Original Research Article

Change in age of diagnosis of type 2 diabetes in last one decade

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Received: 20-11-2020 / Revised: 07-01-2021 / Accepted: 31-01-2021

Abstract

Background: The prevalence of diabetes is rapidly increasing throughout the country. People diagnosed with type 2 diabetes mellitus (T2DM) at a younger age seems to have higher risk of developing diabetes-related complications as compared to those who are diagnosed at late age.

Aims and Objective: To report the change in age at diagnosis of T2DM patients.**Methods:** Self-reported age at diagnosis of T2DM patients attending the OPD of Diabetes, Obesity and Thyroid Center, Gwalior was recorded. Patients with Type 1 Diabetes and gestational diabetes mellitus were excluded. Individuals with diabetes who were not able to report their age at diagnosis, were also excluded from the present study. A total of 1000 patients diagnosed between 2011 – 2018 (Group A) were compared with 998 patients who were diagnosed between 2006 –2010 (Group B).**Results:** The age at diagnosis of diabetes mellitus was much earlier in group A (34.96±12.879 years) as compared to group B (44.5 ± 10.172 years) ($p<0.001$). Fasting plasma glucose (FPG) and glycated hemoglobin (HbA1c) were found to be significantly higher in Group A as compared to Group B. No difference was found with respect to age and postprandial plasma glucose (PPG). The same trend was observed even on sub-group analysis by gender. Before 2010 age had a significant correlation with FPG and PPG but after 2010this correlation existed only for FPG and not for PPG. No correlation was found with HbA1c in either cohort. Also, the correlation was significantly positive for females but negative for males. After 2010, the correlation was negative between age at diagnosis and FPG.**Conclusion:** A decrease in age at diagnosis was observed among the patients who were diagnosed after 2010 as compared to patients who were diagnosed with T2DM before 2010.

Keywords: Diabetes complications, age of onset, diabetes prevalence, glycated hemoglobin, fasting plasma glucose, postprandial plasma glucose

Introduction

As per the reports of the International Diabetes Federation (IDF), 415 million people are suffering from diabetes and out of which, 91% are suffering from type 2 diabetes mellitus (T2DM) [1]. The prevalence of T2DM has been exponentially increasing over time. Abraham et al using Framingham Heart Study data noted that the overall annual incidence rates of T2DM per 100 persons has increased from 3.0 (in the 1970) to 5.5 in the first decade of 2000s [2].Indian Heart Association has projected India as the home for 109 million individuals with diabetes mellitus by the year 2035 [3]. American Diabetes Association study has also projected that there will be greatest increase in the people diagnosed with diabetes by 2030 [4]. This high incidence is assigned due to the combination of genetic susceptibility and sedentary lifestyle (high-calorie and low-activity) adopted by the Indian population [5].Risk of developing diabetes related complications are high among the individuals diagnosed with T2DM at younger age as compared to those who are diagnosed at late age. Former individuals also own a cluster of adverse cardiovascular risk factors at an earlier age [6,7].Given the increasing prevalence of diabetes in the Indians and the evidence that T2DM is being diagnosed in younger populations, the onset of T2DM may be occurring at a much younger age in the Indian population. An understanding of this trend will help to define the magnitude of this health problem. Hence in present population-based study we have tried to observe the change in the age of diagnosis of T2DM among the individuals who were diagnosed before the year 2010 as compared to individuals who were diagnosed with T2DM after 2010.

Materials and Methods

The present study included one thousand nine hundred nighty eight T2DM patients who visited the Diabetes, Obesity and Thyroid Center, Gwalior (M.P.) between 2006 to 2018. For the individuals coming for the first time at the center or do not know the status of their diabetes; were diagnosed based on American Diabetes Association diagnostic criterions. For others we assessed patients for diagnosed diabetes using the question, "Have you ever been informed by your doctor or health care professional that you have diabetes or "*Madhumeh*?" We considered the individual to have diabetes if he/she said "Yes" to above question. Age at diagnosis was determined by the individual's self-report of their age ("when the doctor or health care professional first told you that you had diabetes or "*Madhumeh*")Patients with Type 1 Diabetes and gestational diabetes mellitus were excluded. Individuals with diabetes who were not able to report their age at diagnosis, were also excluded from the present study.In total, 1998 T2DM patients were selected, out of which 998 patients were diagnosed between 2006 to 2009 (Group B) and 1000 were diagnosed between the year 2010 to 2018 (group A).Details including age and sex were recorded. Fasting plasma glucose (FPG), postprandial plasma glucose (PPG) and glycated hemoglobin (HbA1c) were also determined.All the data analysis was performed using IBM SPSS ver. 20 software. Frequency distribution and cross tabulation was used to prepare the tables. Quantitative data is expressed as mean ± standard deviation whereas categorical data is expressed as number and percentage.Quantitative data was compared using unpaired t-test. Correlation was established between the variables using Pearson correlation test. Level of significance was assessed at P=<.05.

Results

In present study we found that the age at diagnosis of diabetes mellitus was significantly lower in group A (34.96±12.87 years) as compared the group B (44.5 ± 10.17 years) ($P<0.001$).No difference in gender distribution was found in group B to group A in diabetic population (p=0.568).

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Table 1: Comparing baseline age, fasting plasma glucose, postprandial plasma glucose and glycated hemoglobin between groups

Variable	Group	N	Mean	Std. Deviation	Range	P Value*
Age	Gr A (2006-2010)	998	52.11	15.99	18-76	0.98
	Gr B (2011-2018)	1000	53.11	11.21	22-88	
FPG	Gr A (2006-2010)	982	176.37	66.59	42-496	0.001
	Gr B (2011-2018)	991	194.88	83.79	23-625	
PPG	Gr A (2006-2010)	993	257.87	89.38	58-680	0.168
	Gr B (2011-2018)	986	263.79	98.14	72-750	
HbA1c	Gr A (2006-2010)	479	8.77	2.19	5.3-15	0.001
	Gr B (2011-2018)	944	9.68	3.64	5.4-15	

FPG; fasting plasma glucose, PPG; postprandial plasma glucose, HbA1c; glycated hemoglobin, N; no of patients, *P<0.05 considered as statistically significant, p computed by unpaired t-test

Table 2: Subgroup Analysis of age, fasting, postprandial and glycated hemoglobin with Gender

Gender	Variable	Group	N	Mean	Std. Deviation	P Value*
Female	Age	Gr A (2006-2010)	415	53.23	21.43	0.45
		Gr B (2011-2018)	407	52.35	10.35	
	FPG	Gr A (2006-2010)	407	179.86	68.43	0.003
		Gr B (2011-2018)	403	195.62	83.72	
	PPG	Gr A (2006-2010)	413	258.08	87.97	0.69
		Gr B (2011-2018)	402	260.67	99.20	
	HbA1c	Gr A (2006-2010)	29	8.57	2.57	0.007
		Gr B (2011-2018)	382	9.41	2.18	
Male	Age	Gr A (2006-2010)	583	51.32	10.49	0.342
		Gr B (2011-2018)	592	51.94	11.78	
	FPG	Gr A (2006-2010)	575	173.91	65.21	<0.001
		Gr B (2011-2018)	587	194.49	83.95	
	PPG	Gr A (2006-2010)	580	257.72	90.46	0.133
		Gr B (2011-2018)	583	266.01	97.51	
	HbA1c	Gr A (2006-2010)	50	8.83	1.93	0.005
		Gr B (2011-2018)	561	9.87	4.37	

FPG; fasting plasma glucose, PPG; postprandial plasma glucose, HbA1c; glycated hemoglobin, N; no of patients, *P<0.05 considered as statistically significant, p computed by unpaired t-test

Table 3: Correlation of Gender with the glycemic parameters (FPG, PPG and HbA1c)

Group				FBG	PPBG	HbA1c
Till 2010	Female	Age	Pearson Correlation	0.288	0.246	-0.196
			Sig. (2-tailed)	0.046	0.036	0.308
			N	407	413	29
	Male	Age	Pearson Correlation	-0.128**	-0.104*	-0.188
			Sig. (2-tailed)	0.002	0.012	0.191
			N	574	579	50
After 2010	Female	Age	Pearson Correlation	-0.182	-0.032	0.064
			Sig. (2-tailed)	0.029	0.518	0.210
			N	403	402	382
	Male	Age	Pearson Correlation	-0.085*	-0.014	0.018
			Sig. (2-tailed)	0.039	0.733	0.669
			N	587	583	561

FPG; fasting plasma glucose, PPG; postprandial plasma glucose, HbA1c; glycated hemoglobin,N; no of patients, Age; age at diagnosis, P<0.05 considered as statistically significant, P computed by unpaired t-test*. Correlation is significant at the 0.05 level (2-tailed), **. Correlation is significant at the 0.01 level (2-tailed).

Discussion

Using a population-based cohort of T2DM patients, we found that age of diagnosis of T2DM has decreased significantly among the patients who were diagnosed after 2010 as compared to patients who were diagnosed before the year 2010. This is an alarming finding for the nation as the previous reports have shown a negative effect of early diagnosis of T2DM. To put these findings in a meaningful context, for two patients of the same age group, but with 10 years of difference in age of diagnosis or we can say diabetes duration (earlier diagnosis and hence longer duration of diabetes) had approximately 30% and 60% greater risk of death from any cause and from CVD as compared to patients with higher age of diagnosis (and lesser duration of diabetes) [8].In present study, FPG and HbA1c were found to significantly higher in patients who were diagnosed after 2010 as compared to patients who were diagnosed before 2010. However, no difference was observed with respect to PPG. Another interesting finding which was revealed that before2010 age had a significant correlation with FPG and PPG, but this correlation only existed for FPG and not for PPG. No correlation was found with HbA1c in either cohort. Further, the correlation was significantly positive for females but negative for males. After 2010 the correlation was negative between age at diagnosis and FPG.In present study mean age of diagnosis of T2DM has decreased from 44.5 years among the patients who were diagnosed between 2006 to 2010 to 35 years approx. among the patients who were diagnosed with T2DM between 2010 to 2018.An Australian study reported that those people diagnosed with T2DM at the age of 10-39 years

accounted for 9% of all new cases in 2011 [9]. Similar trends were reported from the study done in USA, Southwestern United States and New South Wales, making young working age group adults as fastest growing group for new onset of T2DM [10-12]. Previous reports have shown that individuals diagnosed withT2DM at a younger age were found to have a greater risk of developing diabetes-related complications compared with those diagnosed at late age, suggesting a more aggressive phenotype [6]. This finding is petrifying because it projects further large increase in the burden of diabetes and its accompanying complications in the productive age groups in the future. Several reasonable explanations are possible for this dramatic decrease in age of diagnosis among T2DM patients during more than a decade. This change may be due to earlier onset of T2DM among the study cohort or early detection or may be due to the combination of both. This is however unclear whether the decrease in the age of diagnosis was the effect of overall decrease in onset of diabetes among the study cohort or because of earlier detection; this cannot be determined from this data. Moreover, the age at onset of T2DM is decreasing. The shift of age at onset of diabetes at younger ages means that their chances of developing complications at middle age are substantially higher [13]. There are very limited number of studies which have examined the change in the age of diagnosis in T2DM Indian population. However, a recent study from Kancheepuram district of Tamil Nadu by Gopalakrishnan et al including 1680 participants reported that majority of the T2DM patients were in the age group of less than 35 years which provides strength to the present study findings of reduced age of diagnosis among the T2DM population [14]. Even more petrifying results were reported in the study conducted by Indian Council of Medical Research where 25.3% of Indian youth below the age of 25 have type 2 diabetes [15]. Koopman et al in a similar but older study which included patients from National Health and Nutrition Examination Survey (NHANES) 1999-2000 and NHANES III (1988-1994) in US also reported a decrease in mean age at diagnosis from 52.0 to 46.0 years ($P < 0.05$). Though this is not a recent study, but it is also indicating a decreasing tread in the age of diagnosis which was also found in our study [16].However, a National Health Interview Survey which was performed between 2016 to 2017 in US which reported that the mean age of diabetes diagnosis for those with T2DM was 47.9 years, with 89.1% of participants given a diagnosis at age 30 years or older [17]. This study had limitation that information on physician diagnosis of diabetes was self-reported by the participants and therefore prone to misreporting and recall bias. Data from China suggest that the prevalence of T2DM in younger population has increased dramatically in the past two decades [18].In India, preliminary data from a national registry of youth-onset diabetes revealed that 25% of patients with diabetes mellitus who were <25 years old had T2DM [19]. In countries such as the USA, Canada and Australia, the disproportionately higher incidence of T2DM with a trend of earlier age of onset was evident among indigenous populations compared with non-indigenous populations [20, 21]. All these prove the decreasing trend in the age of T2DM diagnosis. As suggested by these nationally representative findings of decreasing mean age at diagnosis of type 2 diabetes, these recommendations might need to be reexamined to include clinical screening recommendations for younger age-groups, especially those at high risk.Present study is also not devoid of the limitations; both the age at diagnosis and the diagnosis itself are self-reported by the patient, which may leave a question mark on the validity of the diagnosis and correct recall of age at diagnosis. However self-reports of T2DM had been used by several population-based studies [22-24]. Moreover, previous studies on other health conditions have also shown that memory for age at the time of diagnosis has been shown to be reasonably accurate when compared with medical records of the patients [16, 25].

Conclusion

We have observed a decrease in age of diagnosis amongT2DM patients before 2010 as compared to patients who were diagnosed after 2010.This is alarming as an individual diagnosed at younger age has higher risk of developing diabetes related complications as compared to individual diagnosed at lateage. Younger age at diagnosis may also reflect a true population trend of earlier onset of T2DM.

Reference

1. International Diabetes Federation. IDF diabetes atlas. 7. Brussels: International Diabetes Federation; 2015.
2. Abraham TM, Pencina KM, Pencina MJ, Fox CS. Trends in diabetes incidence: the Framingham heart study. Diab Care. 2015;38:482–-7.
3. Indian Heart Association Why South Asians Facts Web. 1 January 2019.<http://indianheartassociation.org/why-indians-why-south-asians/overview/>
4. Wild, Sarah, Roglic G, Green A, Sicree R, King H. Global Prevalence of Diabetes. Diabetes Care. American Diabetes Association. 2019; 2(4): 1-26.
5. Kleinfield NR. Modern Ways Open India's Doors to Diabetes. New York Times. 2006. Retrieved 2 January 2019.
6. Today Study Group. Rapid rise in hypertension and nephropathy in youth with type 2 diabetes: the TODAY clinical trial. Diabetes Care 2013; 36:1735-41.
7. West NA, Hamman RF, Mayer-Davis EJ et al. Cardiovascular risk factors among youth with and without type 2 diabetes: differences and possible mechanisms. Diabetes Care 2009; 32: 175-80.
8. Huo L, Magliano DJ, Carstensen B. Impact of age at diagnosis and duration of type 2 diabetes on mortality in Australia 1997-2011. Diabetologia 2018; 61: 1055-63.
9. Australian Institute of Health and Welfare. Type 2 diabetes in Australia's children and young people: a working pape. In: Diabetes Series Australian Institute of Health and Welfare, Canberra. 2014.
10. Grinstein G, Muzumdar R, Aponte L, Vuguin P, Saenger P, DiMartino-Nardi J. Presentation and 5-year follow-up of type 2 diabetes mellitus in African-American and Caribbean-Hispanic adolescents. Horm Res 2003; 60:121-6.
11. Dabelea D, DeGroat J, Sorrelman C et al. Diabetes in Navajo youth: prevalence, incidence, and clinical characteristics: the SEARCH for Diabetes in Youth Study. Diabetes Care. 2009; 32(Suppl 2):S141-7.
12. Craig ME, Femia G, Broyda V, Lloyd M, Howard NJ. Type 2 diabetes in Indigenous and non-Indigenous children and adolescents in New South Wales. Med J Aust. 2007;186:497-9.
13. Mokta JK, Mohan V, Mokta K, Ramesh. Early Intensified Insulin Therapy in Newly Diagnosed Type 2 Diabetes Leads to Sustained Improvement in Glycemic Control and Improved Beta Cell Function. JAPI 2018;66.
14. Gopalakrishnan S, Muthulakshmi M. Type 2 diabetes mellitus and its determinants among adults in an urban area of Kancheepuram district, Tamil Nadu. Int J Community Med Public Health. 2018;5:1956-62.
15. Tandon N, Anjana RM, Mohan V, Kaur T, Afshin A, Ong K et al.India State-Level Disease Burden Initiative Diabetes Collaborators. The increasing burden of diabetes and variations among the states of India: the Global Burden of Disease Study 1990–2016. Lancet Glob Health. 2018; 6: e1352–62
16. Koopman RJ, Arch G. Mainous III, Diaz VA, Geese ME. Changes in Age at Diagnosis of Type 2 Diabetes Mellitus in the United States, 1988 to 2000. Annals of family Medicine. 2005;3 (1): 1-5.
17. GuifengXu, Liu B, Sun Y, Du Y, Snetselaar LG, Hu FB et al. Prevalence of diagnosed type 1 and type 2 diabetes among US

adults in 2016 and 2017: population based study. BMJ. 2018; 362: k1497.
18. Fu J, Prasad HC. Changing epidemiology of metabolic syndrome and type 2 diabetes in Chinese youth. Curr. Diab Rep. 2014; 14: 447.
19. Praveen PA. Registry of Youth Onset Diabetes in India (YDR): rationale, recruitment, and current status. J. Diabetes Sci. Technol 2016;10: 1034-41.
20. Ley SH. Metabolic syndrome and its components as predictors of incident type 2 diabetes mellitus in an Aboriginal community. CMAJ 2009;180: 617–24.
21. Reinehr T. Type 2 diabetes mellitus in children and adolescents. World J. Diabetes. 2013; 4: 270-81.
22. Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS, Koplan JP. The continuing epidemics of obesity and diabetes in the United States. JAMA. 2001;286:1195-200.
23. Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity,diabetes, and obesity-related health risk factors, 2001. JAMA. 2003;289:76-9.
24. Harris MI, Goldstein DE, Flegal KM, et al. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in US adults. Diabetes Care. 1998;518-524.
25. Cowie CC, Rust KF, Byrd-Holt D, et al. Prevalence of diabetes and impaired fasting glucose in adults—United States, 1999-2000. MMWR 2003;52:833-7.
26. Reider CR, Halter CA, Castelluccio PF, Oakes D, Nichols WC, Foroud T. Reliability of reported age at onset for Parkinson's disease. MovDisord. 2003;18:275-279.

Conflict of Interest: Nil
Source of support:Nil