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Original Article

Profile of the subjects with Diabetes: A hospital-based observational study from Ahmedabad, Western India

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ABSTRACT:
Objective: The aim of this study was to assess the profile of the diabetic subjects reporting to tertiary care hospitals at Ahmedabad, Western India.
Methods: From August 2006 to Jan. 31, 2009, a cross-sectional observational study was performed on diabetic subjects attending the Department of Diabetology, All India Institute of Diabetes and Research, and Yash Diabetes Specialties Centre (Swasthya), Ahmedabad. Case histories were recorded on a semi-structured, close-ended pro-forma basis and simultaneously anthropometric measurements and blood pressure were recorded and urine and blood tests were carried out. Data analysis was performed through SPSS (11.5).
Results: A total of 709 diabetic subjects were enrolled through a simple random sampling methodology. Of the total study population, 88 percent hade Type 2 Diabetes Mellitus. Almost all were literate. More than 40 percent of the study subjects had hypertension, 70 percent had dyslipidemia, 62 percent were obese, and 42 percent had uncontrolled glycemic status (HbA1c >9 percent). Hence their overall risk profile, notable obesity, lipid profile, hypertension and glycemic status were very unfavourable.
Conclusion: Our findings suggest a relatively unfavourable risk profile of the diabetic subjects who also suffered from diabetic complications. We recommend modifying the risk profile through early screening, education, and lifestyle modification strategies to improve the quality of life for diabetics.

Keywords: Diabetes; Type 2 Diabetes; Obesity; Polyuria; Glycemic status; BMI

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1. INTRODUCTION

Diabetes Mellitus (DM) is a hereditary and lifestyle-induced lifelong disease. It is a chronic and progressive condition that occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Most diabetics have no symptoms -- the most common symptom is no symptom. Since the beginning is insidious, there is an average delay of three to five years before a diagnosis is made. By the time the condition is diagnosed, an abnormal lipid profile, hypertension, and retinal changes, are often already present. DM affects 6 percent of the world's adult population. It is a silent disease that kills one person every 10 seconds. Worldwide, 4 million deaths are attributable to diabetes every year (1). A very high prevalence of DM was observed in Saudi Arabia, the U.S., Switzerland, and Austria. Researchers believe there is a 250 percent greater incidence of DM in the Middle East, Sub-Saharan Africa, India, Asia, and Latin America (2). With a projected doubling of number of global cases of diabetes by 2030, the development of effective strategies to prevent diabetes is of paramount importance (3).

India, a developing country with fast industrialization and rapid progress on all fronts, is making big strides toward global recognition. The flip side is that the economic prosperity and modern way of life are translating into an increased prevalence of lifestyle-related diseases. India already faces a grave problem with the largest number of people with diabetes (4-5). Literature showed that there is threefold rise of prevalence of diabetes in urban as well as rural areas (6-7). The World Health Organization (WHO) estimated that there are 33 million diabetics in India and that number will reach 80 million by 2030 (8-9). Hence, India will have the largest number of diabetics in the world (every fourth diabetic is an Indian) and will become the diabetic capital of the world. Although it has been recognized as a major cause of death and disability, many who suffer from diabetes are unaware that they are afflicted until they experience a debilitating side effect or complication of the disease.

It is established fact that good clinical and self-care activities can delay complications and improve the quality of life. For this, we must know the risk profile of the diabetic patient. Therefore, we initiated this study to assess the profile of diabetic subjects reporting to tertiary care hospitals in Ahmedabad, Western India.

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2. MATERIAL AND METHODS

The study was a cross-sectional evaluation of Type 1 and Type 2 diabetic subjects attending the Department of Diabetology, All India Institute of Diabetes and Research, and Yash Diabetes Specialties Centre (Swasthya), Ahmedabad, from August 2006 to Jan. 31, 2009. Ahmedabad is the largest district of Gujarat State with an approximate population of 5 million. The city established itself as the home of a booming textile industry and enjoyed major construction boom and population increase. A rising centre of education, information technology, and industries, Ahmedabad remains the cultural and commercial heart of Gujarat and much of Western India.

The study subjects have been defined as newly diagnosed diabetics (diagnosed within the previous six months), attending the Department of Diabetology and Swasthya Hospital for first time during the study period and willing to participate in the study. We chose a sample size of 660 people. We chose this number so we could study at least 20 percent of all newly diagnosed cases, based on the data review of the hospital that showed that at least 100 subjects (newly diagnosed) are presented every month. Hence, during the study period, there would be 3,000 subjects. We also assumed a dropout rate of 10 percent during the study period. Simple random-sampling was used to collect the desired sample of around 660 subjects during the study period.

After satisfying the case definition and obtaining informed consent (written consent from literate subjects and a verbally informed consent from illiterate subjects), the patients were enrolled. The case history was recorded on a semi-structured, close-ended *pro-forma*. We explained in detail the study methodology to the enrolled subjects.

Data on age, sex, education, occupation, and lifestyle factors (, tobacco usage (chewed or smoking), alcohol consumption, diet and physical activity) were collected from all subjects. Detailed medical histories were obtained regarding present complaints. All subjects were also interviewed regarding past history of diabetes, hypertension and other co-morbid conditions, and type(s) of treatment to control the disease. A general physical examination was performed. Height, weight, and blood pressure were measured using standardized procedures. These subjects also underwent various clinical tests like urinalysis (for microalbuminuria - the best indicator for renal dysfunction that was measured by turbidometry using a kit from Biosystems-Barcelona, Spain) (10) and blood sampling (for complete hemogram, plasma glucose, glycosylated haemoglobin[HbA1c], renal function tests, and lipid profile). The blood samples were collected by venipuncture, after ensuring 12 hours of fasting. Total cholesterol (TC), triglycerides (TG) and HDL-C levels were estimated using kits from End Point Assay with Liquid Clearing Factor–LCF,

Span Diagnostics Ltd. India). LDL-C was calculated using the Friedewald formula LDL-C + TC-[HDL-C – (TG in mg/dl/5)] (11-12).

For analysis purposes, current smokers and ex-smokers were categorized in the "ever smoker" group. Similarly, current tobacco chewer/snuffing and ex-tobacco chewer/snuffing were categorized in the "ever tobacco chewer" group. The ever smoker and ever tobacco chewer groups were considered tobacco users. Those who reported consuming alcohol at least once in the previous one-month period were considered current alcohol users. Physical activity was categorized as sedentary (sitting, standing and driving for most of the day, cooking, light cleaning, light yard work, slow walking, and other major activities involve sitting), moderate (an occupation that includes lifting, lots of walking, or other activities that keep you moving for several hours) and heavy (heavy manual labour, a very active lifestyle, dancer or very active sports played for several hours almost daily, an elite athlete in training, or an extremely active lifestyle – both at work and at play and sport – or activity lasting for several hours almost daily).

Blood pressure (BP) was recorded, after the subjects had rested for at least five minutes. Two readings were taken five minutes apart and the mean of two was recorded as the blood pressure. Hypertension was diagnosed based on drug treatment for hypertension or if the blood pressure was >130/80mmHg according to Joint National Committee-7 (JNC-VII) criteria (13). Blood pressure was measured through ausclutatory method in the supine and standing position as recommended by JNC-VII to rule out postural hypotension. Glucose levels were measured in plasma using the GOD-POD End Point Assay (Span Diagnostics Ltd. India).

A diagnosis of DM was confirmed using criteria established by the American Diabetes Association (14): a medical record indicating either a fasting plasma glucose (FPG) level >7.0 mmol/l or ≥126 mg/dl after a minimum 12-hour fast, or two-hour post-glucose level (oral glucose tolerance test) >11.1 mmol/l or ≥200 mg/dl on more than one occasion, with symptoms of diabetes. In the absence of medical records, confirmation was done on self-reported cases by establishing the criteria of regular treatment with anti-diabetics drugs or by performing a two-hour oral glucose tolerance test. Impaired glucose tolerance (IGT) was defined as FPG level of 100 mg/dl (5.6 mmol/l) but <126 mg/dl (7.0 mmol/l) or two-hour OGTT of ≥140 mg/dl (7.8 mmol/l) but <200 mg/dl (11.1 mmol/l).

National Cholesterol Education Programme (NCEP) guidelines (15) were used for definition of dyslipidemia which are the presence of one or more of the following abnormal serum lipid concentrations: a) HYPERCHOLESTEROLEMIA: Serum cholesterol levels >200 mg/dl (>5.2mmol/l) or drug treatment for hypercholesterolemia, and/or b) HIGH LDL CHOLESTEROL: LDLC >100mg/dl (>2.59 mmol/l) or drug treatment for high LDL cholesterol, and/or c) HYPERTRIGLYCERIDEMIA: Serum triglyceride levels >150 mg/dl (>1.7 mmol/l) or drug treatment for hypertriglyceridemia and/or d) LOW HDL CHOLESTEROL: HDL cholesterol levels <40 mg/dl (<1.04 mmol/l) for men and < 50 mg/dl (1.3 mmol/l) for women.

Body mass index (BMI) values were defined according to the recommendations of Indian Medical Council Research (ICMR) for Indians. A study subject was considered obese if the BMI ≥25 kg/m^2 and overweight if BMI = 23-24.9 kg/m^2 (16). The criterion for glycemic status (HbA1c) was good control (< 7 percent), sub-optimal control (7-8 percent), inadequate control (8-9 percent) and uncontrolled (>9 percent) (17).

The study protocol was approved by the Institutional Review Board (IRB) of all India Institute of Diabetes and Research. Data were cleaned, validated, and analyzed using SPSS version 11.5. Quantitative variables were summarized using mean and standard deviation while categorical variables were tabulated using frequencies and percentages. Differences between male and female diabetic subjects were evaluated using the z-test. The level of P <0.05 was considered as the cut-off value for significance.

3. RESULTS

A sample of 709 diabetic subjects was enrolled (Table 1). There were 427 males and 282 females with ages ranging from 2-80 years. Diabetics in the study were evenly distributed in four quartiles by age with a mean 44.25 ± 14.58 years (Table 2). Of the total study sample, 88 percent of subjects had Type 2 DM and 9.3 percent of the subjects had Type 1 diabetes (Table 1). Basic socio-demographic data showed that 84.6 percent (600/709) were Hindu. Almost all study subjects were literate and 55 percent were employed (Table 2).

Table 1. Types of diabetes in Ahmedabad, western India

Type of Diabetes	Number	Percentages
Type 2	622	87.7
Type 1	66	9.3
GDM	10	1.4
IGT	8	1.1
Secondary Diabetes	3	0.4

Table 2. Socio-demographic characteristics of the Diabetic subjects in Ahmedabad, western India

Characteristics	**Number**	**Percentages**
Sex		
Male	427	60.20
Female	282	39.80
Age (yrs)	(mean ± sd)	44.25 ± 14.58
Up to 37	185	26.1
37- 46	174	24.5
46 – 54	188	26.5
>54	162	22.8
Marital Status		
Never Married	73	10.30
Ever Married	636	89.70
Religion		
Hindu	600	84.60
Muslim	53	7.50
Christian	21	3.50
Others	35	4.90
Education		
Nil	03	0.40
Primary School	43	6.10
Secondary School	128	18.10
College	451	63.60
Professional	78	11.00
Others	06	0.80
Occupation		
Labourer	32	4.51
Professional	46	6.48
Businessman	188	26.51
Desk Jobs	120	16.92
Household work	209	29.47
Student	59	8.32
Others	55	7.75

Our subjects had classic diabetic symptoms such as nocturia (309/709), polyuria (226/709), polydypsia (161/709), and weight loss (195/709) (Table 3). According to BMI groups, 62 percent were obese. Only 8.6 percent had good glycemic status (HbA1c <7%).

Two-thirds of the study sample had dyslipidemia and positive family history for diabetes (Table 4). Hence, the overall risk profile was very poor. Regarding habits, 24.7 percent (175/709) of the subjects had some form of habits; 8 percent (56/709) of the subjects were smokers, 17.3 percent (123/709) were tobacco chewers, and 7.2 percent (51/709) consumed alcohol (Table 4).

There were statistically significant differences between male and female study subjects with respect to mean BMI, mean waist and hip circumferences, mean LDL, and VLDL levels at $p<0.05$ (Table 5).

Table 3. Presenting symptoms of diabetic subjects in Ahmedabad, western India

Characteristics	**Number**	**Percentages**
Weakness	425	59.9
Nocturia	309	43.6
Polyuria	226	31.9
Polydipsia	161	22.7
Weight Loss	195	27.5
Leg pain	169	23.8
Tingling	138	19.5
Burning Micturation	69	9.7
Skin complaint	61	9.6
Vision impairment	57	8.0
Itching of Private parts	54	7.6
Numbness	41	5.8
H/O impotence	28	3.9
Nausea/Vomiting	24	3.4

Table 4. Profile of clinical and other associated factors of diabetic subjects in Ahmedabad, western India

Characteristics	Number	Percentages
BMI Group		
Under weight (< 18.5 Kg/m^2)	58	8.2
Healthy Weight (18.5-22.9 Kg/m^2)	117	16.5
Over Weight (23 – 24.9 Kg/m^2)	96	13.5
Obese (≥ 25.0 Kg/m^2)	438	61.8
Glycosylated Hemoglobin (HbA1c)(mean ± sd)	9.05 ± 1.71	
Glycemic Status		
< 7% (good control)	61	8.6
7 – 8% (sub-optimal control)	165	23.3
8 – 9% (inadequate control)	185	26.1
>9% (uncontrolled)	298	42.0
Family History	469	66.1
Lipid		
Dyslipidemia	502	70.8
Hypertension	320	45.1
Mode of onset		
Acute	528	74.5
Sub-acute	149	21.0
Insidious	32	4.5
Microalbuminuria	66	9.3
Physical activity		
Sedentary	578	81.5
Moderate	123	17.3
Heavy	8	1.1
Addiction	175	24.7
Tobacco chewing	123	17.3
Years of tobacco Chewing (mean ± sd)	12.35 ± 8.62	
Alcohol	51	7.2
Years of Alcohol Drinking (mean ± sd)	9.68 ± 7.64	
Smoking	56	7.9
Years of tobacco Smoking (mean ± sd)	11.46 ± 9.27	
Diet		
Vegetarian	600	84.6
Non-Vegetarian	109	15.4
Treatment (excluding diet)	231	32.6

4. DISCUSSIONS

Diabetes mellitus is a major public health problem and a leading cause of morbidity and mortality worldwide. Its prevalence is on the rise in many areas of the developing world, especially in India, in response to increasing prosperity and sedentary lifestyles. To the best of our knowledge, no similar study has been conducted in Ahmedabad, Western India.

Nonetheless, literature regarding the prevalence of diabetes is available from South and North India (18-21). This study presents observational data from large numbers of subjects with diabetes attending Department of Diabetology, All India Institute of Diabetes and Research, and Yash Diabetes Specialties Centre (Swasthya), Ahmedabad. Based on etiologic classification of diabetes mellitus (Type 1 and Type 2), our study found that Type 2 DM is a major burden in Western India. This complements findings by D. Simon . (22). Achieving optimal glycemic control in diabetic subjects has proven to be a real challenge to healthcare providers. In this study, only 9 percent of the subjects had achieved good glycemic status, which is different from various studies such as a Swedish survey found that 34 percent of Type 2 diabetics had good glycemic control (23). A study by F. Al-Maskari, et al. found that 38 percent of Type 2 DM subjects had good glycemic control (24) and study by J. Al-Kaabi, et al., reported 31 percent of subjects had good glycemic control (17). The reason for the discrepancy may be that this study includes both Type 1 and Type 2 DM patients. Also, the sample was drawn from tertiary care hospital and these subjects may have had diabetes for many years as was evident from complications like renal dysfunction and vision impairment.

The limitations of our study were: i) This is a cross-sectional evaluation of diabetic subjects and we are aware of its limitations, but it does give a clear snapshot of the current situation and may help improve outcomes for subjects and develop a hypothesis that can be tested through analytical studies; ii) Our study population is drawn from hospitals. Nonetheless the area is very wide but of course it is not a population-based study, so we are unable to generalize the results to all of Western India; and iii) We haven't collected data on the duration of diabetes, so we are unable to report the duration of the disease in our subjects.

Table 5. Study population characteristics, clinical and laboratory findings by sex in Ahmedabad, western India

Characteristics	Mean ± SD		P-value
	Male	Female	
Height (cm)	166.95 ± 11.16	153.38 ± 9.55	0.000
Weight (kg)	72.06 ± 17.47	64.31 ± 15.63	0.000
BMI	25.58 ± 5.07	27.07 ± 5.67	0.000
Waist Circumference (cm)	91.84 ± 11.68	88.30 ± 10.43	0.000
HIP Circumference (cm)	97.76 ± 9.31	101.19 ± 12.80	0.000
Blood Pressure			
SBP (mmHg)	127.42 ± 16.90	128.22 ± 17.74	0.558
DBP (mmHg)	84.27 ± 9.51	82.87 ± 9.33	0.061
Hemoglobin	12.64 ± 1.41	11.74 ± 1.34	0.000
Fasting plasma glucose (mg/dl)	180.82 ± 64.19	176.85 ± 61.20	0.440
HbA1c (%)	9.11 ± 1.76	8.94 ± 1.61	0.179
Lipid Profile			
Cholesterol (mg/dl)	194.22 ± 39.25	200.71 ± 45.93	0.055
HDL (mg/dl)	41.34 ± 5.42	41.06 ± 6.01	0.550
LDL (mg/dl)	118.88 ± 31.68	127.32 ± 37.78	0.002
Triglycerides (mg/dl)	181.88 ± 125.87	169.12 ± 137.83	0.225
VLDL (mg/dl)	35.80 ± 18.76	31.88 ± 12.57	0.004

5. CONCLUSION

In summary, the study was performed to learn the basic characteristics - including risk profile of diabetic subjects. This study showed that uncontrolled glycemic status diabetes-associated dyslipidemia and hypertension are prevalent and that approximately two-thirds of the study population are clinically obese. Hence, it is strongly suggested that an appropriate management for at-risk diabetic subjects be implemented, requiring a number of screenings at regular intervals. Early intervention for the prevention of complications can improve the outcome and quality of life for diabetics. The HbA1c test should be ordered at least annually to assess the glycemic status of diabetic subjects. Furthermore, public health officials must raise awareness through health education sessions about diabetes and its risk factors, and explain appropriate lifestyle modifications and interventions. We also recommend reviewing targets of control with each subject during every clinical encounter. This study provides the baseline profile of diabetic subjects and serves as an impetus for further qualitative and quantitative studies to explore socio-cultural and other risk factors affecting the outcomes of diabetes, especially Type 2 DM, which will yield new perspectives and knowledge regarding diabetes management.

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