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An epidemiological study on risk factors of diabetes mellitus among the patients attending a tertiary care hospital of West Bengal, India

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ABSTRACT

The report of World Health Organization (WHO) shows that India tops the world with largest number of diabetic subjects. This increase is attributed to the rapid epidemiological transition accompanied by urbanization and changes in the life style, which is occurring in India. A cross-sectional descriptive study was conducted in the Department of Biochemistry of Calcutta National Medical College among the patients who were doing first time blood examination for diagnosis of diabetes. The objective of this study was to assess socio-demographic profile and risk factors associated with the diabetic patients. Prevalence of diabetes was more (63.6%) among those who had BMI (Body Mass Index) 25 or more, where as the proportion of diabetes was less among the persons having BMI less than 18.5. This association was found to be statistically significant ($\chi 2 = 32.78$, df = 2 p = 0.0001). Prevalence of diabetes was also high among persons consuming tobacco (34.5%) ($\chi 2 = 14.76$, df = 1, p = 0.0001) and animal protein (51.5%) ($\chi 2 = 55.65$, df = 1, p = 0.0001). Lifestyle modifications, reduction of body weight, increasing physical activity are some of the important primary preventive measures to halt the upward trend of diabetes epidemic in India.

Keywords: Diabetes, BMI, risk factors, lifestyle modification

INTRODUCTION

The prevalence of diabetes is rapidly rising all over the globe at an alarming rate[5]. Over the past 30 years, the status of diabetes has changed from being considered as a mild disorder of the elderly to one of the major causes of morbidity and mortality affecting the youth and middle aged people. It is important to note that the rise in prevalence is seen in all six inhabited continents of the globe[13]. Although there is an increase in the prevalence of type-1 diabetes also, the major driver of the epidemic is the more common form of diabetes, namely type-2 diabetes, which accounts for more than 90 per cent of all diabetes cases. Currently, India is passing through an epidemiological transition due to rapid urbanization coupled with economic growth[10]. The changing pattern in the economy is obvious from the current urbanization rate which stands at 35% compared to 15% in the 1950's. This rapid transition will have a major implication on the present and future disease patterns in India with particular reference to non-communicable diseases like diabetes and coronary artery disease (CAD)[9,14]. India is currently experiencing an epidemic of diabetes mellitus. In order to understand the true extent of the problem and its impact on diabetes care, there is a need to review the epidemiology of diabetes from different regions of India. Epidemiology of diabetes in India has an extensive history. From the available region wise population based studies it is clear that in the

last two decades, there has been a marked increase in the prevalence of diabetes among both urban as well as the rural Indians, with southern India having the sharpest increase. Subsequent studies confirmed this high prevalence of diabetes in urban south India. Today, the prevalence of diabetes in the urban metros of India is approaching the figures reported in the affluent migrant Indians[6]. Although in rural India the prevalence of diabetes is much lower than in the urban population, even here the prevalence of diabetes is rapidly rising, though clearly more studies are needed. Environmental and lifestyle changes resulting from industrialization, decrease physical activity, increase in weight and migration to urban environment from rural settings may be responsible to a large extent, for this epidemic of Type 2 diabetes in Indians. In addition, given the large number of people with Type 2 diabetes in our country, the morbidity due to complications associated with it would still be very high[10]. More over a large number of patients who are coming every day to the tertiary health care settings like Medical Colleges for the treatment of other complaints are diagnosed to be suffering from diabetes mellitus. So identification of these locally relevant and avoidable risk factors may help in primordial prevention of the disease. Considering all these factors the present observational and cross-sectional study was conducted with the following objectives:

(1) To find out the socio-economic and demographic profile of the study population.

(2) To assess the association between socio-economic and demographic risk factors with diabetes among the study subjects.

MATERIALS AND METHODS

A hospital based cross-sectional, observational study was conducted in the Department of Biochemistry of Calcutta National Medical College, West Bengal, India during the year 2009. Patients who were attending the Biochemistry department for blood sugar estimation for the first time constituted the study population. Before conducting the study ethical clearance from the Ethical Committee of the college and informed consent from the patients were taken. Data were collected from the study population by using a pre-designed semi-structured schedule. The schedule included socio-demographic and personal characteristics like age, sex, residence, marital status, level of education, per capita income, type of family, religion and mother tongue, food consumption pattern, lifestyle habits such as smoking, consumption of alcohol and level of physical activity. Family history and past history of diabetes, medication history was also included. Socio economic status (SES) was determined by using Prasad's Scale[4]. Weight and height were measured by using a portable weighing machine and steel measuring tape. BMI was calculated from height and weight measurement. "Current smoker/tobacco" user was defined as someone who at the time of the survey smoked/used tobacco in any form either daily or occasionally. The group of "non-smokers" comprised individuals who were never smokers (those who have never smoked at all) and ex-smokers. Regarding consumption of alcohol, a "current drinker" was defined as that who consumed one or more drinks of any type of alcohol in the year preceding the survey. "Fruit consumption" was considered when a person was eating fruit daily and not the average over the period of enquiry (in a week). "Physical activity" referred to any type of vigorous or moderate activity for at least 30 minutes a day for most of the days in a week other than routine daily activities. Data collection period was 6 working days. Daily average 60 – 70 new patients come from different departments for blood sugar estimation. Complete enumeration was done provided the patients gave consent to the study after being fully informed about the purpose of the study. The inclusion criterion was patients who came for blood sugar estimation for the first time. Previously diagnosed diabetic patients who came for subsequent blood sugar checkup during the study tenure and seriously ill new patients were excluded from the study. Total 365 willing patients came for testing the fasting blood sugar for the first time in Biochemistry department during the study tenure. They were interviewed and examined. Due to incompleteness, 11 schedules were rejected. Thus the final sample size came to 354. The criteria for diagnosis of diabetes mellitus was fasting venous plasma glucose level more than 126 mg/dl of venous blood[8]. Method used to measure plasma glucose was glucose oxidase-per oxidase method by using semi-auto analyzer (model- Microlab – 300, Merck).

Dependent variable (Outcome variable) was presence or absence of diabetes mellitus which was binary variable. So association between different risk factors with diabetes was assessed by binary logistic regression model. Continuous variable such as age, educational status, BMI were converted into multinomial categorical variable. Categorical variables are either in binomial or multinomial form as the case may be. For age, reference category was < 20 years, for gender male was reference category, for residence , rural was the reference category, for educational status secondary and above was the reference category, for BMI, <18.5 was the reference category and for socio-economic status, class II of Prasad scale was the reference category. Data were analyzed by using Epi Info version 3.5.1 and SPSS version 17.

RESULTS

Out of 354 patients who came for fasting blood sugar estimation, 84 patients (23.7%) were diagnosed to be suffering from diabetes mellitus. The majority of the study population was in the age group of 21 – 40 years (47.5%) and 67.7% of the study population was female. Rural patients were 58.2% of the study population. Most of the study population was a member of a joint family (60.7%), Hindu by religion (53.7%) and Bengali speaking (82.5%). The marital status revealed that 82.5% were married and 9.6% were widowed, divorced or separated. 47.7% of the study subjects belonged to socio-economic class I and II (**Table 1**).

Table 1 Socio-demographic profile of study subject (n = 354)

Characteristics	Number	Percentage
Age in years		
≤ 20	36	10.2
21 – 40	168	47.5
41 – 60	108	30.5
> 60	42	11.8
Gender		
Male	114	32.3
Female	240	67.7
Religion		
Hindu	190	53.7
Muslim	151	42.6
Others	13	3.7
Residence		
Rural	206	58.2
Urban	148	41.8
Marital status		
Married	292	82.5
Un married	28	7.9
Widow / Divorced	34	9.6
Educational status		
Primary	79	22.3
Secondary	162	45.8
Higher secondary	51	14.4
Graduate	44	12.4
Post graduate	18	5.1
Mother tongue		
Bengali	292	82.5
Hindi	62	17.5
Type of family		
Nuclear	139	**39.3**
Joint	215	**60.7**

Table 2 Distribution of study subjects according to different health conditions, anthropometric indices and risk factors (n = 354)

Variables	Diabetic (n = 84) Number (%)	Non diabetic (n = 270) Number (%)	Significance
Gender*			$\chi^2 = 3.55$
Male	20 (17.5)	94 (82.5)	df = 1
Female	64 (26.7)	176 (73.3)	p = 0.05
Residence *			$\chi^2 = 6.26$
Rural	39 (18.9)	167 (81.1)	df = 1
Urban	45 (30.4)	103 (69.6)	p = 0.01
BMI*			
<18.5	48 (18.6)	210 (81.4)	$\chi^2 = 32.78$
18.5 – 24.99	15 (23.8)	48 (76.2)	df = 2
≥25	21 (63.6)	12 (36.4)	p < 0.01
Family history of Diabetes*			$\chi^2 = 54.85$
Yes	38 (59.4)	26 (40.6)	df = 1
No	46 (15.8)	244 (84.2)	p < 0.01
Nature of Work*			$\chi^2 = 6.68$
Sedentary	62 (21.1)	232 (78.9)	df = 1
Moderate	22 (36.6)	38 (63.4)	p < 0.01
Tobacco use*			$\chi^2 = 14.76$
Yes	48 (34.5)	91 (65.5)	df = 1
No	36 (16.7)	179 (83.3)	p < 0.01
Socio-economic status			$\chi^2 = 1.90$
Class – I	13 (20.0)	52 (80.0)	df = 3
Class – II	23 (22.1)	81 (77.9)	p = 0.59
Class – III	37 (27.6)	97 (72.4)	
Class – IV	11 (21.5)	40 (78.5)	
Daily intake of fruit			$\chi^2 = 1.41$
Yes	17 (19.1)	72 (80.9)	df = 1
No	67 (25.2)	198 (74.8)	p = 0.23
Daily intake of dietary fiber*			$\chi^2 = 39.25$
Yes	46 (46.4)	53 (53.6)	df = 1
No	38 (14.9)	217 (85.1)	p < 0.01
Daily animal protein intake*			$\chi^2 = 55.65$
Yes	49 (51.5)	46 (48.5)	df = 1
No	35 (13.5)	224 (86.5)	p < 0.01
Daily intake of saturated fat*			$\chi^2 = 3.85$
Yes	12 (15.4)	66 (84.6)	df = 1
No	72 (26.1)	204 (73.9)	p = 0.04
Daily intake of sweets			$\chi^2 = 2.16$
Yes	11 (16.2)	57 (83.8)	df = 1
No	73 (25.5)	213 (74.5)	p = 0.14
Regular physical exercise			$\chi^2 = 0.21$
Yes	17 (21.8)	61 (78.2)	df = 1
No	67 (24.3)	209 (75.7)	p = 0.64
Alcohol Intake			**$\chi^2 = 0.47$**
Yes	12 (27.9)	31 (72.1)	**df = 1**
No	72 (23.1)	239 (76.9)	**p = 0.49**

Table 2 depicted that proportion of diabetes was more among females ($\chi 2 = 3.55$, df = 1, p = 0.05) and patients coming from rural areas ($\chi 2 = 6.26$, df = 1, p = 0.0123). Prevalence of diabetes was more (63.6%) among those who had BMI (Body Mass Index) 25 or more, where as the proportion of diabetes was less among the persons having BMI less than 18.5. This association was found to be statistically significant ($\chi 2 = 32.78$, df = 2 p = 0.0001). Prevalence of diabetes was high in persons consuming tobacco (34.5%) ($\chi 2 = 14.76$, df = 1, p = 0.0001) and animal protein (51.5%) ($\chi 2 = 55.65$, df = 1, p = 0.0001). Prevalence of diabetes was also high among the persons who had family history of diabetes (59.4%). However, it was less among the persons who did physical exercise regularly (21.8%). Regarding dietary consumption it was revealed that proportion of diabetes were more among the persons who did not consume fruits regularly (25.2%) but consume animal protein daily (51.5%).

** Female gender, urban resident, BMI >18.5, positive family history of diabetes, sedentary lifestyle, use of tobacco, non-consumption of daily dietary fiber, daily animal protein and saturated fat consumption were significantly associated risk factors of diabetes among the study population.*

Table 3 Association between Diabetes Mellitus and risk factors by binary logistic regression analysis

Predictor Variables	B	S.E.	Wald	df	p value	Exp (B) / OR
Age*	6.520	0.382	8.168	1	**0.002**	1.823
Gender	7.997	8.256	0.000	1	0.983	0.329
Residence*	-1.411	1.142	4.912	1	**0.015**	1.219
Educational status*	-.882	0.378	6.129	1	**0.006**	0.732
BMI*	14.881	0.858	0.000	1	**0.000**	1.600
Family history of diabetes*	1.871	0.211	3.770	1	**0.016**	1.228
Socio-economic status	-1.796	6.482	0.000	1	0.109	0.341
Nature of work*	1.965	1.518	4.881	1	**0.006**	3.207
Tobacco use*	21.412	0.561	8.942	1	**0.002**	1.998
Alcohol use*	-.721	0.309	0.000	1	**0.041**	0.189
Daily intake of fruit	24.843	8.114	3.647	1	0.505	7.825
Intake of dietary fiber	0.879	0.561	6.980	1	0.154	5.421
Saturated fat intake*	0.721	0.981	3.187	1	**0.042**	2.431
Animal protein intake*	-.043	8.223	0.000	1	**0.001**	0.719
Intake of sweets	-1.254	0.463	12.649	1	0.239	0.282
Regular physical exercise*	-2.462	1.923	16.871	1	**0.018**	5.643
Constant	3.765	2.198	0.000	1	1.000	**63.892**

Association of study variables with diabetes was analyzed by binary logistic regression and reflected in **Table 3**. The socio-demographic variables like age, educational status and nature of work were significantly associated with diabetes. Anthropometric index like BMI, dietary factors like consumption of animal protein, saturated fat intake, health conditions like family history of diabetes, alcohol consumption and tobacco use were also significantly associated with diabetes. Other factors like sex, intake of fruits, sweets and dietary fibers were also analyzed but no associations were found. Among the risk factors of diabetes considered for this study 72.9% could be explained by logistic regression analysis.

**Age, residence, educational status, BMI, family history of diabetes, nature of work, tobacco and alcohol use, daily saturated fat and animal protein intake, regular physical exercise are significant predictor variables for diabetes among study population*

DISCUSSION

Among the study population, 23.7% were diagnosed to be suffering from diabetes mellitus. In our study an attempt has been made to find out the association between different risk factors with diabetes by binary logistic regression analysis. The study revealed that prevalence of diabetes was significantly increased with increasing age. Similar findings were also reported (Chou P et.al., 1992) in a study conducted in Taiwan (OR = 1.04)[1]. Significantly higher prevalence of diabetes among the females was observed by Chou P et.al[1]. However the present study did not find any association between diabetes and sex of the patient. It was also evident that diabetes mellitus was significantly associated with urbanization (p value 0.015)[11]. The prevalence of diabetes is more among people living in urban areas (OR = 1.21) than in rural areas. A recent national survey on diabetes conducted in six major cities in India showed that the prevalence of diabetes in urban adults among Chennai residents was 13.5%, Bangalore 12.4%, Hyderabad 16.6%, Kolkata 11.7%, New Delhi 12.6% and Mumbai 9.3%. Thus it was clear that in the last two decades, there had been marked increase in prevalence of diabetes among urban Indians[11]. The speculated reason for this escalation in prevalence was due to changes in lifestyle. Recently studies had shown that with affluence, the prevalence of diabetes and related disorders tend to increase[8]. This was in marked contrast to that seen in developed countries, where an inverse relationship between diabetes and socio-economic status was noted and the prevalence of diabetes was higher in the lower socio-economic group. A population based study in urban south India called CUPS involving two residential areas representing lower and middle income groups in Chennai showed the prevalence of diabetes was significantly higher among middle income group (12.4%) compared to lower income group (6.5%)[2]. However the present study did not show any such significant difference (p=0.59). The association between diabetes mellitus and some of the host factors like family history was taken into consideration. The finding of the present study corroborated with existing knowledge of familial presence of this disease[1]. The present study also highlighted the significant association between BMI and presence of diabetes among the study population. Obesity had long been accepted as a risk factor of diabetes and the risk was related to both the duration and degree of obesity. Similar findings were observed by Chou P et.al[1]. The cut off values for ideal body weight applicable to western population might not hold well in the generally lean Indians. Moreover, insulin resistance which was found to be a characteristic feature of Asian Indian, despite their lean body mass, could be adversely affected by even small increase in the body mass. In other words higher BMI, rather than obesity appeared to be a risk factor in Indians. The present study highlighted significant association between sedentary life style and physical exercise with the occurrence of diabetes mellitus. Lack of exercise and sedentary lifestyle appeared to be an important risk factor for the development of diabetes mellitus. Lack of exercise may alter the interaction between insulin and its receptors. A significant relationship was observed between diabetes and intake of animal protein, fat intake, alcohol and tobacco use. Similar association was observed (Umemura S et.at.,1983) in a study conducted in Japan[12]. Risk factors of diabetes identified, were not the same in all the studies conducted in different places and it emphasized the

need for identification of risk factors in the specific area for better prevention and control of diabetes and its consequences. With the increasing prevalence of diabetes, the mortality and morbidity from the disease will also increase. If the current trend could not be arrested, India will have the largest number of diabetic cases by 2025. Therefore, the need of the day today is to take primary preventive measures like lifestyle modifications, reduction of body weight, increasing physical activity and planned urbanization etc, in order to arrest the emergence of a major health care challenge facing India.

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