabetes Mellitus to achieve better understanding of the economic burden of the disease. The study utilized primary data by directly interviewing the patient and did not rely on health records alone. Though the former method has more accurate than the latter, although it may carry an element of recall bias. We minimized this by asking questions in a reasonably narrow time period so the participant can remember the information accurately. About 2.5 percent of patients provided inadequate information. Our sample was representing patients from different socioeconomic classes. Data about monthly income was missing in a number of patients, this may be due to some cultural values where other family members contribute to the income.

About 60 percent of patients who had regular follow up visits were insured. This is may be due to the link between the PHC visits and supplementation with monthly requirements of supported medications with 75 percent discount. Most of those visits were to general practitioner and might have not included sessions with a diabetes educator probably due shortage of the diabetes educating staff. The mean annual cost of diabetes care was significantly higher among those above 55 years compared to those below 55, although employment rate was significantly lower among those aged above 55 years. Guidelines for diabetes treatment were not available and this is indicated by the frequency and types of ordered laboratory investigations.

The mean annual cost for patients with medical Insurance was lower than those with no medical insurance, but when comparing the cost of hospital admissions between the two groups, there was no significant difference, hence indicating that the difference in the mean annual cost is due to reduction of ambulatory services: follow up-visits, medications and Laboratory investigations.

About one fourth of diabetic patient stated that they had no enough supply of diabetes medications, a rate which is higher than the one estimated by Mekki in 2000 [12].

Among patients who did the HbA1c test, 17% had a satisfactory Glycemic control in comparison to the study done by Elrayah-Eliadarous.H, where HbA1c of more than (6.5%) done in 77% was considered unsatisfactory [13]. There was no statistically significant difference in diabetes cost among those with good and others with poor Glycemic control, this raises a question about the effectiveness of provided services in achieving good glycemic control and indicating the need for studies exploring the cost effectiveness of the provided services.

Diabetes Cost is higher among males compared to females (P .0.003), this may be due to the differences in incidence of diabetes related complications as it was found that, men tend to suffer more microvascular complications although women have higher morbidity and mortality from cardiovascular complications [17].

Another possible reason for this could be related to sex based difference in socioeconomic status or care seeking behavior, an area need to be explored by further studies.

5. CONCLUSIONS

The estimated mean annual cost of diabetes care was SDG 12193 (range 137000-193600). The median annual cost was calculated to avoid the effect of outliers and it was 3,820 SDGs/year = (238.75USD). Which is higher than the estimate of previous studies 175 USD by Elrayah-Eliadarous. Agreeing with international studies, hospitalization accounts for the greatest part of the cost.

The mean annual cost of Diabetes among insured patients was significantly lower than that of the non-insured ($p < 0.01$). The total annual cost was significantly lower among those with regular follow up visits than those with irregular visits ($P < 0.03$).

6. RECOMMENDATIONS

Improve the health insurance coverage and quality of diabetes services and to make them accessible for better follow up, Encouragement of further studies to explore unanswered

questions like why the diabetes cost is more among males.

7. LIMITATIONS

Missing data about monthly income was an obstacle in the calculation of the percentage of the family income that was lost due to diabetes care.

The exact percentage expenditure born by the government in the management of the disease is beyond the scope of the work.

The exact financial cost of each complication alone, an important element to complete the picture of the economic burden, was not studied due to limited resources.

Limited recourses to access a larger sample size.

CONSENT

Written consent was taken from Khartoum State Ministry of Health. Consent was taken from every patient after explaining research purpose, benefits and their rights.

ETHICAL APPROVAL

Ethical approval was secured from the Department of Community Medicine Ethical Committee.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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