

# **DETERMINANTS OF DIRECT COST OF TYPE 2 DIABETES: A MULTI LOG-LINEAR REGRESSION MODEL**

**Dr. SUBHA P P**

**Assistant Professor, Department of Development Economics**

**Government College Mananthavady, Wayanad (District), Kerala, India**

## **Abstract**

The present study is an investigation into the direct cost of Type 2 diabetes among casual workers in Malappuram district. The estimation of direct cost from the patient's perspective gives the exact economic burden that a patient bears due to the disease and its severity. The direct cost analysis includes outpatient and inpatient costs. The distribution of outpatient, inpatient and total direct cost based on various components of medical care and non medical care cost reveals the share of each component. The summary statistics of outpatient, inpatient and total direct cost analysis pointed out the yearly out of pocket expenses that an individual Type 2 diabetic patient spends for the treatment of the disease. The Mann Whitney Test used to test the statistical significance of the difference in the median direct cost for total direct cost based on severity of the Type 2 diabetic patients. Further, the total direct cost variability can be predicted by the Multi Log-Linear Regression Model. The analysis of the direct cost helps the diabetic patients to measure the approximate cost the disease entails and make a suitable planning for future care and future spending.

## **Key Words**

Type 2 Diabetes, Direct Cost, Outpatient Cost, Inpatient Cost, Severity of Type 2 diabetes

## **1 Introduction**

Diabetes is a chronic disease that occurs when the body fails to produce adequate insulin or when the body cannot make use of the insulin produced. Insulin is a hormone produced by the beta cells of the pancreas that regulates the metabolism of glucose and other nutrients in our body. Type 1 diabetes, Type 2 diabetes and Gestational diabetes are the three important type of diabetes. Type 1 diabetes is diabetes which occurs because of the deficient insulin production of the body. It is also called as insulin dependent diabetes. People having Type 1 diabetes needed regular administration of insulin, which helps them to access a normal level of insulin in their blood. Usually Type 1 diabetes can be seen in children therefore it is otherwise called as juvenile or child onset diabetes. The Type 2 diabetes occurs mainly because of the insulin resistance of the body .This type of diabetes commonly seen in adults. Hence, it is known as adult onset diabetes. Gestational diabetes is diabetes which temporarily occurs in pregnant women. Women with Gestational diabetes will have higher risk of developing Type 2 diabetes in future (World Health Organization [WHO], 2016). Among the three types, Type 2 diabetes is the most common type which accounted for 90% of people with diabetes globally. Further, the number of people with Type 2 diabetes is growing exponentially worldwide and the rise is associated with ageing populations, economic development, increasing urbanisation, less healthy diets and reduced physical activity.

## **2 Cost of Illness Studies**

The cost of illness studies is considered as the best evaluation technique for assessing the cost of a disease in the health sector. The economic burden of a disease can be better described by the cost of illness studies. It helps to identify the various cost components, estimate the cost, the cost variability, and their interrelations with the factors that are

associated with the disease. With the help of cost studies, one can recognise the need for appropriate management of the disease and make suitable decisions regarding the allocation of resources. The cost of a specific illness can be divided into 'direct cost' – the expenses on medical and non medical care, 'indirect cost'- the value of lost production because of reduced working time and the 'intangible cost'-the pains and sufferings of the disease (WHO, 2009).

### **3 Research Problem**

Kerala has been going through an epidemiological transition during the last three decades. Kerala's disease profile has changed from communicable to non communicable diseases. Kerala has experienced a substantial shift in her dietary and physical inactivity patterns. Increasing preference for high carbohydrate and high calorie diet, consumption of processed foods, a sedentary lifestyle and overweight and obesity boost the incidence of diabetes in Kerala. A study relating to the cost of diabetes is essential to understand the exact economic burden of the disease that patients and their family have to bear. Presently there does not exist any comprehensive study on the cost of the treatment of diabetes in the Kerala context. Therefore, it is the need of the times to make a careful assessment of the costs of diabetes treatment.

### **4 Significance of the Study**

The gravest problems health care providers and planners face pertain to scarcity of resources and increasing costs. For better allocation of adequate resources they need data on current estimation of costs which will help them maximise the use of resources for the treatment and prevention of diabetes. According to American Diabetes Association [ADA] (2013), a better understanding of the cost of diabetes including direct, indirect and intangible costs and its various determinants helps in decision making and reducing economic burden associated with the disease.

## **5 Theoretical Framework of the Study**

As far as health is considered as an important productive resource, the theoretical framework of the study deals with the various Health Economic Theories which mainly draw on the Human Capital. Human capital is considered as a key factor for increasing productivity and economic growth. Economists are deepened their view that just like knowledge and skills, health is also important as a form of human capital which will have productive use. Health is also an important determinant of the value of labour which poor people believed as the most important asset in their life (Bloom, 2014).

Various authors have defined human capital in different ways. Becker defined human capital as “activities that influence future real income by imbedding resources in people such as schooling, on- the job training, medical care, and consumption of vitamins and acquisition of information about the economic system as investment in human capital” (Becker, 1962). In the words of Schultz (1961) direct expenditures on education, health and internal migration are considered as investment in human capital.

## **6 Conceptual Framework of the Study**

The present study has a *Cost of Illness Framework* from the patient’s perspective. According to the cost of illness framework, the major components of economic costs of diabetes are the direct cost, indirect cost and the intangible cost. The study assesses the direct cost of Type 2 diabetic patients. The direct cost of Type 2 diabetes mainly includes both the medial care cost and non medical care cost for both outpatient and inpatient care. The direct cost increase the economic burden of the patients through increased out of pocket expenses. The conceptual framework of the study can be illustrated in Figure 1.

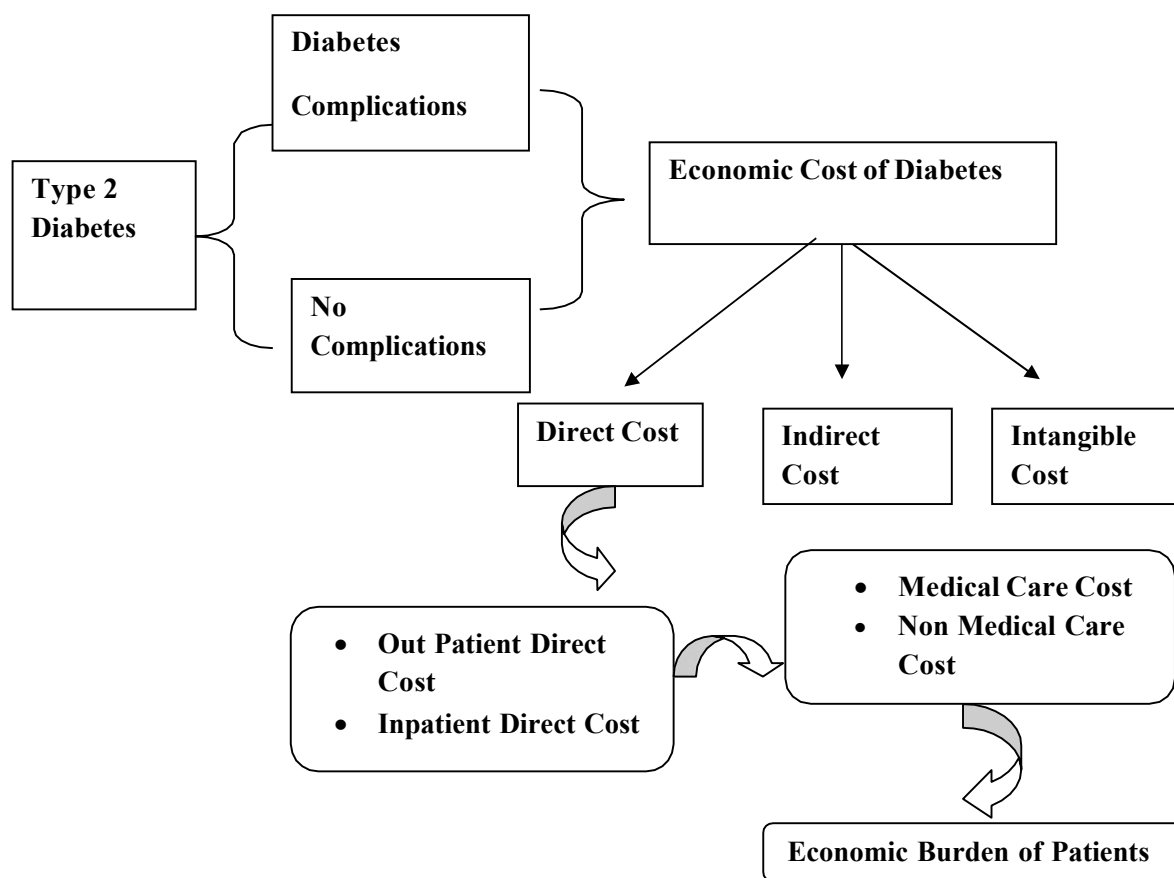


Figure 1 Conceptual Frame work of the Study

Source: The Author

## 7 Methodology of the Study

The present study is a descriptive cum analytical study based on cross sectional data. The data have been collected from 360 Type 2 diabetic patients who have been doing casual work in Malappuram district, Kerala, where the prevalence of diabetes is reported to have been high. The district has the largest number of casual workers in the state. Both descriptive and analytical statistics have been employed to analyse the objectives. The descriptive statistics include Mean, Median, Standard Deviation, Skewness and Kurtosis. The analytical

statistics includes non parametric test like Mann Whitney U Test and Multi Log- Linear Regression Models.

## **8 Analysis and Results**

### **8.1 Direct Cost of Type 2 Diabetes**

The direct cost of Type 2 diabetes was estimated based on out of pocket expenses made by the patients for both medical care and non medical care. The medical care expenses are the expenses made by the patients for the treatment of the illness while, non medical care costs are the costs that are caused by the illness. The Type 2 diabetic patients have to meet expenses for both outpatient and inpatient care. The outpatient expenditures are those expenditures incurred by the patients for the outpatient visits to doctors, all costs on laboratory tests and medications and non medical expenses such as transportation cost, food cost and other costs, while the inpatient expenditures are the expenditures for hospital treatment. The study estimates the annual total direct cost of Type 2 diabetes by adding the outpatient and inpatient cost.

### **8.2 Outpatient Direct Cost of Type 2 Diabetes**

Outpatient (OP) direct costs are the payments made by the Type 2 diabetic patients for their outpatient treatment. Originally, the OP direct cost including both medical care and non medical care costs has been collected on a monthly basis. Then the annual cost has been estimated by multiplying the monthly cost by twelve. The medical care cost includes medicine costs and cost on consultation and laboratory charges, while the non medical care cost consists of transportation cost, food cost and other expenses. Among the components of medical care cost, consultation cost is the fee paid by the patients to both the general practioners and specialists doctors, while the cost on laboratory charges includes the lab

charges for both sugar tests and other lab tests for complications. The third component, i.e.; cost on medication includes cost on drugs which again includes oral anti diabetic drugs and other drugs for complications, cost on insulin and other disposables. The cost on non medical care includes mainly three components that are travel expenses, food expenses and other expenses. The travel expenses consist of all cost on transportation for outpatient visit. Sometimes patients wanted to test the sugar level before and after breakfast. Further, they have to wait for much time for consultation. All these necessitate the patients eating foods at restaurants and hotels. Thus, the food expenditure here means payments made by the patients for having food from outside home. Finally, all other expenses patients incur including for diet control form the last component of non medical care, that is, the other expenditure.

### 8.3 Distribution of OP Direct Cost and its Components

The distribution of OP direct cost of Type 2 diabetes over its components is represented in Figure 2, 3, 4 and 5.

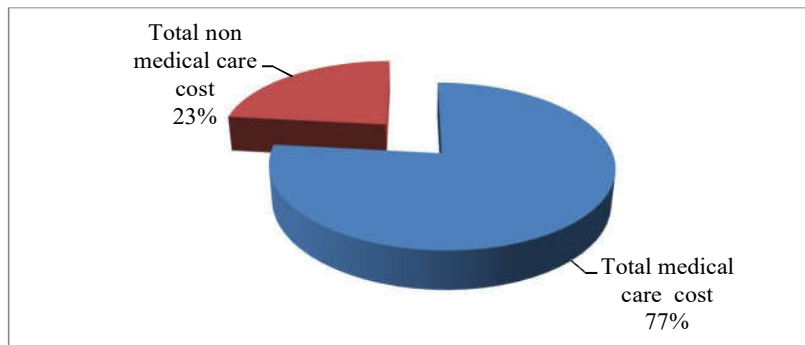


Figure 2 Share of medical care and non medical care cost

Source: Primary Data

Figure 2 shows that out of the total outpatient direct cost, the share of total medical care cost is higher than that of total non medical care cost. The share of medical care cost accounts for nearly three times higher than that of the non medical cost.

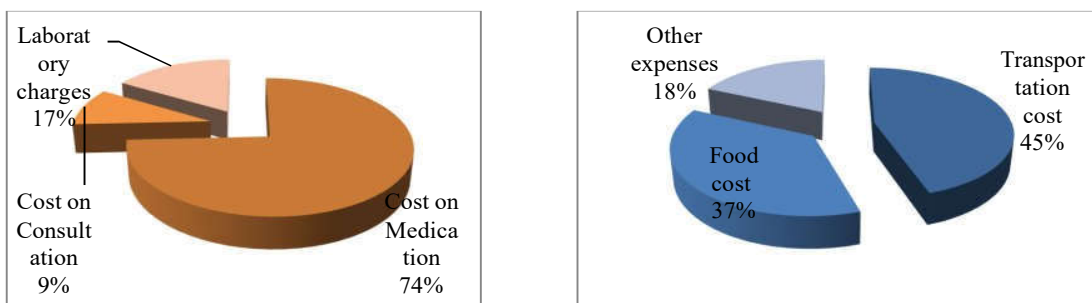


Figure 3 Components of medical care cost Figure 4 Components of non medical care Cost.

Source: Primary Data

It is evident from Figure 3 that among the components of medical care cost, medication has the highest share (74 per cent). This indicates the importance of anti diabetic agents like oral drugs and insulin and the medicines used for different types of severe diabetics. The Figure also shows that the share of medication is nearly four times and eight times higher than that of laboratory charges (17 per cent) and consultation cost (9 per cent) respectively.

Figure 4 indicates that among the components of non medical care cost, transportation cost has the highest share (45 per cent). Further, it also adds that the food cost (37 per cent) has not a negligible share in the total non medical care cost.

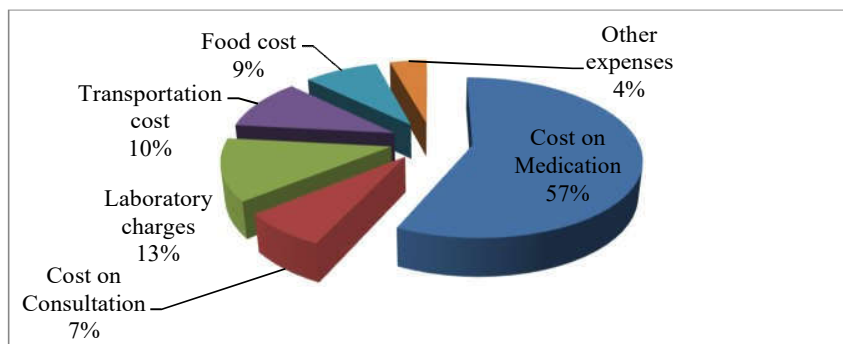


Figure 5 Distribution of each components of total OP direct cost

Source: Primary Data



As per Figure 5 among the components of total outpatient, direct cost, cost on medication has the highest share (57 per cent), while the other components have only a less share in the total OP cost.

### 8.4 Inpatient Direct Cost of Type 2 Diabetes

In this section, the cost of Type 2 diabetes incurred by Inpatients (IP) is examined. It includes both medical care cost and non medical care cost. Medical care cost for inpatients includes cost on consultation, laboratory charges, cost on medication, surgery charges, ICU charges and charges on bed or rooms, while the non medical cost for inpatient care includes cost on travelling, food and diet and other expenses. The hospitalisation cost in the study is calculated as the annual cost incurred by the patients during the year, prior to the survey period. The primary survey has revealed that out of the 360 diabetic patients, 115 (31.94 per cent) were hospitalised during the one year period prior to the survey.

### 8.5 Distribution of IP Direct Cost over its Components

In order to analyse the share of each component of IP medical care cost, IP non medical care cost and the total IP direct cost, the researcher has prepared component pie charts as represented in Figure 6, 7 and 8 and 9.

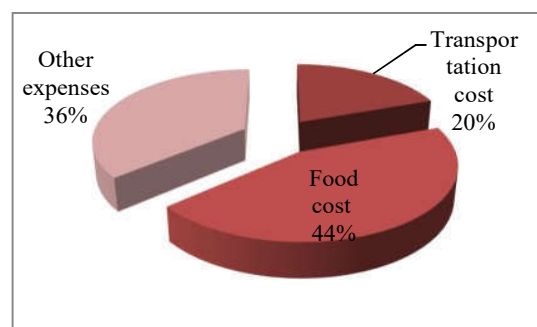
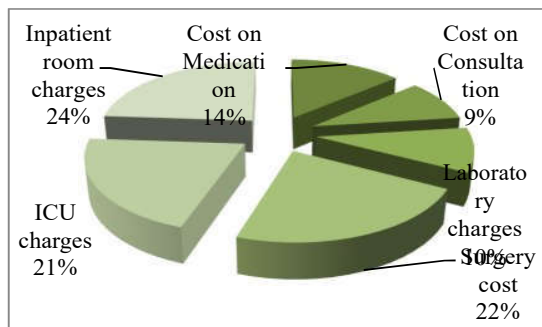


Figure 6 IP direct cost:

Components of medical care cost

Figure 7 IP direct cost:

components of non medical care cost

Source: Primary Data

Figure 6 shows that among the components of IP medical care cost inpatient room charges have had the highest share of 24 per cent, followed by surgery cost (22 per cent) and ICU charges (21 per cent). This indicates that in the case of inpatients having severity, the length of stay in hospital necessitates higher spending on inpatient room rent, surgery and ICU than cost on medication, consultation and laboratory charges.

It is evident from Figure 7 that among the components of IP non medical care cost, the share of food cost has the highest share (44 per cent).

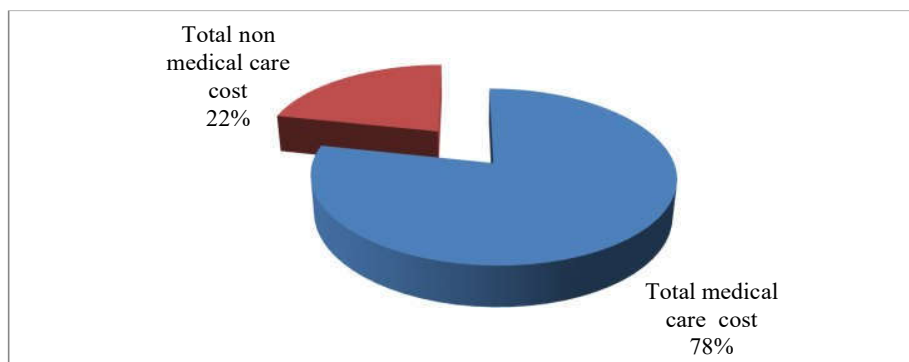


Figure 8 IP direct cost: share of medical care and non medical care cost

Source: Primary Data

It can be seen from the Figure 8 that out of the total IP direct cost, the share of medical care cost has been higher than non medical care cost indicating that the Type 2 diabetic patients who were hospitalised spend 78 per cent of total cost for their medical care, which is nearly four times higher than the non medical care cost.

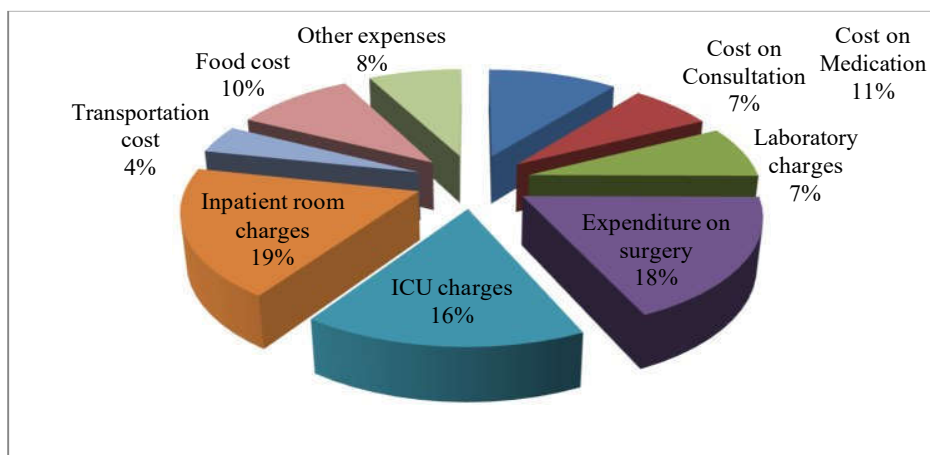


Figure 9 Distribution of each components of total IP direct cost

Source: Primary Data

Figure 9 shows that out of the total IP direct cost inpatient room charges, surgery charges and ICU charges account for the highest share of 19 per cent, 18 per cent and 16 per cent respectively.

### 8.6 Total Direct Cost of Type 2 Diabetes

The total direct cost of Type 2 diabetes is the total cost incurred by the patients for both outpatient and inpatient care. In the present study, the researcher has calculated the total cost of Type 2 diabetes, adding together the outpatient cost and the inpatient cost incurred by the patients per year. The total direct cost analysis gives a clear picture of the annual expenditure that a Type 2 diabetic patient paid for outpatient and inpatient care. Out of the 360 sample respondents, 115 patients have sought hospitalized treatment. Therefore they have incurred expenditure on both outpatient and inpatient care, while the remaining 245 patients have had to spend a sum for outpatient care only. Their inpatient care expenditure is considered zero in the analysis.

## 8.7 Total Direct Cost: Summary Statistics

The summary statistics of annual total direct cost of Type 2 diabetic patients is represented in Table 1 and Table 2. The Table 1 shows the mean, SD, median, minimum and maximum of annual total direct cost while Table 2 represents the skewness, kurtosis and coefficient of variation of annual total direct cost.

Table 1

*Total Direct Cost: The Summary Statistics (Average and Dispersion)*

Cost components	Mean	SD	Median	Minimum	Maximum	N
Cost on Medication	10522	12156	5700	0	49800	360
Cost on Consultation	1736.4	2502.8	60	60	9800	360
Laboratory charges	2663.2	3380.5	360	120	13760	360
Expenditure on surgery	1308.4	6263.3	0	0	100000	360
ICU charges	1222.8	3082.5	0	0	18000	360
Inpatient room charges	1390	2725.1	0	0	15000	360
<b>Total medical care cost</b>	18643	24422	7920	180	155560	360
Transportation cost	2074.9	1971.8	1200	240	14000	360
Food cost	2159.3	2420.9	1200	0	14400	360
Other expenses	1308.7	3086.6	0	0	26000	360
<b>Total non medical care cost</b>	5542.9	6928.7	2400	600	48100	360
<b>Total direct cost</b>	24186	30432	9630	1020	173960	360

Note. SD- Standard Deviation, N- Number of Patients

Source: Primary Data

It can be seen from Table 1 that the mean (SD) of the total direct cost is Rs. 24186 (30432), while the median cost is Rs. 9630. Among the components of medical care cost, the

cost on medication accounts for the highest share. The mean (SD) of the medication cost is Rs.10322 (12156), while the median cost is Rs. 5700. Further, among the components of non medical care cost, the mean (SD) cost is higher for of food cost (Rs.2159.3 (2420.9)) while the median cost Rs. 1200.

Table 2.

*Total Direct Cost: The Summary Statistics (Skewness and Kurtosis)*

Cost components	Skewness	Kurtosis	CV	N
Cost on Medication	1.0016	0.45308	1.1777	360
Cost on Consultation	1.1675	0.06571	1.4414	360
Laboratory charges	1.201	0.18808	1.2693	360
Expenditure on surgery	11.698	172.36	4.787	360
ICU charges	2.9455	8.9344	2.5208	360
Inpatient room charges	2.6025	7.88	1.9605	360
<b>Total medical care cost</b>	1.6532	2.9267	1.31	360
Transportation cost	2.2455	6.2687	0.95031	360
Food cost	1.8664	3.8093	1.1212	360
Other expenses	3.3353	14.502	2.3586	360
<b>Total non medical care cost</b>	2.3016	6.0021	1.25	360
<b>Total direct cost</b>	1.6236	2.2659	1.2582	360

Source: Primary Data collected from Malappuram District, Kerala

It is evident from Table 2 that each component of the total direct cost has a very high value of skewness and kurtosis. The high skewness and kurtosis, of total direct cost indicate that the distribution of total direct cost data consists of outliers. The presences of outliers are because some patients have to pay a higher amount for the treatment of the disease because of its severity and treatment in private hospital.

### 8.8 Total Direct Cost and Severity of the Disease

Severity of Type 2 diabetes has a profound impact on the total direct cost. If the patient has severity of the disease, he has to spend more treatment cost for both outpatient and inpatient care. The impact of severity on the direct cost of Type 2 diabetes is represented in Table 3

Table 3

*Total Direct Cost and Severity of Type 2 Diabetes*

Severity of Type 2 diabetes	Mean	SD	Median	N	Mann Whitney Test Result		
					Mean Rank	U Statistic	P value
No severity	6357.14	6079.30	2940	198	116.92	3449.000	p<.001
Severity	45976.48	33927.56	46630	162	258.21		

*Note.* SD- Standard Deviation, N- Number of Patients

Source: Primary Data

Table 3 shows that the analysis of the influence of severity on the total direct cost reveals that median cost is higher for patients having severity than patients have no severity of the disease. For patients have diabetes severities, the annual mean (SD) cost is Rs. 45976.48 (33927.56) and the median cost is rupees 46630. On the other hand, the annual mean (SD) cost of patients without severity was only Rs. 6357.14 (6079.30) and the median cost Rs. 2940. The conclusion follows that, the cost that the severely inflicted patients have to bear is much higher than that borne by patients without complications.

To test the variability in the distribution of total direct cost of Type 2 diabetes among patients with or without severity of the disease, the following null and alternative hypothesis are formulated and tested.

H<sub>0</sub>: There is no significant difference in the direct cost of Type 2 diabetes among patients with or without severity of the disease.

H<sub>1</sub>: There is significant difference in the direct cost of Type 2 diabetes among patients with or without severity of the disease.

Due to the non normality of the total direct cost data, the study performed a non parametric Mann Whitney U Test to assess the hypothesis. The test result indicates that there is a statistically significant difference in the total direct cost of Type 2 diabetes across the two categories of severity of the disease, U=3449.000, p<.001. Therefore, we reject the null hypothesis (H<sub>0</sub>) and not rejected the alternative hypothesis that severity significantly affects the direct cost. The relationship is positive.

### 8.9 Total Direct Cost and the Type of Hospitals

It has been found by analysing the data that majority of the sample respondents approach government hospitals for their outpatient treatment and private hospitals for inpatient treatment. The study analysed the hospital wise data of total direct cost of Type 2 diabetes and the result is given in Table 4.

Table 4

*Total Direct Cost of Type 2 Diabetes and Choice of Hospital*

Types of Hospital	Mean	SD	Median	N	Mann Whitney Test Result		
					Mean Rank	U Statistic	P value
Private hospital	54335.28	32519.20	52960	123	282.82	1990.000	p<0.001
Govt. hospital	8538.66	11935.19	4236	237	127.40		

*Note.* SD- Standard Deviation, N- Number of Patients

Source: Primary Data

It is evident from Table 4 that the mean (SD) cost of patients who sought treatment in private hospital per year is Rs. 54335.28 (32519.20); while the median cost Rs. 52960. Further, the mean (SD) cost of patients who sought treatment in government hospital was Rs. 8538.66 (11935.19); while the median cost stood at Rs. 4236.

To test the variability in the distribution of total direct cost of Type 2 diabetes among patients seek treatment in different type of hospitals, the following null and alternative hypothesis are formulated and tested.

$H_0$ : There is no significant difference in the direct cost of Type 2 diabetes among patients seek treatment in different type of hospitals.

$H_1$ : There is significant difference in the direct cost of Type 2 diabetes among patients seek treatment in different type of hospitals.

Due to the non normality of the total direct cost data, the study performed a non parametric Mann Whitney U Test to test the hypothesis. The test result indicates that there is a statistically significant difference in the distribution of total direct cost in the case of the two types of hospitals where Type 2 diabetic patients sought treatment;  $U=1990.000$ ,  $p<0.001$ . So we reject the null hypothesis ( $H_0$ ) and accept the alternative hypothesis that there existed a statistically significant difference in the direct cost of Type 2 diabetes among patients who seek treatment in different type of hospitals.

### **8.10 Determinants of Direct Cost of Type 2 Diabetes - Multi Log-Linear Regression Model**

In the study of the cost of Type 2 diabetes, it is important to analyse its determinants, which will help understand the factors that determine the cost. Many studies related to the



direct cost of Type 2 diabetes have reported the influence of various demographic, socio economic and diabetes related factors. According to Brandle et al. (2003), patients demographic characteristics, diabetes related characteristics have significant influence on the annual medical costs of Type 2 diabetes. In a study by Grimaccia and Kanavos (2014) reveals that that direct costs of diabetes are associated with complication and the resultant hospitalization. Williams et al. (2017) conducted a study in United States, and affirmed that there is the sex differences in cost of Type 2 diabetes. Chen et al. (2017) in their study points out that hospitalization, various microvascular and macrovascular complications and drug costs are the major factors that increase the direct cost of Type 2 diabetes.

In the study, the researcher seeks to analyse the determinants of direct cost, which constitute the major part of the total cost of the disease. The data on total direct cost for outpatient and inpatient treatment have been highly skewed because of the presence of frequent small values in the data set. This is because in the sample, patients having no severity of the disease and seeking treatment in government hospitals will incur only a very small amount of cost. Due to the asymmetry of the distribution of total direct cost data, a method of log transformation has been followed for attaining normality of the total direct cost. For analysing the determinants of total direct cost, a Log- Linear Regression Model is used. The outcome variable in this model is the total direct cost in logarithmic forms. Total direct cost, the dependent variable, is the sum of direct cost on both outpatient and inpatient treatment incurred during the last year (of survey). The explanatory variables are various demographic, socio economic and diabetes related characteristics of the Type 2 diabetes patients.

The Log- Linear Regression Model of total direct cost on its regressors can be represented as

$$\text{Ln}(Y_i) = \alpha + \alpha_1 D_1 + \alpha_2 D_2 + \dots \alpha_n D_n + e$$

Where,

$\ln(Y_i)$  = the log transformed total direct cost

$D_1, D_2 \dots D_n$  = are the dummy explanatory variables

$\alpha, \alpha_1, \alpha_2 \dots \alpha_n$  are parameters

e is the error term

Table 5

*Multi Log-Linear Regression Model Showing Determinants of Total Direct Cost of Type 2 Diabetes. Dependent Variable- Log Total Direct Cost*

<i>Predictors</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>
const	9.29841	0.4337	21.44	<0.0001***
Age	-0.0113453	0.00771	-1.472	0.1418
Female (RC)				
Male	0.35916	0.09018	3.983	<0.0001***
Rural (RC)				
Urban	0.12391	0.0711	1.743	0.0823
Hindus (RC)				
Muslims	0.02488	0.08492	0.2929	0.7697
Christians	0.45729	0.22631	2.021	0.0441**
Illiterate	0.61211	0.22112	2.768	0.0059***
Primary Level	0.26925	0.19305	1.395	0.164
High School Level	-0.274262	0.20076	-1.366	0.1728
Higher Secondary Level	-0.270939	0.23027	-1.177	0.2402
College Level(RC)				
Primary Sector	-0.0878392	0.07347	-1.196	0.2327
Secondary Sector	-0.0819742	0.12105	-0.6772	0.4987
Service Sector(RC)				
Duration	-0.0126005	0.01568	-0.8035	0.4222
No family history(RC)				

Family history	0.07389	0.06996	1.056	0.2916
No severity (RC)				
Severity	0.70075	0.10212	6.862	<0.0001***
Private Hospitals(RC)				
Govt. hospitals	-0.875821	0.14896	-5.879	<0.0001***
No hospitalisation (RC)				
Hospitalisation	1.21247	0.12094	10.03	<0.0001***
Mean dependent var	9.222032	S.D. dependent var		1.405839
Sum squared resid	137.2712	S.E. of regression		0.632620
R-squared	0.806530	Adjusted R-squared		0.797505
F(16, 343)	89.36779	P-value(F)		1.0e-111
Log-likelihood	-337.2717	Akaike criterion		708.5433
Schwarz criterion	774.6071	Hannan-Quinn		734.8116

*Note.* RC- Reference Category

Source: Primary Data

Table 5 represents the multivariate analysis of the determinants of direct cost of Type 2 diabetes. It is evident from the table that gender, religion, education, severity of the disease, type of hospital, and hospitalisation are the significant factors affecting the direct cost. “The coefficients of dummy variables in semi- logarithmic functions are interpreted by following the approach suggested by Halvorsen and Palmquist. According to Halvorsen and Palmquist Approach, the effect of a dummy variable is expressed as  $\exp(\beta)-1$ , and the percentage effect is  $100 * \exp(\beta)-1$ ” (as cited in Mwai & Muriithi, 2016). The same can also be explained by Gujarati (2004). According to him “in order to interpret the coefficients of dummy regressors as suggested by Halvorson and Palmquist, take the antilog (to the base e) of the estimated dummy coefficient and subtract 1 from it and multiply the difference by 100”. In this study, the researcher also follows the said method for interpreting the coefficients of the dummy variables in the Model. Gender has had a significant influence on the direct cost and the result indicates that male patients have to pay 43.21% in excess of what female patients pay as direct cost. Religion also has a vital influence on the direct cost.

The result indicates that the direct cost of Type 2 diabetes that the patients professing Christianity meeting is 57.98% higher than what the patients believing in Hinduism meet. The Table further reveals that education shows a significant influence on direct cost. The result indicates that the cost illiterate patients pay more than is 84.43% higher than patients having college level education do pay.

Severity of the disease is another important factor that affects the variability in direct cost of Type 2 diabetes. The table again reveals that the patients who suffer from severe diabetes spend 2.02 times more cost than patients having no severity do pay. Type of the hospital where a patient chooses to undergone treatment significantly determines the cost. Patients treated in a government hospital incur less than 58.35% of what those treated at private hospitals incur. Further, hospitalisation also entails a significant increase in the cost. A patient having been hospitalised spends 3.36 times more money than a patient who has not been hospitalised spends.

The multi log-linear regression result also shows that age, place of residence, occupational category, duration of diabetes and family history do not show any significant influence on the direct cost of Type 2 diabetes.

Hence, it can be concluded that gender, religion, education, severity of the disease, type of hospital and hospitalisation are the significant factors affecting the direct cost of Type 2 diabetes.

### **8.11 Model Adequacy Tests**

The adequacy of the above model, total direct cost of Type 2 diabetes, has been tested using Ramsey's RESET Test for specification, White Test for heteroskedasticity and test for normality of residual. The test results are shown in Table 6.

Table 6

*Results of Model Adequacy Tests*

Sl. No	Tests	Results
1	RESET test for specification	Null hypothesis: specification is adequate  Test statistic: $F(2, 341) = 1.16843$  with p-value = $P(F(2, 341) > 1.16843) = 0.312097$
2	White's test for heteroskedasticity	Null hypothesis: heteroskedasticity not present  Test statistic: $LM = 143.631$  with p-value = $P(\text{Chi-square}(122) > 143.631) = 0.0880975$
3	Test for normality of residual	Null hypothesis: error is normally distributed  Test statistic: $\text{Chi-square}(2) = 1.93958$  with p-value = $0.379162$

Source: Primary Data

It emerges from Table 6 that the model of direct cost of Type 2 diabetes is adequate as the p values of Ramsey’s RESET Test for specification, White Test for heteroskedasticity and test for normality of residual are 0.312097, 0.0880975 and 0.379162 respectively.

### **9 Implications of the Study**

The findings of the study assert that the expenses incurred by diabetes patients for their treatment and thereby controlling their blood sugar level are mostly recurring. This increases the economic burden of the patients for a long period. The medicines like oral drugs, insulin and both drugs and insulin are used by the patients depending on their disease condition

diagnosed. Patients having severity of Type 2 diabetes needs specialist's consultation, and more drugs in quantity and dosage related to the complications in addition to the usual diabetic drugs. Furthermore, patients seeking treatment in private hospital incurred four times higher costs than those seeking treatment in government hospitals. All these intimate that for reducing the economic burden at the patient level requires much care for reducing the chances of severity. At state level, better treatment facilities in government hospitals are to be arranged for treating complications especially for the poor. Thus, appropriate policies are inevitable and needs to make more investment in the public health sector.

As casual workers are belonging to the low social and economic stratum of the society and earn very low income these higher costs negatively affects their family budget. The patients were forced to borrow money from friends and relatives, money lenders, self help groups and banks for meeting this out of pocket expenses. The situation can well be described in the words, 'distress financing'. The patients, due to their treatments, are thus likely to fall in the so called 'distress financing'. Therefore, policy attention is very much essential to tackle this problem. The government needs to make more investments in the health care sector by starting more medical colleges, advanced treatment facilities, more number of fair price medical shops and laboratory facilities. All these will help the patients for reducing the cost burden at reasonable levels.

## **10 Conclusion**

The high level of direct cost for treatment of Type 2 diabetes forced the patients without severity to spend a higher share of their family budget for meeting the expenses and patients with severity or complications definitely had to borrow from all sources they have access to and eventually they fall into a debt trap. This, as the usual economic logic suggests, leaves a small proportion of income for consumption of goods and services other than

medicines and related services. At the macro level, this higher cost for treatment affects the purchasing power of the people for their daily living. A corollary of this is that the demand for money as proportion of income of patients sharply increases to meet the lifelong recurring expenses for treatment and meeting the unforeseen and immediate hospitalisation, if turns to be imperative. All these impair the family budget and often patients and their families fall in a financial crunch. Thus, it is better to launch comprehensive health insurance system in the country for all citizens irrespective of their occupation and profession.

## References

World Health Organization. (2016). (p. 11). *Global Report on Diabetes*. Geneva, Switzerland: Author

World Health Organisation. (2009). *WHO Guide to identifying the economic consequences of disease and injury*. Geneva Switzerland: Department of Health System Financing Health System and Services

American Diabetes Association. (2013, April). Economic costs of diabetes in the U.S.in 2012. *Diabetes Care*, 36, 1033-1046

Bloom, D. E. (2014). The shape of global health. *Finance & Development*, 51, (p. 9).

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *The Journal of Political Economy*, 70, (p. 9).

Schultz, T. W. (1961, March). Investment in human capital. *The American Economic Review*, 51, (p. 1).

Brandle, M., Zhou, H., Smith, B. R., Marriott, D., Burke, R., Tabaei, B. P., . . . Herman, W. H. (2003, August). The direct cost of type 2 diabetes. *Diabetes Care*, 26(Number8), 2300-2304.

Grimaccia, F., & Kanavos, P. (2014). Cost, outcomes, treatment pathways and challenges for diabetes care in Italy. *Globalization and Health*, 1-6. Retrieved from <http://www.globalizationandhealth.com/content/10/1/58>.

Williams, J. S., Bishu, K., Dismuke, C. E., & Egede, L. E. (2017). Sex differences in health care expenditures among adults with diabetes:evidence from medical expenditure panel survey, 2002-2011. *BMC Health Services Research*, --8. doi:10.1186/s12913-017-2178-3.

Chen, D., Liu, S., Tan, X., & Zhao, Q. (2017). Assessment of hospital length of stay and direct costs of type 2 diabetes in Hubei Province, China. *BMC Health Service Research*, 1-9. doi:10.1186/s12913-017-2140-4.

Mwai, D., & Muriithi, M. (2016). Economic effects of non communicable diseases on household income in Keniya: A comparative analysis perspective. *Public Health Research*, 6(3), 83-90. doi:10.59923/j.phr.20160603.02.

Gujarati, D. N. (2004). *Basic Econometrics*. New York: The Mc Graw Hill Publishing Company.