Original Research Article

A study to evaluate different conditions leading to diagnosis of T2DM in a tertiary care hospital in Eastern India

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ABSTRACT

Background: Diabetes is one of the most important public health problems. There is paucity of Indian data as to which conditions leads to diagnosis of T2DM. The present study endeavors to throw some light on the problem.
Methods: A cross-sectional and retrospective study including 321 subjects, performed at a tertiary care hospital in eastern India. Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (min-max) and results on categorical measurements are presented in number (%). Significance is assessed at 5 % level of significance pooled chi-square/Fischer's exact test used to explore association between study variables.
Results: A total of 321 patients (male: female - 2.61: 1) diagnosed with diabetes over a period of 24 months were included. Mean age at diagnosis being 45.54±10.8 years respectively. Out of these, only 23.05 % presented with osmotic and other symptoms (foot ulcer, weight loss etc.) suggestive of diabetes. A substantial 43.52% of total patients were diagnosed during general healthcare check-up (35.2% in OPD and 8.32% during perioperative evaluation). Remaining patients diagnosed with diabetes included 8.28% patients admitted with acute coronary syndrome, 13.4% with infections of different types and 11.75% with other non-related diseases. Among diagnosed diabetics, 50.47% had HTN and 41.12% had IHD. Diabetic Males have higher prevalence of IHD (48.28%) than females (22.47%), p <0.001. Prevalence of HTN is higher among diabetic females (48.28%) than males (22.47%), p <0.046. The prevalence of HTN and IHD steadily increased with the increasing age group, p<0.001.
Conclusions: The results of this study suggest that a very low percentage of the patients present with symptoms suggestive of diabetes. Hence, it is prudent to evaluate adult patients coming in contact with healthcare system for diabetes by simple inexpensive test.

Keywords: Adults, Diagnosis, General health check-up, Type 2 diabetes

INTRODUCTION

The estimated global prevalence of diabetes is approximately 366 million which is expected to reach 552 million by 2030.[1] In India alone, the prevalence of type 1 and type 2 diabetes is 70,200 and 69.2 million respectively as per the 2015 IDF Atlas.[1] It is essential to diagnose type 2 diabetes early in order to prevent the progression of both macro and microvascular complications. Around fifty percent of the diabetic population are not aware of their disease, which is approximately 183 million of people.[2] Moreover, type 2 diabetes can be present for around 9-12 years before being diagnosed, resulting in complications being present even at the time of diagnosis.[3] Nevertheless, it is possible to prevent diabetes as well as development of its complications by lifestyle and pharmacological interventions as demonstrated by several randomized

controlled trials.[4-7] Therefore, it is of paramount importance to detect and treat type 2 diabetes early. Hence, the objectives of this study are to study the different conditions which may lead to diagnosis of type 2 diabetes.

METHODS

This cross-sectional study utilized administrative data of BM Birla Heart and Research Centre, Kolkata, West Bengal, India accumulated over a period of 24 months. Individuals reporting that they were not diagnosed with diabetes earlier and who consented to share their data were eligible for the study. Diabetes is diagnosed as per the American Diabetes Association (ADA) diagnostic criteria with presence of any one or more of the following: Fasting plasma glucose (FPG) concentration (after 8 or more hours of no caloric intake) ≥ 126 mg/dL, or plasma glucose concentration ≥ 200 mg/dL 2 hours after ingesting a 75-g oral glucose load in the morning after an overnight fast of at least 8 hours, or symptoms of hyperglycemia (e.g., polyuria, polydipsia, polyphagia) and a random (casual, non-fasting) plasma glucose concentration ≥ 200 mg/dL, or glycosylated hemoglobin (HbA1C) level $\geq 6.5\%$.

Descriptive statistical analysis was carried out in the present study. Results of continuous measurements were presented as mean ± standard deviation (min-max) and results of categorical measurements were presented in number (%). Significance was assessed at the 5 % level. Pooled chi-square/fischer's exact test used to explore association between study variables.

SAS (statistical analysis system) version 9.2 for windows, SAS Institute Inc. Cary, NC, USA and SPSS version 20.0 was used for the analysis of the data and Microsoft word and Excel were used to generate graphs and tables.

RESULTS

The study sample consisted a total of 321 patients (male: female - 2.61:1) diagnosed with T2D over a period of 24 months were included. Mean age at diagnosis being 45.54±10.8 years respectively. The baseline characteristics of the study population are enlisted in Table 1. The mean age of the study population being 54.7 years with a standard deviation of 11.1 years. Maximum number of subjects (31.78%) belonged to the sixth decade age group, followed by 23.68% and 24.61 % of the seventh and the fourth decade respectively. Of our study subjects, 72.27% are males. Only 2.49% of our T2D subjects are underweight, 21.81% are normal weight, 22.19% are over-weight and a substantial 53.58% are obese. Out of 321 subjects, only 23.05 % presented with osmotic and other symptoms (foot ulcer, weight loss etc.) suggestive of diabetes. A substantial 43.52% of total patients were diagnosed during general healthcare check-up (35.2% in OPD and 8.32% during perioperative

evaluation). Remaining patients diagnosed with diabetes included 8.28% patients admitted with acute coronary syndrome, 13.4% with infections of different types and 11.75% with other non-related diseases. Among diagnosed diabetics, 50.47% had HTN and 41.12% had IHD.

Table 1: Baseline characteristics of the study population.

Parameter	Number of subjects	Percent
Age (in years)		
21-30	2	0.62
31-40	40	12.46
41-50	76	23.68
51-60	102	31.78
61-70	79	24.61
>70	22	6.85
Gender		
Female	89	27.73
Male	232	72.27
BMI (kg/m^2)		
Less than 18.5	8	2.49
18.5-22.9	70	21.81
23-24.9	71	22.19
>=25	172	53.58
HTN Present	162	50.47
Ischemic heart disease present	132	41.12
Religion		
Hindu	268	83.48
Muslim	37	11.53
Christian	16	4.99

Table 2: Different health condition leading to diagnosis of diabetes.

Conditions	Number of subjects	Percent
General health check-up (OPD Check-up + routine peri-operative evaluations)	138	43.52
OPD check-up	111	35.2
Routine peri-operative evaluations	27	8.32
Admitted with acute coronary syndrome	26	8.28
Infection of different types	42	13.4
Osmotic and other symptoms suggestive of diabetes	74	23.05
Other non-related diseases	39	11.75
Total	**321**	**100**

Diabetic males have higher prevalence of IHD (48.28%) than females (22.47%), p <0.001. Prevalence of HTN is higher among diabetic females (48.28%) than males (22.47%), p <0.046. The prevalence of HTN and IHD

steadily increased with the increasing age group, p <0.001.There is no significant difference in the age of diagnosis for the age groups 21-30, 31-40 and 41-50. However the age of diagnosis for the age group 51-60, 61-70 and more than 70 increased significantly with the higher age groups. (p <0.05 as determined by ANOVA with post-hoc Bonferroni and Tukey's test).

Table 3: Age at diagnosis of diabetes for various risk factors and co-morbidities.

	Mean	Std. dev.	p-value
Overall subjects	45.54	10.81	
Age 21-30	26.50	3.54	
Age 31-40	32.89	4.55	
Age 41-50	39.13	5.79	***
Age 51-60	47.27	7.23	
Age 61-70	52.14	9.13	
Age >70	59.14	14.20	
Female	45.29	11.37	0.79
Male	45.64	10.61	
HTN Absent	43.40	9.80	0.0005
HTN Present	47.60	11.35	
IHD Absent	43.01	10.17	<0.0001
IHD Present	49.23	10.69	
BMI < 18.5	46.52	11.39	
BMI ~ 18.5-22.9	47.49	11.02	NS
BMI ~ 23-24.9	44.34	10.65	
BMI >=25	44.92	10.61	

P <0.05 considered as statistically significant

Table 4: Association between age with HTN and IHD in diabetes subjects.

Age group	Ischemic heart disease		p-value
	HTN present	IHD present	
21-30 (n)	1	0	
31-40 (n)	8	3	
41-50 (n)	33	16	
51-60 (n)	54	47	<0.001
61-70 (n)	53	50	
>70 (n)	13	16	
Total	**162**	**132**	

p<0.05 considered as statistically significant

There is no significant difference in the age of diagnosis of the males and females subjects, p = 0.79 as determined by unpaired t-test. Hypertensive subjects have significantly higher age at diagnosis of diabetes, p - 0.0005 as determined by unpaired t-test. Age of diabetes diagnosis have no relation with BMI status (p = 0.73, as determined by ANOVA with post-hoc Bonferroni and Tukey's test). Subjects with IHD have significantly higher age at diagnosis of diabetes, p ≤ 0.0001 as determined by unpaired t-test.

Table 5: Characteristics of the study sample by gender.

	Male	Female	p-value
HTN	109 (46.98%)	53(59.55%)	0.046
IHD	112 (48.28%)	20 (22.47%)	< 0.001
BMI	27.34±4.91	25.22±5.62	0.032

P <0.05 considered as statistically significant

DISCUSSION

Type 2 diabetes can be present for 9-12 years before being diagnosed and in most of the cases, complications are often present at the time of diagnosis.[3] The prime reason for the undetected diabetes for such a long time is the absence of classical osmotic symptoms of diabetes as well as other symptoms which may hint an index of suspicion among the treating clinician. In our study, we found only 23.05 % subjects presented with osmotic and other symptoms (foot ulcer, weight loss etc.) suggestive of diabetes. Thus the remaining 77% subjects were asymptomatic for diabetes and don't warrant any tests to diagnose diabetes as per the clinical acumen.

Insulin resistance and beta-cell dysfunction are chiefly responsible for the development of type 2 diabetes and its related complications and both are present very early in the natural history of diabetes.[8] The progression of from pre-diabetes to diabetes and time to develop complications varies from patient to patient. In some individuals complications may develop early at lower glucose concentrations or during increases in glucose rather than after thresholds for a diagnosis are reached and remain consistent.[8] In actuality, diabetes may be initially detected at the same time diabetes complications are being diagnosed, as showed by Ruigomez and colleagues.[10] In the same line, the UKPDS VIII also had evidently demonstrated that 50% of patients had diabetes related tissue damage at the time of diagnosis.[11] These previous observations are in the same line with our findings, as IHD were present in 42.12 % of our study subjects' respectively. Around 8.28% of study subjects were diagnosed with T2D when admitted with acute coronary syndrome (ACS).

To further gain an understanding on the gender based differences, Roche et al. had found that that for males and females, high blood pressure was positively associated with diabetes. This finding is consistent with Meisinger et al. who also found that hypertension was strongly associated with diabetes in both males and females. In the same line, our data also demonstrated that HTN was present in 50.47% of the study subjects.[12] Furthermore, our data demonstrated that females had a higher prevalence of HTN than their male counterparts, whereas the prevalence of IHD was higher in the male subgroup. Roche and colleagues also found males and females who do not have a regular doctor are less likely to be diagnosed with diabetes than those who do. This could be

due to the fact that those who have a doctor have an increased opportunity to discuss symptoms and to be screened for diabetes.

Being overweight or obese was associated with diabetes for males only in this study. Similarly, Njolstad et al also found that BMI was positively associated with diabetes; however, after controlling for other factors BMI was a stronger predictor in men.[13] In addition, abdominal fat is associated with higher risk of diabetes and males usually carry weight in their abdominal region while females tend to carry weight in their hips and thighs.[14] Previous research has found that men are diagnosed at lower BMI levels than females, which suggest males are more susceptible to diabetes than females.[15] Similarly the present study demonstrates males had a higher BMI than the female cohort.

There are also several limitations that need to be addressed. Firstly, this was a cross-sectional study and therefore not as strong as a cohort or intervention study. Secondly, the study was carried out in a tertiary care cardiac center. As a result, the sample of diabetes cases may be less than the true number of incident cases. Also the subjects presenting to this centre are affluent and may not be a true representative of the general population.

CONCLUSION

The results of this study suggest that a very low percentage of the patients present with symptoms suggestive of diabetes. Hence, it is prudent to evaluate adult patients coming in contact with healthcare system for diabetes by simple inexpensive test

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