Original Article

Prevalence of Type 2 Diabetes Mellitus among Urban Sikh Population of Amritsar

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ABSTRACT

Context: Type 2 Diabetes Mellitus (T2DM) refers to a group of common metabolic disorders that share the phenotype of Hyperglycemia. More than 60 % of the world's population with diabetes comes from Asia. **Aim:** To study the prevalence of Type 2 Diabetes Mellitus among Sikh individuals living in the urban localities of Amritsar. **Settings and Design:** The study was designed in the Faculty of Sports Medicine & Physiotherapy, Guru Nanak Dev University ,Amritsar , Punjab, India. The data collection was carried out in various urban localities of Amritsar. Blood samples were analyzed in the Biochemistry laboratory, whereas data analysis and article preparation was carried out in the Faculty of Sports Medicine and Physiotherapy. **Materials and Methods:** Multi-stage random sampling was done with a sample size of 1089 patients. **Statistical Analysis:** The data was analyzed in Stata 11.2 software. Various tests used in the study are Mean ± SD, Pearson Chi Square Test, Students' *t* test and multiple logistic regression test. **Results:** Our study showed that the prevalence rate of Type 2 Diabetes Mellitus is 23.2% with the confidence interval of 20.7–25.7. Proportionately more patients with T2DM had hypertension (46.6%). Likewise proportionately more patients, 67.5% had hypertrigylerdemia, 67.6% had low HDL levels, 59.2 % had hypercholesterolemia and 73.1% suffered from metabolic syndrome. **Conclusions:** Our study clearly indicates that the young Sikh adults below40 years of age have similar high BMI, WC and WHR to that of the older adults above 40 years of age. It is necessary to adopt appropriate preventive strategies and interventions in high-risk individuals to curb the growing epidemic of diabetes. Innovative community outreach programs need to be designed and implemented to create awareness and early screening and treatment of diabetes, especially in the urban population.

Keywords: Diabetes mellitus, India, prevalence, urban population

Introduction

The International Diabetes Federation has predicted that the number of individuals with diabetes will increase from 240 million in 2007 to 380 million in 2025, with 80% of the disease burden in low and middle-income countries.[1] The Diabetes Epidemic is more pronounced than in India than anywhere else as the WHO reports show that 32 million people had Diabetes in the year 2000.[2] The Indian Council of Medical Research (ICMR) study carried out in 1970's reported a prevalence of 2.3% in urban areas[3,4] which rose to 12 15 % in 2000's. A better understanding about the cause of the modifiable risk factors and habits predisposing this community toward developing Type 2 Diabetes Mellitus (T2DM) is necessary for future planning of healthcare, policy and delivery in order to ensure that the effects of the disease are addressed.[5] So far, no data is available in this particular section of the population regarding the prevalence of the T2DM. The objective of the study was

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to assess the prevalence of T2DM and its risk factors in the urban Sikh population of Amritsar.

Subjects and Methods

The sample size of 1089 patients was calculated. Anticipated prevalence was 20% and allowable precision was 4%.The multi-stage cluster randomized sampling was done using the probabilities proportional size (PPS) method. This study focused on urban Sikhs living in Amritsar, Punjab, India. The Sikhs constitute 70% of the total population of Amritsar according to 2011 census report. The area was arbitrarily divided into five equal zones namely (Z_1, Z_2, Z_3, Z_4, and Z_5). Each zone constituted of 13 censes wards .The list provided the name, age and address of those eligible for voting (>18 years). The fieldwork was completed within a period of 20 months, starting in January 2012. A total of 215 patients from each zone were randomly selected. In the selection of the family in a particular ward, WHO method of sampling (Random method of multi-stage sample collection) was followed to prevent any non uniformity. A model consent form was designed to ensure compliance with ICMR guidelines regarding the use of humans in the research. All the protocols and consent documents were reviewed and approved by the Institutional Ethics Committee of Faculty of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar. The complete detailed performa of all the family members was filled by the investigator, which included number of members in the family, age, educational status and so on. One male and one female member were randomly selected from the list provided by the respondent of the family. These two family members were requested to fill in the self-designed, professionally validated questionnaire. Blood pressure was recorded in sitting position after 5 min rest with a mercury sphygmomanometer according to the standard guidelines. The fasting blood sample (venous blood sample was analyzed for all the biochemical parameters.) was taken for the biochemical readings. The anthropometric readings were taken namely height, weight, waist and hip circumference.

Table 1: Gender-wise distribution of the biochemical parameters in diabetics and non-diabetics (Mean ± SD)

Age (years)	Male	Female
Non diabetics	47.6 ± 14.8	46.6 ±14.5
Diabetics	56.8 ±11.5	55.7 ±12.4
Serum cholesterol (mg per 100 mL)		
Nondiabetics	199.9 ± 45.8	195.5 ±45.7
Diabetics	209.5 ±46.0	208.8 ±43.5
Serum triglycerides (mg per 100 mL)		
Nondiabetics	163.3 ± 63.7	153.5 ± 61.8
Diabetics	142.4 ± 48.6	173.0 ± 56.1
High density lipoprotien (mg per 100 mL)		
Nondiabetics	45.4 ±9.9	45.0 ±10.2
Diabetics	45.7 ±10.1	40.5 ±8.9
Low density lipoprotien (mg per 100 mL)		
Nondiabetics	147.4 ± 46.4	142.2 ±42.7
Diabetics	163.0 ±58.0	155.0 ±43.0
Very low density lipoprotien (mg per 100 mL)		
Nondiabetics	34.0 ± 21.5	31.1 ± 17.7
Diabetics	28.2 ± 9.6	34.4 ± 11.4
SBP (mm of mercury)		
Nondiabetics	125.5 ±12.8	124.8 ±13.6
Diabetics	126.1 ±9.9	129.4 ±11.6
DBP (mm of mercury)		
Nondiabetics	84.0 ± 9.0	83.0 ± 9.3
Diabetics	83.4 ± 7.1	85.8 ± 8.3
BMI		
Nondiabetics	25.8 ± 5.1	26.0 ± 5.3
Diabetics	26.6 ±4.0	26.6 ± 5.1
Waist circumfrence (cm)		
Non Diabetics	83.0 ± 13.2	84.0 ± 13.6
Diabetics	86.0 ± 10.5	85.3 ±1.3
Hip circumfrence(cm)		
Nondiabetics	97.9 ± 14.0	97.3 ± 13.4
Diabetics	97.3 ± 14.6	100.2 ± 12.5
Waist hip ratio		
Nondiabetics	0.86 ± 0.2	0.88 ± 0.2
Diabetics	0.90 ± 0.2	0.86 ± 0.1

Results

Table 1 shows the prevalence of T2DM in the urban Sikh population of Amritsar with respect to the BMI and waist to hip ratio (WHR).

Demographic and clinical profile of patients with and without T2DM

Table 2 shows the gender-wise prevalence of T2DM across different age groups. The study also shows significantly higher rates of T2DM in the older age groups, which has been explained in Table 3. The T2DM rates increase from 4% in the age group of 20–29 years peaking to 32.5% in the age group of 60 + years.

The Chi square outputs of significant proportions with several clinical, demographic and biochemical parameters available to the present study comparing the patients with and without T2DM are shown in Table 4. Proportionately more patients with T2DM had hypertension (46.6%). Likewise proportionately more

Table 2: Age specific and age standardized prevalence of Type 2 Diabetes Mellitus gender-wise in percentage with 95% confidence interval

Age group (in years)	Prevalence of T2DM in % age with 95% CI					
	Male		Female		Total	
	n	Prevalence in % age with 95% CI	n	Prevalence in % age with 95% CI	n	Prevalence in % age with 95% CI
20–29	30	3.3 (-3.4,10.1)	45	4.4(-0.2,10.7)	75	4.0 (0.0,8.0)
30–39	96	9.4(3.4,15.3)	96	7.3(2.0,12.6)	192	8.0(4.0,12.3)
40–49	136	23.5(16.3,30.8)	127	17.3(10.7,24.0)	263	20.5 (15.6,25.4)
50–59	147	33.3(25.6,41.0)	104	29.8 (20.9,38.7)	251	31.9 (26.1,37.7)
60+	178	31.4(24.6,38.3)	130	33.8(25.6,42.1)	308	32.5 (27.2,37.7)
Total	587	25.0 (21.5,28.5)	502	21.5 (17.5,24.7)	1089	23.2(20.7,25.7)

Table 3: Risk factors for Type 2 Diabetes Mellitus

Variables	T2DM		*p*-value	Unadjusted odds ratio with 95% CI	Adjusted odds ratio with 95% CI
	Nondiabetics *n* (%age)	Diabetics *n* (%age)			
Age (in years)					
20–29	72 (8.6)	3 (1.1)	<0.00	1.0	1.0
30–39	176 (21.0)	16 (6.3)		2.2 (0.6,7.7)	2.1 (0.6,7.5)
40–49	209 (25.0)	54 (21.3)		6.2 (1.9,20.4)	5.6(1.7,18.7)
50–59	171 (20.4)	80 (31.6)		11.2 (3.4,36.7)	9.5 (2.8,31.5)
60+	208 (24.8)	100 (39.5)		11.5 (3.5,37.5)	9.2 (2.8,30.5)
Physical activity					
Mild	39 (4.6)	6 (2.3)	0.14	1.0	-------
Moderate	99 (11.8)	24 (9.4)		1.6 (0.6,4.1)	
Heavy	698 (83.4)	223 (88.1)		2.0 (0.9,5.0)	
Type of oil used					
Refined	601 (71.8)	160 (63.2)	0.01	1.0	1.0
Desi Ghee	140 (16.7)	49 (19.3)		1.3 (0.9,1.9)	1.3 (0.9,1.9)
Dalda	95 (11.3)	44 (17.3)		1.7 (1.1,2.6)	1.7 (1.1,2.6)
Hypertension					
Not present	563 (67.3)	135 (53.3)	<0.00	1.0	1.0
Present	273 (32.6)	118 (46.6)		1.8 (1.3,2.4)	1.4 (1.0,1.9)
Serum triglycerides					
<150 mg/dL	407 (48.6)	82 (23.4)	<0.00	1.0	1.0
≥ 150 mg/dL	429 (51.3)	171 (67.5)		1.7 (1.3,2.3)	1.2 (0.9,1.7)
High density lipoprotein					
< 40 mg/dL for males	429 (51.3)	171 (67.6)	<0.00	1.0	1.0
< 50 mg/dL for females					
≥ 40 mg/dL for males	407 (48.7)	82 (32.4)		1.9 (1.4,2.5)	2.1 (1.6,2.9)
≥50 mg/dL for females					
Serum cholesterol					
< 200 mg/dL	472 (56.4)	103 (40.7)	<0.00	1.0	1.0
≥ 200 mg/dL	364 (43.5)	150 (59.2)		1.9 (1.4,2.5)	1.4 (1.0,1.9)
Metabolic syndrome					
Not present	647 (77.3)	68 (26.8)	<0.00	1.0	-------
Present	189 (22.6)	185 (73.1)		9.3 (6.8,12.9)	-------

patients, 67.5% had hypertrigylerdemia, 67.6% had low HDL levels, 59.2 % had hypercholesterolemia and 73.1% suffered from metabolic syndrome.

Detailed correlates of T2DM in univariate analysis and multivariate logistic regression method showing significant predictors of T2DM are summarized in Table 4. Advancing age, medium of cooking (oil used), hypertension, hypercholesterolemia, hypertrigylerdemia, and low serum HDL levels significantly contributed to the increased T2DM risk.

Those with low HDL levels have double the risk of developing T2DM as compared to the individuals who had healthy HDL levels. Similarly, increased serum cholesterol and serum triglycerides increased the risk of developing T2DM one and half times more.

Very few individuals in this study were in the category of healthy BMI. Only 32.6 % (n = 355) of the individuals presented with a healthy BMI as per the WHO guidelines. 6.7% (n = 73) were reported underweight, whereas 36.7% (n = 400) were reported as pre-obese and 24% (n = 261) presented as obese. The patient population presented a picture of general obesity as central obesity was not significantly present in this population. General obesity is related to the abnormal lipid profile values that is increased serum cholesterol, serum triglyride, LDL and decreased HDL values.

Discussion

The overall prevalence of T2DM in urban Sikh population of Amritsar was 23.2% with a slightly higher prevalence along men (25%) compared with women (21.5%).The previous studies reported the prevalence rates ranged from 8.9% to 12.6 % in the various communities and setups.[6-8] The present study also revealed that the prevalence of T2DM increases with age. In the target population of 20 years and above, the prevalence of T2DM increased with age from 4% in 20–29 years old age group through 8% in those aged 30–39 years, 20.5% in age group 40–49 years, 31.9% in 50–59 year-old age group and 32.5% in those aged more than or 60 years. Various studies observed a similar trend in rural populations.[6, 9] This is also quite consistent with the studies carried out outside the Indian subcontinent like in the United States,[10] Denmark[11] and Hong Kong.[12] Hence, age is considered to be the most consistent risk factor around the world for rise in T2DM prevalence.

Variation in prevalence rates (3–11.2%) of diabetes mellitus have been reported from the urban areas of India.[13,14] In the urban population of Delhi, the prevalence of diabetes mellitus ranged from 1.6 to 9%, being more common in obese individuals.[15] In rural Indian population, it is reported to be in the range of 1–5%.[14,16,17] Similarly in a rural community in the Punjab, only 4.6% were diabetic.[18] On bivariate analysis, the prevalence of T2DM was found to be significantly associated with age, hypertension, high-serum Cholesterol, low HDL high TG levels, and medium of cooking that is the oil used. Multiple logistic regression analysis identified age, hypertension, serum cholesterol, serum triglycerides as independently associated factors for diabetes. These findings were similar to those reported by Ramachnadran, *et al*.[8] We also found serum HDL and medium of cooking food (oil used) as independently associated factors for diabetes.

Disturbance of lipid metabolism appears to be an early event in the development of T2DM, potentially preceding the disease by several years.[19] In addition, the different components of diabetic dyslipidemia are believed to be metabolically linked.[20,21] Dyslipidemia associated with insulin resistance is characterized by moderately

Table 4: Body mass index: waist hip ratio distribution in the sample population

BMI	Waist hip ratio	Number
Normal	0.79 ± 0.15	355
Underweight	0.71 ± 0.2	73
Pre-obese	0.91 ± 0.18	400
Obese	0.2	261

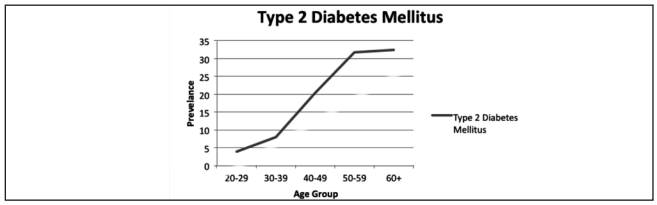

Figure 1: Age-wise trend of Type 2 Diabetes Mellitus

Table 5: Mean and SD values of the anthropometric physiological and biochemical parameters accordingly to age group

Age(in years)	BMI	Waist circumfrence	Waist hip ratio	Serum triglycerides	Serum cholestrol
0–40	26.4 ± 5.3	85.7 ±13.5	0.89 ±0.19	150.7 ± 66.1	188.8 ± 46.2
>40	26.3 ± 5.3	84.9 ±13.7	0.88 ± 0.20	173.3 ±66.5	210.8±47.8
Age(in years)	**High density lipoprotien**	**Low density lipoprotien**	**Very low density lipoprotien**	**SBP**	**DBP**
0–40	44.4 ± 10.3	135.4 ± 42.6	31.1 ±11.5	121.3 ±11.5	80.5 ±8.1
>40	43.4 ±9.3	156.8 ±14.6	34.8 ±14.6	129.2 ±13.2	85.7 ±9.0

increased triglyceride levels carried in very-low-density lipoprotein particles, reduced high-density lipoprotein cholesterol levels carried in small HDL particles, and LDL-C levels that do not differ substantially from those of individuals without T2DM.[20-22] [Figure 1] Prabhakran, *et al*.[23] reported the association between T2DM and hypertension, hypercholesterolemia and hypertriglyridemia. Vikram, *et al*.[24] in their study in North India observed a strikingly high prevalence of abdominal obesity and generalized obesity in T2DM. Although Mohan, *et al*.[25] reported an association between physical activity and T2DM, we did not find an such association in the subject population in the current study. Our study clearly indicates that the young Sikh adults below 40 years of age have similar high BMI, WC and WHR to that of the older adults above 40 years of age [Table 5]. It is necessary to adopt appropriate preventive strategies and interventions in high-risk individuals to curb the growing epidemic of diabetes.

Pertaining to this rising trend of the T2DM in the urban Sikh population of Amritsar, the individuals are getting diabetic in the most productive years of their life. To curb this rise, regular screening of the people should be done to rule out any risk factors associated with T2DM. Educational awareness camps should be organized to make them aware of the disease and its risk factors.

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Conflicts of interest
There are no conflicts of interest

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