Original Article

The Costs of Treating Long Term Diabetic Complications in a Developing Country: A Study from India

Satyavani Kumpatla**, Hemalatha Kothandan***, Shabana Tharkar****, Vijay Viswanathan*

Abstract

Objective: Diabetes is a major public health problem associated with huge economic burden in developing countries. The aim was to assess the direct costs of treating long-term diabetic complications among hospitalized subjects with type 2 diabetes.

Methods: A total of 368 (M: F, 254:114) hospitalized patients were divided into groups based on the presence of complications and were compared with a group without any complications (Group1; n=86), Group2; n=67 with chronic kidney disease, Group3; n=53 with cardiovascular complications, Group4; n=58 who underwent foot amputation, Group5; n=66 with retinal complications and Group6; n=38 with presence of two complications. Details on socio-demography, hospitalization, direct costs of all inpatient care were recorded. The data on expenditure was obtained from hospital bills.

Results: The patients with foot complications or with presence of two diabetic complications tend to stay long for every inpatient admission. On an average, patients with foot complications (19020 INR) and those who had two complications (17633 INR) spent four times more and patients with renal disease (12690 INR), cardiovascular (13135 INR) and retinal complications (13922 INR) spent three times more than patients without any complications (4493 INR). The median expenditure for hospital admissions for the previous two years was higher for patients with foot and cardiovascular complications and it was highest if they had presence of two complications.

Conclusions: The present study highlights the direct cost estimates and economic burden of treating severe long term diabetic complications. It is therefore important that emphasize should be placed on primary and secondary preventive measures of diabetes.

Introduction

Diabetes is termed as ‘pandemic’ in the 21st century, due to rising prevalence across all countries and it has been granted the status of ‘public health priority’ in most of the nations. People with diabetes mellitus have substantially higher risk of developing microvascular and macrovascular complications, dyslipidemia, hypertension and other co morbidities than those without diabetes. It’s associated co morbidities exert a huge economic burden both at the individual level and at national level. The cost of diabetes treatment is attributable to long term complications such as kidney failure, blindness, heart disease, foot amputations and their economic and social consequences. In a developing country like India, where most of the cost of diabetes care is out of pocket expenditure, the patients face an enormous cost burden, wherein absence of insurance policies further escalates the same.

It has been reported that there will be 50.8 million people with diabetes in India, which approximates to 17.8% of the world diabetes population. The rate of occurrence of diabetes related complications are also high in India. People with diabetes are up to four times more likely to develop cardiovascular diseases and up to 40 times more likely to require lower limb amputation than people without diabetes. Furthermore, diabetes is among the leading causes of visual impairment, blindness and kidney failure in adults.

Data from developed nations like USA and Europe indicate high costs of diabetes care, but data from low and middle income countries pertaining to economics of diabetes care is sparse. A substantial proportion of the costs of diabetes treatment arise from treating long term complications particularly cardiovascular, foot and renal diseases. Little is known about the cost of treating these complications in developing countries. A fairly comprehensive study from Europe reporting the expenditure involved in diabetes care concluded that the largest impact is from diabetes related chronic complications rather than the direct treatment of diabetes per se. Several studies have reported the direct cost11–13 and one study on indirect and intangible cost related to diabetes care from India, while the cost of treatment and management of its complications has not yet been quantified fully. Presence and severity of diabetic complications, are the most important determinants of treatment, monitoring these complications, need for hospitalization are therefore important factors related to costs. There is a general lack of information on the current costs involved in treating diabetic complications. Therefore, this study was carried out to assess the direct costs of treating long term diabetic complications such as retinal, renal, cardiovascular and foot complications among hospitalized subjects with type 2 diabetes, in comparison with the hospital costs for patients with no complications.

Material and Methods

This cross sectional study was conducted at a specialized
diabetes care centre in Chennai, Tamil Nadu, between June 2008 and December 2009. The centre where the study was conducted is a hospital exclusively for diabetic patients with 100 beds capacity. The recruited study subjects were type 2 diabetic patients hospitalized with severe long term diabetic complications and another group without any complications seeking treatment for management of diabetes during a period of one and half year. A total of 487 subjects were randomly selected for this study. Subjects who are in the early stages of diabetic complications and those with the presence of three or more than three complications were excluded from the study. A total of 368 (M: F 254:114) subjects were post stratified into groups based on the presence of long term diabetic complications and were compared with a group of subjects without any complications. Group 1 consisted of type 2 diabetic patients without any diabetic complications (n=86, M:F=49:37). Group 2 subjects were patients with chronic kidney disease (n=67,M:F=50:17). Group 3 consisted of patients with cardiovascular complications (n=53, M:F=37:16). Group 4 were type 2 diabetic patients who had undergone a foot amputation (n=58,M:F=42:16). Group 5 patients had severe retinal complications (n=66; M:F=49:17) who underwent cataract surgery or laser photo coagulation treatment. Group 6 consisted of patients having presence of any of the above two complications (n=38, M:F=27:11). Group 3 patients had cardiovascular complications and underwent treatment in private hospitals and were referred to the specialized diabetes care centre for routine management of diabetes. The remaining study group subjects were enrolled at diabetes care centre. A written informed consent was obtained from all the study group subjects were enrolled at diabetes care centre. The remaining study group subjects were enrolled at diabetes care centre. A written informed consent was obtained from all the study participants and the ethics committee of the institution approved the study.

The data collection was done by administering a well designed questionnaire (Appendix). The questionnaire was pretested on 15 patients and necessary modifications were made in the questionnaire. The study questionnaire contained the details such as socio-demographic, diabetes history, presence of diabetes complications, education status, occupation details, family history of diabetes and diabetic complications, habits, treatment details, family income, hospitalization details, Socio economic status and direct cost of all inpatient care. Anthropometric details such as height and weight were recorded and body mass index (BMI) (kg/m²) was calculated using the standard formula. Biochemical details including fasting and postprandial glucose values, HbA1c, %, urea and creatinine values, renal function reports, lipid profile values were recorded from the investigations report during hospitalization.

The direct medical and non medical costs were recorded. The direct medical cost per unit per patient was assessed based on the expenditure for medical consultations, laboratory charges, medicines, hospital admission charges, surgery expenses, money spent on other investigations such as radiological examination, echo cardiogram, scan, doppler and biothesiometry etc and the non medical costs include the cost of accompanying attendant and the transportation charges. Number of days hospitalized, reasons for hospitalization and surgery details were also recorded for the study subjects. Details of expenditure on hospitalization for the previous 2 years and mode of payment of hospital bills were also obtained. None of the participants refused to answer any of the questions. The current data on expenditure was obtained from the hospital bills and the previous 2 years expenditure details were obtained from the records or original bills maintained by the patients. The patients provided the bills to the researcher and the individual cost estimate was calculated by the researcher. The questionnaire was administered by a single research officer who was well trained and entire process of data collection took about 45 min per patient.

### Statistical analysis

Mean ± Standard Deviation (SD) and proportions are reported for the variables. Due to the skewed distribution of the cost variables, the median values and ranges are reported and median test was used for group comparison. For other multiple group comparisons, non parametric Kruskal Wallis One Way ANOVA was used followed by Mann-Whitney U test. P values are adjusted for multiple comparisons by using Bonferroni correction method. χ² test with Yate’s correction was used for comparison of proportions. Non-parametric Kendall’s correlation coefficient test was used to determine the association of age, HbA1c and duration of diabetes with total cost. Multiple linear regression analysis was carried out for evaluating the association of cost on various subject characteristics. Total treatment cost which includes laboratory charges, medical consultations, medicine cost, hospitalization charges, other investigations cost, and transportation charges was log transformed due to the skewness. The total cost was regressed against categorized age by 10 years, gender, duration of diabetes, HbA1c, number of hospitalized days and the risk group (the coefficient on complication group represents the estimated total cost involved in treating the complications compared to the cost on group without any complications). A p value of <0.05 was considered statistically significant. SPSS package (version 16.0) was used for statistical analysis.

### Results

It was found that 6.8% of the total study subjects were aged between 30–39 years (n=25, M:F=16:9), 14.9% were aged between 40–49 years (n=55, M:F=39:16), 39.7% were aged between 50–59 years (n=146, M:F=90:56) and 38.6% were aged equal to or more than 60 years (n=142, M:F=109:33). The Socio-demographic, clinical and treatment details of the study groups are shown in Table 1. The mean age of the study subjects was 57.9 ±10.7 years and the mean duration of diabetes was 13.6±8.6 years. The subjects with presence of complications were older compared to the subjects without any diabetic complications. BMI was similar in all the study groups. The group of subjects with complications had longer duration of diabetes than group 1 subjects without complications. A significant proportion of subjects in the complications study groups (Group 2 to Group 6) had positive family history of diabetes complications than Group 1 (p=0.001). It was shown that more than 50% of the subjects in Group 2 to Group 6 had school education. Occupational status varied among the study groups (p =0.008). Majority of subjects (70%) were from an urban location in the four study groups. Approximately, half of the subjects had a total family income per month less than 10,000 INR (215 US$) in all the study groups. The personal habits such as smoking, alcohol consumption and tobacco chewing were similar in all the study groups (p = 0.443). Majority of them (66%) were treated with oral hypoglycemic agents alone in group 1, whereas most of them were on combination of oral hypoglycemic agents and insulin treatment in the complications study groups.

The biochemical details of the study groups are shown in Table 2. A significant difference was seen in fasting and postprandial glucose values between the study groups (p = 0.017 and p = 0.003). HbA1c% was similar in all the study groups (p = 0.132). Lipid profile was also similar except LDL and VLDL cholesterol in all
the study groups. Urea and creatinine levels showed significant difference between the study groups (p<0.0001).

Table 3 shows the details of direct costs of treating severe long term diabetic complications during hospitalization between the study groups. The diabetic patients with foot complications or with the presence of two diabetic complications tend to stay longer for every inpatient admission. The total median expenditure including laboratory charges, medical consultations, medicines, hospital charges, charges for other investigations and transportation charges was more in the complications groups (Group 2 to Group 6) compared to the group without any complications (Group 1). The expenditure for laboratory charges and medical consultations was high for diabetic patients with foot complications (Group 4) than their counterparts with the presence of other severe diabetic complications such as chronic kidney disease, cardiovascular and retinal complications. The transportation charges and medicines cost was significantly higher in Group 4 to Group 6. The expenditure on doing other investigations which includes echo cardiology, doppler and biothesiometry, scan, radiological examination, etc was similar in all the study group subjects with the presence of complications. On an average, diabetic patients with foot complications (19020 INR) and those who have presence of two complications (17633 INR) spent 4 times more and patients with chronic kidney disease (12690 INR), cardiovascular complications (13135 INR) and retinal complications (13922 INR) spent three times more than patients without any complications (4493 INR). The total median expenditure for the hospital admissions in the previous 2 years was significantly higher for patients with foot complications (150000 INR) and cardiovascular complications (200000 INR) and it was highest if they have presence of two complications (282500 INR).

The total cost correlated significantly with age (r=0.178, p<0.0001) and duration of diabetes (r=0.177, p<0.0001) but
Table 2: Comparison of biochemical details among the study groups

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (Without complications)</th>
<th>Group 2 (Renal)</th>
<th>Group 3 (Cardiovascular)</th>
<th>Group 4 (Foot)</th>
<th>Group 5 (Retinal)</th>
<th>Group 6 (Two complications)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=86</td>
<td>N=67</td>
<td>N=53</td>
<td>N=58</td>
<td>N=66</td>
<td>N=38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasting (mg/dl)</td>
<td>162.2±61.9</td>
<td>173.1±54.6</td>
<td>161±75.4</td>
<td>146.8±53.9</td>
<td>157.3±58.8</td>
<td>131.3±39.9</td>
<td>0.017</td>
</tr>
<tr>
<td>Postprandial</td>
<td>248.8±92.2</td>
<td>255.5±75</td>
<td>214.5±84</td>
<td>219.7±70.6</td>
<td>242±83.7</td>
<td>202.3±52.2</td>
<td>0.003</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>8.9±2.2</td>
<td>8.8±2.0</td>
<td>9.2±2.1</td>
<td>9.8±1.9</td>
<td>9.4±1.8</td>
<td>9.4±2.2</td>
<td>0.132</td>
</tr>
<tr>
<td>Total Chol (mg/dl)</td>
<td>175.3±50.2</td>
<td>166.6±57.2</td>
<td>167.5±54.2</td>
<td>148±37.6</td>
<td>162.8±49.9</td>
<td>149.3±34.5</td>
<td>0.076</td>
</tr>
<tr>
<td>Triglycerides(mg/dl)</td>
<td>161.8±72.3</td>
<td>193±108.5</td>
<td>166±95.2</td>
<td>166.2±95.9</td>
<td>167±98.9</td>
<td>137.2±59.1</td>
<td>0.277</td>
</tr>
<tr>
<td>HDL - Chol (mg/dl)</td>
<td>42.8±9.7</td>
<td>37.6±8.7</td>
<td>38.3±14.2</td>
<td>38.4±18.1</td>
<td>37.8±11.7</td>
<td>35.3±11.1</td>
<td>0.106</td>
</tr>
<tr>
<td>LDL – Chol (mg/dl)</td>
<td>115.5±69.2</td>
<td>89.3±27.4</td>
<td>90.6±35.5</td>
<td>89.5±39.1</td>
<td>94.2±35.5</td>
<td>93±27.9</td>
<td>0.025</td>
</tr>
<tr>
<td>VLDL – Chol (mg/dl)</td>
<td>25.5±13</td>
<td>33.8±19.1</td>
<td>28.7±15.3</td>
<td>22±14</td>
<td>31.3±23.2</td>
<td>24.5±14.0</td>
<td>0.035</td>
</tr>
<tr>
<td>Urea (mg/dl)</td>
<td>24.0±7.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>72.7±27.9</td>
<td>38.8±22.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>33.4±19.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40.4±24.3&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>39.7±22.8&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Creatinine (mg/dl)</td>
<td>0.72±0.17&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.3±1.0</td>
<td>1.2±0.8&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>1.08±0.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.3±0.9&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>1.2±0.74&lt;sup&gt;b&lt;/sup&gt;</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Values are in mean ± SD; P<0.03; a Vs group 1, b Vs Group 2

Table 3: Details of expenditure for treating diabetic complications among the study groups

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (Without complications)</th>
<th>Group 2 (Renal)</th>
<th>Group 3 (Cardiovascular)</th>
<th>Group 4 (Foot)</th>
<th>Group 5 (Retinal)</th>
<th>Group 6 (Two complications)</th>
<th>P value between groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=86</td>
<td>N=67</td>
<td>N=53</td>
<td>N=58</td>
<td>N=66</td>
<td>N=38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No of Days</td>
<td>1 (1-8)</td>
<td>4 (1-12)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 (1-11)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6 (3-30)&lt;sup&gt;a,b,c&lt;/sup&gt;</td>
<td>5 (2-20)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6 (2-25)&lt;sup&gt;a,b,c&lt;/sup&gt;</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Laboratory charges</td>
<td>1215 (250-5800)</td>
<td>3600&lt;sup&gt;a&lt;/sup&gt; (865-6980)</td>
<td>3135&lt;sup&gt;a&lt;/sup&gt; (915-9390)</td>
<td>3715&lt;sup&gt;a&lt;/sup&gt; (350-10501)</td>
<td>3218&lt;sup&gt;a&lt;/sup&gt; (750-9900)</td>
<td>3635&lt;sup&gt;a&lt;/sup&gt; (1395-8275)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Medical consultations</td>
<td>350 (150-1050)</td>
<td>1000&lt;sup&gt;a&lt;/sup&gt; (100-300)</td>
<td>1050&lt;sup&gt;a&lt;/sup&gt; (100-420)</td>
<td>1500&lt;sup&gt;a,b&lt;/sup&gt; (200-9425)</td>
<td>800&lt;sup&gt;a&lt;/sup&gt; (100-4900)</td>
<td>1075&lt;sup&gt;a&lt;/sup&gt; (200-7050)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Medicines (INR)</td>
<td>800 (200-5000)</td>
<td>1500&lt;sup&gt;a&lt;/sup&gt; (450-8500)</td>
<td>1800&lt;sup&gt;a,b&lt;/sup&gt; (300-12000)</td>
<td>2000&lt;sup&gt;a&lt;/sup&gt; (480-20000)</td>
<td>2000&lt;sup&gt;a&lt;/sup&gt; (150-9330)</td>
<td>2500&lt;sup&gt;a,b,c&lt;/sup&gt; (300-20000)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hospital charges(INR)</td>
<td>1083 (100-4395)</td>
<td>4010&lt;sup&gt;a&lt;/sup&gt; (1450-16505)</td>
<td>4100&lt;sup&gt;a&lt;/sup&gt; (580-24015)</td>
<td>6907&lt;sup&gt;a,b,c&lt;/sup&gt; (3400-53740)</td>
<td>4738&lt;sup&gt;a&lt;/sup&gt; (500-43215)</td>
<td>6527&lt;sup&gt;a,b,c&lt;/sup&gt; (1430-20205)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Other investigations</td>
<td>450 (200-2810)</td>
<td>1050&lt;sup&gt;a&lt;/sup&gt; (250-2930)</td>
<td>1200&lt;sup&gt;a&lt;/sup&gt; (300-2080)</td>
<td>1240&lt;sup&gt;a&lt;/sup&gt; (120-5972)</td>
<td>1200&lt;sup&gt;a&lt;/sup&gt; (250-3280)</td>
<td>1279&lt;sup&gt;a&lt;/sup&gt; (250-4500)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Transportation charges</td>
<td>300 (50-10000)</td>
<td>650&lt;sup&gt;a&lt;/sup&gt; (100-300)</td>
<td>500&lt;sup&gt;a&lt;/sup&gt; (100-2400)</td>
<td>1000&lt;sup&gt;a&lt;/sup&gt; (200-15000)</td>
<td>1000&lt;sup&gt;a&lt;/sup&gt; (100-3000)</td>
<td>1000&lt;sup&gt;a&lt;/sup&gt; (120-35000)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Total expenditure (INR)</td>
<td>4493 (2640-17095)</td>
<td>12690&lt;sup&gt;a&lt;/sup&gt; (4465-57415)</td>
<td>13135&lt;sup&gt;a&lt;/sup&gt; (3130-62530)</td>
<td>19020&lt;sup&gt;a,b,c&lt;/sup&gt; (10070-86520)</td>
<td>13922&lt;sup&gt;a&lt;/sup&gt; (4800-66165)</td>
<td>17633&lt;sup&gt;a,b,c&lt;/sup&gt; (6140-49260)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Previous expenditure</td>
<td>30000 (5000-100000)</td>
<td>100000&lt;sup&gt;a&lt;/sup&gt; (20000-30000)</td>
<td>200000&lt;sup&gt;a&lt;/sup&gt; (20000-50000)</td>
<td>150000&lt;sup&gt;a,b&lt;/sup&gt; (12000-50000)</td>
<td>100000&lt;sup&gt;a&lt;/sup&gt; (12000-50000)</td>
<td>282500&lt;sup&gt;a,b,c&lt;/sup&gt; (25000-450000)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

1 US$ = 46.50INR (approximately); Values are median (range) in Indian Rupees; P<0.03; a Vs Group 1, b Vs Group 2, c Vs Group 3, d Vs Group 4, e Vs Group 5

showed no correlation with HbA1c (r=0.063, p=0.092). Correlation of HbA1c with duration of hospital stay was also non-significant (r=0.071, p=0.072). The results of regressing the total treatment cost showed that duration of diabetes [regression coefficient (0.098), p=0.018], number of hospitalized days [regression coefficient (0.70), p<0.001] and the risk group (regression coefficient (0.106, p=0.016) were significantly associated with total expenditure. The overall model was statistically significant (p<0.0001) with an adjusted R square = 0.588.

Table 4 shows the reasons for hospitalization of the study population and it also shows the details of the severe diabetic complications among the study groups. Majority of them were hospitalized to undergo cataract surgery or laser photocoagulation treatment (22.3%) and foot amputation (19%). The other reasons for hospitalization were due to elevated renal parameters (18.8%) and to manage cardiovascular complications(16.6%). About 6.8% were admitted to have a general checkup,6.5% due to severe hyperglycemia and 3.3% because of frequent hypoglycemic symptoms. A small proportion of subjects were admitted due to several other reasons related to
and a larger proportion of $58 billion is spent annually just to treat diabetes related chronic complications. The overall annual direct economic burden of diabetes in 2002 was $2.44 billion among urban population of china and the estimate was recently updated to $2.29 billion. In south Asia, the direct cost involved in diabetes management is US$ 5 billion and indirect costs a total of US$ 10 billion. Such cost related data varies from country to country and hence cannot compare the cost estimates. Comparison of results from various health economic studies are complicated by differences in study design, selection of patients, prevalence rates, health care systems and treatment practices. Even though there are reports available from India on economics of diabetes care, literature on cost of treating diabetes related complications is sparse. Lack of data on the economic burden of treating diabetes related complications in developing countries motivated us to plan this study. The present study highlights the direct cost estimates involved in treating severe long term diabetic complications such as renal, cardiovascular, retinal and foot complications in comparison with patients without any complications.

In terms of discussing the findings of the current study, it is worth mentioning that, the direct healthcare costs for treating diabetes complications is on the rise. The study revealed that the average cost of treating and managing diabetes related foot complications was the highest among all other complications of diabetes. The duration of stay in the hospital, number of visits made for post surgical dressings, hospital charges, laboratory charges and medical consultations are the factors which were significantly related to the increased cost. The duration of hospital stay was substantially longer in patients with foot complications and those who had presence of two complications. Such information on hospital stay days and costs may help to emphasize earlier intervention and prevention of complications of diabetes. Diabetes patients with presence of two complications came second in the rankings of highest direct health care cost estimates per admission. As expected, the group without any complications was younger and had shorter duration of diabetes. The detailed description of the surgery procedures are also provided in Table 4. Figure 1 shows the mode of payment of hospital bills for inpatient admission in the study population.

**Discussion**

Management and treatment of diabetes is one of the most expensive conditions. Due to its chronicity and the associated complications, the cost of diabetes treatment is increased by two to four times than the people without diabetes. Even the presence of a single comorbid condition like hypertension increases the cost of management of disease by 1.5 times when compared to those diabetic patients who do not have any other associated co morbidities.

Total direct costs of diabetes are highest in US ($116 billion)
results support this well established fact that complications get worse with longer duration of diabetes.

The total expenditure correlated significantly with age and duration of diabetes. The expenditure involved in treating long term complications was significantly associated with duration of diabetes, number of hospitalized days and presence of complications in the current study. The model explained 58.8% of the variations.

The total expenditure for treating renal, cardiovascular and retinal complications was more or less similar among type 2 diabetic patients. The expenditure incurred on transportation and medicines was high for people with foot and retinal complications and with presence of two complications. Patients with foot and those who had presence of two complications spent 4 times more and patients with renal, cardiovascular and retinal spent 3 times more in comparison with patients without any complications. The total expenditure for 2 years related to treating these complications was high for foot and cardiovascular complications and it was highest if they had two complications. Though the number of days of hospitalization for the cardiovascular complication group was less compared to the other groups, the expenditure incurred for the previous 2 years was the highest.

In developed countries, diabetic foot care accounts for up to 20% of total health care resources available for diabetes. In developing countries, it has been estimated that foot problems may account for as much as 40% of the resources available. In western countries, the economic cost of a diabetic foot ulcer is thought to be between US$ 7000 and US$ 10,000 where healing is complicated and amputation required, this cost may increase to as much as US$ 65,000 per person. Diabetic foot ulceration and amputations were estimated to cost US health care payers $10.9 billion in 2001 and the corresponding UK estimates based on the same methodology were that 5% of total national health service expenditure in 2001 ($3 billion) was attributable to diabetes. The total annual cost of diabetes related foot complications was estimated to be £252 million. The above cost estimates shows that prevention is the best option to tackle this costly treatment and managing these complications.

Another interesting finding of the current study is the proportional increase in the cost in relation to the number of complications. The subjects with multiple complications, on an average are spending a large proportion of their annual income, which is again mostly ‘out of pocket’ expenses as shown in the study, with an evidence of negligible insurance claims. Majority of the study patients (approximately 50%) depended on personal savings or either borrowing loan or selling properties to pay the hospital bills, which highlights the need for health policies reformation in terms of friendly payment options.

Another study from India demonstrated that there is an increasing trend in expenditure on diabetes care. Expenditure incurred by both urban and rural subjects in relation to the number of complications was proportionately increased and they spent a large percentage of income on diabetes management.

A study from North India also assessed comprehensively the cost of ambulatory care of diabetes in a small sample. The largest proportion of the total cost was made up of direct costs (68%), followed by indirect costs (28.7%) and provider’s costs (2.8%). The study showed that diabetes is an expensive illness to treat in developing countries. Only the direct health care costs have been estimated in the present study, while evidence from published reports suggests that costs of treating diabetes and its complications constitutes 86% of direct costs and 95% of the indirect costs. The assessment of indirect costs is beyond the scope of the current study and hence it is limited to direct healthcare costs alone. On comparison with multiple groups the study has thus shown that major proportion of direct healthcare costs is due to diabetes complications and not due to actual diabetes treatment. Published reports from other studies are in favour of the above results.

There are few limitations to our study. It is important to note that the data collected is from a specialized diabetes care centre and the generalizability of results may be limited to certain private health care centres, the projected cost estimates were mainly based on urban patients whose pattern of disease may be different compared to rural patients. We could not assess the indirect cost and the cost of care for structured and comprehensive assessment of disability in this study. The cost estimate, especially for non-medical cost such as transportation charges, was to some extent based on patient recall which could have had recall bias. With this study design, there is the possibility of many confounding factors related to cost. Despite these limitations, the findings from this study are significant and important for medical care cost of diabetes in India. The data are current and cover the direct costs involved in treating different long term diabetic complications.

India, as such has the largest number of people with diabetes than any other country and foot problems and amputations remain very common. This may considerably increase the cost of treatment unless intervention policies are framed to prevent and control diabetes complications. Significant reductions in amputations can be achieved by well-organised diabetic foot care teams and by good diabetes control. Special interventions should be planned and implemented in susceptible individuals and populations through modifications of risk factors and determinants.

In conclusion, the study revealed that the excess of the diabetes mellitus related healthcare costs may be attributable to complications of diabetes. Strategies that aim at reducing the escalating cost burden must have a focus on achieving targeted glycemic control, prompt and effective management of complications, operationalize regular and early screening for complications. Awareness creation on primary and secondary prevention of diabetes and its complications is the need of the hour, alongside capacity strengthening of medical and paramedical professionals involved in diabetes care.

**Conflict of Interest**

None declared.

**Acknowledgement**

We are grateful to the patients without whose invaluable information the study could not have been completed.

**Appendix**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Name :</td>
</tr>
<tr>
<td>2.</td>
<td>Age :</td>
</tr>
<tr>
<td>3.</td>
<td>Age at onset of diabetes:</td>
</tr>
<tr>
<td>4.</td>
<td>Duration of diabetes:</td>
</tr>
<tr>
<td>5.</td>
<td>Gender: (1) Male (2) Female</td>
</tr>
<tr>
<td>6.</td>
<td>Complications details: Do you have any diabetic complications? (1) Yes (2) No</td>
</tr>
<tr>
<td></td>
<td>If No,</td>
</tr>
</tbody>
</table>
1. Group 1 (without complications)
2. Renal (Group 2)
3. Cardiovascular (Group 3)
4. Foot complications (Group 4)
5. Retinal complications (Group 5)
6. Presence of any above 2 complications (Group 6)
7. Other complications

7. Family history:

Family history of DM: Family history of other diabetic complications:
(1) Yes (2) No
If yes, ______________
1. Father
2. Mother
3. Both parents
4. Siblings
5. Others
6. Presence of any above 2 complications (Group 6)
7. Other complications

7. Family history:

Family history of DM: Family history of other diabetic complications:
(1) Yes (2) No
If yes, ______________
1. Father
2. Mother
3. Both parents
4. Siblings
5. Others

8. Locality: (1) Urban (2) Rural

9. Educational status:

1. Illiterate
2. School
3. Graduate / Post Graduate
4. Professional

10. Occupation:

1. Unskilled worker
2. Skilled worker
3. Office job
4. Business
5. Professional
6. Retired/Unemployed
7. House wife

11. Socioeconomic status:

Total family income in Indian rupees per month
1. <10,000
2. 10,000 – 20,000
3. >20,000

12. Food Habits: (1) Vegetarian (2) Non-vegetarian

13. Habits: (1) Smoking (2) Alcohol (3) Tobacco chewing (4) None

14. Are you taking treatment: (1) Yes (2) No

If yes, (1) OHA (2) Insulin (3) OHA+Insulin

15. Anthropometric details:

Weight:_________Kgs
Height:_________cns
BMI:_________Kg/m²

16. Biochemical parameters:

Parameters Value
Fasting plasma glucose (mg/dl)
Postprandial glucose (mg/dl)
HbA1c %
Serum total cholesterol (mg/dl)
Triglycerides (mg/dl)
HDL cholesterol (mg/dl)
LDL cholesterol (mg/dl)
VLDL cholesterol (mg/dl)
Urea (mg/dl)
Creatinine (mg/dl)
Albumin/Creatinine ratio
Protein/Creatinine ratio
Creatinine clearance (ml/min)

17. Hospitalization details or reason for hospitalization:

1. Which complication led to hospitalization___________
2. No. of days admitted in hospital __________________
3. Have you undergone any surgery due to the diabetic complications? (1) Yes (2) No

If yes, details _________________________________________

18. Cost details (INR) during hospitalization:

S. No. Particulars Charges in Indian Rupees
1. Lab charges
2. Medical consultations
3. Medicines
4. Hospitalization charges
5. Other Investigations
6. Transportation charges

Total expenditure (Rs)

19. Previous 2 years expenditure details:

Lab charges ______________________
Medical consultations ______________________
Medicines ______________________
Hospitalization charges ______________________
Surgery cost ______________________
Other investigations ______________________
Transportation charges ______________________

Total expenditure for past 2 years __________________ in rupees

20. Mode of payment of hospital bills:

1. Personal savings
2. Medical Insurance
3. Company reimbursement
4. Borrowing loan
5. Mortgage
6. Selling property

References


