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Original Research Article

Prevalence of Type 2 Diabetes Mellitus in an Urban Area of Nanded City (Maharashtra, India)

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ABSTRACT

Introduction: In 2020 India is going to be the capital of diabetes as it is reported that 1 out of 4 individuals will be an Indian diabetic in the world.
Unfortunately, there is still inadequate awareness about the real dimension of the problem among the general public. Hence an attempt is being made to find the prevalence and associated risk factors of type 2 diabetes mellitus in urban population of aged 30 years and above of Nanded city (Maharashtra-India).
Material and methods: The present community based cross-sectional study was conducted in urban area of Nanded City of Maharashtra state (India) during July - December 2013. The study population included 780 subjects 30 years & above age group selected by random sampling method.
Results and discussion: In the present study prevalence of type 2 diabetes mellitus was found to be 9.7% in population aged 30 years and above.
In this study statistically significant association was found between type2 DM and advancing age of the subject, unemployed subjects, high S-E group, having family history of DM, calorie consumption at or above recommended, alcohol consumption, performing sedentary physical activity, having hypertension, obese subjects and having abnormal WHR. No statistical significant association was found between type 2 DM and sex of the subject, religion, educational status, marital status, type of family, type of diet and smoking habit.
Conclusion: Regular screening of high risk persons should be conducted and people should be encouraged to adopt healthy lifestyle for prevention and control of diabetes mellitus.

Key words: Type 2 DM, Obesity, BMI, WHR, Sedentary life style

INTRODUCTION

Diabetes mellitus is one of the most common noncommunicable diseases prevalent globally and there is substantial evidence that it is a modern epidemic in many developing and newly industrialized nations, thus posing a serious threat to be met within the 21st century. (1)

According to recent estimates(2011), approximately 366 million (8.5%) people worldwide in 20–79 years age group have diabetes and by 2030, 552 million (8.9%)

people of the adult population is expected to have diabetes with 51% increase in the number of people with diabetes. [2]

The International Diabetes Federation (IDF) estimates the total number of people in India with diabetes to be around 61.3 million in 2011, projected to reach 101.2 million by 2030. India currently stands at number two in the list of top 10 countries. [2] Another estimate has projected that in 2020 India is going to be the capital of diabetes as it is reported that 1 out of 4 individuals will be an Indian diabetic in the world. [3]

Unfortunately, there is still inadequate awareness about the real dimension of the problem among the general public in India. There is also a lack of awareness about the existing interventions for preventing diabetes and the management of complications. [4]

Since studies on diabetes mellitus are scanty from this region of Marathwada (Maharashtra-India) and there is no reported community based study in Nanded city of this region, an attempt is being made to find out the prevalence and associated risk factors of type 2 diabetes mellitus in urban population of aged 30 years and above of this city.

MATERIALS AND METHODS

The present community based cross-sectional descriptive study was conducted in Municipal Corporation area of Nanded City of Maharashtra state (India) during July - December 2013. According to 2011 census, total population of city was 430,733. [5] The study population included all men and women of 30 years & above age group.

The sample size calculated for the present study was 800 by considering the prevalence (p) 12.1%, [6] allowable error 20% of prevalence and adding 10% study population to this estimated sample size as to compensate non-response or incomplete answers.

Sampling technique:

The municipal corporation had 65 wards. According to probability proportional to size (PPS) sampling system [7] list of subjects (30 years and above) for each ward was prepared using voter list (Electoral list amended in 2012) and from this list of each ward the study subjects were selected randomly by using random number table. If eligible selected subject was unavailable during the first home visit, they were approached on another pre-informed date as per their convenience. Even after three such visits if the subject was non-compliant, then he / she was considered as non-respondent.

Inclusion criteria:

1. All the men and women aged 30 years and above.
2. Men and women who had given written consent.
3. Known cases of type 2 diabetes mellitus.

Exclusion criteria:

1. Pregnant women and lactating women up to 12 weeks post-partum were excluded from the study due to possibility of impaired glucose tolerance status due to pregnancy.
2. Type 1 diabetes mellitus cases - Those cases of diabetes mellitus which have disease prior to age 30 years and requirement of insulin as the initial therapy. [8]

Ethical considerations:

Ethical committee approval was obtained prior to the start of the study from Institutional Ethics Committee of Dr. S. C, Govt. Medical College, Nanded.

Tools and techniques for data collection:

The data was collected by visiting the recruited study subjects at their houses. These subjects were interviewed by administering a predesigned and semi-structured questionnaire. Before collection

of the data, written consent was taken from all the study subjects after explaining the purpose of the study in detail.

Socio-demographic characteristics of study subjects like age, sex, religion, marital status, education, occupation, [9] socio economic status [10,11] and type of family etc were recorded. Information regarding personal habits such as alcohol consumption and smoking, physical activity, dietary history, medical history about diabetes and hypertension was obtained from all subjects. Total Physical activity was assessed by combining scores of occupational and leisure time activities. Leisure time physical activity such as brisk walking, cycling, swimming and house hold work with duration was enquired. [12]

Family history of diabetes mellitus in their family members like mother, father, brother, sister, grandparents was enquired. Dietary history was assessed by 24 hour recall method for each study subject. Total calorie intake was calculated by approximate caloric values of cooked food preparations. [13]

Clinical examination of each study subject was carried out in their own house by maintaining the privacy. Female subjects were examined in the presence of female health worker. Blood pressure was measured as per WHO guidelines. [14] Anthropometric measurements of each study subject i.e. weight, height, waist circumference and hip circumference were measured as per the standard techniques. [15,16]

Subjects were asked to remain on overnight fast and after confirmation of fasting, OGTT was performed as per the WHO guidelines. [17] Known cases of diabetes mellitus were excluded from OGTT but included in the study as cases of diabetes mellitus.

Data analysis:

A database was created in Microsoft Excel software 2007 version. Data analysis was carried out with the help of statistical measures such as percentages, proportion, Chi-square test and Chi-square test for trend using software Graph Pad Prism Version 5.01 and Open Epi Version 2.3.

RESULTS AND DISCUSSION

Out of 800 study subjects, 20 could not be studied due to various reasons like absence at home even after three visits - 7, migrated to other place - 4, not willing - 4, pregnant women - 3 and lactating women - 2. Hence 780 (97.5%) subjects were studied for present study during the period July - December 2013.

Table 1 shows results of Oral Glucose Tolerance Test. Out of total 780 study subjects, 49 study subjects were already diagnosed as Type 2 DM (known cases) and hence excluded from OGTT. Thus OGTT was performed in 731 study subjects.

Table 1: Results of Oral Glucose Tolerance Test (n=731)

Results (OGTT)	Male (%)	Female (%)	Total (%)
Normal Glucose Tolerance (NGT) (<140 mg/dl)	318(90.1)	331(87.6)	649(88.8)
Impaired Glucose Tolerance (140 to <200 mg/dl)	23(06.5)	32(08.5)	55(07.5)
Diabetes Mellitus (≥200 mg/dl)	12(03.4)	15(03.9)	27(03.7)
Total	353(48.3)	378(51.7)	731(100)

In the present study out of 731 subjects, normal glucose tolerance was seen in 649 (88.8%), Impaired Glucose Tolerance (IGT) in 55 (7.5%) and diabetes mellitus in 27 (3.7%) subjects. Individuals with impaired glucose tolerance may be euglycaemic in their daily lives & diabetes will not necessarily develop in them. IGT is not a clinical entity in its own right [17] and hence considered as non-diabetics. Thus total cases of type 2 diabetes mellitus in the present study were 76 i.e. 27 newly diagnosed cases and 46 known cases of diabetes mellitus. Thus the prevalence of

Type2 DM among study subjects was 9.7% (95% C.I. 7.5-11.9).

The ratio of known cases to newly detected Type2 DM was 1.8:1 i.e. approximately behind every two known cases of DM there was one undiagnosed case of DM which signifies the hidden burden of the disease in this population.

Various studies done in urban Indians show the prevalence of Type2 DM in the range from 5.3% to 15.7 %. [6,18,19]

Present study had shown that the prevalence of type 2 DM is high in this urban population i.e. 9.7%. The global prevalence of diabetes in 2008 was estimated to be 10% in adults [4] which is comparable to prevalence observed in this study.

Table 2: Socio-demographic characteristics of subjects and diabetes mellitus

Demographic factors		Diabetics (%)	Non-diabetics (%)	Total (%)
Age Group (Years)	30 – 39	06(03.4)	173(96.6)	179(22.9)
	40 – 49	21(08.9)	215(91.1)	236(30.3)
	50 – 59	28(14.2)	169(85.8)	197(25.3)
	60 – 69	15(13.0)	100(87.0)	115(14.7)
	≥70	06(11.3)	47(88.7)	53(06.8)
Sex	Male	33(08.8)	341(91.2)	374(47.9)
	Female	43(10.6)	363(89.4)	406(52.1)
Religion	Hindu	23(08.3)	255(91.7)	278(35.6)
	Muslim	27(12.8)	184(87.2)	211(27.1)
	Buddhist	25(10.5)	212(89.5)	237(30.4)
	Others(Sikh, Jain)	01(01.9)	53(98.1)	54(06.9)
Type of family	Nuclear	56(10.1)	497(89.9)	553(70.9)
	Joint	20(08.8)	207(91.2)	227(29.1)
Educational status	Illiterate	19(11.7)	143(88.3)	162(20.8)
	Primary school	13(08.2)	146(91.8)	159(20.4)
	Middle school	15(07.8)	178(92.2)	193(24.7)
	Secondary school	12(11.4)	93(88.6)	105(13.5)
	Higher secondary	8(08.5)	86(91.5)	94(12.1)
	Graduation & above	9(13.4)	58(86.6)	67(08.5)
Marital Status	Unmarried	00(00.0)	26(100)	26(03.3)
	Married	72(10.1)	641(89.9)	713(91.4)
	Others (widowed, divorced	04(09.8)	37(90.2)	41(05.3)
Occupation	Unemployed	49(12.2)	354(87.8)	403(51.7)
	Unskilled	06(03.7)	156(96.3)	162(20.8)
	Semiskilled	10(09.0)	101(91.0)	111(14.2)
	Skilled	07(09.9)	64(90.1)	71(09.1)
	Professionals	04(12.1)	29(87.9)	33(04.2)
S-E status	Class I	04(33.3)	08(66.7)	12(01.5)
	Class II	10(17.2)	48(82.8)	58(07.4)
	Class III	24(13.7)	150(86.2)	174(22.3)
	Class IV	18(08.0)	206(92.0)	224(28.7)
	Class V	20(06.4)	292(93.6)	312(40.0)

Relation between Socio-demographic characteristics of study subjects and diabetes mellitus is shown in table 2.

It is observed that prevalence of diabetes mellitus increased significantly with advancing age. (χ^2 test for trend = 9.513, df = 1, $p < 0.05$) Such type of finding is also observed by various authors in India population. [6,19,20]

Although the diabetes may occur at any age, surveys indicate that prevalence rises steeply with age. Type 2 diabetes usually occurs in the middle year of life and thereafter begins to rise in frequency. It may be due to glucose tolerance decreases with age due to deterioration in insulin sensitivity with increasing age and also probably due to less work, less exercise, carbohydrate

intolerance and improved life expectancy. Hence the age is considered most consistent risk factor world over for rise in DM prevalence. This is quite consistent with the studies done outside the Indian subcontinent like in USA, [21] Denmark [22] and Hongkong. [23]

Prevalence was observed more in females (10.6%) as compared to males (8.8%). Since females in this part of Indian subcontinent are sedentary house wives, have less outdoor activities hence tend to be more obese which could explain the increased prevalence of DM in them as compared to men. [24] But in this study this difference is not statistically significant (χ^2 = 0.6916, df = 1, p > 0.05). Similar findings were also reported by other studies. [18,25,19,26]

In the present study high prevalence of diabetes mellitus among Muslims (12.8%), as compared to other religions was observed. However this association is not significant (χ^2 = 6.918, df = 3, p > 0.05). Similar findings were also observed by Tandle BV, [18] Vijayakumar G et al, [27] Rao CR et al, [28] Dowse GK et al. [29]

The present study reveals that there is no statistical association between educational status and type 2 DM (χ^2 = 3.561, df = 5, p > 0.05).Bharati DR et al [30] also found no association between type 2 DM with education in their study.

However in contrast to present study findings, Arora V et al [19] reported that the prevalence of diabetes mellitus was influenced by education.

The prevalence of diabetes mellitus among married study subjects was 10.1% and among widowed & divorced subjects it was 9.8%. No case of DM was found in unmarried. The association between marital status and diabetes mellitus among study subjects was not statistically significant (χ^2 = 2.909, df = 2, p > 0.05).

The prevalence of diabetes mellitus was highest 12.2% among unemployed subjects, 12.1% among professionals, 9.9% among skilled workers, 9.0% among semiskilled workers and lowest 3.7% among unskilled workers. The difference was statistically significant (χ^2 = 9.675, df = 4, p < 0.05). Similar observations were also reported by Ramachandran A et al [6] and Arora V et al. [19]

The prevalence of diabetes mellitus was 10.1% among study subjects belonging to nuclear families and 8.8% among subjects belonging to joint families. The difference was not statistically significant (χ^2 = 0.3169, df = 1, p > 0.05).

In the present study, it is observed that prevalence of DM increased from low socioeconomic group to high S-E group i.e. from 6.4% in class V to 33.3% in class I S-E group. The Chi-square for trend for S-E status and type2 DM is found to be statistically significant (χ^2 test for trend = 16.52, df = 1, p < 0.001). Association between DM and S-E status was also observed by various authors in their studies. [6,27] Higher socioeconomic classes are associated with high calorie diet intake and sedentary lifestyle which lead to obesity and then to diabetes.

Table 3 shows high risk factors present in the subjects and diabetes mellitus. The prevalence of diabetes mellitus was significantly high 19.9% among subjects with family history of diabetes mellitus compared to 7.4% among study subjects without family history of diabetes mellitus. (χ^2 = 20.92, df = 1, p < 0.001). Family history of type 2 diabetes mellitus is one of the major contributing factors in causation diabetes in next generation i.e. NIDDM is having genetic predisposition. Similar findings were noted by various authors in their studies. [6,21,31-33]

Table 3: High risk factors present in the subjects and diabetes mellitus

High risk factors		Diabetics (%)	Non-diabetics (%)	Total (%)
Family H/O DM	Yes	29(19.9)	117(80.1)	146(18.7)
	No	47(07.4)	587(92.6)	634(81.3)
Diet pattern	Vegetarian	22(08.2)	245(91.8)	267(34.2)
	Mixed diet	54(10.5)	459(89.5)	513(65.8)
Calorie intake	≥2100 kcal	42(17.4)	199(82.6)	241(30.9)
	<2100 kcal	34(06.3)	505(93.7)	539(69.1)
H/O Alcohol consumption	Alcoholics	16(14.8)	92(85.2)	108(28.9)
	Non-alcoholics	17(06.4)	249(93.6)	266(71.1)
Smoking habit	Smokers	14(09.8)	129(90.2)	143(38.2)
	Non-smokers	19(08.2)	212(91.8)	231(61.8)
Physical activity	Sedentary	30(17.0)	146(83.0)	176(22.5)
	Light	27(12.1)	196(87.9)	223(28.6)
	Moderate	16(05.6)	270(94.4)	286(36.7)
	Heavy	3(03.2)	92(96.8)	95(12.2)
hypertension	Present	21(14.9)	120(85.1)	141(18.1)
	Absent	55(08.6)	584(91.4)	639(81.9)
BMI	Non obese (≤29.99)	61(08.6)	648(91.4)	709(90.9)
	Obese (≥30.00)	15(21.1)	56(78.9)	71(09.1)
Waist Hip Ratio	Normal (Male <1.0, Female <0.85)	34(06.6)	479(93.4)	513(65.8)
	Abnormal (Male >1.0, Female >0.85)	42(15.7)	225(84.3)	267(34.2)

The prevalence of diabetes mellitus was 10.5% (54/513) among subjects with mixed diet pattern and 8.2% (22/267) in vegetarian subjects. The association between diet pattern and diabetes mellitus was not statistically significant (χ^2 = 1.044, df = 1, p > 0.05). But it was observed that the prevalence of diabetes mellitus in subjects consuming calories at or above recommended level was more (17.4%) while it was 6.3% in those consuming below recommended level. The association between calorie intake and prevalence of diabetes mellitus was statistically highly significant (χ^2 = 23.41, df = 1, p < 0.001). It may be because of higher calories consumption if it is associated with physical inactivity causes obesity which is important determinant of insulin resistance.

As in the present study no women was found to be alcoholic hence these were excluded from denominator. The prevalence of diabetes mellitus in alcoholics was 14.8% (16/108), and in non-alcoholics it was 6.4% (17/266). The association between alcohol consumption and diabetes mellitus was statistically significant (χ^2 = 4.412, df = 1, p < 0.05). Excessive intake of alcohol can increase the risk of diabetes by damaging the pancreas and liver and by promoting obesity. Similar finding were also observed by Carlsson S. [(34)]

As in the present study no women was found to be smoker hence these were excluded from denominator. The prevalence of diabetes mellitus in smokers was 9.8% (14/143), and in non smokers 8.2% (19/212). The association between smoking and diabetes mellitus was not statistically significant (χ^2 = 0.2689, df = 1, p > 0.05). No statistical association between smoking and diabetes was observed by Gupta A et al [(35)] Morris RD et al [(36)] and Uchimoto S et al [(37)]

On the contrary to the findings of present study, Tandle BV [(18)] and Ahmad J et al [(26)] showed that association of smoking and diabetes mellitus was significant.

The role of smoking in causation of diabetes mellitus is still uncertain; some showing statistical association between smoking and diabetes and others does not.

In the present study prevalence of DM was found to increase from lowest

(3.2%) among subjects performing heavy physical activities to highest (17.0%) among subjects performing sedentary physical activities. The association between physical activity and prevalence of diabetes mellitus was highly significant (χ^2 = 22.37, df = 3, p <0.001). Physical inactivity may alter the interaction between insulin and its receptors and subsequently lead to type2 DM.

Similar findings were also observed in various studies. [6,18,26,28,30] Globally physically inactivity accounts for 14% of diabetes mellitus. It acts as a major risk factor for obesity which has significant relation with diabetes mellitus. [38]

The prevalence of diabetes mellitus among subjects having hypertension was 14.9% while it was 8.6% among normotensive subjects. The association between hypertension and diabetes mellitus was statistically significant (χ^2 = 5.191, df = 1, p < 0.05). Both diabetes mellitus and hypertension occur in increasing frequency with increasing age and they have a common predisposing factor i.e. insulin resistance. Similar findings were also recorded in various studies. [27,32]

The prevalence of diabetes mellitus was 8.6% among non obese subjects and 21.1% among obese subjects. The association between BMI (≥30.00) and DM was highly significant (χ^2 = 11.51, df = 1, p < 0.001). The prevalence of diabetes mellitus among subjects having abnormal WHR was 15.7% and 6.6% among those having normal WHR. The association between WHR and diabetes mellitus was also highly significant (χ^2 = 16.55, df = 1, p < 0.001). A higher WHR (>1in men & >0.85 in female) indicates abdominal fat accumulation and these persons are having increased risk for diabetes due to insulin resistance as compared to less serious gynoid fat distribution in which fat is more evenly and peripherally distributed around the body.

In some instances obesity reduces the number of insulin receptors on target cells. Evidences both from prospective and cross sectional studies suggest obesity to be strongly linked to diabetes. [18,27,39]

CONCLUSION

Type 2 diabetes mellitus is a chronic hereditary and lifestyle induced lifelong disease. It is of public health importance on account of its long term effect leading to serious complications including heart disease, blindness, kidney failure, neuropathy with risk of foot ulcers, amputations and premature death. Therefore it is important to detect and treat it before the occurrence of any complication. Regular screening of high risk persons such as those who are aged 30 years & above, obese, having sedentary lifestyle and family history of diabetes mellitus should be conducted. The population should be encouraged to adopt healthy lifestyle i.e. avoiding sedentary behavior, increasing physical exercise, avoid excess alcohol and should consume balanced diet etc.

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