ORIGINAL ARTICLE

Retrospective Study

Risk factors in patients with type 2 diabetes in Bengaluru: A retrospective study

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Abstract

BACKGROUND
Risk factors such as hereditary, ecological, and metabolic are interrelated and contribute to the development of type 2 diabetes mellitus. Family history (FH) of diabetes mellitus, age, obesity, and physical inactivity are some of the risk factors for the development of type 2 diabetes.

AIM
To study various aetiological determinants and risk factors for type 2 diabetes in Bangalore, India. This retrospective study examined questionnaire from patients attending the Diabetes Clinic.

METHODS
Data on various parameters were obtained through a questionnaire from 533 patients on the first visit to the diabetes clinic. Data regarding various aetiological determinants and risk factors *viz*.: Genetic risk factor and few modifiable risk factors were collected. Chi-squared test was used for statistical analysis.

RESULTS
A higher incidence of type 2 diabetes in males and younger population was observed in Bangalore, India. Obesity and FH were significant risk factors for not only type 2 diabetes but also early onset of diabetes. In addition, maternal history of type 2 diabetes and consanguinity increased incidence of early onset type 2 diabetes.

CONCLUSION
Risk factors such as obesity and FH (maternal history of type 2 diabetes) and consanguinity may play an important role in screening of family members of type 2 diabetes patients which may lead to early intervention and reduced risk of subsequent complications. Moreover, susceptible population can be counselled for the management of the type 2 diabetes including periodic investigation of blood glucose levels and lifestyle changes.

Core tip: Obesity, family history, maternal history of type 2 diabetes, and consanguinity play an important role in increasing incidence of early onset type 2 diabetes and should be used as parameters in screening of patients for type 2 diabetes. This may aid in initiating early life style changes to delay the onset of disease and/or reduce its severity. It may also lead to early diagnosis in high risk patients.

INTRODUCTION

According to International Diabetes Federation (IDF) Diabetes Atlas eighth edition 2017, the IDF South-East Asia region is at the epicentre of the diabetes crisis which includes India at the second position behind China with a diabetes population of 82 million. In 2017, there were more than 72946400 cases of diabetes in India. As per the IDF estimates India would gallop to the first position with a diabetes population of 151 million by 2045[1].

Hereditary, ecological, and metabolic risk factors contribute to the development of type 2 diabetes mellitus (T2DM) and are interrelated. Higher risk of diabetes with a family history (FH) of diabetes mellitus, age, obesity, and physical inactivity has been identified. Influence of dietary habits and lifestyle are critical and are responsible for higher occurrence and prevalence of obesity and diabetes in the urban population[2,3]. In addition, individuals with T2DM are often accompanied with co-morbid conditions such as cardiovascular diseases, diabetic neuropathy, nephropathy, and retinopathy[4]. This imminent crisis warrants study of aetiology and risk factors in the "real world" medical practice. "Real world" practice environment is an invaluable source of information and may reveal important trends in the aetiology, management, and treatment of diseases in "real world" medical practice.

Bearing in mind the need to preserve the naturalistic environment and manage with available staff resources for compiling data in the busy medical practice setting and yet generate meaningful conclusions. We at our diabetes centre initiated a data collection drive in form of a questionnaire. Our objective for the retrospective analysis was to gain insights into the patient profile and associated risk factors.

MATERIALS AND METHODS

Patients

This is a retrospective analysis of information obtained from patients with T2DM diagnosis attending the outpatient department (OPD) from July 2016 to July 2017. The patients who visited our OPD for the first time were required to complete a questionnaire. Our staff assists the incapable patients in completing the questionnaire. With the help of the questionnaire, information regarding various aetiological determinants and risk factors were sought namely: genetic risk factor–FH, demographic characteristics- age, gender, and ethnicity and among modifiable risk factors- obesity and physical inactivity.

The bases of categorising patients in different groups are described as follow: (1) FH: It includes information on history of T2DM in either or both parents or a first degree relative, accordingly they were classified as either positive with FH (FH+) or no FH (FH-) of diabetes mellitus; (2) Proposed classification of weight by body mass index (BMI) in adult Asians[5]: < 18.5 kg/m²: Underweight; 18.5–22.9 kg/m²: Normal BMI; ≥ 23 kg/m²: Overweight; At risk 23-24.9 kg/m² increased; Obese I 25-29.9 kg/m² moderate; Obese II ≥ 30 kg/m² severe; (3) Physical activity: "Sedentary" was defined as patients who neither exercised nor walked at all. Among these, patients who were

working had a sedentary job profile. "Strenuous" was defined as people who did some form of exercise like walking, jogging, were trained for marathons or whose job involved significant physical activity like labourers, sales personnel, *etc*.

Statistical analysis
Chi-squared test as recommended by Campbell and Richardson was used. The confidence interval was calculated[6].

RESULTS

Information on various parameters described above was obtained from 533 patients. Among these type 1 diabetes (*n* = 2), gestational diabetes mellitus (*n* = 1), chronic pancreatitis (*n* = 1), prediabetes (*n* = 6) those with no diagnosis of T2DM (*n* = 2), incomplete information (*n* = 2) were excluded. Thus, of the 533 questionnaires obtained, 519 were considered evaluable based on the information provided. The overall characteristics of patients are listed in Table 1.

Gender
Compared to females the proportion of male patients diagnosed with T2DM was significantly higher (55.68% *vs* 44.12%; *P* = 0.0002).

Obesity
Among 519 patients the information on BMI was available for 479 patients. It was noted that the patient population diagnosed with T2DM was significantly overweight or obese (88.30% *vs* 11.69%; *P* < 0.0001). In patients in the age group up to 40 years, the prevalence of obesity and diagnosis of T2DM was higher in males than females (80.76% *vs* 77.27%); whereas in patients 41-50 years the proportion was reverse (females *vs* males; 85.39 *vs* 79.31).

Physical activity
Among the patients who were diagnosed with T2DM, significantly higher proportion of patients followed a sedentary lifestyle compared to a strenuous one (74.89% *vs* 25.10%; *P* < 0.0001). Across the age groups the proportion of patients with a sedentary lifestyle or occupation was significantly higher compared to strenuous. However, even in patients in the latter group, obesity was prevalent; probably due to a diet conducive to weight gain (Table 2).

FH
Among 519 patients, 308 (59.34%) had a FH+ of diabetes. Compared to paternal, the maternal positive FH was higher in patients diagnosed with T2DM (59.68% *vs* 49.52%).

Risk factors for early onset type 2 diabetes
The patients were categorised into five age groups according to the age of onset of type 2 diabetes. It was noted that the proportion of patients with onset of diabetes at younger age groups (≤ 40 years and 41-50 years) was significantly higher, almost twice compared to older age groups (51 to ≥ 70 years) (Table 3).

Further subgroup analysis demonstrated that in the 125 patients with new onset or recent (< 3 mo) onset of diabetes in the one year study period (July 2016-2017), the proportion patients with young onset diabetes [YOD (aged ≤ 40 years)] was numerically the highest (Table 4).

FH
Among 519 patients, 308 had a FH+ of diabetes. Of these 39.93% patients were ≤ 40 years whereas those with FH- the percent patients with YOD were almost half (39.93% *vs* 20.85%, *P* < 0.0001) (Table 5). In non-obese, T2DM patients diagnosed early, about 80% had a FH+. On exclusion of consanguinity cases, 28.57% demonstrated FH+ as a risk factor. However, consanguinity was not a significant independent risk factor in non-obese patients since all consanguineous cases had positive FH (Table 6).

Effect of consanguinity
Among 506 patients for whom the consanguinity data was available, 141 patients reported consanguineous marriages of first-degree cousins (CG+). When these patients were grouped according to age of onset of diabetes, YOD was noted in approximately 35% patients. Also between age group comparison in CG+ patients indicated that, age group 1 (age ≤ 40 years) had almost twice as patients with T2DM than (CG+) age group 3 (age 51-60 years). After adjusting for obesity as a risk factor,

Table 1 Demographic characteristics of outpatient department patients diagnosed with type 2 diabetes mellitus included in the retrospective analysis	
Characteristics	*n* (%)
Total patients	519
Male	289 (55.68)
Female	229 (44.12)
Transgender	1 (0.19)
Average age (yr)	53.28
Ethnicity	Indian

the consanguinity parameter was still a significant risk parameter for developing early onset diabetes (age ≤ 40 years) (CI: 1.7293 to 23.3104; *P* = 0.0178) (Table 7). For the remaining age groups, there was no significant difference between consanguinity and obesity as a risk factor for onset of T2DM.

Effect of hypothyroidism
Among female patients, hypothyroidism did not demonstrate any significant impact on age of onset of diabetes.

DISCUSSION

Gender roles and gender identity are influenced by a complex relationship between genetic, endocrine, and social factors[7]. Gender is a vital genetic factor in regulation of homeostasis and affects susceptibility to cardio-metabolic risk factors. It also influences management of T2DM. Previous studies have demonstrated inconsistent gender distribution among patients diagnosed with T2DM. In 2013, IDF reported that there were 14 million times more men affected with diabetes than women[8]. Studies in Northern India show female predominance whereas data from Southern India have reported higher prevalence in males. Few others have found no gender inclination in prevalence of T2DM[9]. Data from our retrospective analysis reaffirm the higher prevalence of T2DM in males in Southern India. Men apparently are more disposed than women to the consequences of inactivity and obesity, conceivably due to variances in insulin sensitivity and regional fat deposition[10].

Several studies have shown a high prevalence of abdominal obesity and generalized obesity as evaluated by body fat percentage in type 2 diabetic individuals[11,12]. Approximately 44% of the diabetes burden, is attributable to overweight or obesity[13]. In the current study, obesity was a major risk factor for T2DM similar to the findings in previous studies. The data showed that the proportion patients with T2DM being obese or overweight patients was eight times higher than patients who were non-obese/non-overweight. The proposed mechanisms linking the two are increased production of adipokines/cytokines, which may lead to insulin resistance and decrease in levels of adiponectin, ectopic fat deposition, mitochondrial dysfunction which not only decreases insulin sensitivity but also affects β-cell function[14].

Apart from genetics, obesity is rooted primarily in improper diet or physical inactivity, however in the current study we observed that even in patients who had an active or strenuous lifestyle the prevalence of obesity was comparable to the sedentary group. This may imply that the nutritional transition, to highly-saturated fats, sugar, and refined foods and the transport facilities and increased stress, particularly in the urban populations may play an important role[15].

A FH of diabetes is related with a range of metabolic abnormalities and is a strong risk factor for the development of T2DM. The elevated risk of T2DM is mediated, at least in part, by both genetic and common environmental components amongst family members[15]. In our study more than half of the patients diagnosed with T2DM indicated FH+ of diabetes. Also the risk is greater with maternal than paternal FH, the findings in our study substantiate the same since approximately 10% higher risk was noted in patients with positive maternal FH.

Further subgroup analysis according to the influence of factors discussed previously on early onset T2DM showed that the proportion of patients diagnosed with T2DM in the younger age group (≤ 40 years -50 years) was twice as high than the older patient group (> 50 years), *P* < 0.0001.

Subgroup analysis of our data demonstrated that in the patients with new onset or

Table 2 Proportion of patients based on physical activity: Sub grouped based on body mass index

Groups	Age range (Y)	Sedentary (%)	Obese/OW (%)	Strenuous (%)	Obese/OW (%)	Sedentary *vs* strenuous *P*
Group 1	≤ 40	68.00	75	31.90	84.61	< 0.0001
Group 2	41-50	75.60	80.64	24.39	87.50	< 0.0001
Group 3	51-60	77.35	78.04	22.64	91.66	< 0.0001
Group 4	61-70	87.50	100	12.50	100.00	< 0.0001
Group 5	> 70	83.33	50	16.66	50.00	< 0.0001

OW: Overweight.

recent (< 3 mo) onset of diabetes in the one year study period (July 2016-2017), the proportion patients with YOD (aged ≤ 40 years) was numerically the highest compared to other age groups and significantly higher in patients in the age groups < 40-50 years compared to patients in the age group of > 50 years. Like it was pointed out in the discussion regarding FH+ the proportion of patients with FH+ were twice at higher risk of YOD than FH-, which reconfirms that FH+ could be an important factor increasing susceptibility to YOD.

Even in absence of obesity as a risk factor, FH+ had a significant influence on YOD with more than 80% with documented FH+. However, consanguinity was not a significant independent risk factor in non-obese patients. After adjusting for obesity as a risk factor, the consanguinity parameter was still a greater risk parameter for developing early onset diabetes (age ≤ 40 years).

Type 2 diabetes and its related complications enforce heavy health burdens worldwide and there have been not effective measures to fully manage with the diseases. T2DM affecting almost all populations in both developed and developing countries with high rates of diabetes-related morbidity and mortality. Multiple risk factors mainly obesity, FH specifically maternal history of type 2 diabetes and consanguinity play an important role to development of T2DM. To overcome these risk factors, screening of patient's family members is essential to identify in early stage and conquer this disease and improve the quality of life with increases in overall life span of individuals.

Strengths and limitations

We have used subjects of verified incident diabetes mellitus cases within south region of India (Bengaluru). The diversity of the cohort in terms of lifestyle and social characteristics due to metropolis city allows a robust assessment of the risk factors for diabetes mellitus. However, there are some limitations in this study. We used retrospective data that lacked detailed patient's information in detail on lifestyle as well as physical, hereditary, and some laboratory parameters. We have tried to use all possible parameters that define the risk factors most accurately. However, more detailed information on large set of population in future studies can help understand the risk of diabetes.

Table 3 Distribution of patients according to age of onset of type 2 diabetes mellitus

Age at onset of diabetes (yr)		%	P value
Group 1	≤ 40	32.30	0.0001 Group 1 vs 3 < 0.0001 Group 1 vs 4 < 0.0001 Group 1 vs 5
Group 2	41-50	34.04	< 0.0001 Group 2 vs 3 < 0.0001 Group 2 vs 4 < 0.0001 Group 2 vs 5
Group 3	51-60	21.27	
Group 4	61-70	12.18	
Group 5	> 70	0.21	

Table 4 Age at new onset (< 3 mo) of diabetes (years)

Age at new onset (< 3 mo) of diabetes (yr)		n (%)
Total new T2DM diagnosis		97
Group 1	≤ 40	32 (32.98)
Group 2	41-50	27 (27.83)
Group 3	51-60	25 (25.77)
Group 4	61-70	7 (7.21)
Group 5	> 70	6 (6.18)

T2DM: Type 2 diabetes mellitus.

Table 5 Association of family history and age of young onset diabetes

Parameter	FH+	FH-	P value
FH n (%)	308 (59.34)	211 (40.65)	< 0.0001
Age of onset ≤ 40 yr (%)	39.93	20.85	< 0.0001

FH+: Positive family history; FH-: No family history.

Table 6 Association of Family history, consanguinity and young onset diabetes

Risk factor	Non obese T2DM patients (%)		P value
FH+	80	20	P < 0.0001
CG+	51.42	48.57	NS

T2DM: Type 2 diabetes mellitus; FH+: Positive family history; CG+: First-degree cousins.

Table 7 Association of consanguinity and young onset diabetes

Age group	T2DM patients (%)	T2DM obese patients (%)	
≤ 40 yr	34.50	21.83	P = 0.0178
51-60 yr	17.60	14.78	NS
	P = 0.0012	NS	

T2DM: Type 2 diabetes mellitus; NS: Not siginificant.

ARTICLE HIGHLIGHTS

Research background

The highest risk of diabetes with a family history (FH) of diabetes mellitus, age, obesity, and physical inactivity were identified. Influence of dietary practices and lifestyle factors are critical, making occurrence and prevalence of obesity and diabetes significantly more in the urban

population. As per the International Diabetes Federation estimates India would gallop to the first position with a diabetes population of 151 million by 2045.

Research motivation
"Real world" practice environment is an invaluable source of information and reveals important trends in the "real world" medical practice.

Research objectives
Our diabetes centre initiated a data collection drive in form of a questionnaire. Our objective for the retrospective analysis was to gain insights into the patient profile and associated risk factors.

Research methods
Information was obtained through a questionnaire from patients on their first visit to our diabetes clinic. Information regarding various aetiological determinants and risk factors *viz.*: Genetic risk factor and few modifiable risk factors was sought. Chi-squared test is used for statistical analysis.

Research results
Statistical analysis of the organized information obtained indicated a higher incidence of type 2 diabetes in males and younger population. Obesity, FH was significant risk factors for not only type 2 diabetes but also early onset of diabetes. In addition, maternal history of type 2 diabetes and consanguinity were found to play an important role in increasing incidence of early onset type 2 diabetes.

Research conclusions
Particular attention to risk factors like obesity, FH specifically maternal history of type 2 diabetes and consanguinity may be important for screening of patient's family members to initiate early intervention and reduce risk of subsequent complications. Moreover, susceptible population can be counselled regarding the risk, periodic investigation of blood glucose levels and lifestyle changes.

Research perspectives
Multiple risk factors mainly obesity, FH specifically maternal history of type 2 diabetes and consanguinity play an important role to development of type 2 diabetes mellitus. To overcome this risk factors, screening of patient's family members is essential to identify in early stage and conquer this disease and improve the quality of life with increases in overall life span of individuals.

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