

# A Retrospective Hospital Record Based Analysis on Demographic Profile and Associated Complications/Comorbidities in Type 2 Diabetic Patients Attending a Clinic of Punjab, India

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**Abstract:** *Background:* India is home to the second largest number of adults living with type 2 diabetes (T2D) worldwide. Comorbidities like obesity, hypertension and dyslipidemia have also increased dramatically with rising prevalence of type 2 diabetes and are known to affect both the course and outcome of the disease. The large proportion of patients presenting with T2D in our clinic prompted us to do this study because there is need to increase awareness of metabolic risk factors and how to prevent them. Furthermore, for the prevention and better management of diabetes, it is also vital to know the profile of these patients.

**Methods:** This was a retrospective clinic-record based study involving a total of 760 type 2 diabetic patients visiting our diabetes clinic from 2011 to 2015 to assess demographic profile and co-morbidities/complications associated with T2D patients.

**Results:** Among the 760 study participants, we found that 303 were males and 457 were females. T2D was most common (72.37%) among those between age group of 41-60 years. Almost 75.13% had uncontrolled diabetes. Dyslipidemia (hypertriglyceridemia) was the most common comorbidity seen in nearly 95.92% T2D patients in this study. Nearly 65.53% of the diabetic patients were hypertensive and 59.87% were either overweight or obese. Macrovascular complications were also seen in a significant 24.74% of the T2D patients and amongst microvascular complications neuropathy and retinopathy (20.13% and 19.34% respectively) were common.

**Conclusion:** In this study most of the type 2 diabetic patients were between 41-60 years of age group with females being the majority of them. Neuropathy and retinopathy were most common diabetes related complications. There was high proportion of dyslipidemia, hypertension and obesity among these T2D patients.

**Keywords:** Type 2 Diabetes Mellitus, Demographic profile, Complications, Comorbidities, Hypertriglyceridemia.

## 1. INTRODUCTION

Type 2 Diabetes Mellitus (T2D) is a common metabolic disorder characterized by persistent hyperglycemia, insulin resistance and impaired  $\beta$ -cell function. T2D imposes a major impact on public health due to its life threatening consequences causing end-organ damage, including diabetic retinopathy, nephropathy, neurological and cardiovascular complications [1]. High morbidity and mortality in T2D could also be the result of a complex interplay of several comorbidities like chronic hyperglycemia, hypertension, dyslipidemia and obesity [2].

The metabolic syndrome (MetS) is the term used to describe the coexistence of "metabolic" risk factors such as central obesity, dyslipidemia, hyperglycemia and hypertension. Comorbidities are known to affect both the course and outcome of the disease [3]. Management of metabolic and cardiovascular disease (CVD) risk factors is therefore of great importance in T2D care. Glycemic control provides only a limited success in reducing the macrovascular complications

associated with T2D and therefore addressing other metabolic risk factors (like hypertension, dyslipidemia and obesity) that also contribute to CVD morbidity and mortality is equally important [4-6]. In this observational study, we have tried to find out the common associated complications and comorbidities in patients who were already diagnosed with type 2 diabetes.

## The Epidemiological Transition

With a rise in non-communicable diseases in India, diabetes has been an epidemic. In the last few decades, the prevalence of T2D and associated comorbidities has increased 10 fold in both urban and rural India. As per the very recent International Diabetic Federation (IDF) 2015 data, India is home to the second largest number of adults living with diabetes worldwide, after China. In India, the prevalence of T2D is 8.7 % in 20-79 year age group with 69.2 million people with T2D and the number is expected to increase to 123.5 million by 2040 [7]. This dramatic rise in the prevalence of type 2 diabetes and related metabolic disorders like obesity, hypertension and the dyslipidemia could be related to the rapid urbanization and changes in life style that has occurred during the last few decades. (Refer Table 1 for details).

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**Table 1: Demonstrates Various Factors Responsible for Higher Prevalence of Diabetic and Associated Comorbidities in Indians**

Factors contributing to higher incidence of diabetes and associated comorbidities in Indians [8-15]	
<b>Lifestyle and genetic factors</b>	
Diet rich in carbohydrate and low in omega-3 fatty acids	
Increased availability of refined and processed foods rich in calories	
Sedentary life compared to other ethnic groups	
Abnormal variants of Apo C3 (causing lipoprotein lipase inhibition) and ApoE3 (formation of VLDL) genes.	
Thrifty gene ("Starvation Gene Theory")	
<b>Body composition</b>	
Shorter height	
Lower body mass index	
Excess body fat in relation to body mass index	
Abdominal adiposity	
High waist-to-hip ratio	
High intra-abdominal fat	
Truncal adiposity	
Thick subscapular skinfold thickness	
More abdominal subcutaneous fat	
Less lean body mass	

India is a land of cultural and geographical diversity and therefore prevalence of T2D is not uniform across the country and varies from region to region. Many studies on diabetes prevalence have been conducted in India [16, 17] but little or no data has been available about the diabetic patients of Punjab. It is one of the economically prosperous states with which comes a modern life-style placing the population at increased risk of many non-communicable diseases including T2D. The large proportion of patients presenting with T2D in our clinic prompted us to do this study because there is need to increase awareness of metabolic risk factors and how to prevent them. Furthermore, for the prevention and better management of diabetes, it is also vital to know the profile of these patients. Hence the current research was carried out with an objective to study the demographic profile and associated complications/comorbidities in type 2 diabetes patients attending our clinic.

## 2. METHODOLOGY

### METHOD

This is a retrospective analysis of data collected during routine clinical practice to assess demographic profile and co-morbidities/complications associated with T2D patients.

### Data Collection

The data of T2D patients who attended our clinic from the period 2011 to 2015 were collected from available medical records. Information on demographic details (age, gender, BMI), clinical profile (duration of diabetes), laboratory measurements (glycemic, lipid, blood pressure, renal functions) was gathered. Also, any available information on diabetes complications and associated co-morbidities was recorded. The SAS® system for Windows was used for statistical analysis and "p" value of  $<0.05$  was considered as significant.

## 3. RESULTS

A total of 760 type 2 diabetes patients' data on demographic and clinical profile was collected from medical records and analyzed.

**Table 2: Depicts Demographic Profile of T2D Patients Attending Clinic**

Variable	Number of patients in Study (N=760)
Mean Age (years)	51.87 $\pm$ 9.44 years
Gender	457 females
	303 Males
Age	Patients (N=760) (%)
$\leq$ 30 years	13(1.71%)
31-40 years	90(11.84%)
41-50 years	277(36.45%)
51-60 years	273(35.92%)
$\geq$ 61 years	107(14.08%)
Mean Duration of DM (years)	7.24344 $\pm$ 5.85 years

### Demographic Profile

The information on the age of all type 2 diabetes patients and duration of diagnosis of Diabetes at the time of their visit to clinic was collected from the records. Mean age of the type 2 diabetes patients during their visit to our clinic was 51.87 $\pm$ 9.44 years. Out of total enrollees, 303(39.86%) were males and 457(60.13%) were females. The mean age of male patients was 51.61 $\pm$ 8.95 years and that of female patients was 52.26 $\pm$ 10.14 years. The number of females with disease was more compared to males. The gender distribution among T2D patients (male/female) was 0.66: 1 in this study. Mean duration

of diabetes in these patients was  $7.24 \pm 5.85$  years. Age wise distribution clearly indicates that 14.08% diabetic patients were in age group  $\geq 61$  years, while 35.92% were in the age group of 51-60 years, while 36.45% were in the age group of 41-50 years and 11.84% were in the age group of 31-40 years.

### Clinical Profile of Type 2 Diabetes Patients

This section describes the anthropometric measurements and biochemical parameters of the patients.

#### Body Mass Index (BMI)

Height and weight of patients were measured at the time of their visit to clinic. We could calculate BMI values of 722 patients using data on height and weight. The mean BMI value of patients was  $26.434 \pm 5.40$  kg/m<sup>2</sup>. The mean Body mass index (BMI) was found to be 26.29 kg/m<sup>2</sup> for males and 26.52 kg/m<sup>2</sup> for females in this study.

**Table 3: Depicts BMI of T2DM Patients Attending Clinic**

BMI	(mean $\pm$ SD)
BMI kg/m <sup>2</sup>	$26.434 \pm 5.40$
Males BMI kg/m <sup>2</sup> (mean $\pm$ SD)	$26.29 \pm 5.496$
Females BMI kg/m <sup>2</sup> (mean $\pm$ SD)	$26.52 \pm 5.348$
Variable (BMI- kg/m <sup>2</sup> )	Patients, n=722 (%)
< 18.5 (underweight)	15 (2.08%)
18.5 -24.99(normal)	252 (34.90%)
$\geq 25$ -29.99 (overweight)	280 (38.78%)
$\geq 30$ (obese)	175 (24.24%)

#### Glucose Levels at the Time of Visit to clinic

Fasting and postprandial glucose levels of patients were documented at the time of their visit to clinic. Mean fasting and postprandial glucose levels of these patients were  $181.92 \pm 66.96$  mg/dL and  $260.80 \pm 82.45$  mg/dL respectively. 40.69% (309) of the T2D patients had their fasting glucose level (FBG)  $\geq 150$  mg/dL. Regarding the postprandial measurement (PPG), 70.13 % (533) patients had their glucose level more than 200 mg/dL.

#### Mean Glycosylated Hemoglobin

Glycosylated hemoglobin level (HbA1c) is an indicator of long term glycemic control. At baseline, mean HbA1c values for diabetes patients was  $8.59 \pm 5.37\%$ . A wide variation was observed in the

individual HbA1c values ranging from 5.0% to 12.9 %. Out of 760, 75.13% (571) patients had uncontrolled diabetes i.e. their HbA1c was more than 7 % at the time of their visit to clinic.

**Table 4: The Details of Glucose Level Estimation are Given in Table Below**

Glycemic Variables	Mean
PPG(mg/dL)	$260.7967 \pm 82.45$
FBG(mg/dL)	$181.92 \pm 66.96$
HbA1c (%)	$8.5588 \pm 5.37$
Uncontrolled DM (HbA1c > 7%)	571 (75.13%)

#### Chronic Complications

According to the medical records, patients were screened at the time of their visit, for any long term / chronic complication of diabetes (retinopathy, neuropathy, nephropathy, macrovascular complications). The diagnosis was made by the physician at the reporting centre. In these diabetes patients, neuropathy (including Diabetic foot) was seen in 20.13% patients followed by retinopathy in 19.34% patients. Nephropathy (Albumin:Creatinine ratio  $> 30$   $\mu$ g albumin/mg creatinine) was reported in 106 patients. Macrovascular complications such as coronary artery disease, peripheral vascular disease, etc. were reported in 188 ((24.74%) patients. The prevalence of complications was higher among T2D patients with longer duration of diabetes.

**Table 5: The Distribution of Chronic Complications in these T2D Patients**

Chronic Diabetes Complication	Affected n (%)
Neuropathy	153 (20.13%)
Retinopathy	147 (19.34%)
Nephropathy	106 (13.95%)
Macrovascular	188 (24.74%)

#### Co-Morbidities

Analysis showed that dyslipidemia is most common associated co-morbid condition in these T2D patients followed by hypertension and obesity. High triglycerides were the most common lipid abnormality observed. Mean triglyceride levels were  $247.53 \pm 143.64$  mg/dL. As high as 95.92% (n=729) patients had

**Table 6: Depicting Common Co-Morbidities Associated with T2D and their Mean Values**

Types of Co-morbidities	Patients (N=760) n (%)	Mean value
Hypertension		
SBP $\geq$ 140 mmHg	498	146.24 $\pm$ 21.17
DBP $\geq$ 90 mmHg	533	93.22 $\pm$ 35.88
Dyslipidemia (mg/dL)		
TG $\geq$ 150	729	247.53 $\pm$ 143.64
TG $\geq$ 200	485	
TG $\geq$ 500	13	
TC $\geq$ 200	627	233.05 $\pm$ 41.3
HDL F $\leq$ 50	402	43.94 $\pm$ 10.59
HDL M $\leq$ 40	88	43.57 $\pm$ 4.84
LDL $\geq$ 100	393	96.12 $\pm$ 53.69
VLDL $\geq$ 30	743	94.4649 $\pm$ 53.27
Obesity		
(BMI- kg/m <sup>2</sup> )		26.434 $\pm$ 5.404
< 18.5 (underweight)	15 (1.97%)	
18.5 -24.99(normal)	252 (33.16%)	
$\geq$ 25-29.99 (overweight)	280 (36.84%)	
$\geq$ 30 (obese)	175(23.03%)	

triglycerides  $>$  150mg/dL and about 13 patients in this analysis had TGs more than 500mg/dL.

Other lipid abnormalities seen were raised Total Cholesterol (TC) in 82.5% participants (627), raised Low Density Lipoproteins (LDL) in 51.71% (393) subjects. Low High Density Lipoproteins (HDL) was more common in females with 87.6% (402) of females had their HDL  $\leq$ 50 mg/dL. On the other hand 29.04% of males had their HDL levels below the normal level i.e.  $\leq$ 40 mg/dL. Mean values of all lipid parameters are mentioned in the Table 6.

#### **High Blood Pressure**

Analysis reflected that 65.53% (498) of the participants had systolic blood pressure above normal (SBP  $\geq$ 140 mmHg) and even a higher number of patients 70.13% (533) had raised diastolic blood pressure (DBP  $\geq$  90mmHg). Mean values for SBP and DBP were 146.24 $\pm$ 21.17 and 93.22 $\pm$ 35.88 mm Hg respectively.

#### **Obesity**

Mean BMI of the patients in this analysis was 26.434  $\pm$  5.04 kg/m<sup>2</sup>. As per the classification of BMI, 33.16% had normal BMI; whereas 1.97% patients were underweight, 59.87% of the participants (455) had BMI

above the normal range (BMI $\geq$ 25 kg/m<sup>2</sup>) with 36.84% in pre-obese category and 23.03% in obese category.

#### **4. DISCUSSION**

The prevalence of type 2 diabetes is rising at an alarming rate in India. It is home to the second largest number of adults living with diabetes worldwide, after China with 69.2 million T2D patients (IDF 2015) [9]. In this study Diabetes mellitus, hypertension and Dyslipidemia co-occur at levels much greater than would be predicted solely on the basis of their prevalence. As high as 95.92% of T2D patients had high triglycerides ( $\geq$ 150mg/dL) and 65.53% had systolic blood pressure above normal ( $\geq$ 140mmHg). Also 59.87% of the participants had BMI above the normal range (BMI $\geq$ 25 kg/m<sup>2</sup>). Similar kind of association was seen in a US prevalence study published in 2004, with 72% of diabetes patients in the study had associated dyslipidemia and 74% had associated hypertension. About 56% of the patients had all three, i.e. diabetes, hypertension and dyslipidemia together [18]. As per a recent Indian (Gujarat) study, nearly 60% of the diabetic patients were also hypertensive and almost 3/4th of the patients had high waist hip ratio and 21% patients were obese [19].

With regard to gender, majority (60.13%) of the T2D patients were females and 50% of the total were above 50 years of age. Mean age of the patients in this study was  $51.87 \pm 9.44$  years with mean duration of onset of diabetes around 7 years. This suggests that majority of these patients had onset of Diabetes much below 50 years of age. These results were very much in concordance with the recent ICMR-INDIAB national diabetes survey where over half of the subjects had an onset of diabetes below 50 years of age with  $51.9 \pm 12.4$  years as mean age and  $6.9 \pm 6.4$  years, the mean duration of diabetes [20]. However another Indian study published recently in 2015 states that T2D is more common among those above age of 60 years followed by 51-60 years [19].

With regard to the glycemic control, 75.13% patients in this study had uncontrolled diabetes ( $\text{HbA1c} > 7\%$ ). Mean  $\text{HbA1c}$  was  $8.5588 \pm 5.37\%$  and the mean fasting and postprandial blood sugar levels reported were  $181.92 \pm 66.96$  mg/dL and  $260.80 \pm 82.45$  mg/dL. According to a large multicenter study by Mohan *et al.* from India the mean  $\text{HbA1c}$  of T2D patients was  $8.9 \pm 2.1\%$  and the mean fasting (FPG), post prandial (PPG) plasma glucose levels were  $148 \pm 50$  mg/dl and  $205 \pm 66$  mg/dl respectively [20]. As per the recent Indian (Gujarat) study, almost two thirds participants had uncontrolled diabetes [19].

The prevalence of complications showed a linear trend with duration of disease, with neuropathy and retinopathy being most common seen in 20.13% and 19.34% subjects. Macrovascular complications were also seen in a significant 24.74% of the T2D patients. Similarly, as per recent ICMR-INDIAB national diabetes survey, neuropathy was the most common complication (41.4%), followed by complications: Foot (32.7%), eye (19.7%), cardiovascular (6.8%) and nephropathy (6.2%). The number of diabetic complications increased with mean duration of diabetes [20].

## LIMITATIONS OF STUDY

The data collected for this study was from a single clinic. Hence, this study estimates may not reflect the actual population burden of diabetes in Punjab, but would still be of utility in gauging natural history, comorbidities and complications. Since the data from the period 2011-2015 were collected retrospectively from available medical records, the information on socio economic status, family history, life style practices etc. were missing for those participants. The

data on drugs and treatment practices were largely missing and hence not considered in the analysis.

## CONCLUSION

The type 2 diabetic patients that visited our clinic belong to both genders, however females were much more than males, and majority of the patients were above 40 years at the time of their visit. Our data suggests that dyslipidemia (hypertriglyceridemia) is the most common comorbidity seen with T2D patients followed by hypertension and obesity. All three of these comorbidities could be responsible for high morbidity and mortality in T2D and therefore should be considered and addressed together along with hyperglycemia without any delay.

## COMPETING INTERESTS

The authors have declared that no competing interests exist.

## FUNDING

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## ETHICS STATEMENT

As there was no use of human subjects in this study, only clinic-based data was used for analysis, we didn't seek any ethical approval.

## AUTHOR CONTRIBUTIONS

Dr. Hardev Singh Sandhu conceived the study, collected the data and also helped in manuscript writing and editing. Dr. Savpreet S Sandhu, contributed by refining the ideas and also by editing the manuscript. Dr. Gagandeep Kaur contributed in data analysis and manuscript writing.

## ABBREVIATIONS

BMI	= Body mass index
CVD	= Cardiovascular disease
DBP	= Diastolic blood pressure
FBG	= Fasting blood glucose
HbA1c	= Glycosylated hemoglobin
HDL-C	= High density lipoprotein cholesterol
IDF	= International Diabetic Federation

LDL-C	= Low density lipoprotein cholesterol
MetS	= Metabolic syndrome
PPG	= Post prandial glucose
SBP	= Systolic blood pressure
TC	= Total Cholesterol
TG	= Triglycerides
T2D	= Type 2 Diabetes Mellitus
VLDL-C	= Very low density lipoprotein cholesterol

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