Research Article

Evaluation of certain risk factors of type 2 diabetes mellitus: a case–control study

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Abstract

Background: Type 2 diabetes mellitus is the most general type of diabetes. It usually occurs after age of 40 years. In India, the risk factors for diabetes are seen more frequently, and along with this, there is ignorance about diabetes mellitus and the lack of perception about this problem.

Objective: To study the prevalent risk factors (nonmodifiable and modifiable) of type 2 diabetes mellitus and to estimate strength of association of these risk factors and occurrence of the disease.

Materials and Methods: This case–control study was conducted at Endocrine and Diabetes Research Center and Tertiary-Care Hospital, Miraj. Maharashtra, India. Predesigned and pretested pro forma semi open-ended questionnaire was used to collect data from cases and control subjects. A total of 300 type 2 diabetes mellitus cases and 600 control subjects were included in this study.

Result: About 54.33% of cases were observed in the age group of > 40–50 years. About 69.66% were male and 30.34% female cases. There was significant association between modifiable risk factors and type 2 diabetes mellitus, while nonmodifiable risk factors (age, gender) were not significantly associated.

Conclusion: Type 2 diabetes mellitus is a chronic disease of multifactorial causation.

KEY WORDS: Alcohol consumption, body mass index (BMI), cigarette smoking, physical activity, type 2 diabetes mellitus

Introduction

Diabetes mellitus is described in Ayurveda under the names of “Prameha” and “Madhumeha”[1] around 250 BC. It has also been described in Greek Medicine by Arateus as “the melting down of flesh and limbs into urine.”[2] The basic underlying anomaly is a net (relative or absent) shortage of the hormone insulin. Insulin is fundamentally the only hormone that can bring down blood glucose. Type 2 diabetes mellitus is a result of both impaired insulin secretion and resistance to its action—often secondary to obesity (relative deficiency). Type 2 diabetes mellitus often appears gradually when the human body is unable to efficiently use the insulin it produces. Insulin helps sugar get into cells to maintain normal blood sugar (glucose) levels. It often begins after the age of 40 years, but age range can start from 20+ years.[3] The estimated diabetes prevalence worldwide for 2010 was 285 million people corresponding to 6.4% of the world’s adult population. By 2030, 438 million (7.8%) people of the adult population is expected to have diabetes similarly; for India, this increase is estimated to be 87 million in 2030.[4] India has become diabetic capital of the world with over 20 million diabetic patients, and this number is projected to increase to 57 million by 2015.[5] About 80% of type 2 diabetes mellitus is preventable by modifying

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diet, increasing physical activity, and improving the living environment. However, because of lack of effective prevention and control programs, the incidence of diabetes is likely to continue rising globally.[6] Most of the studies related to diabetes mellitus are either of the descriptive nature or depict the clinical profiles. As such, analytic type (case–control study or cohort study) has not been carried out in this area of western Maharashtra; the case–control study of type 2 diabetes mellitus has thus been conducted.

Materials and Methods

This case–control study was conducted for 1 calendar year (i.e., from April 1, 2010 to March 31, 2011).

Study Area and Place

The cases were taken from Dr. Patawardhan's Endocrine and Diabetes Research Center and Pathology Laboratory, Miraj, Maharashtra, India. The control subjects were obtained from tertiary-care government hospital, Miraj.

Sample Size

Sample size was estimated by using 40% prevalence rate with an allowable error of 15% of prevalence rate, and it came to 266. This minimum requisite sample size of patients presenting type 2 diabetes mellitus was rounded up to the higher side, and, thus, the sample size of total 300 qualifying patients was achieved by using simple randomization method of sampling. Diabetes mellitus is largely a silent asymptomatic disease. Its early detection depends upon various factors related to human perception and behavior. Therefore, its reliable prevalence rate may not be calculated. At the most, we can think of the modest estimates depending upon rates quoted by authentic sources such as the WHO or ICMR. Therefore, we took 40% prevalence rate for calculation in concurrence with the estimated prevalence quoted by the WHO.[7] Total ratio of cases-to-controls was maintained at 1:2 with the method of group matching. Thus, a total of 600 control subjects were obtained from the tertiary-care government hospital ensuring that all the other characteristics are comparable except the presence of type 2 diabetes mellitus in the control group.

Data Collection

A predesigned, pretested structural questionnaire was used for data collection. All the questions were explained to the study subjects, and total confidentiality was assured. Ethical clearance for this study was accorded by Institutional ethical committee in April 2010. Blood pressure was recorded in a sitting position in right arm by using Diamond Deluxe mercury sphygmomanometer. Single sphygmomanometer was used for checking all the study subjects, and it was tested for accuracy time-to-time throughout the study. Height of each study subject was measured to the nearest 0.1 cm by using a prestandardized and appropriately calibrated standardized flexible measuring tape. The same procedure was followed for measuring the weight to the nearest 50 g by using standardized weighing machine. By using a measuring tape, waist circumference was measured at the level which was midway between the lowest rib margin and the iliac crest and hip circumference measured around widest portion of buttocks.

Inclusion Criteria

Cases: All patients of type 2 diabetes mellitus >40 years of age (both genders) who were willing to participate in this study.

Control subjects: All the patients >40 years of age (both genders) not presenting type 2 diabetes mellitus who were willing to participate in this study.

Exclusion Criteria

Persons who were not willing to participate in the study and had not given written consent were excluded from this study.

Cases: All type-1 diabetes mellitus patients and all type 2 diabetes mellitus patients of < 40 years of age group (both genders), critically ill persons, and pregnant female subjects were excluded from the study.

Control subjects: Persons < 40 years of age (both genders), critically ill persons, and pregnant female subjects were excluded from the study.

Analysis of Data

Data were entered in Microsoft excel sheet, and analysis was done using statistical software SPSS. Odds ratio and χ^2-test were used for statistical analysis.

Definition of Type 2 Diabetes Mellitus

A type 2 diabetic patient means a person who has been proved to be revealing type 2 diabetes mellitus on the basis of pertinent investigations and certified duly by the competent endocrinologist to that effect. The persons of both genders >40 years of age fulfilling the above criteria were labeled as presenting type 2 diabetes mellitus, irrespective of the duration of illness.

Result

Maximum persons were in the age group of >50–60 years in both the groups, accounting for 55% of total study population. This was followed by age group of >40–50 years age group, accounting for 35% of total study subjects. Old people (>60–70 years) and very old people (>70 years) accounted for about 10.67% in both the groups. In the cases, the minimum age recorded was 41 years, and the maximum age recorded was 74 years. In the control subjects, the minimum age recorded was 41 years, and the maximum age recorded was 76 years. There was statistically nonsignificant association among the various age groups of cases and control subjects [Table 1]. A total of 209 (69.66%) cases and 417 (69.5%) control subjects were men. Ninety-one (30.34%) cases and 183 (30.5%) control subjects were women [Figure 1].

Table 1: Age-wise distribution of study subjects

S. no.	Age group in years	Cases (*n* = 300)	Control subejcts (*n* = 600)	Total (*n* = 900)
1[a]	>40–50	105 (35)	210 (35)	315 (35)
2[a]	>50–60	163 (54.33)	326 (54.33)	489 (54.33)
3[b]	>60–70	25 (8.33)	50 (8.33)	75 (8.33)
4[b]	>70	7 (2.34)	14 (2.34)	21 (2.34)
Total		300 (100)	600 (100)	900 (100)

[b]Parentheses show group-wise percentages.
Odds ratio = 1[a] (a = S. no. 1: 2); odds ratio = 1[b] (b = S. no. 3: 4)
$\chi^2 = 0$; $df = 3$; $p = 1$; Not significant.

Table 2: Family history of type 2 diabetes mellitus observed in study subjects

S. no.	Family history	Cases (*n* = 300)	Control subjects (*n* = 600)	Total (*n* = 900)
1[a]	Absent	225 (30.82)	50 (69.18)	730 (100)
2[b]	One parent	57 (45.23)	69 (54.77)	126 (100)
3[b]	Both parents	18 (40.9)	26 (59.1)	44 (100)
Total		300 (33.33)	600 (66.67)	900 (100)

[b]Parentheses show group-wise percentages.
Odds ratio = 0.56 (absent[a] vs. present[b]).
$\chi^2 = 11.24$; $df = 2$; $p = 0.003$; Significant.

Table 3: Physical activity observed in study subjects

S. no.	Physical activity	Cases (*n* = 300)	Control subjects (*n* = 600)	Total (*n* = 900)
1[a]	Sedentary/mild	137 (45.66)	204 (34)	341 (37.89)
2[b]	Moderate	122 (40.67)	316 (52.67)	438 (48.67)
3[b]	Vigorous	41 (13.67)	80 (13.33)	121 (13.44)
Total		300 (100)	600 (100)	900 (100)

[b]Parentheses show group-wise percentages.
Odds ratio = 1.63 (S. no. 1[a] vs. S. no. 2[b] + 3[b]).
$\chi^2 = 13.12$; $df = 2$; $p = 0.0014$; Significant.

Table 4: Alcohol consumption observed in study subjects

S. no.	Alcohol consumption	Cases (*n* = 300)	Control subjects (*n* = 600)	Total (*n* = 900)
1[a]	Absent	206 (68.67)	458 (76.33)	664 (73.78)
2[b]	Present	94 (31.33)	142 (23.67)	236 (26.22)
Total		300 (100)	600 (100)	900 (100)

[b]Parentheses show group-wise percentages.
Odds ratio = 1.37 (present[b] vs. absent[a]).
$\chi^2 = 6.961$; $df = 2$; $p = 0.0307$; Significant.

Table 5: Distribution of study subjects as per blood pressure

S. no.	Blood pressure (mm Hg)	Cases (*n* = 300)	Control subjects (*n* = 600)	Total (*n* = 900)
1[a]	Normal (<120/<80)	116 (38.67)	358 (59.67)	474 (52.67)
2[b]	Prehypertension (120–139/80–89)	122 (40.67)	160 (26.66)	282 (31.33)
3[b]	Hypertension stage 1 (140–159/90–99)	52 (17.33)	70 (11.67)	122 (13.56)
4[b]	Hypertension stage 2(≥160/≥100)	10 (3.33)	12 (2)	22 (2.44)
Total		300 (100)	600 (100)	900 (100)

[b]Parentheses show group-wise percentages.
Odds ratio = 0.42 (normal[a] vs. above normal[b]).
$\chi^2 = 35.45$; $df = 3$; $p = <0.0000001$; Highly significant.

Table 6: Distribution of study subjects as per degree of obesity

S. no.	Degree of obesity (BMI = kg/m²)	Cases (*n* = 300)	Control subjects (*n* = 600)	Total (*n* = 900)
1	< 18.5 (Underweight)	8 (2.7)	15 (2.5)	23 (2.56)
2	18.5–24.99 (Normal)	197 (65.66)	480 (80)	677 (75.22)
3	25–29.99 (Overweight)	71 (23.67)	75 (12.5)	146 (16.22)
4	≥30 (Obese)	24 (8)	30 (5)	54 (6)
Total		300 (100)	600 (100)	900 (100)

Parentheses show group-wise percentages.
Odds ratio: 0.45 (BMI < 25 kg/m² vs. BMI ≥ 25 kg/m²).
$\chi^2 = 23.86$; $df = 3$; $p = 0.00002$; Highly significant.

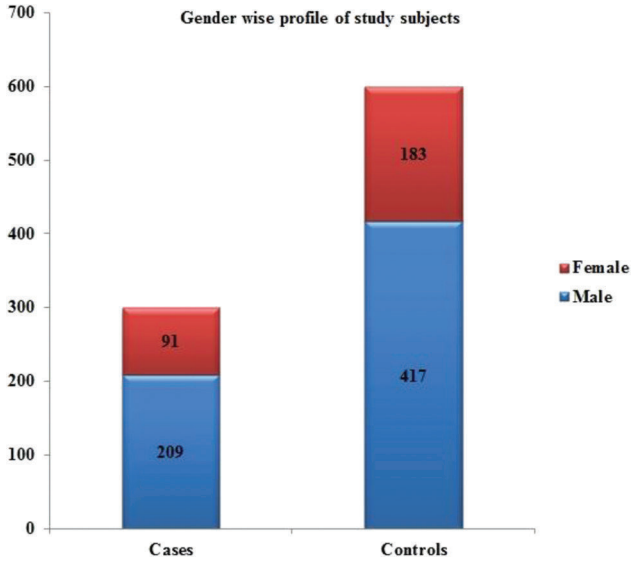

Figure 1: Gender-wise profile of study subjects.

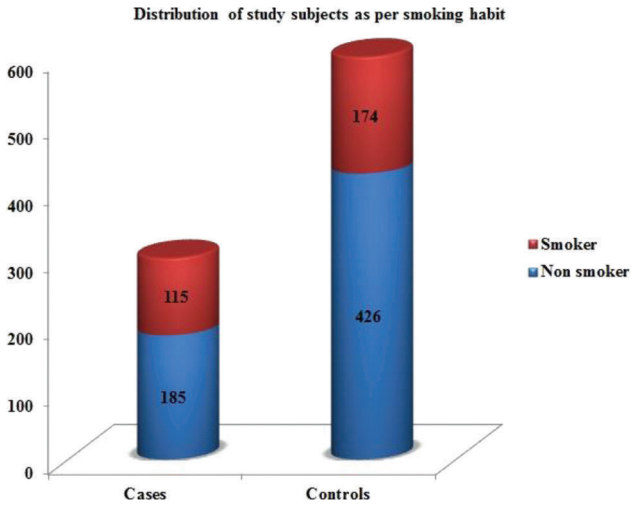

Figure 2: Distribution of study subjects as per smoking habit.

Two hundred (66.67%) cases and 390 (65%) control subjects were from urban area, while 100 (33.33%) cases and 210 (35%) control subjects were from rural area. Of the total 300 type 2 diabetic patients, only 75 (i.e., one-fourth) showed positive family history of diabetes mellitus and remaining 75% (225 cases) showed no history of diabetes mellitus in the family. Positive family history of diabetes mellitus showed statistically significant association with the disease. Odds ratio of 0.56 showed the chance of development of type 2 diabetes mellitus was about half when compared with positive family history in one or both parents [Table 2]. Maximum number of study subjects [438 (48.67%)] were doing one or other moderate physical activities, while 341 (37.89%) and 121 (13.44%) study subjects belonged to sedentary and vigorous type of activity, respectively. Significant association was observed in sedentary/mild physical activity as risk factor for the development of type-2 diabetes mellitus [Table 3]. In this study, history of alcohol consumption was absent in all the female subjects. Of 300 cases, in 206 (68.67%) cases, history of alcohol consumption was absent, while 94 (31.33%) cases were alcohol drinkers. The association between alcohol intake and type-2 diabetes mellitus was found to be statistically significant ($p < 0.05$), with an odds ratio of 1.37 for those in which alcohol consumption was present, which indicated that the alcohol consumption did enhance the risk of type-2 diabetes mellitus [Table 4]. Except five female subjects (control subjects), none of the female participants presented the history of cigarette smoking. A total of 115 (38.33%) cases and 174 (29%) controls were cigarette smokers. The χ^2-test indicated significant correlation between smoking and occurrence of type-2 diabetes mellitus (i.e., higher risk among smokers than nonsmokers) [Figure 2]. Majority of cases [i.e., 122 (40.67%) cases] were in prehypertensive stage. Sixty-two cases were with hypertension, of which 52 were in stage 1 hypertension and 10 cases presented stage 2 hypertension; 116 (38.67%) cases were normotensive. Theχ^2-test indicated statistically highly significant association between hypertension as risk factor and type 2 diabetes mellitus [Table 5]. Majority of cases [i.e., 197 (65.66%) cases] showed normal BMI. Seventy-one (23.67%) cases were overweight, while 24 (8%) cases showed mild obesity. Eight (2.7%) cases were underweight. None of the cases showed moderate or severe obesity.

BMI-wise difference was statistically highly significant risk factor for developing type 2 diabetes mellitus [Table 6].

Discussion

In this case–control study, 54.33% of type 2 diabetes mellitus cases were in the age group of >50–60 years, followed by >40–50 years (35%), >60–70 years (8.33%), and least in >70 years age. Association between different age group as risk factor and type 2 diabetes mellitus was statistically not significant. Similarly, studies by Radzeviciene and Ostrauskas[8] Banerjee et al.,[9] and Bener et al.[10] also showed nonsignificant association between age group as risk factor and type 2 diabetes mellitus. A study by West et al.[11] showed association between the age groups was highly significant; however, age group in that study ranged from 10 to 22 years, which goes in favor of type 1 diabetes mellitus, and, thus, cannot be comparable to this study. This study showed the ratio of male:female was 69.66%:30.34% in cases and 69.5%:30.5% in control subjects. A study by Wang et al.[12] observed male:female ratio of 72.02%:27.03% in cases and 69.82%:31.18% in control subjects. In a study done by Dutt et al.,[13] male to female ratio was 60%:40% in both cases and control subjects. In this study, there was significant association between positive family history of type 2 diabetes mellitus and development of the disease, which was comparable to different studies done by Radzeviciene and Ostrauskas[8] Banerjee et al.,[9] Wang et al.,[12] Dutt et al.,[13] and Belmokhtar et al.[14] In our study, sedentary physical activity was a significant risk factor associated with type 2 diabetes mellitus. Similar observations were showed in the studies by Wang et al.,[12] Dutt et al.,[13] and Belmokhtar et al.[14] Of 300 cases, 94 (31.33%) of them showed history of alcohol consumption, which was significantly associated with type 2 diabetes mellitus similar to study done by Dutt et al.,[13] while in the study by Bener et al.,[10] it was highly significant. In this study, cigarette smoking was the possible risk factor in relation to type 2 diabetes mellitus. Similarly, studies by Radzeviciene and Ostrauskas,[8] Wang et al.,[12] Dutt et al.[13] showed cigarette smoking was significant risk factor, while studies by Poulton et al.[15] and Duc Son et al.[16] showed cigarette smoking was a nonsignificant risk factor. We showed comparison between normotensive subjects versus hypertensive subjects was statistically highly significant suggesting that increasing degree of hypertension correlated with type 2 diabetes mellitus, which was coherent with the studies by Bener et al.[10] and Belmokhtar et al.[14] In the other studies done by Wang et al.[12] and Rama Laksmi et al.,[17] it was shown that there was statistically nonsignificant difference between persons with hypertension and persons without hypertension for the development of type 2 diabetes mellitus. We observed inverse relation of normal body mass index with type 2 diabetes mellitus, which was comparable to studies done by Radzeviciene and Ostrauskas,[8] West et al.,[11] Dutt et al.,[13] and Belmokhtar et al.[14] Owing to the type of study, it was not possible to apply the drawn inferences to the general population, especially in larger geographic dimensions, which was the limitation of this study.

Conclusion

The nonmodifiable risk factors such as age and gender were statistically nonsignificant in relation to type 2 diabetes mellitus except family history of the disease. The modifiable risk factors such as sedentary physical activity, alcohol consumption, hypertension, and obesity were significantly associated with type 2 diabetes mellitus. Thus, type 2 diabetes mellitus is of multifactorial origin, and no single cause can be attributed to it.

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