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Prevalence of Diabetes Mellitus and its Risk Factors in Urban Population of Agra District: A Community Based Study

KEYWORDS: Diabetes Mellitus, Impaired Fasting Glucose, Diagnostic Gap, Body Mass Index, Waist Circumference, Waist-Hip Ratio

Dr Ravindra Singh
MD (Community Medicine) District Consultant (RMNCH+A) Dhule, Maharashtra

Dr S K Misra
MD, DPH Proff & Head Department of Community Medicine S N Medical College, Agra, UP

Dr Menaal Kaushal
MD (Community Medicine) Junior Resident-III Department of Community Medicine S N Medical College, Agra, UP

Dr Vishal Agarwal
MD (Community Medicine) Junior Resident-III Department of Community Medicine S N Medical College, Agra, UP

ABSTRACT *Background: In last two decades prevalence of Diabetes Mellitus in India is increasing at a high rate and currently India is the Diabetic Capital of the World. Reliable and informative epidemiological evidence is vital to quantify impacts and predictors of disease and to facilitate formulation of prevention and control strategies. In North India particularly Uttar Pradesh the area specific data regarding diabetes mellitus is scarce. Objectives: Prevalence of Type-II Diabetes Mellitus and its associated risk factors in urban population of the Agra city. Materials and Methods: A Cross-sectional, community based study was conducted from June 2012 to June 2013 among adults in the age group of 30 year and above residing in Agra City. A three stage random sampling technique was adopted to achieve the desired sample size. Result: The prevalence of Diabetes Mellitus was found to be 16.3%, It was 17.8% among males and 14.8% among females. Almost half (8.1%) were newly diagnosed while the remaining were known diabetics; thus the diagnostic gap was found to be 50%. In the present study statistically significant association is observed between prevalence of diabetes mellitus with age, socioeconomic class, obesity and family history. Conclusion: Almost half of the diabetes patients are unaware about their diabetic status thus reflecting the need for a regular screening program. Life style modifications to timely detect and intervene in the pathogenesis of diabetes mellitus are also required.*

INTRODUCTION

Diabetes mellitus is growing rapidly worldwide and it is reaching epidemic proportions[1,2]. It is estimated that there are currently 285 million people with diabetes worldwide and this number is set to increase up to 438 million by the year 2030[3]. The major proportion of this increase is estimated to be accounted by the developing countries, where the disorder predominantly affects younger adults in the economically productive age group. India has earned the dubious reputation of being the diabetic capital of the world having 50.8 million estimated Indians living with Diabetes Mellitus (2010)[4]. India is currently facing a doubly burdensome epidemiologic transition, further propelled by a demographic transition[4].

Studies carried out in different regions of India depict large regional as well as rural-urban disparities in the prevalence of diabetes. Scarcity of good quality epidemiological data is a serious limitation for further research[4]. Several important questions regarding the regional distribution, determinants and interventions for diabetes remain unanswered. Reliable and informative epidemiological evidence is the vital to quantify impacts and predictors of disease and to facilitate formulation of prevention and control strategies. The present study is planned to generate area specific information regarding the prevalence of Type-II Diabetes Mellitus and its associated risk factors in urban population of the Agra city.

MATERIAL & METHODS

A Cross-sectional, community based study was conducted from June 2012 to June 2013 among adults in the age group of 30 year and above residing in Agra City. A statistically valid sample size of 604 was calculated by applying the formula for sample size estimation as:

Minimum sample size= 4 (PQ)/ L^2

Where: P= Prevalence of 14.2% (from a previous study in Urban Chandigarh[5])

Q= 100- P

And L= 20% of P

The sample size was further increased to 670 to include 10% non-response error. 37 (0.55%) subjects who volunteered for blood sugar examination and were not from sampling frame, hence were excluded from the study, thus all the observations are based on information collected from 633 subjects.

A three stage random sampling technique was adopted to achieve the desired sample size. A house-to-house survey was done and all individuals of each household who fulfilled the inclusion criteria were included in the sample size.

After establishing a good rapport and obtaining written consent from participating subjects, the information was recorded in a predesigned and pretested schedule. The subjects were briefed about the procedure of the investigation and a repeat visit was made on the consecutive day early in the morn-

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ing to measure fasting capillary blood glucose with the help of Glucocard - Vital Glucometer (ARKRAY USA, Inc.). The patients found with deranged blood sugar level were offered detailed counseling and free treatment options at the nearby government health facility. Study protocol was presented to the college ethical committee and clearance was received prior to initiation of study. The data was compiled and statistically analyzed using SPSS-16 software.

Definitions and Diagnostic Criteria:
Case definition of Diabetes Mellitus was based on drug treatment for diabetes (insulin or oral hypoglycemic agents) and/or criteria laid by the WHO i.e. Fasting Plasma Glucose 126 mg/dl and for Impaired Fasting Glucose (IFG) =110-126 mg/dl[6]. Physical activity level was graded as sedentary, moderate and heavy based on a physical activity questionnaire, which included job-related, leisure time activities and specific questions on exercise[7]. The monthly income of the family was also noted. Obesity was defined as per WHO guidelines[8].

Results
The prevalence of Diabetes Mellitus was found to be 16.3%; it was 17.8% among males and 14.8% among females. Almost half (8.1%) were newly diagnosed while the remaining were known diabetics; thus the diagnostic gap was found to be 50%. The standardized prevalence (standardized with census 2011 population) of Diabetes Mellitus was calculated to be 14.6%.

Prevalence of Diabetes Mellitus was observed positively correlated (p-0.004) with the age of study subjects. It was 4.9% in the age group of 30-39 year. It rose up to 15.4% in 40-49year age group, 24.5% and 27.8% respectively in 50-59year and 60-69 year age group. A statistically significant decline (15.4%) however was observed in those aged 70 year and above [Table-1].

The prevalence of Diabetes Mellitus was observed to be almost similar among Hindus and Muslims. Diabetes Mellitus was significantly higher among Other Caste (21.9%) than those belonging to OBC (12.5%) and Scheduled Caste (5.8%).The prevalence of Diabetes Mellitus was observed among those belonging to Lower Socio-Economic Class (SEC) to be 9.9% [See Table 2].

The risk of Diabetes Mellitus seemed to increase with rise in Body Mass Index (BMI). Diabetes was twice higher among overweight and obese category–I (21.9% & 22.5%) and three times higher among the obese category–II (33.3%) as compared to those having normal and below normal BMI (11.3 & 11.1%) [Table 3].Diabetes Mellitus and IFG both were found to be significantly higher among centrally obese subjects (24.3% and 13.3% respectively) as compared to the non-obese (13.1% and 7.1% respectively). IFG also reflected a similar pattern. Prevalence of Diabetes Mellitus was higher (18.3%) among those having higher Waist Hip Ratio (WHR) as compared to the normal WHR category (14.0%). However, this difference is statistically insignificant.

The prevalence of Diabetes Mellitus showed an inverse trend with physical activity [Table 3]. It was significantly higher (five times more) among those having positive family history of Diabetes Mellitus. The prevalence of Diabetes Mellitus was lower(13.5%) among those who daily consumed 5 or more servings of fruits and vegetables as compared to among those who took lesser servings (16.6%), though this difference was found to be statistically insignificant [Table 4].

Variables significant in Univariate analysis were included for binary logistic regression. Age, Waist circumference and family history of Diabetes Mellitus were independent risk factors for Diabetes Mellitus in binary logistic regression. After 40 years age, unit (decade) increase in age increased the odds of Diabetes Mellitus by 3.84 times. The Odds of developing Diabetes mellitus was 1.87 times among those with higher Waist Circumference (>88cm for female and >102cm for male) compared to those with normal Waist Circumference. Income, socio economic status and BMI did not significantly contribute as risk factors for developing Diabetes mellitus in this study [Table 5].

Discussion
The prevalence of Diabetes mellitus in the present study was found to be 16.3% and the diagnostic gap was found to be 50%.A little less than a tenth (8.8%) of the study subjects were found to have Impaired Fasting glucose. ***R M Anjana et al.***[5] conducted a multicentric study and reported prevalence of Diabetes Mellitus that varied between 10.9% to 14.2%and IFG from 4.8% to 9.3 % in urban population of different regions of India. Similarly other studies (after 2005) also reported wide regional variation (from 10.9% to 19.5%) of diabetes prevalence in urban India[9-15]. Present study findings corroborated with the previous studies in prevalence of Diabetes Mellitus, IFG as well as in diagnostic gap that also was found to vary between 40% to 60%[5, 10, 13-15].

In the present study, the age wise distribution of Diabetes Mellitus reflected a rising trend up to the age of 69 year, followed by a significant decline, observed due to survival bias, thereafter. Similar findings were also reported by Ramachandran A et al[9].The present study documented the prevalence of diabetes mellitus as high as 21% among Middle SEC closely followed bythose (17.5%) among Upper SEC subjects but it was significantly lower (9.9%) among Lower SEC subjects. India is witnessing a shifting trend in the prevalence of Diabetes Mellitus from Higher SEC to Lower SEC and thus it appears to be shedding its label of "The Disease of the affluent". This reflects that India is running on the Western track with a falling trend of diabetes among Higher SEC individuals, as compared to the Middle SEC[16]. Lack of adequate knowledge and a rapid economic development is further propelling this shift.

In the present study, diabetes was found to be positively associated with Age, BMI, WC, WHR and positive Family history. All these factors are well known risk factors of diabetes as already presented in various studies, previously. In the present study, Binary logistic regression successfully highlighted Age, BMI and family history of Diabetes as Independent risk factors. Though Physical Activity and Dietary intake of fruits and vegetables are known protective factors, the present study could not significantly establish their link with occurrence of Diabetes, as a very small proportion of the study population practiced vigorous physical activity or consumed adequate servings of fruits and vegetables.

Conclusion
Variables significant in Univariate analysis were included for binary logistic regression. Age, Waist circumference and family history of Diabetes Mellitus were independent risk factors for Diabetes Mellitus in binary logistic regression. After 40 years age, unit (decade) increase in age in-

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creased the risk of Diabetes Mellitus by 3.84 times. Diabetes mellitus was 1.87 times among those with higher Waist Circumference (>88cm for female and >102cm for male) compared to those with normal Waist Circumference. Income, socio economic status and BMI did not significantly contribute as risk factors for developing Diabetes mellitus in this study.

Prevalence of Diabetes Mellitus among adult population of Agra city is as high as in other metro cities of India and half of the diabetics are unaware of their diabetic status. There is a need of regular screening programs as a part of health care delivery system to timely detect and intervene in the pathogenesis of diabetes and related morbidities. Most of the risk factors of Diabetes Mellitus are lifestyle related thus a due emphasis must be laid on programs promoting Life style modifications from early age, with regard to physical activity, especially for individuals with family history of diabetes, to prevent or at least postpone the occurrence of Diabetes.

Table – 1 Prevalence of Diabetic and IFG in the Study Subjects

Age	Male			Female			Total		
	N	Diabetes (%)	IFG (%)	N	Diabetes (%)	IFG (%)	N	Diabetes (%)	IFG (%)
30-39	79	4 (5.1)	3 (3.8)	105	5 (4.8)	7 (6.7)	184	9(4.9)	10(5.4)
40-49	78	9 (11.5)	8 (10.3)	78	15 (19.2)	8 (10.3)	156	24(15.4)	16(10.3)
50-59	76	18 (23.7)	10 (13.1)	75	19 (25.4)	7 (9.3)	151	37(24.5)	17(11.3)
60-69	54	19 (35.2)	4 (7.4)	36	6 (16.7)	4 (11.1)	90	25(27.8)	8(8.9)
≥70	27	6 (22.2)	3 (11.1)	25	2 (8.0)	2 (8.0)	52	8(15.4)	5(9.6)
Total	**314**	**56 (17.8)**	**28 (8.9)**	**319**	**47 (14.7)**	**28 (8.8)**	**633**	**103(16.3)**	**56(8.8)**
***p-value**	**<0.0001**		**0.17**	**<0.0011**		**0.69**	**<0.0001**		**0.125**

*chi-square for trend test applied

Table 2: Bivariate analysis of diabetes prevalence and its social factors

Variable	Category	N	Diabetes Mellitus (%)	Impaired Fasting Glucose (%)	p-value
Religion	**Hindu**	581	95(16.4)	50(8.6)	0.78
	Muslims	51	8(15.7)	6 (11.8)	
Caste	**Others**	351	77(21.9)	35(10.0)	<0.00
	OBC	138	18(12.5)	16(11.1)	
	SC	144	8(5.8)	5(3.6)	
Family Income (Rs)	**>30000**	88	19 (21.6)	11 (12.5)	0.09
	20000-30000	53	12 (22.6)	6 (11.3)	
	10000-20000	117	20 (17.1)	11 (9.4)	
	5000-10000	153	25 (16.3)	16 (10.5)	
	<5000	222	27 (12.2)	12 (5.4)	
Occupation	**Service**	111	14(12.6)	8(7.2)	<0.00
	Shop-owner/ Business	219	51(23.3)	32(14.6)	
	House wife	116	17(14.7)	3(2.6)	
	Laborer	131	8(6.1)	7(5.3)	
	Retired/Unemployed	56	13(23.2)	6(10.7)	
Education	**Illiterate**	83	10 (12.0)	7 (8.4)	<0.00
	Up to Middle class	123	8 (6.5)	9 (7.3)	
	High School/ Intermediate	197	42 (21.3)	15 (7.6)	
	Graduate/Post-graduate	230	43 (18.7)	25 (10.9)	
Socio-Economic Class	**Upper(I)**	80	14 (17.5)	7 (8.8)	<0.00
	Upper Middle(II)/ Lower Middle(III)	310	65 (21.0)	36 (11.6)	
	Upper Lower(IV)/ Lower (V)	243	24 (9.9)	13 (5.3)	
Total		633	103(16.3)	56(8.8)	

Table 3 Bivariate analysis of diabetes prevalence with anthropometric measurements

Variable	Category	N	Diabetes Mellitus (%)	Impaired Fasting Glucose (%)	p-value
BMI	**<18.5**	54	6(11.1)	1(1.9)	<0.00
	18.5-22.9	191	19(9.9)	16(8.4)	
	23-24.9	110	15(13.6)	10(9.1)	
	≥25	278	63(22.7)	29(10.4)	
Waist Circumference	**Normal**	452	59(13.1)	32(7.1)	<0.00
	High	181	44(24.3)	24(13.3)	
WHR	**Normal**	294	41(14.0)	25(8.5)	<0.00
	High	339	62(18.3)	31(9.1)	
Total		633	103(16.3)	56(8.8)	

Table 4 Bivariate analysis of diabetes prevalence with family history, physical activity and servings of study subjects

Variable	Category	N	Diabetes Mellitus (%)	Impaired Fasting Glucose (%)	p-value
Physical Activity	**Sedentary**	397	71 (17.9)	34 (8.6)	0.16
	Moderate	213	31 (14.6)	22 (10.3)	
	Vigorous	23	1 (4.3)	0	

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Family History	**Absent**	495	50(10.1)	33(6.7)	<0.00
	One Parent	89	29(32.6)	16(18)	
	Both Parent	20	10(50)	2(10)	
	Brother/Sister/Both	29	14(48.3)	5(17.2)	
Serving of fruits and vegetables*	**<5**	559	93(16.6)	47(8.4)	0.48
	≥5	74	10(13.5)	9(12.2)	
Total		633	103(16.3)	56(8.8)	

*1 Serving = 80gms Fruits and Vegetables

Table 5Binary Logistic Regression Analysis of Risk Factors for Diabetes Mellitus

Variable	Odds ratio	CI (95%)	p-value
Age	3.84	1.81-8.17	.000
Family History	0.25	0.14-0.43	.000
WC	1.87	1.04-3.39	.037
SES	0.52	0.24-1.10	.088
Income	0.71	0.36-1.40	.325
BMI	1.40	0.68-2.90	.354
WHR	1.18	0.60-2.31	.615

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