Journal of Vibration Engineering

Registered

- ✓ SCOPUS
- ✓ GOOGLE SCHOLAR
- ✓ DIGITAL OBJECT IDENTIFIER (DOI)
- ✓ IMPACT FACTOR 6.1

Our Website
www.jove.science

DETERMINANTSOFDIRECTCOSTOFTYPE2DIABETES:AMULTILOG-LINEAR REGRESSION MODEL

Dr.SUBHAPP

Assistant Professor, Department of Development EconomicsGovernmentCollegeMananthavady,Wayanad(District),Kerala,India

Abstract

The present study is an investigation into the direct cost of Type 2 diabetes among casualworkers in Malappuram district. The estimation of direct cost from the patient's perspectivegivestheexacteconomic burdenthat apatientbearsduetothediseaseanditsseverity.Thedirect cost analysis includes outpatient and inpatient costs. The distribution of outpatient,inpatientandtotaldirectcostbasedonvariouscomponentsofmedicalcareandnonmedicalcarecostrevealstheshareofeachcomponent.Thesummarystatisticsofoutpatient,inpatientand totaldirectcostanalysisispointedouttheyearlyoutofpocketexpensesthatanindividualType2diabeticpatientspendsforthetreatmentofthedisease.TheMannWhitneyTestusedto test the statistical significance of the difference in the median direct cost for total directcostbasedonseverityoftheType2diabeticpatients.Further,thetotaldirectcostvariabilitycan be predicted by the Multi Log-Linear Regression Model. The analysis of the direct costhelps the diabetic patients to measure the approximate cost the disease entails and make asuitableplanningforfuturecareandfuturespending.

KeyWords

Type2Diabetes,DirectCost,OutpatientCost,InpatientCost,SeverityofType2diabetes

1 Introduction

Diabetes is a chronic disease that occurs when the body fails to produce adequateinsulin or when the body cannot make use of the insulin produced. Insulin is a hormoneproducedbythebetacellsofthepancreasthatregulatesthemetabolismofglucoseandothe rnutrientsinourbody.Type1diabetes,Type2diabetesandGestationaldiabetesarethethreeimport anttypeofdiabetes.Type1diabetesisdiabeteswhichoccursbecauseofthedeficientinsulinproduct ionofthebody.Itisalsocalled asinsulindependentdiabetes.PeoplehavingType 1 diabetes needed regular administration of insulin, which helps them to access anormal level of insulin in their blood. Usually Type 1 diabetes can be seen in childrenthereforeitisotherwisecalledasjuvenileorchildonsetdiabetes.TheType2diabetesoccur smainlybecauseoftheinsulinresistanceofthebody.Thistypeofdiabetescommonlyseeninadults. Hence, it is known as adult onset diabetes. Gestational diabetes is diabetes whichtemporarily occurs in pregnant women. Women with Gestational diabetes will have higherrisk 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 isgrowingexponentiallyworldwideandtheriseisassociatedwithageingpopulations,economic development, increasing urbanisation, less healthy diets and reduced physicalactivity.

2 CostofIllnessStudies

Thecostofillnessstudiesisconsideredasthebestevaluationtechniqueforassessingthe cost of a disease in the health sector. The economic burden of a disease can be betterdescribed by the cost of illness studies. It helps to identify the various cost components,estimatethecost,thecostvariability,andtheirinterrelationswiththefactorsthatare

associated with the disease. With the help of cost studies, one can recognise the need forappropriatemanagementofthediseaseandmakesuitabledecisionsregardingtheallocationofr esources.Thecostofaspecificillnesscanbedividedinto'directcost'– theexpensesonmedicalandnonmedicalcare,'indirectcost'- thevalueoflostproductionbecauseofreducedworkingtimeandthe'intangiblecost'- thepainsandsufferingsofthedisease(WHO,2009).

3 ResearchProblem

Kerala has been going through an epidemiological transition during the last threedecades. Kerala's disease profile has changed from communicable to non communicablediseases. Kerala has experienced a substantial shift in her dietary and physical inactivitypatterns. Increasing preference for high carbohydrate and high calorie diet, consumption ofprocessed foods, a sedentary lifestyle and overweight and obesity boost   the   incidence ofdiabetesinKerala.Astudyrelatingtothecostofdiabetesisessentialtounderstandtheexacteecono mic burden of the disease that patients and their family have to bear. Presently theredoesnotexistanycomprehensivestudyonthecostofthetreatmentofdiabetesintheKeralacon text.Therefore, it is the need of the times to make a careful assessment of the costs ofdiabetestreatment.

4 SignificanceoftheStudy

The gravest problems health care providers and planners face pertain to scarcity ofresourcesandincreasingcosts.Forbetterallocationofadequateresourcestheyneeddataoncurre nt estimation of costs which will help them maximise the use of resources for thetreatment and prevention of diabetes. According to American Diabetes Association [ADA](2013),abetterunderstandingofthecostofdiabetesincludingdirect,indirectandintangible costs and its various determinants helps in decision making and reducing economic

burdenassociatedwiththedisease.

5 TheoreticalFrameworkoftheStudy

As far as health is considered as an important productive resource, the theoreticalframeworkofthestudydealswiththevariousHealthEconomicTheorieswhichmainly drawontheHumanCapital.Humancapitalisconsideredasakeyfactorforincreasingproductivitya ndeconomicgrowth.Economistsaredeepenedtheirviewthatjustlikeknowledge and skills, health is also important as a form of human capital which will haveproductive use. Health is also an important determinant of the value of labour which poorpeoplebelievedasthemostimportantassetintheirlife(Bloom,2014).

Variousauthorshavedefinedhumancapitalindifferentways.Beckerdefinedhumancapit alas"activitiesthatinfluencefuturerealincomebyimbeddingresourcesinpeoplesuchasschooling ,on-thejobtraining,medicalcare,andconsumptionofvitaminsandacquisitionofinformationaboutthe economicsystemasinvestmentinhumancapital"(Becker,1962).Inthe words of Schultz (1961) direct expenditures on education, health and internal migrationareconsidered asinvestmentinhumancapital.

6 ConceptualFrameworkoftheStudy

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 ofdiabetesarethedirectcost,indirectcostandtheintangiblecost.Thestudyassessesthedirectcost of Type 2 diabetic patients. The direct cost of Type 2 diabetes mainly includes both themedial carecostandnonmedicalcarecostforboth outpatient andinpatientcare.Thedirectcost increase the economic burden of the patients through increased out of pocket expenses.TheconceptualframeworkofthestudycanbeillustratedinFigure1.
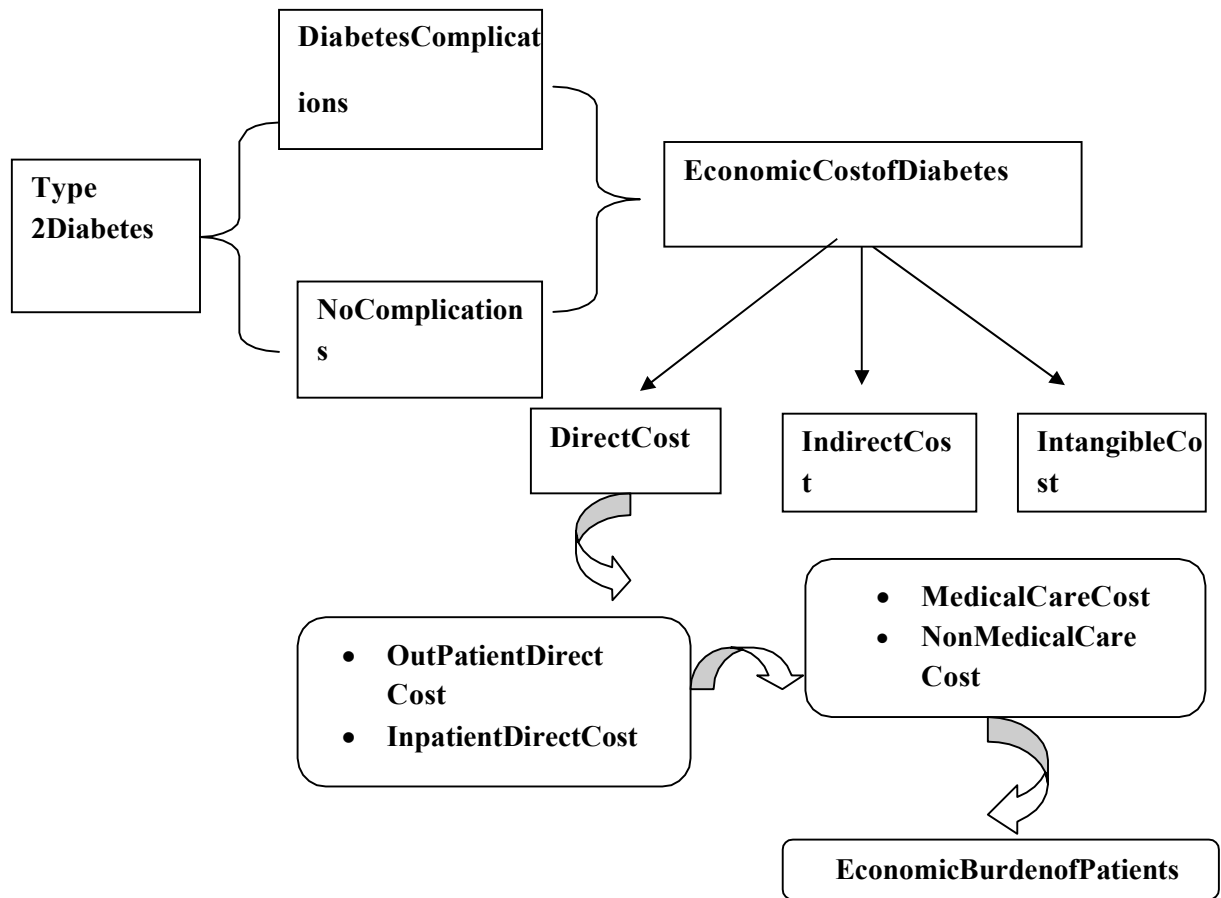
*Figure1*ConceptualFrameworkoftheStudySour

ce:TheAuthor

7 MethodologyoftheStudy

The present study is a descriptive cum analytical study based on cross sectional data.Thedatahavebeencollectedfrom360Type2diabeticpatientswhohavebeendoingcasualwork in Malappuram district, Kerala, where the prevalence of diabetes is reported to havebeenhigh.Thedistricthasthelargestnumberofcasualworkersinthestate.Bothdescriptiveand analytical statistics have been employed to analyse the objectives. The descriptivestatisticsincludeMean,Median,StandardDeviation,SkewnessandKurtosis.Theanalytical

statisticsincludesnonparametrictestlikeMannWhitneyUTestandMultiLog-

LinearRegressionModels.

8 AnalysisandResults

8.1 DirectCostofType2Diabetes

The direct cost of Type 2 diabetes was estimated based on out of pocket expensesmadebythepatientsforbothmedicalcareandnonmedicalcare.Themedicalcareexpense saretheexpensesmadebythepatientsforthetreatmentoftheillnesswhile,nonmedicalcarecosts are the costs that are caused by the illness. The Type 2 diabetic patients have to meetexpensesfor bothoutpatient and inpatient care. The outpatient expenditures are those expendituresincurredbythe   patientsforthe outpatientvisitstodoctors,allcostsonlaboratorytestsandmedicationsandnonmedicalexpensess uchastransportationcost,foodcost and other costs, while the inpatient expenditures are the expenditures for hospitaltreatment. The study estimates the annual total direct cost of Type 2 diabetes by adding theoutpatientandinpatientcost.

8.2 OutpatientDirectCostofType2Diabetes

Outpatient(OP)directcostsarethepaymentsmadebytheType2diabeticpatientsfortheirou tpatienttreatment.Originally,theOPdirectcostincludingbothmedicalcareandnonmedical care costs has been collected on a monthly basis. Then the annual cost has beenestimated by multiplying the monthly costby twelve. The medicalcare cost includesmedicine costs and cost   on   consultation   and   laboratory   charges,   while   the   non   medical carecostconsistsoftransportationcost,foodcostandotherexpenses.Amongthecomponentsofme dical   care   cost,   consultation   cost   is   the   fee   paid   by   the   patients   to   both   the generalpractionersandspecialistsdoctors,whilethecostonlaboratorychargesincludesthelab

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 andotherdrugsforcomplications,costoninsulinandotherdisposables.Thecostonnonmedicalcare includes mainly three components that are travel expenses, food expenses and otherexpenses. 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, theyhavetowaitformuchtimeforconsultation.Allthesenecessitatethepatientseatingfoodsatrestaurantsandhotels.Thus,thefoodexpenditureheremeanspaymentsmadebythepatientsfor having food from outside home. Finally, all other expenses patients incur including fordietcontrolformthelastcomponentofnonmedicalcare,thatis,theotherexpenditure.

8.3 DistributionofOPDirectCostanditsComponents

ThedistributionofOPdirectcostofType2diabetesoveritscomponentsisrepresentedinFigure2, 3,4and5.

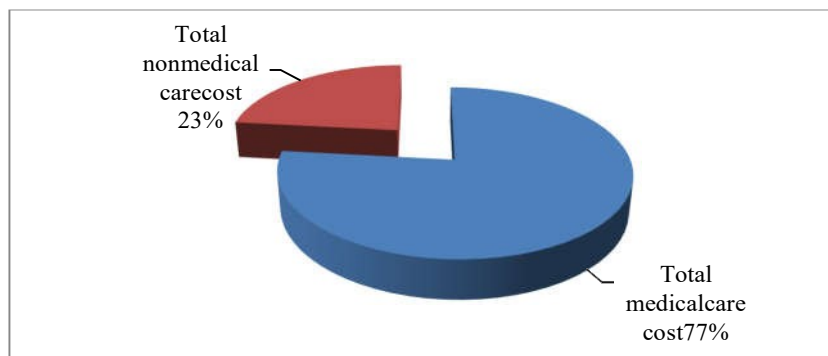*Figure2*ShareofmedicalcareandnonmedicalcarecostSource:PrimaryData

Figure 2 shows that out of the total outpatient direct cost, the share of total medicalcare cost is higher than that of total non medical care cost. The share of medical care costaccountsfornearlythreetimeshigherthanthatofthenonmedicalcost.
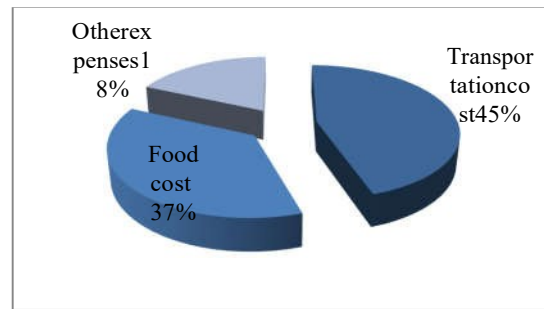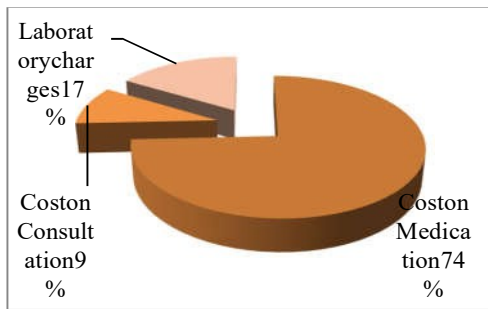
*Figure3*Componentsofmedicalcarecost*Figure4*ComponentsofnonmedicalcareCost.Source:P

rimaryData

ItisevidentfromFigure3thatamongthecomponentsofmedicalcarecost,medicationhasth

ehighestshare(74percent).Thisindicatestheimportanceofantidiabeticagents like oral drugs

and insulin and the medicines used for different types of severediabetics. The Figure also

shows that the share of medication is nearly four times and eighttimes higher than that of

laboratory charges (17 per cent) and consultation cost (9 per cent)respectively.

Figure4indicatesthatamongthecomponentsofnonmedicalcarecost,transportationcost

has the highest share (45 per cent). Further, it also adds that the food cost (37 per

cent)hasnotanegligibleshareinthetotalnonmedicalcarecost.

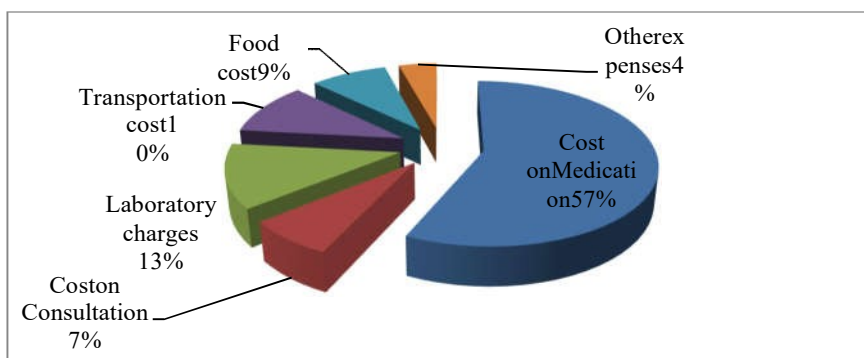*Figure5*DistributionofeachcomponentsoftotalOPdirectcostSour

ce:PrimaryData

As per Figure 5 among the components of total outpatient, direct cost, cost onmedication has the highest share (57 per cent), while the other components have only a lessshareinthetotalOPcost.

8.4 InpatientDirectCostofType2Diabetes

Inthissection,thecostofType2diabetesincurred byInpatients(IP)isexamined.Itincludes both medical care cost and non medical care cost. Medical care cost for inpatientsincludes cost on consultation, laboratory charges, cost on medication, surgery charges, ICUcharges and charges on bed or rooms, while the non medical cost for inpatient care includescost on travelling, food and diet and other expenses. The hospitalisation cost in the study iscalculated as the annual cost incurred by the patients during the year, prior to the surveyperiod.Theprimarysurveyhasrevealedthatoutofthe360diabeticpatients,115(31.94perce nt)werehospitalisedduringtheoneyearperiodpriortothesurvey.

8.5 DistributionofIPDirectCostoveritsComponents

InordertoanalysetheshareofeachcomponentofIPmedicalcarecost,IPnonmedicalcareco standthetotalIPdirectcost,theresearcherhaspreparedcomponentpiechartsasrepresentedinFigur e6,7and8and9.

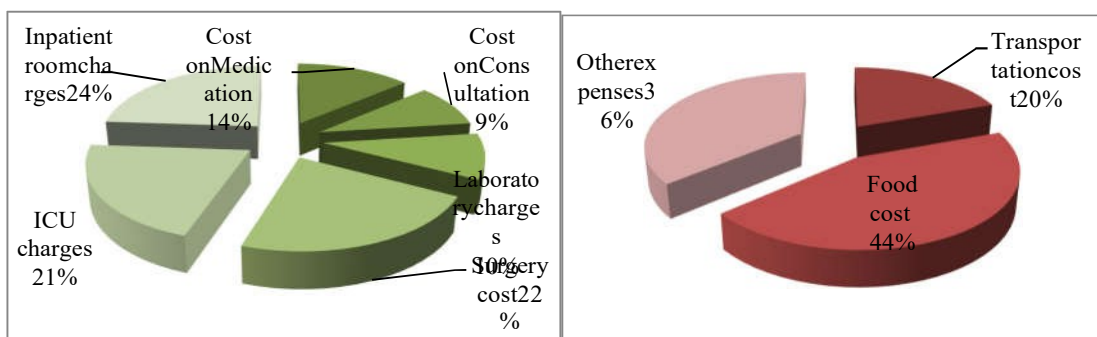*Figure6*IPdirectcost:

cost:Componentsofmedicalcarecost

Figure 7 IP direct

componentsofnonmedicalcarecostSo

urce:PrimaryData

Figure 6 shows that among the components of IP medical care cost inpatient roomchargeshavehadthehighestshareof24percent,followedbysurgerycost(22percent)andICU charges (21 per cent). This indicates that in the case of inpatients having severity, thelength of stay in hospital necessitates higher spending on inpatient room rent, surgery andICUthancostonmedication,consultationandlaboratorycharges.

It is evident from Figure 7 that among the components of IP non medical care cost,theshareoffoodcosthasthehighestshare(44percent).

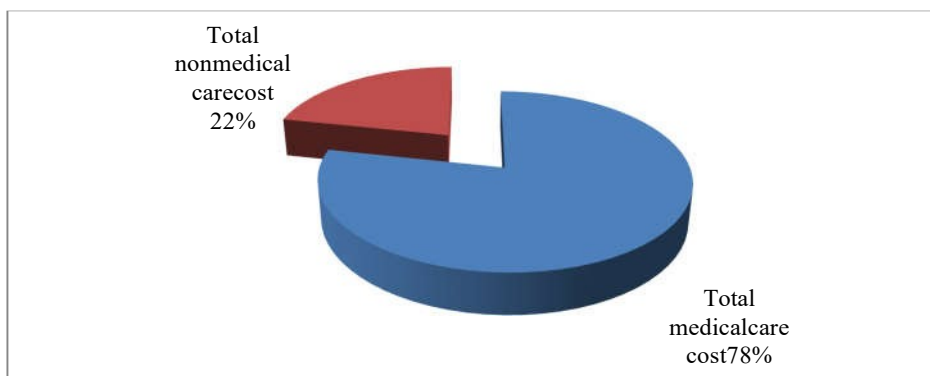*Figure8*IPdirectcost:shareofmedicalcareandnonmedicalcarecostSourc e:PrimaryData

It can be seen from the Figure 8 that out of the total IP direct cost, the share ofmedical care cost has been higher than non medical care cost indicating that the Type 2diabeticpatientswhowerehospitalisedspend78percentoftotalcostfortheirmedicalcare,whichi snearlyfourtimeshigherthanthenonmedicalcarecost.
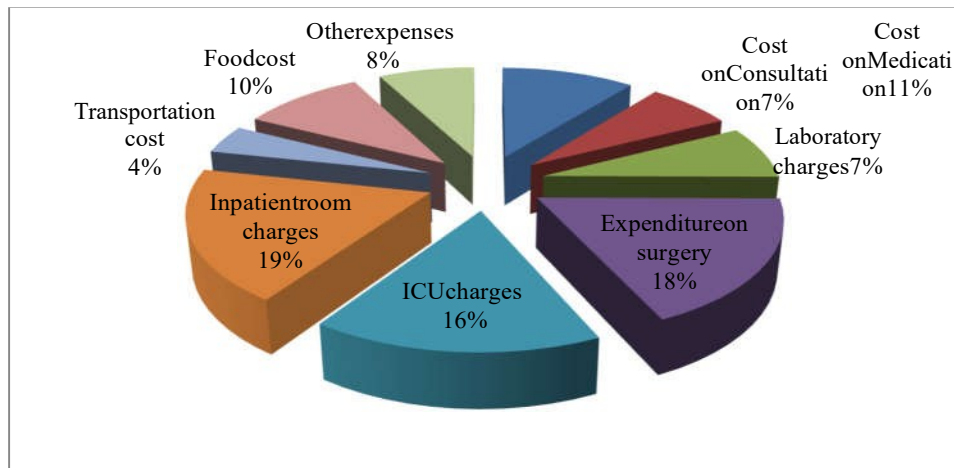
*Figure9*DistributionofeachcomponentsoftotalIPdirectcostSource:PrimaryData

Figure 9 shows that out of the total IP direct cost inpatient room charges, surgerychargesandICUchargesaccountforthehighestshareof19percent,18percentand16percentrespectively.

8.6 TotalDirectCostofType2Diabetes

The total direct cost of Type 2 diabetes is the total cost incurred by the patients forbothoutpatientandinpatientcare.Inthepresentstudy,theresearcherhascalculatedthetotalcost ofType2diabetes,addingtogethertheoutpatientcostandtheinpatientcostincurredbythe patients per year. The total direct cost analysis gives a clear picture of the annualexpenditure that a Type 2 diabetic patient paid for outpatient and inpatient care. Out of the360 sample respondents, 115 patients have sought hospitalized treatment. Therefore theyhave incurred expenditure on both outpatient and inpatient care, while the remaining 245patientshavehadtospendasumforoutpatientcareonly.Theirinpatientcareexpenditureisconsideredzerointheanalysis.

8.7 TotalDirectCost:SummaryStatistics

The summary statistics of annual total direct cost of Type 2 diabetic patients isrepresentedinTable1andTable2.TheTable1showsthemean,SD,median,minimumandmaximum of annual total direct cost while Table 2 represents the skewness, kurtosis andcoefficientofvariationofannualtotaldirectcost.

Table1

TotalDirectCost:TheSummaryStatistics(AverageandDispersion)

Costcomponents	Mean	SD	Median	Minimum	Maximum	N
CostonMedication	10322	12156	5700	0	49800	360
CostonConsultation	1736.4	2502.8	60	60	9800	360
Laboratorycharges	2663.2	3380.5	360	120	13760	360
Expenditureonsurgery	1308.4	6263.3	0	0	100000	360
ICUcharges	1222.8	3082.5	0	0	18000	360
Inpatientroomcharges	1390	2725.1	0	0	15000	360
Totalmedicalcarecost	18643	24422	7920	180	155560	360
Transportationcost	2074.9	1971.8	1200	240	14000	360
Foodcost	2159.3	2420.9	1200	0	14400	360
Otherexpenses	1308.7	3086.6	0	0	26000	360
Totalnonmedicalcare cost	5542.9	6928.7	2400	600	48100	360
Totaldirectcost	24186	30432	9630	1020	173960	360

*Note.*SD-StandardDeviation,N-

NumberofPatientsSource:PrimaryData

It can be seen from Table 1 that the mean (SD) of the total direct cost is Rs. 24186(30432),whilethemediancostisRs.9630.Amongthecomponentsofmedicalcarecost,the

cost on medication accounts for the highest share. The mean (SD) of the medication cost isRs.10322(12156),whilethemediancostisRs.5700.Further,amongthecomponentsofnonmedi cal care cost, the mean (SD) cost is higher for of food cost (Rs.2159.3 (2420.9)) whilethemediancostRs.1200.

Table2.

TotalDirectCost:TheSummaryStatistics(SkewnessandKurtosis)

Costcomponents	Skewness	Kurtosis	CV	N
CostonMedication	1.0016	0.45308	1.1777	360
CostonConsultation	1.1675	0.06571	1.4414	360
Laboratorycharges	1.201	0.18808	1.2693	360
Expenditureonsurgery	11.698	172.36	4.787	360
ICUcharges	2.9455	8.9344	2.5208	360
Inpatientroomcharges	2.6025	7.88	1.9605	360
Totalmedicalcarecost	1.6532	2.9267	1.31	360
Transportationcost	2.2455	6.2687	0.95031	360
Foodcost	1.8664	3.8093	1.1212	360
Otherexpenses	3.3353	14.502	2.3586	360
Totalnonmedicalcarecost	2.3016	6.0021	1.25	360
Totaldirectcost	1.6236	2.2659	1.2582	360

Source:PrimaryDatacollectedfromMalappuramDistrict,Kerala

ItisevidentfromTable2thateachcomponentofthetotaldirectcosthasaveryhighvalueofsk ewnessandkurtosis.Thehighskewness andkurtosis,oftotaldirectcostindicatethatthedistributionoftotaldirectcostdataconsistsofoutlier s.Thepresencesofoutliersarebecausesomepatientshavetopayahigheramountforthetreatmentoft hediseasebecauseofitsseverityandtreatment inprivatehospital.

8.8 TotalDirectCostandSeverityoftheDisease

Severity of Type 2 diabetes has a profound impact on the total direct cost. If thepatient has severity of the disease, he has to spend more treatment cost for both outpatientandinpatientcare.TheimpactofseverityonthedirectcostofType2diabetesisrepresentedinTable3

Table3

TotalDirectCostandSeverityofType2Diabetes

Severityof Type2diabetes	Mean	SD	Median	N	MannWhitneyTestResult		
					Mean Rank	U Statistic	Pvalue
Noseverity	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 PatientsSource:PrimaryData

Table 3 shows that the analysis of the influence of severity on the total direct costreveals that median cost is higher for patients having severity than patients have no severityof the disease. For patients have diabetes severities, the annual mean (SD) cost isRs.45976.48(33927.56)andthemediancostisrupees46630.Ontheotherhand,theannualmean(SD)costofpatientswithout severitywasonlyRs.6357.14(6079.30)andthemediancostRs.2940.Theconclusionfollowsthat,thecostthattheseverelyinflictedpatientshavetobearismuchhigherthanthatbornebypatientswith outcomplications.

To test the variability in the distribution of total direct cost of Type 2 diabetes amongpatientswithorwithoutseverityofthedisease,thefollowingnullandalternativehypothesis

areformulatedandtested.

H_0: There is no significant difference in the direct cost of Type 2 diabetes amongpatientswithorwithoutseverityofthedisease.

H_1: There is significant difference in the direct cost of Type 2 diabetes among patientswithorwithoutseverityofthedisease.

Due to the non normality of the total direct cost data, the study performed a nonparametricMannWhitneyUTesttoassessthehypothesis.Thetestresultindicatesthatthereisas tatisticallysignificantdifferenceinthetotaldirectcostofType2diabetesacrossthetwocategories of severity of the disease, U=3449.000, p<.001. Therefore, we reject the nullhypothesis (H_0) and not rejected the alternative hypothesis that severity significantly affectsthedirectcost.The relationshipispositive.

8.9 TotalDirectCostandtheTypeofHospitals

It has been found by analysing the data that majority of the sample respondentsapproachgovernmenthospitalsfortheiroutpatienttreatmentandprivatehospitalsfor inpatient treatment. The study analysed the hospital wise data of total direct cost of Type 2diabetesandtheresultisgiveninTable4.

Table4

TotalDirectCostofType2DiabetesandChoiceofHospital

Typesof Hospital	Mean	SD	Median	N	MannWhitneyTestResult		
					Mean Rank	U Statistic	Pvalue
Privatehospital	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-StandardDeviation,N-

NumberofPatientsSource:PrimaryData

ItisevidentfromTable4thatthemean(SD)costofpatientswhosoughttreatmentinprivate 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 wasRs.8538.66(11935.19);whilethemediancoststoodatRs.4236.

TotestthevariabilityinthedistributionoftotaldirectcostofType2diabetesamongpatients seek treatment in different type of hospitals, the following null and alternativehypothesisareformulatedandtested.

H_0: There is no significant difference in the direct cost of Type 2 diabetes amongpatientsseektreatmentindifferenttypeofhospitals.

H_1:ThereissignificantdifferenceinthedirectcostofType2diabetesamongpatientsseektre atmentindifferenttypeofhospitals.

Due to the non normality of the total direct cost data, the study performed a nonparametricMannWhitneyUTesttotestthehypothesis.Thetestresultindicatesthatthereisa statistically significant difference in the distribution of total direct cost in the case of thetwotypesofhospitals   whereType2diabetic patientssoughttreatment;U=1990.000,p<0.001.Sowerejectthenullhypothesis(H_0)andacceptth ealternativehypothesisthatthereexisted a statistically significant difference in the direct cost of Type 2 diabetes amongpatientswhoseektreatmentindifferenttypeofhospitals.

8.10 Determinants of Direct Cost of Type 2 Diabetes - Multi Log-LinearRegressionModel

InthestudyofthecostofType2diabetes,itisimportanttoanalyseitsdeterminants,whichwil lhelpunderstandthefactorsthatdeterminethecost.Manystudiesrelatedtothe

direct cost of Type 2 diabetes have reported the influence of various demographic, socioeconomicanddiabetesrelatedfactors.AccordingtoBrandleetal.(2003),patientsdemograph iccharacteristics,diabetesrelatedcharacteristicshavesignificantinfluenceontheannualmedicalc ostsofType2diabetes.InastudybyGrimacciaandKanavos(2014)revealsthatthatdirectcostsofdi abetesareassociatedwithcomplicationandtheresultanthospitalization. Williams et al. (2017) conducted a study in United States, and affirmed thatthereisthesexdifferencesincostofType2diabetes.Chenetal.(2017)intheirstudypointsout that hospitalization, various microvascular and macrovascular complications and drugcostsarethemajorfactorsthatincreasethedirectcostofType2diabetes.

In the study, the researcher seeks to analyse the determinants of direct cost, whichconstitute the major part of the total cost of the disease. The data on total direct cost foroutpatient and inpatient treatment have been highly skewed because of the presence offrequent small values in the data set. This is because in the sample, patients having noseverity of the disease and seeking treatment in government hospitals will incur only a verysmall amount of cost. Due to the asymmetry of the distribution of total direct cost data, amethod of log transformation has been followed for attaining normality of the total directcost. For analysing the determinants of total direct cost, a Log- Linear Regression Model isused. The outcome variable in this model is the total direct cost in logarithmic forms. Totaldirect cost, the dependent variable, is the sum of direct cost on both outpatient and inpatienttreatment incurred during the last year (of survey). The explanatory variables are variousdemographic, socio economic and diabetes related characteristics of the Type 2 diabetespatients.

TheLog-

LinearRegressionModeloftotaldirectcostonitsregressorscanberepresentedas$Ln(Y_i)=\alpha+\alpha_1 D_1$

$+\alpha_2 D_2+\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \alpha_n D_n+e$

Where,

$Ln(Y_i)$=thelogtransformedtotaldirectcost

$D_1, D_2 ..... D_n$=arethedummyexplanatoryvariables

$\alpha, \alpha_1, \alpha_2 .... \alpha_n$areparameters

eistheerrorterm

Table5

MultiLog-LinearRegressionModelShowingDeterminantsofTotalDirectCostofType2Diabetes.DependentVariable-LogTotalDirectCost

Predictors	Coefficient	Std.Error	t-ratio	p-value
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***
PrimaryLevel	0.26925	0.19305	1.395	0.164
HighSchoolLevel	−0.274262	0.20076	−1.366	0.1728
HigherSecondaryLevel	−0.270939	0.23027	−1.177	0.2402
CollegeLevel(RC)				
PrimarySector	−0.0878392	0.07347	−1.196	0.2327
SecondarySector	−0.0819742	0.12105	−0.6772	0.4987
ServiceSector(RC)				
Duration	−0.0126005	0.01568	−0.8035	0.4222
Nofamilyhistory(RC)				

Familyhistory	0.07389	0.06996	1.056	0.2916
Noseverity(RC)				
Severity	0.70075	0.10212	6.862	<0.0001[***]
PrivateHospitals(RC)				
Govt.hospitals	−0.875821	0.14896	−5.879	<0.0001[***]
Nohospitalisation(RC)				
Hospitalisation	1.21247	0.12094	10.03	<0.0001[***]
Meandependentvar	9.222032	S.D.dependentvar		1.405839
Sumsquaredresid	137.2712	S.E.ofregression		0.632620
R-squared	0.806530	AdjustedR-squared		0.797505
F(16,343)	89.36779	P-value(F)		1.0e-111
Log-likelihood	-337.2717	Akaikecriterion		708.5433
Schwarzcriterion	774.6071	Hannan-Quinn		734.8116

Note. RC- Reference CategorySource:PrimaryData

Table5representsthemultivariateanalysisofthedeterminantsofdirectcostofType2 diabetes. It is evident from the table that gender, religion, education,severity of thedisease, type of hospital, and hospitalisation are the significant factors affecting the directcost."Thecoefficientsofdummyvariablesinsemi-logarithmicfunctionsareinterpretedbyfollowingtheapproachsuggestedbyHalvorsenandPalmquist.AccordingtoHalvorsenandPalmquist Approach, the effect of a dummy variable is expressed as exp (β)-1, and thepercentageeffectis100*exp(β)-1)"(ascitedinMwai&Muriithi,2016).Thesamecanalsobe explained by Gujarati (2004). According to him "in order to interpret the coefficients ofdummyregressorsassuggestedbyHalvorsonandPalmquist,taketheantilog(tothebasee)of the estimated dummy coefficient and subtract 1 from it and multiply the difference by100".Inthisstudy,theresearcheralsofollowsthesaidmethodforinterpretingthecoefficientsoft hedummyvariablesintheModel.Genderhashadasignificantinfluenceonthe direct cost and the result indicates that male patients have to pay 43.21% in excess ofwhatfemalepatientspay asdirectcost.Religionalsohasavitalinfluenceonthedirectcost.

The result indicates that the direct cost of Type 2 diabetes that the patients professingChristianity 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. Theresult indicates that the cost illiterate patients pay more than is 84.43% higher than patientshavingcollegeleveleducationdopay.

Severityofthediseaseisanotherimportantfactorthataffectsthevariabilityindirectcost of Type 2 diabetes. The table again reveals that the patients who suffer from severediabetes spend 2.02 times more cost than patients having no severity do pay. Type of thehospital 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 atprivate hospitals incur. Further, hospitalisation also entails a significant increase in the cost.Apatienthavingbeenhospitalisedspends3.36timesmoremoneythanapatientwhohasnotbeenhospitalisedspends.

Themultilog-linearregressionresultalsoshowsthatage,placeofresidence,occupational category, duration of diabetes and family history do not show any significantinfluenceonthedirectcostofType2diabetes.

Hence, it can be concluded that gender, religion, education, severity of the disease,typeofhospitalandhospitalisationarethesignificantfactorsaffectingthedirectcostofType2diabetes.

8.11 ModelAdequacyTests

Theadequacyoftheabovemodel,totaldirectcostofType2diabetes,hasbeentestedusingRamsey'sRESETTestforspecification,WhiteTestforheteroskedasticityandtestfornormalityofresidual.ThetestresultsareshowninTable6.

Table6

ResultsofModelAdequacyTests

Sl. No	Tests	Results
1	RESETtestforspecification	Nullhypothesis:specificationisadequate Teststatistic:$F(2,341)=1.16843$ withp-value=$P(F(2,341)>1.16843)=0.312097$
2	White's test forheteroskedasticity	Nullhypothesis:heteroskedasticitynotpresentTeststatistic:$LM=143.631$ withp-value=$P(Chi\text{-}square(122)>143.631)=0.0880975$
3	Testfornormalityofresidual	Nullhypothesis:errorisnormallydistributed Teststatistic:$Chi\text{-}square(2)=1.93958$withp-value=$0.379162$

Source:PrimaryData

ItemergesfromTable6thatthemodelofdirectcostofType2diabetesisadequateasthe p values of Ramsey's RESET Test for specification, White Test for heteroskedasticity andtestfornormalityofresidualare0.312097,0.0880975and0.379162respectively.

9 ImplicationsoftheStudy

The findings of the study assert that the expenses incurred by diabetes patients for theirtreatmentandtherebycontrollingtheirbloodsugarlevelaremostlyrecurring.Thisincreasestheeconomicburdenofthepatientsforalongperiod.Themedicineslikeoraldrugs,insulinandbothdrugsandinsulinareusedbythepatientsdependingontheirdiseasecondition

diagnosed. Patients having severity of Type 2 diabetes needs specialist's consultation, andmore drugs in quantity and dosage related to the complications in addition to the usualdiabeticdrugs.Furthermore,patientsseekingtreatmentinprivatehospitalincurredfourtimes highercoststhanthoseseekingtreatmentingovernmenthospitals.Alltheseintimatethatforreduci ng the economic burden at the patient level requires much care for reducing thechancesofseverity.Atstatelevel,bettertreatmentfacilitiesingovernmenthospitalsaretobearra nged for treating complications especially for the poor. Thus, appropriate policies areinevitableandneedstomakemoreinvestmentinthepublichealthsector.

As casual workers are belonging to the low social and economic stratum of the societyand earn very low income these higher costs negatively affects their family budget. Thepatients were forced to borrow money from friends and relatives, money lenders, self helpgroupsandbanksformeetingthisoutofpocketexpenses.Thesituationcanwellbedescribedint hewords,'distressfinancing'.Thepatients,duetotheir treatments,arethuslikelytofallin the so called 'distress financing'. Therefore, policy attention is very much essential totackle this problem. The government needs to make more investments in the health caresector by starting more medical colleges, advanced treatment facilities, more number of fairpricemedicalshopsandlaboratoryfacilities.Allthesewillhelpthepatientsforreducingthecost burdenatreasonable levels.

10 Conclusion

The high level of direct cost for treatment of Type 2 diabetes forced the patientswithoutseveritytospendahighershareoftheirfamilybudgetformeetingtheexpensesandp atients with severity or complications definitely had to borrow from all sources they haveaccesstoandeventuallytheyfallintoadebttrap.This,astheusualeconomiclogicsuggests,lea vesasmallproportionofincomeforconsumptionofgoodsandservicesotherthan

medicinesandrelatedservices.Atthemacrolevel,thishighercost

fortreatmentaffectsthepurchasing power of the people for their daily living. A corollary of

this   is   that   the

demandformoneyasproportionofincomeofpatientssharplyincreasestomeetthelifelongrecurrin

gexpensesfortreatmentandmeetingtheunforeseenandimmediatehospitalisation,ifturnstobeim

perative.Alltheseimpairthefamilybudgetandoftenpatientsandtheirfamiliesfallina   financial

crunch. Thus, it is better to launch comprehensive health insurance system in

thecountryforallcitizensirrespectiveoftheiroccupationandprofession.

References

WorldHealthOrganization.(2016).(p.11).*GlobalReportonDiabetes*.Geneva,Switzerland:Aut

hor

WorldHealthOrganisation.(2009).*WHOGuidetoidentifyingtheeconomicconsequencesofdisea

se and injury*. Geneva Switzerland: Department of Health System Financing

HealthSystemandServices

American Diabetes Association. (2013, April). Economic costs of diabetes in the

U.S.in2012.*DiabetesCare,36*,1033-1046

Bloom,D.E.(2014).Theshapeofglobalhealth.*Finance&Development,51*,(p.9).

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *The Journal

ofPoliticalEconomy,70*,(p.9).

Schultz,T.W.(1961,March).Investmentinhumancapital.*TheAmericnEconomicReview,51*,(p.

1).

Brandle,M.,Zhous,H.,Smith,B.R.,Marriott,D.,Burke,R.,Tabaei,B.P.,...Herman,W. H.(2003,August).Thedirectcostoftype2diabetes.*DiabetesCare,26*(Number8),2300-2304.

Grimaccia,F.,&Kanavos,P.(2014).Cost,outcomes,treatmentpathwaysandchalengesfordiabet escareinItaly.*GlobalizationandHealth*,1-6.Retrievedfromhttp:www.globalizationandhealth.com/content/10/1/58.

Williams, J. S., Bishu, K., Dismuke, C. E., & Egede, L. E. (2017). Sex differences in healthcare expenditures among adults with diabetes:evidence from medical expenditure panelsurvey,2002-2011.*BMCHealthServicesResearch*,--8.doi:10.1186/s12913-017-2178-3.

Chen, D., Liu, S., Tan, X., & Zhao, Q. (2017). Assessment of hospital length of stay anddirectcostsoftype2diabetesinHubeiProvince,China.*BMCHealthServiceResearch*,1-9.doi:10.1186/s12913-017-2140-4.

Mwai, D., & Muriithi, M. (2016). Economic effects of non communicable diseases onhousehold 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 PublishingCompany.

.