

Glycaemic Control and Complications of Type II Diabetes Mellitus - At Two Public Sector Diabetic Clinics

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Abstract

Objective: To determine the frequency of complications including retinopathy, nephropathy, cardiovascular diseases and neuropathy and to determine the relationship between poor glycaemic control and complications among diabetic patients visiting outpatient clinics of tertiary care hospitals of Karachi.

Methods: A cross-sectional descriptive study was conducted for a period of six months from April 2015 to September 2015 at the diabetic clinics of Civil Hospital and National Institute of Diabetes and Endocrinology after taking the ethical approval from the Dow University of Health Sciences (DUHS). Type II diabetic patients (n=400) were included through purposive sampling technique after taking written consent. Pregnant/lactating women and terminally ill diabetic patients were excluded. Data was collected through a pre-designed questionnaire. Data was entered and analyzed by SPSS v.21.00. Frequencies and Percentages were calculated. Regression analysis was performed to determine the relationship between glycaemic control and complications of diabetes.

Results: Out of 400 diabetic patients, 323 (90%) participants were above 40 years of age, 278 (69.5%) were females and 122 (30.5%) were males. About 28.8% had cardiovascular complications, 19.2% had renal complications, 65.3% had visual problems and 58% experienced loss of sensation. Approximately 59.5% patients had poor glycaemic control while 39.5% had good glycaemic control. Patients with poor glycaemic control (HbA1c >8.0) were at a higher risk of developing hypertension and numbness of hands and feet.

Conclusion: This study concluded high frequency of complications among Type II diabetes mellitus patients. Proportion of poor glycaemic control was found high. Diabetic complications were associated with poor glycaemic control.

Keywords: Diabetes mellitus, diabetic retinopathy, diabetic neuropathy, diabetic nephropathy, diabetes complications.

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Introduction

Type II diabetes mellitus (DM) is a metabolic disorder of Public Health importance across the world¹. According to the World Health Organization Global estimates, the prevalence of diabetes was

2.8% in the year 2000 and projected to be 4.4% by 2030². The burden of diabetes and its complications is uprising globally affecting people of all age groups³. Diabetes mellitus has been linked with several acute and chronic diseases and complications including end-stage renal diseases, limb amputations, cardiovascular diseases and acute blindness, frequency of diabetic complications vary in different communities depending on various genetic, socio-demographic, lifestyle and environmental factors⁴. Literature suggests that diabetes and its associated complications are among the common reasons for hospitalization and death⁵.

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A systemic review which included thirty-five international studies evidenced that overall prevalence for diabetic retinopathy (DR) was 34.6% and further reported that poor glycaemic controls and longer duration of DM were strongly linked with diabetic retinopathy⁶. Previous literature evidenced that incidence of congestive heart failure and myocardial infarctions are magnified in individuals with diabetes⁷ with poor control of blood glucose. Another longitudinal study, which continued for more than 20 years, concluded that risk of myocardial infarction and stroke increases 2 to 3 folds in diabetic patients⁸. A systemic review from South Asian countries observed that the risk of developing cardiovascular diseases and their complications among diabetic patients was at an earlier age in South Asians as compared to Europeans⁹. A study from Pakistan reported highest prevalence of hypertension as a concurrent complication of Type II diabetes mellitus¹⁰. A Chinese retrospective longitudinal study in which renal biopsy was done reported that nearly 8% of the type II diabetic patients had co-existing diabetic nephropathy¹¹. A previous study from Pakistan reported higher prevalence of diabetic nephropathy among diabetic patients¹². Diabetic neuropathy is an irreversible and painful complication of diabetes mellitus affecting more than 30% diabetic patients globally. Previous literature from Pakistan evidenced that prevalence of diabetic foot syndrome was about 14%, which is quite alarming¹³.

Poor and inadequate glycaemic control is a major public health threat for the development of complications among diabetic patients. Clinical trials have suggested that tight glucose control helps in reducing the burden of diabetic complications¹⁴. Glycosylated haemoglobin measurement reflects the average glycaemic control over a period of three months¹⁵.

Pakistan is facing a rapid rise of Type II DM and related complications especially in urban population which increases the burden on health care system. Previously, studies on diabetic complications have been conducted in Pakistan but recent

update on the state of diabetes and its concomitant complications is lacking. The difficulties to achieve an appropriate glycaemic control in developing countries are attributed to several socio-economic hurdles. The magnitude of poor glycaemic control in patients with type 2 diabetes in Pakistan has not been extensively studied, nor the effect of poor glycaemic control on the development of diabetic complications received greater attention in this setting. The aim of this study is to provide frequency of complications including retinopathy, nephropathy, cardiovascular and neuropathy and determine the relationship between poor glycaemic control and complications among diabetic patients visiting the outpatient clinics of tertiary care hospitals of Karachi.

Patients and Methods

This hospital based cross sectional study was conducted at the diabetic outpatient clinics of National Institute of Diabetes and Endocrinology (NIDE), Dow International Medical College (DIMC) and Civil Hospital Karachi (CHK). Diabetic clinics of CHK and NIDE caters more than 1000 patients monthly. Ethical approval of the study was obtained from Institutional Board Review (IRB-592/DUHS/2015/56). A sample size of 400 was calculated by using Raosoft calculator, keeping the highest proportion of diabetic complications of (55%)¹¹ with 95% confidence interval and 5% margin of error and 10% non-response rate. About 400 Type II diabetes mellitus patients who were attending outpatient clinics from April to September 2015 were included in the study through purposive sampling technique. Diabetic patients who were above 18 years of age of either gender and diagnosed more than six months prior to the date of interview were included. Pregnant/ lactating women and patients who were terminally ill were excluded from the study. Written consent was taken from all study participants before enrolling them in the study. Information regarding demographics, detailed history of complications and its characteristics was obtained through a predesigned and pre-tested questionnaire. Weight and height were measured to calculate Body Mass

Index (BMI), systolic and diastolic pressures were measured by sphygmomanometer. Patients with systolic blood pressure >130 mmHg and diastolic blood pressure of >80 mmHg measured in sitting, lying and standing positions along with pre-existing history of hypertension were considered as Hypertensive. Ophthalmoscopy was done to examine the presence of retinal haemorrhage, macular oedema and exudates for retinopathy performed by the ophthalmologist. Cardiovascular complications like Myocardial Infarction (MI), Acute Coronary Syndrome (ACS) and stroke were assessed on basis of retrospective pre-existing history of the patient and ECG findings. Neuropathy was based on the history of loss of sensation and persistent numbness. Those patients who had latest haemoglobin A1c or Glycated haemoglobin (HbA1c)>8.0 were labeled as having poor glycaemic control. Data was entered and analyzed by SPSS version 21. Mean and standard deviation were calculated for continuous data. Frequencies and percentages were calculated for categorical data. Univariate analysis was performed to determine the association between HbA1c and complications of type II diabetes mellitus with 95% confidence interval and p-value<0.05 was considered significant. In multiple logistic regression model HbA1c>8.0 (poor glycaemic control) among diabetic patients was entered as a dependent variable and all complications were taken as independent variable, p-value<0.05 was considered as significant.

Results

There were 400 diabetic patients included in the study. Demographic data (Table1) shows that mean age of the study participants was 51.6 ±14.31. About 323 (80%) participants were more than 40 years of age, 278 (69.5%) were females and 122 (30.5%) were males, 204 (50%) were obese, 291 (73%) had a positive family history of diabetes and 38 (9.5%) were smokers.

Detailed history regarding microvascular and macrovascular complications of diabetes mellitus was obtained. Fig 1 shows that 115 (28.8%) had

cardiovascular complications, 77 (19.2%) had renal complications, 261 (65.3%) had visual problems, 232 (58%) experienced loss of sensation, and in 34 (8.5%) a history of foot ulcers was present. The frequency distribution of complications of diabetes (Table 2) among study participants shows that females over 40 years of age had more complications as compared to males of similar age group.

Glycaemic control was assessed by recent HbA1c levels. Fig 2, shows that about 238 (59.5%) patients had poor glycaemic control and only 162 (39.5%) had good glycaemic control.

Table 3. shows that regression analysis. In univariate analysis we found that those diabetic patients who had poor glycaemic control (HbA1c >8.0) had higher risk of developing hypertension (C.O.R=2.176, 95% C.I. 1.386-3.418) and numbness of hands and feet (C.O.R= 1.600, 95% C.I. 1.024-2.499) as compared to those who had HbA1c <8.0. In multivariate analysis after adjusting for all co-variate hypertension (A.O.R=2.939, 95% C.I. 1.435-3.992) and numbness of hands and feet (A.O.R= 1.525, 95% C.I. 1.029-2.510) remained significantly associated with poor glycaemic control.

Discussion

The findings of this study suggest that females had higher rates of complications. Moreover, vision defects and sensory losses were common complaints reported by the study participants.

In this study females had higher rates of diabetic complications. Similar findings have been reported by a cross sectional study from Jeddah¹⁶ in which the frequency of diabetic complications was found significantly higher among females. However, in contrast to our findings previous international studies^{17,18} showed linear increase in long-term complications of diabetes in both sexes. These findings are probably due to variation in the duration of diabetes, diabetic control and lifestyle of study patients or it can be explained by the fact that overall flow of female diabetic patients in outpatient clinics was high as compared to male diabetic patients.

Table 1. Socio-demographic characteristics of study participants N=400

Socio-demographic characteristics	Frequency n=400	Percentage (%)
Age in years		
18-30	14	3.5
31-40	63	15.7
>40	323	80.8
Gender		
Male	122	30.5
Female	278	69.5
Body Mass Index (kg/m²)		
≤18.5	20	5
18.6-24.9	176	44
≥25	204	51
Educational attainment		
Illiterate	147	36.75
Primary	90	22.5
Secondary	57	14.25
Graduation	77	19.25
Post-graduation	29	7.25
Total Household income in Rupees		
<10,000		
10,000-30,000	92	23
31,000-50,000	209	52.3
>50,000	62	15.5
	37	9.2
Family history of diabetes		
Yes	291	72.8
No	109	27.2
Smoker		
Yes	38	9.5
No	362	90.5
Any form of substance abuse		
Yes	24	6
No	376	94

Table 2. Age-gender wise distribution of complications of Type II diabetes mellitus among study participants

Complications	Males n=122		Females n=278	
	≤40 years	≥40 years	≤40 years	≥40 years
CVS diseases	2	23	16	74
Kidney disease	0	13	11	53
Foot ulcers	1	8	4	21
Eye disease	7	64	41	149
Infertility	0	4	8	4
Loss of sensation	7	45	45	135
Other complications	5	22	28	73

Table 3. Univariate and multivariate analysis

Complications	HbA1c <8	HbA1c >8	C.O.R (95%C.I.)	p-value	A.O.R(95%C.I.)	p-value
Heart diseases						
Yes	30	85	1.049(0.642-1.715)	0.849	0.686(0.382-1.232)	0.207
No	77	208				
Hypertension						
Yes	43	174	2.176 (1.386-3.418)	0.001	2.939 (1.435-3.992)	0.001
No	64	119				
Kidney diseases						
Yes	18	59	1.247 (0.697-2.230)	0.457	1.197 (0.626-2.289)	0.587
No	89	234				
Vision defects						
Yes	71	191	0.949 (0.595-1.515)	0.828	0.687 (0.408-1.158)	0.159
No	36	102				
Numbness of hands and feet						
Yes	53	179	1.600 (1.024-2.499)	0.039	1.525 (1.029-2.510)	0.06
No	54	114				
Infertility						
Yes	4	12	1.100 (0.347-3.486)	0.872	1.258 (0.384-4.124)	0.705
No	103	288				
Foot ulcers						
Yes	9	25	1.016 (0.458-2.252)	0.969	0.883 (0.378-1.974)	0.728
No	98	268				

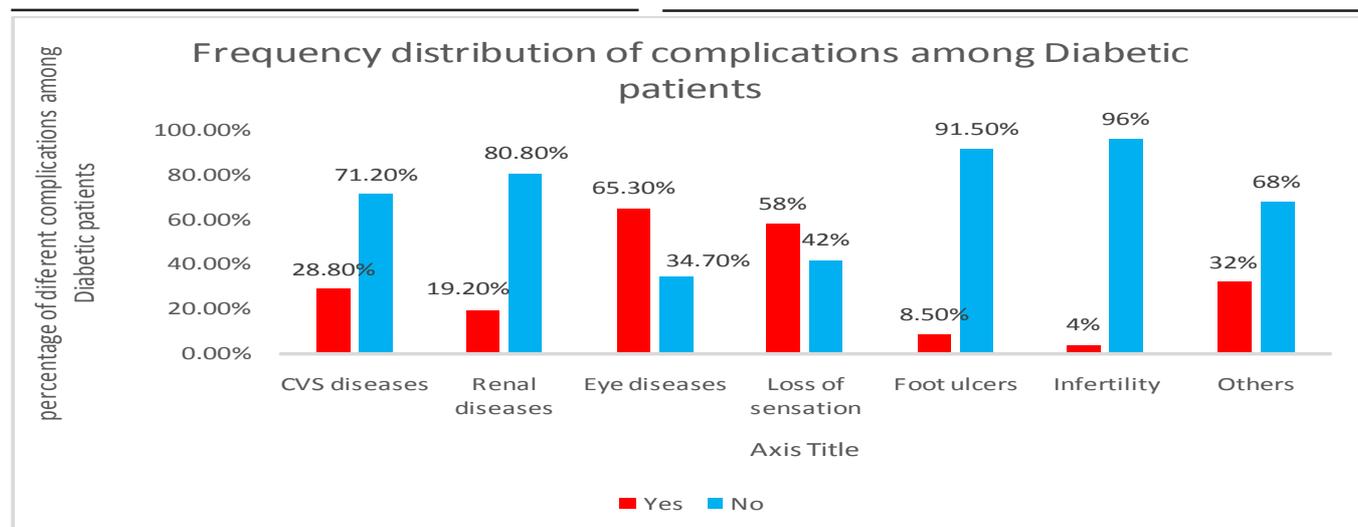


Fig 1. Frequency distribution of complications among diabetic patients

This study found that vision problems and eye diseases were the most frequent complication of diabetes. Nearly one third of the study participants reported vision defects and eye diseases including cataract, retinopathy and glaucoma and eye infections. Similar results have been reported by a study conducted in Germany, which showed highest frequency of diabetic retinopathy amongst all complications¹⁹. A cross-sectional study conducted in nine cities of Pakistan recruited diabetic patients and examined for retinopathy through ophthalmoscope, found that 57% of the study population had undiagnosed diabetic retinopathy²⁰. Another cross-sectional study conducted in Pakistan on newly diagnosed patients of type II diabetes mellitus reported that 15% of the newly diagnosed patients had diabetic retinopathy²¹. However, low frequency of diabetic retinopathy has been reported from Middle East where diabetic nephropathy exceeds the rates of other diabetic complications²². Thus high rates of diabetic retinopathy observed in our study are more likely due to specialized fundal examination carried out by highly qualified experienced ophthalmologist which further improved the diagnostic accuracy of this study.

In this study, the frequency of loss of sensation was found to be the second common complication of diabetes mellitus among study participants, this is consistent with the findings of cross sectional study from Iran which showed a relatively higher proportion of diabetic neuropathy among type II DM patients. Furthermore, they found significant association of diabetic neuropathy among type II diabetics with history of foot ulcers, age of participant and duration of diabetes²³. However, previous study from Pakistan reported a much higher proportion (74%) of diabetic neuropathy among type II diabetic patients. This variation in the frequencies of diabetic nephropathy in Pakistan can be attributed to different methodological approach used in this study²⁴.

This study found that majority of the diabetic patients had deranged HbA1c and they were considered to have poor glycaemic control. Similar re-

sults have been reported by the studies from middle income individual and developing countries^{25,26}. Previous literature individual suggested that poor glycaemic control was associated with increased risk of diabetes related complications. Several socio-demographic, genetic and environmental factors can be attributed to poor glycaemic control in our study population. This finding reflects the worsening of diabetes control over time and need of proper diet, medications and lifestyle counseling to improve the status of glycaemic control in our population. We found that poor glycaemic control was significantly associated with higher odds of developing hypertension and peripheral neuropathy. Similar results have been reported from study from India, which reported that microalbuminuria and hypertension have been significantly associated with poor glycaemic control²⁷. Another study from Pennsylvania reported that poor glycaemic control was significantly associated with peripheral neuropathy and ultimately leads to surgical site infection in limb amputation surgeries²⁸. However in contrast to our findings a study reported that hyperglycaemia and poor glycaemic control are not the only culprit for development of complications as there may be gene involvement²⁹. This is probably due to the fact that hypertension and poor sensations are usually the first signs commonly detected by the patients as well as physician and these complications may lead to development of other complications as they all are interlinked. Limitations of this study include that it is across sectional study so temporal association could not be made. Secondly it is a hospital-based study from two public sector institutes where majority are from lower socio-economic background so these findings cannot be generalized.

Findings of this study suggest early diagnosis and regular follow up for prevention of complications. Good control of blood sugar among diabetic patients and lifestyle modifications can leads to improved quality of life among type II diabetic patients. Further interventional studies are recommended to examine the role of lifestyle modification on the prognosis of diabetes complications in our scenario.

Conclusion

This study concluded a high frequency of complications of type II diabetes mellitus and proportion of poor glycaemic control was alarmingly high. This study reported diabetic complications higher among female gender. Microvascular complications were significantly associated with poor glycaemic control. Educational programs emphasizing on lifestyle modifications along with proper adherence to treatment regimen can benefit in maintaining good glycaemic levels and better prognosis.

Conflict of Interest

Authors have no conflict of interests and received no grant/ funding from any organization for this study.

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