Original Article

REAL-world evidence of risk factors and comorbidities in YOUNG Indian adults with type 2 diabetes mellitus: A REAL YOUNG (diabetes) study

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Abstract

Objective: To assess the clinical characteristics, risk factors, and comorbidities associated with type 2 diabetes mellitus (T2DM) in young adult patients. **Methods:** This is a retrospective, multicentric real-world study that included young adults (18–45 years) with T2DM. Primary information including demographics, medical and family history, biochemical measures (pre-and post-prandial blood glucose levels, glycosylated hemoglobin [HbA1c] and blood pressure, and lipid parameters) smoking and drinking habits were collected retrospectively from the medical records of the respective hospitals/clinics. Data were analyzed using descriptive and appropriate comparative statistics. **Results:** A total of 22,921 patients from 623 sites were included. The median age was 37.0 years and the majority were men (61.6%). The proportion of patients from the age group >35–≤45 years was 62.7%. Among all patients, 46.9% had only T2DM; however, 53.1% of patients had T2DM with other comorbidities (T2DM with hypertension, dyslipidemia, and both). The majority of patients had elevated body mass index (BMI) (overweight, 46.6%; and obese, 22.9%). Family history of T2DM (68.1%) was most common in overall population. Sedentary lifestyle (63.1%), alcohol consumption (38.9%), and regular smoking (23.1%) were the most common associations in patients with T2DM with dyslipidemia and hypertension. Uncontrolled HbA1c level (≥7%) were observed in 79.2% of patients. The level of HbA1c was significantly increased with the duration of T2DM and sedentary lifestyle ($p < 0.001$). **Conclusion:** Higher BMI, family history of T2DM, sedentary lifestyle, alcohol consumption, and smoking were the most common risk facors, while hypertension and dyslipidemia were the most prevalent comorbidities associated with T2DM in young Indian adults.

Keywords: Diabetes, hypertension, risk factors, sedentary lifestyle, young

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Introduction

Diabetes mellitus (DM) is one of the most prevalent noncommunicable diseases that leads to significant morbidity and mortality. The pandemic of DM had affected 9.3% of global population in 2019 and is projected to increase to more than 10% by 2030. In India, the estimated number of people living with diabetes was 77 million in 2019 and it will reach 101 and 134 million by 2030 and 2045, respectively.[1]

The Indian Council of Medical Research–India Diabetes (ICMR-INDIAB) study reported that around 51% of the adult population (with mean age ranging from 35.8 to 43.9 years) from 15 states of India have diabetes or prediabetes.[2] This study also highlighted that the take-off point for diabetes was in the age group of 25–34 years in both urban and rural areas of India indicating the early onset of diabetes from the young age.[2] Indian patients present a high rate of progression from prediabetes to diabetes mainly due to the aggressive nature of the disease.[3,4] Evidence suggests an early onset of type 2 diabetes mellitus (T2DM) in Indians as compared to Western populations.[3-5] Several studies have revealed a high prevalence of T2DM in young population.[6,7] Therefore, it is of paramount importance to screen the young Indian population for early diagnosis of prediabetes to prevent progression to T2DM and the risk of associated comorbidities.

Major risk factors associated with T2DM are obesity, family history, sedentary lifestyle, and comorbidities.[8] Consumption of energy-dense foods with reduced physical activity is the key contributor to obesity among young people. Family history is another factor associated with the development of T2DM in offsprings. Consequently, the offspring of a parent with T2DM has high chances of having T2DM in adulthood and the risk is even higher when both the parents have T2DM.[9] Insulin resistance is a common key mechanism in the pathogenesis of T2DM and other comorbid conditions include hypertension, dyslipidemia, polycystic ovary syndrome, and rheumatoid arthritis. These risk factors predominantly affect the young population which could lead to longer disease exposure and increased chronic complications.[10-12] Hence, the early identification of risk factors is necessary to avoid further complications and comorbidities.

With the view of limited real-world evidence about the prevalence of various risk factors and associated comorbidities among the young adult populations from India, the present real-world study was aimed to determine the patterns of T2DM, risk factors, and comorbidities in young Indian adults.

Materials and Methods

This is a retrospective, multicentric, and real-world study conducted across 623 sites in India. The study protocol was approved by an Independent Ethics Committee. The study was conducted in accordance with the ethical principles that are outlined in the Declaration of Helsinki.

Study population

The present study included young adults of either sex, age within the range of 18 to 45 years who were diagnosed with T2DM. Demographic details (age, sex, weight, height, and sedentary lifestyle), medical and family history, biochemical measures (pre-and post-prandial blood glucose levels, HbA1c, blood pressure, and lipid parameters), smoking and alcohol habits were extracted from hospital/clinical records and a single dataset was created.

Definitions

According to the Standards of Medical Care in Diabetes by the American Diabetes Association (ADA) 2020, optimal glycemic control in nonpregnant adults was defined as HbA1c <7%, while uncontrolled diabetes was defined as HbA1c ≥7%; fasting blood glucose (FBG) was defined as >130 mg/dL, and postprandial blood glucose (PPG) was defined as ≥200 mg/dL.[13]

Obesity: Generalized obesity was defined as BMI ≥25 kg/m^2; overweight as BMI 23–25 kg/m^2, and abdominal obesity was defined as waist ≥90 cm (males) and ≥80 cm (females).[14]

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) software, version 23.0. Data were presented as number and percentages or median (interquartile range). Normal distribution of quantitative data was assessed by Shapiro–Wilk test. The comparison of quantitative and qualitative variables between the groups was done using the Mann–Whitney U test and Chi-square test, respectively. A P value < 0.05 was considered statistically significant.

Results

A total of 22,921 patients with a median (IQR) age of 37.0 (33.0–39.0) years were included in this study. The proportion of men (61.6%) was higher than women (38.4%). A total of 46.6% of the patients were categorized as overweight, 22.9% of patients were obese, 28.9% were normal weight, and 1.5% were underweight. Among the patients, 46.9% had only T2DM, while the incidence of patients diagnosed with T2DM and hypertension was 27.8% followed by T2DM with dyslipidemia and hypertension (13.5%), and T2DM with dyslipidemia (11.7%). Family history of T2DM was present in 15,368 (68.1%) patients. The median levels of HbA1c, fasting plasma glucose (FPG), and postprandial plasma glucose (PPG) were 7.8%, 140.0 mg/dL, and 215.0 mg/dL across all the population, respectively [Table 1]. The correlation coefficient of FPG level was found to be significantly positive with the PPG level (r^2 = 0.5463) [Figure 1a]

Age group-wise observations

The majority of patients belonged to the age group of >35 to ≤45 years (n = 14376). The proportion of patients diagnosed

Table 1: Demographic characteristics of study population

Parameters	Number of patients (*n*=22921)
Age (years)	37.0 (33.0-39.0)
Age group (years), *n* (%)	
≥18-≤25	881 (3.8)
>25-≤35	7664 (33.4)
>35-≤45	14376 (62.7)
Sex, *n* (%)	
Men	14129 (61.6)
Women	8792 (38.4)
Anthropometric parameters	
Height (cm) [*n*=22327]	164.0 (158.0-170.0)
Weight (kg) [*n*=22748]	72.0 (65.0-80.0)
BMI, (kg/m^2) [*n*=22303]	26.8 (24.3-29.6)
Underweight	336 (1.5)
Normal weight	6453 (28.9)
Overweight	10396 (46.6)
Obese	5118 (22.9)
Waist circumference (cm) [*n*=16272]	90.0 (74.0-198.0)
Diagnosed with *n* (%)	
T2DM	10760 (46.9)
T2DM with dyslipidemia	2691 (11.7)
T2DM with HTN	6369 (27.8)
T2DM with HTN and dyslipidemia	3101 (13.5)
Family history, *n* (%) [*n*=22581]	
T2DM	15368 (68.1)
T2DM with HTN	7578 (33.1)
T2DM with dyslipidemia	4294 (19.2)
T2DM with HTN and dyslipidemia	3451 (15.1)
Smoking habits, *n* (%) [*n*=21831]	
Former	1123 (5.1)
Occasional	3470 (15.9)
Regular	3800 (17.4)
No	13438 (61.6)
Alcohol consumption, *n* (%) [*n*=22139]	6380 (28.8)
Sedentary lifestyle, *n* (%) [*n*=21817]	11348 (52.0)
Duration (days) [*n*=21275]	600.0 (180-1080)
Biochemical parameters	
FPG (mg/dL) [*n*=21272]	140.0 (120.0-170.0)
PPG (mg/dL) [*n*=21517]	215.0 (180.0-265.0)
HbA1c (%) [*n*=17404]	7.8 (7.0-8.6)
SBP (mm Hg) [*n*=9065]	142.0 (130.0-158.0)
DBP (mm Hg) [*n*=9034]	90.0 (83.0-98.0)

Data shown as median (IQR), unless otherwise specified. BMI, body mass index; DBP, diastolic blood pressure; T2DM, type 2 diabetes mellitus; FPG, fasting plasma glucose; HbA1c, hemoglobin A1c; HTN, hypertension; IQR, interquartile range; PPG, postprandial plasma glucose; SBP, systolic blood pressure

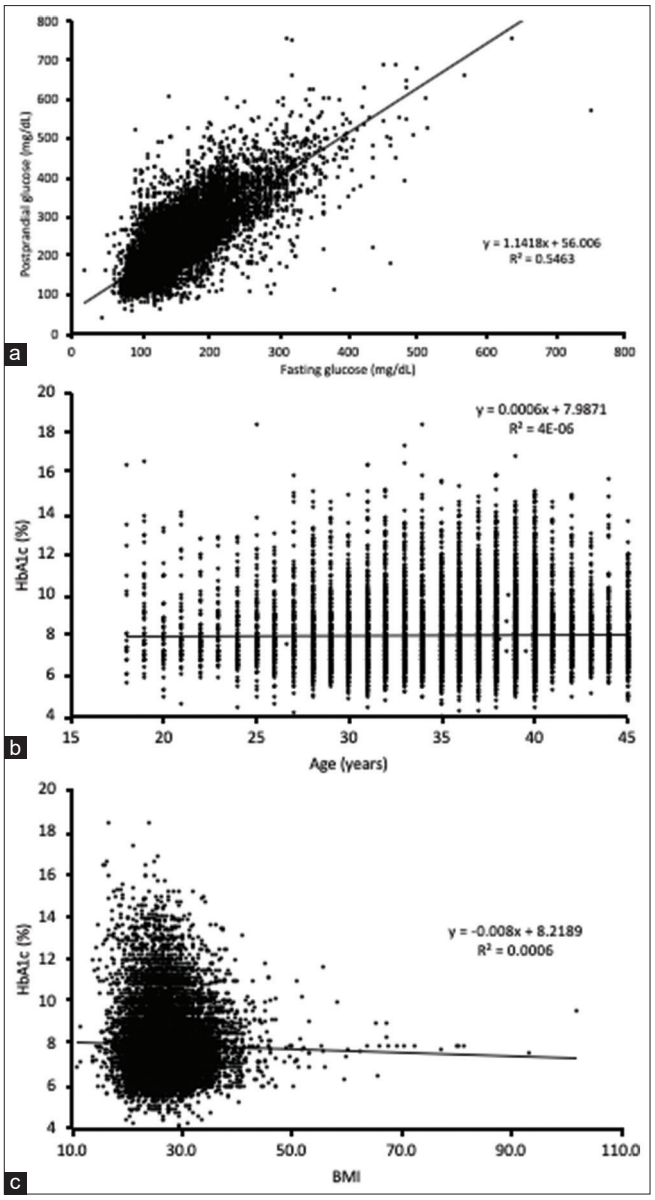

Figure 1: Scatter plots showing the correlation between a) FPG and PPG, b) HbA1c and age, and c) HbA1c and BMI. BMI, body mass index; FPG, fasting plasma glucose; HbA1c, hemoglobin A1c; HTN, hypertension; PPG, postprandial plasma glucose

with T2DM only was significantly higher in the youngest age group (≥18 to ≤25 years, 62.1%), while the proportion of patients having T2DM with hypertension was significantly higher in the age group of >35 to ≤45 years (67.8%) (p < 0.001). The incidence of risk factors showed an increasing trend from the ≥18 to ≤25 years age group to the >35 to ≤45 years age group. The median waist circumference was significantly higher in the patients of age group >35 to ≤45 years (90 cm) as compared to the other two age groups (≥18–≤25 years: 87cm; and >25–≤35 years: 89 cm) (p < 0.001) [Table 2].

A family history of T2DM was reported in more than 60% of the patients across all the age groups (≥18 to ≤25 years, 61.1%; >25 to ≤35 years, 66.7%; and > 35 to ≤ 45 years, 69.2%) [Figure 2a]. Regular smoking and alcohol consumption were more common in patients of the age group >35 to ≤45 years (p < 0.001), while a sedentary lifestyle was observed in over 45% of the population across all the age groups. The mean BMI showed a significantly increasing trend from the youngest age group to the oldest group (p < 0.001) [Figure 3a]. A significantly higher level of mean FPG was observed in patients of the age group >35 to ≤45 years (142.0 mg/dL) compared to the other age groups [Figure 3b, *P* < 0.001]. The mean PPG and HbA1c concentrations were significantly higher in the patients of age group >35 to ≤45 years (216 mg/dL and 7.8%, respectively) as compared to patients of the age group >25–≤35 years (p < 0.001) [Figure 3c and 3d].

Table 2: Age group-wise analysis

Parameters	Group A (≥18-≤25 years) (*n*=881)*	Group B (>25-≤35 years) (*n*=7664)**	Group C (>35-≤45 years) (*n*=14376)#	*P*
Age (years)	24.0 (21.0-25.0)	32.0 (30.0-34.0)	39.0 (28.0-40.0)	<0.001[a-c]
Sex, *n* (%)				<0.001
Men	496 (56.3)	4505 (58.8)	9128 (63.5)	
Women	385 (43.7)	3159 (41.2)	5248 (36.5)	
Waist circumference (cm)	[*n*=656] 87.0 (79.0-95.7)	[*n*=5501] 89.0 (80.0-96.5)	[*n*=10115] 90.0 (80.0-98.0)	0.005[a], <0.001[b,c]
Diagnosed with, *n* (%)				
T2DM	547 (62.1)	4083 (53.3)	6130 (42.6)	<0.001
T2DM with dyslipidemia	81 (9.2)	869 (11.3)	1741 (12.1)	
T2DM with HTN	162 (18.4)	1892 (24.7)	4315 (67.8)	
T2DM with HTN, and dyslipidemia	91 (10.3)	820 (10.7)	2190 (15.2)	
Smoking habits, *n* (%)	[*n*=831]	[*n*=7279]	[*n*=13721]	
Former	72 (8.7)	404 (5.6)	647 (4.7)	<0.001
Occasional	68 (8.2)	1081 (14.9)	2321 (16.9)	
Regular	66 (7.9)	1107 (15.2)	2627 (19.1)	
No	625 (75.2)	4687 (64.4)	8126 (59.2)	
Alcohol consumption, *n* (%)	[*n*=841] 132 (15.7)	[*n*=7412] 2017 (27.2)	[*n*=13886] 4231 (30.5)	<0.001
Sedentary lifestyle, *n* (%)	[*n*=825] 388 (47.0)	[*n*=7334] 3639 (49.6)	[*n*=13658] 7321 (53.6)	<0.001
Duration (days)	[*n*=835] 420.0 (180.0-1080.0)	[*n*=7088] 480.0 (240.0-1020.0)	[*n*=13352] 720.0 (360.0-1080.0)	0.552[a], <0.001[b,c]

Data shown as median (IQR), unless otherwise specified. *n=881; **n=7664; #n=14376 unless otherwise specified. [a]group A vs B; [b]group B vs C; [c]group A vs C. T2DM, type 2 diabetes mellitus; HTN, hypertension; IQR, interquartile range.

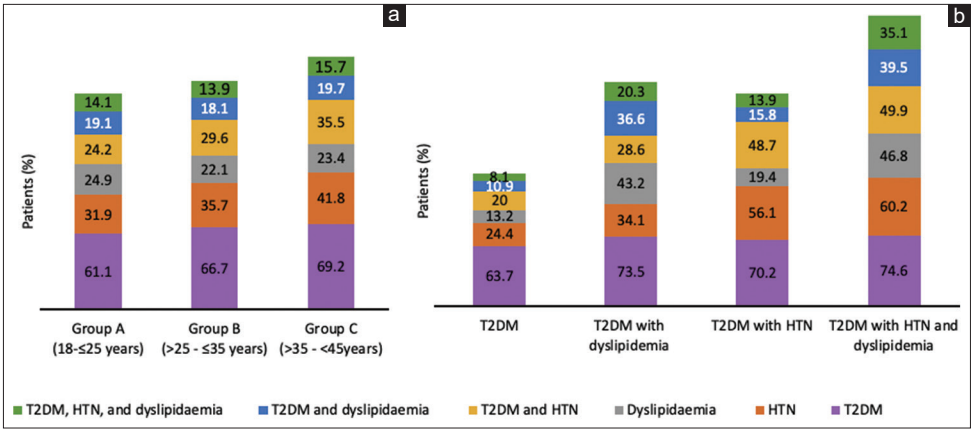

Figure 2: Distribution of patients according to family history (a) and age group and (b) diagnosis. DM, diabetes mellitus; HTN, hypertension

Diagnosis-wise observation

The majority of patients belonged to the age group of >35 to ≤45 years among all the diagnosis groups (T2DM, 57.0%; T2DM with hypertension, 64.7%; T2 DM with dyslipidemia, 67.8%; and T2DM with hypertension and dyslipidemia, 70.6%). Alcohol consumption was highest in the patients diagnosed with T2DM with dyslipidemia and hypertension ($p < 0.001$). Regular smoking was highest in patients having T2DM with dyslipidemia and hypertension (23.1%) and T2DM with dyslipidemia (22.4%). A sedentary lifestyle was more common in patients having T2DM with hypertension and dyslipidemia (63.1%) compared to other diagnosis ($p < 0.001$) [Table 3]. The median PPG level was higher in the patients diagnosed with T2DM along with hypertension and dyslipidemia compared to patients with T2DM, T2DM with hypertension, and T2DM with dyslipidemia. The median HbA1c levels showed poor glycemic control across all the groups (7.6%–8.0%) [Table 3]. A family history of T2DM was reported in majority of the patients (range, 63.7%-74.6%) across all the diagnosis-wise groups. A family history of hypertension was most common in patients diagnosed with T2DM with hypertension (56.1%) and T2DM with dyslipidemia and hypertension (60.2%) ($p < 0.001$) [Figure 2b].

Glycosylated hemoglobin HbA1c level-wise observation

The majority of patients diagnosed with T2DM (n = 13796) had uncontrolled HbA1c levels (≥7%). Of patients with uncontrolled T2DM, a substantial proportion (n = 10793, 78.2%) had levels of HbA1c in the range of ≥7% to ≤9% while 3003 (21.8%) patients had HbA1c levels >9%. Only

3608 (20.7%) patients had controlled HbA1c levels (<7%). Regression analysis showed a large variability between age and BMI with HbA1c [Figure 1b and 1c]. The levels of HbA1c were significantly increased with increasing duration of T2DM (<7%, 540 days; ≥7 to ≤9%, 600 days; >9%, 720 days; $P < 0.001$) and sedentary lifestyle (<7%, 51.3%; ≥7 to ≤9%, 51.5%; >9%, 55.3%; $P = 0.001$).

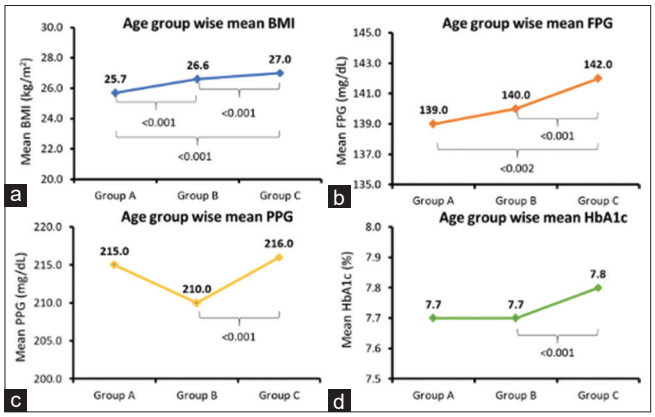

Figure 3: Age group-wise analysis. (a) BMI, (b) FPG, (c) PPG, and (d) HbA1c. *Group A vs B, Group B vs C, Group A vs C. Group A, ≥18–≤25 years; Group B, >25–≤35 years; Group C, >35–≤45 years. BMI, body mass index; FPG, fasting plasma glucose; HbA1c, hemoglobin A1c; PPG, postprandial plasma glucose

Discussion

The present study evaluated the risk factors associated with T2DM along with comorbidities like hypertension and dyslipidemia in young Indians diagnosed with T2DM in the real-world setting. The key findings were as follows: majority of patients were men in the age group of >35 to ≤45 years; around 70% of population had elevated BMI, more than half of the patients had additional associated one or two comorbidities (hypertension, dyslipidemia or both); family history of T2DM, sedentary lifestyle, elevated BMI, alcohol consumption, and regular smoking were the common risk factors associated with T2DM; the incidence of uncontrolled HbA1c level was very common (79.2%); and the risk of elevated HbA1c increased with increasing duration of T2DM and sedentary lifestyle.

Early diagnosis of T2DM has become a fundamental step in the management and reducing the complications and mortality risk associated with T2DM. The present study showed that the incidence of T2DM was strongly associated with nonmodifiable risk factors including age and family history. Around 60% of patients in the youngest age group were diagnosed with T2DM alone. Similarly, an evidence-based STEPS study reported that the prevalence of diabetes was 51% in patients of the age group 25–44 years, suggesting that half of the population were young adults.[15] The burden of DM in India has increased with the

Table 3: Diagnosis-wise analysis

Parameters	Group A (T2DM only) (*n*=10760)*	Group B (T2DM with dyslipidemia) (*n*=2691)**	Group C (T2DM with HTN) (*n*=6369)#	Group D (T2DM with Dyslipidemia and HTN) (*n*=3101)##	*P*
Age (years)	36.0 (32.0-39.0)	38.0 (34.0-40.0)	37.0 (34.0-39.0)	38.0 (35.0-40.0)	<0.001[a-f], 0.009[d]
Age group (years), *n* (%)					<0.001
≥18-≤25	547 (5.1)	162 (2.5)	81 (3.0)	91 (2.9)	
>25-≤35	4083 (37.9)	1892 (29.7)	869 (32.3)	820 (26.4)	
>35-≤45	6130 (57.0)	4315 (67.8)	1741 (64.7)	2190 (70.6)	
Sex, *n* (%)					<0.001
Men	6393 (59.4)	4012 (63.0)	1697 (63.1)	2027 (65.4)	
Women	4367 (40.6)	2357 (37.0)	994 (36.9)	1074 (34.6)	
BMI (kg/m²)	[*n*=10457] 26.2 (23.8-28.9)	[*n*=6182] 27.1 (24.8-29.8)	[*n*=2629] 27.4 (25.0-30.0)	[*n*=3035] 27.8 (25.3-30.8)	<0.001[a-f], 0.041[d]
Waist circumference (cm)	[*n*=7345] 89.0 (80.0-96.0)	[*n*=4491] 90.0 (77.0-96.5)	[*n*=2041] 92.0 (83.0-98.0)	[*n*=2395] 91.0 (80.0-100.0)	0.166[a], 0.007[b], <0.001[c], 0.689[d], 0.158[e], 0.132[f]
Smoking habits, *n* (%)	[*n*=10312]	[*n*=6127]	[*n*=2555]	[*n*=2837]	
Former	487 (4.7)	351 (5.7)	119 (4.7)	166 (5.9)	<0.001
Occasional	1443 (14.0)	1128 (18.4)	400 (15.7)	499 (17.6)	
Regular	1360 (13.2)	1374 (22.4)	411 (16.1)	655 (23.1)	
No	7022 (68.1)	3274 (53.4)	1625 (63.6)	1517 (53.5)	
Alcohol consumption, *n* (%)	[*n*=10440] 2271 (21.8)	[*n*=6209] 2121 (34.2)	[*n*=2608] 868 (33.3)	[*n*=2882] 1120 (38.9)	<0.001
Sedentary lifestyle, *n* (%)	[*n*=10268] 4849 (47.2)	[*n*=6096] 3196 (52.4)	[*n*=2589] 1497 (57.8)	[*n*=2864] 1806 (63.1)	<0.001
FPG (mg/dL)	[*n*=9929] 140.0 (120.0-170.0)	[*n*=5856] 142.0 (124.0-170.0)	[*n*=2573] 140.0 (120.0-175.0)	[*n*=2914] 141.0 (121.0-180.0)	0.011[a], <0.001[b,c], 0.500[d], 0.148[e], 0.244[f]
PPG (mg/dL)	[*n*=10055] 210.0 (177.0-262.0)	[*n*=5947] 219.0 (188.0-262.0)	[*n*=2568] 217.0 (180.0-270.0)	[*n*=2947] 220.0 (183.0-278.0)	0.006[a], <0.001[b,c], 0.146[d], 0.009[e], 0.091[f]
HbA1c (%)	[*n*=8038] 7.6 (7.0-8.5)	[*n*=4624] 7.8 (7.1-8.4)	[*n*=2223] 7.9 (7.1-8.9)	[*n*=2519] 8.0 (7.2-9.0)	<0.001[a,c,d,f], 0.048[b], 0.006[e]

Data shown as median (IQR), unless otherwise specified. *n=10760; **n=2691; #n=6369; ##n=3101, unless otherwise specified. [a]group A vs B; [b]group A vs C; [c]group A vs D; [d]group B vs C; [e]group B vs D; [f]group C vs D. BMI, body mass index; T2DM, type 2 diabetes mellitus; FPG, fasting plasma glucose; HbA1c, hemoglobin A1c; HTN, hypertension; IQR, interquartile range; PPG, postprandial plasma glucose

increasing incidences of T2DM diagnosis (from 5.5% to 7.7%) in the adult population (20 years and older) in the last few decades.[16]

A family history of T2DM is the most important nonmodifiable risk factor responsible for the early occurrence of T2DM. This study showed that more than 60% of patients across all age groups had a family history of T2DM. Similar findings were observed in studies done by Patel *et al.* in Gujarat and Geetha *et al.* in Tamil Nadu which reported positive family history of DM in around 60% of the population.[17,18] People with a positive family history are more prone to develop DM at the early stages of life.[17] This showed that family history of T2DM is highly associated with the increasing risk of T2DM in young population. Early screening in young population can be helpful in identifying the people with a positive history of DM and can be made aware of the early risk of diabetes and modify the lifestyle accordingly. Behavioral modification including proper physical activity and healthy diet will be advised to these patients for delaying the early onset of this disease.

In the present study, among patients diagnosed with T2DM, hypertension (27.8%) was the most common comorbidity followed by dyslipidemia (11.7%) and the triad of T2DM, dyslipidemia, and hypertension (13.5%). Dyslipidemia and hypertension are the major risk factors associated with macrovascular diseases and emphasizing strict glycemic control may help in delaying or preventing macrovascular disease. The comorbid association of T2DM and dyslipidemia was strongly associated with the age group of young adults. Similarly, a STEPS survey reported the prevalence of T2DM-associated comorbidities and among patients with T2DM as 60% of them had hypertension and 36% patients had dyslipidemia.[15]

The present study is a large-scale study involving a large cohort of the young Indian adults and therefore could provide the evidence with respect to the strong correlation between these risk factors.[19,20] A recently published cross-sectional study evaluated that lifestyle factors including alcoholism, smoking, obesity, and family history were the risk factors related to diabetes.[21] In the present study, the prevalence of T2DM was more common in young adult patients of age ranging from 25 to 45 years. Further, family history of T2DM, regular smoking, and sedentary lifestyle were the other risk factors observed in our population. A recent meta-analysis also demonstrated supporting evidence with respect to common risk factors associated with T2DM that include smoking, sedentary lifestyle, and obesity.[22]

The target level of HbA1c in patients with T2DM is usually less than 7%.[13] A high level of HbA1c increases the risk of T2DM-related complications. Therefore, an early intensive management of uncontrolled HbA1c is needed to reduce these complications. In the current study, a majority of patients had uncontrolled HbA1c levels (≥7%). Also, a rising trend was observed with respect to FPG and PPG levels with the severity of HbA1c. This is in accordance with an observational study on patients diagnosed with T2DM who had high mean levels of HbA1c (8.5%) with increased FPG (165.4 mg/dL) and PPG (258.4 mg/dL).[23] A recent TIGHT (The Investigation of Glycosylated Hemoglobin on Therapy in Indian Diabetics) study evaluated glycemic control in adult Indians and their association with microvascular complications. The authors revealed that more than half (53.1%) of the patients were young adults (<55 years) and poor glycemic control was very common in Indian population with T2DM (76.6%).[19] These observations are in concordance with the present study and together indicate a high burden of poor glycemic control in Indian adults.

Several limitations of this study should be considered. This study did not record the socioeconomic and educational statuses of the patients, medications consumed by the patients which could have added valuable data while inferring the observations.

Conclusion

The overall observations indicate that men from the age group of 25–45 years were most commonly affected by T2DM. Elevated BMI, family history of T2DM, sedentary lifestyle, alcohol consumption, and smoking are the risk factors associated with DM in young Indian adults. Hypertension and dyslipidemia are the prevalent comorbidities associated with T2DM. Hence, early diagnosis of diabetes and the associated comorbidities and treating hyperglycemia and its comorbidities to target levels early in the course of disease is necessary for alleviating the long-term risk of T2DM-related complications.

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Ethics approval and consent to participate

The study protocol was approved by an Independent Ethics Committee. As this was a retrospective study, consent was not obtained.

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Conflicts of interest

Dr. Mahesh V. Abhyankar and Dr. Santosh Revankar are employees of USV Pvt Ltd. All other authors have no conflicts of interest.

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