CLINICAL STUDY

A Study of Somatic Status and Complications Among Female Diabetic Patients from Mysore Urban Area

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ABSTRACT

In recent years, India has undergone rapid urbanization and socioeconomic development. Changes in time trends have resulted in erratic lifestyle, characterized by physical inactivity, unhealthy eating habits and resultant increase in obesity and diabetes. Diabetes is a major cause of mortality and morbidity in India and its prevalence is increasing at an alarming rate. Chronic complications of diabetes, especially coronary artery diseases and chronic renal diseases results in frequent hospitalization. The main aim of the investigation was to study the somatic status and diabetic complications among the female hospitalized and non-hospitalized patients. A total of 80 female volunteers (40 hospitalized and 40 non-hospitalized) of a private hospital in Mysore, with known history of type 2 diabetes mellitus for more than 2 years, were recruited for the study. The tools were developed to collect information on personal history, demography, socioeconomic status, dietary habits and anthropometric measurements. Suitable statistical analysis was applied to the data. The results projected that majority of the patients were hospitalized on an average of at least three times a year. More than 90% of the subjects exhibited blood sugar >300 mg on admission. The reason for high morbidity status included poor dietary habits and erratic lifestyle practices among the female hospitalized patients as compared to non-hospitalized patients. Adapting a healthy lifestyle and maintenance of normal blood sugar level can reduce the incidence of complications and hospitalization among the subjects.

Keywords: Urbanization, socioeconomic development, obesity, diabetes, somatic status, diabetic complications, hospitalized and non-hospitalized patients

Diabetes is a multifactorial disease that combines hereditary and environmental factors. The prevalence of diabetes is increasing globally. Diabetes is pandemic in both developed and developing countries. In the year 2000, it was estimated that there are 175 million diabetics worldwide and expected to increase to 354 million by the year 2030.

Based on a compilation of studies from different parts of the world, World Health Organization (WHO) has projected that the maximum increase in diabetes would occur in India.[1] Presently, India is facing a major health care burden due to the high prevalence of type 2 diabetes as it is a major cause of mortality and morbidity in India, and is increasing at an alarming rate. Genetic predisposition superimposed by erratic lifestyle - physical inactivity, unhealthy eating habits is one of the major causes for increase of diabetes in India. The prevalence of type 2 diabetes is found to be 4-6 times higher in the urban areas as compared to rural areas.

The onset of diabetes among Indians is about a decade earlier than their western counterparts and this has been noted in Asian Indians in several studies. Studies show that among urban Asian Indians even minor changes in body mass index (BMI) central adiposity tilts the metabolic balance towards hyperglycemia/insulinemia. Asian Indians are said to have higher upper body adiposity measured as waist-hip ratio (WHR). The cut-off values for normal waist circumference were 80 cm and 0.8 for WHR among women.[2]

The cardiometabolic risk associated with abdominal obesity is attributed to the presence of visceral adipose tissue (VAT), which promotes insulin resistance, dyslipidemia and hypertension.[3-5] A national survey of diabetes in the year 2000 conducted in six major cities in India reported 54.1% of diabetes developed in most productive years of life and had higher risk of developing complications of diabetes.[6,7]

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Asian dyslipidemia is characterized by high serum levels of triglycerides (TG) and lipoprotein a {Lp(a)}, borderline high levels of low-density lipoprotein (LDL) and low levels of high-density lipoprotein (HDL) cholesterol.

Asian Indians have high ratio of total cholesterol (TC) to HDL, TG/HDL and apoB/apoA.[8-10] These ratios are highly correlated with premature incidence and severity of coronary artery disease (CAD) as well as acute myocardial infraction among Asian Indians. On an average, diabetic patients stay in the hospital 1-3 days longer than patients without diabetes. The prevalence of micro- and macrovascular complications were more in Asians when compared to Europeans. Acute and chronic complications of diabetes, especially cardiovascular diseases (CVDs), results in hospitalization of many patients with diabetes.[11] The projections of the present study throw light on the Mysore female diabetic subjects and can be used to develop prevention strategies by consulting physicians.

METHODOLOGY

A total of 80 volunteers (40 non-hospitalized and 40 hospitalized) with known history of type 2 diabetes mellitus for more than 2 years were recruited for the study. Volunteers willing to participate and belonging to the age group of 30-70 years with no history of hormonal therapy or hyperthyroidism were included as subjects. Anthropometric measurements like height, weight, mid-upper-arm circumference (MUAC), triceps skin fold (TSF), were recorded using standard procedures.[12] Indices viz. BMI, WHR were calculated as an index of obesity. Biochemical assessment included fasting blood sugar (FBS), postprandial blood sugar (PPBS) and lipid profile. The values were recorded from the medical record of the patients. A pretested questionnaire was applied to elicit information.

Description of the methods applied to collect the data is given below.

Anthropometric Measurements

- **Height (cm)** was measured with the subject standing, back to a stadiometer in the base feet. Feet were kept parallel with the heels together. The moving arm of the stadiometer was lowered to touch the top of the head and height was measured to the nearest 1.0 mm.
- **Weight (kg)** was measured to the nearest 0.005 kg with a weighing machine, which was calibrated daily by using known 5 kg weights.
- **MUAC (cm)** was measured on the right arm at the point between the tip of shoulder and tip of olecranon in the elbow bent at 90°.
- **Skin fold thickness (mm)** was measured according to the protocol described by Durmin and Womersley (1) using skin fold calipers (beta-technology incorporated; USA).
- **Triceps skin fold (mm)** was measured at mid-point of right arm elbow, bent at 90° on the lateral side.
- **Waist circumference (cm)** was measured midway between the lateral ribs and iliac crests. The subjects were asked not to tuck their stomach in, and the measurement was taken in gentle expiration. Their clothes were loosened around the waist area.
- **Hip circumference (cm)** was measured at the widest part over the trochanters with the feet kept 25-30 cm apart.

Statistical Analysis

The collected data was compiled for obtaining mean ± SD. Student *t*-test was used for comparison of groups. All the analysis was done using windows based SPSS statistical package (version 11.0). Significant figures used; $0.05 < p < 0.10$* Moderately significant, $0.01 < p \leq 0.05$** Strongly significant $p \leq 0.01$.

RESULTS

The baseline characteristics of the subjects are shown in Table 1. From among the 80 subjects, 40 were hospitalized and the other 40 non-hospitalized. The mean age of the subjects was 57 (hospitalized) and 60 (non-hospitalized) years. Majority of the subjects from both the groups (74%) reported to have family history of diabetes. It was observed that majority (32%) of hospitalized subjects developed diabetes at an younger age (35-45 years), while among the non-hospitalized subjects the onset was after 45 years of age (37%).

A considerably higher percentage of the subjects were found to have basic primary school education (40%) and 30% were illiterate. High majority (47%) of the subjects were found to be daily wagers and were economically backward and belonged to the among the hospitalized group. Diet history showed that a high percentage (68%) of the subjects were nonvegetarians. It is noteworthy to mention that a significantly higher mean body weight ($p = 0.031$) and BMI ($p = 0.005$) was seen among the hospitalized subjects while, TSF (0.038) was significantly higher among the non-hospitalized subjects. Waist circumferences was above the normal cut-off level (>80 cm) recommended for Asian Indians in both the groups.

Table 1. Baseline Characteristics of the Subjects

	Hospitalized (n = 40)	Non-hospitalized (n = 40)	Total (n = 80)
Age (years)			
≥35-<45	4 (10)	3 (7)	7 (8.7)
≥45-<55	10 (26)	9 (23)	19 (23.7)
≥55-<65	13 (32)	12 (30)	25 (31.3)
>65	13 (32.5)	16 (40)	29 (36.3)
Age of onset of diabetes			
≥35-<45	13 (32)	07 (18)	25 (20)
≥45-<55	08 (20)	15 (37)	29 (23)
≥55-<65	12 (30)	8 (20)	25 (20)
>65	07 (18)	10 (25)	21 (17)
Marital status			
Married	40 (100)	40 (100)	80 (100)
Unmarried	-	-	-
Education			
Illiterates	10 (25)	13 (32.5)	24 (30)
1-7th	14 (35)	10 (25)	18 (22.5)
8-10th	8 (20)	10 (25)	15 (18.7)
PUC and above	8 (20)	7 (17.5)	23 (28.8)
Family history of diabetes mellitus			
Yes	30 (75)	29 (73)	59 (74)
No	10 (25)	11 (27)	21 (26)
Income			
≥5,000	4 (10)	-	4 (5)
10-20,000	19 (47.5)	9 (22.5)	28 (35)
20-40,000	8 (20)	11 (27.5)	19 (23.8)
40-60,000	4 (10)	12 (30)	16 (20)
>60,000	5 (12.5)	8 (20)	13 (16.2)
Type of diet			
Vegetarians	14 (35)	12 (30)	26 (32)
Non-vegetarians	26 (65)	28 (70)	54 (68)

Protein status as indicated through MUAC was within the normal range (Table 2).

Different comorbid conditions of the subjects are presented in Table 3. Sixty-two percent of the hospitalized subjects had myocardial infarction as a major complication. The mean duration of diabetes among these subjects was found to be 8 years.

Among the non-hospitalized subjects, though the duration of diabetes was longer, complication of myocardial infarction was found only in 22% of the subjects. Among the subjects, chronic obstructive pulmonary disease (COPD) appeared to be a common complication in both the groups. It was observed that subjects having diabetes for more than 15 years developed chronic kidney diseases (CKDs), which accounted for 13% among hospitalized and 7% in non-hospitalized subjects.

Table 2. Mean ± SD Anthropometric Measures and Indices

Parameters	Hospitalized patients (n = 40)	Non-hospitalized patients (n = 40)	P value
Height (cm)	157.4 ± 5.4	157.4 ± 5.8	1.000
Weight (kg)	63.2 ± 10.1	58.8 ± 7.5	0.031
BMI (kg/m^2)	25.9 ± 4.2	23.6 ± 2.9	0.005
Waist (cm)	88.6 ± 10.5	85.8 ± 6.1	0.219
WHR (cm)	0.83 ± 0.04	0.81 ± 0.03	0.204
MUAC (cm)	28.0 ± 3.7	26.8 ± 2.6	0.093
TSF (cm)	19.6 ± 2.7	20.9 ± 2.8	0.038

Table 3. Complications and Duration of Diabetes

Hospitalized patients			Non-hospitalized patients	
Complications	**n**	**Duration of diabetes**	**n**	**Duration of diabetes**
Myocardial infarction	25	8	9	12
COPD	10	5	10	8
CKD	5	>15	3	>15

The correlation of somatic measures with biochemical parameters are presented in Table 4. Significant associations were observed in hospitalized subjects against various body and biochemical parameters. Higher BMI showed significant association with TC and LDL. Hip circumference showed inversely significant relationship with LDL. BMI showed moderately significant association with FBS only in non-hospitalized subjects (Table 5).

Correlation between various biochemical parameters are shown in Table 6. Significant association was found between FBS and TG only among hospitalized subjects. Those with high FBS also had high PPBS among the hospitalized subjects. While among non-hospitalized subjects PPBS was highly significant with HDL. TG showed significant correlation with TC and LDL among only the non-hospitalized subjects.

Table 4. Mean Biochemical Parameters of the Subjects

Biochemical parameters (mg)	HP	NHP	't' value	P value
TC	199.5 ± 36.7	198.0 ± 35.8	0.179	0.858
HDL	46.4 ± 13.2	40.4 ± 7.4	2.57	0.012
LDL	119.6 ± 31.2	112.7 ± 30.4	1.00	0.315
TGs	157.1 ± 59.9	146.4 ± 35.8	0.98	0.331
FBS	176.7 ± 68.3	158.0 ± 23.5	1.63	0.107
PPBS	326.2 ± 99.8	267.2 ± 62.7	3.16	0.002

HP = Hospitalized; NHP = Non-hospitalized; TGs = Triglycerides.

Table 5. Correlation for Somatic Measures

Parameters		Hospitalized patients	Non-hospitalized patients
BMI	TC	0.016*	NS
	LDL	0.015*	NS
	FBS	NS	0.041*
	PPBS	NS	NS
Hip circumference	LDL	0.018*	NS
WHR	LDL	0.038*	NS
TSF	LDL	0.042*	NS

*Moderately significant, NS = Not significant.

Table 6. Correlation of Biochemical Parameters

Parameters		Hospitalized patients	Non-hospitalized patients
FBS	TG	0.016*	
	PPBS	0.0002**	
PPBS	HDL		0.004**
TG	TC	NS	0.0001**
	LDL	NS	0.001**

**Highly significant.

DISCUSSION

Epidemiological studies conducted in southern India show a steady increase in the prevalence of diabetes in the urban population. The earlier reports from Chennai showed a male preponderance in the prevalence of diabetes, which in subsequent years had shifted slightly towards a female excess.[6,7,13-16] In India, nearly 75% of the type 2 diabetics have first-degree family history of diabetes indicating a strong familial aggregation. Risk factors for developing type 2 diabetes, peculiar to the Indian population, are high familial aggregation, central obesity, insulin resistance and lifestyle changes due to urbanization.[17]

Insulin resistance has been demonstrated to be a characteristic feature of Asian Indians. In the present study, the onset of diabetes was found to be between the age groups of 35-45 years and all the subjects reported family history of diabetes. The mean age of onset of diabetes was found to be 35 years. Several studies on the Asian population reveal that the onset of diabetes is seen before the age of 50 years and at the time of diagnosis of diabetes most of them had developed micro- and macrovascular complications.[18] Familial aggregation, a typical feature of the Indian population, could be one of the cause for early onset of diabetes among the subjects.

The three urban diabetic surveys conducted in 1989, 1995 and 2000 in randomly collected areas in the city of Madras (now known as Chennai) reported no significant time-related change in the prevalence of obesity as measured by BMI.[7,13] Analysis of these surveys showed, that among the diabetic women, a higher percentage had BMI of 23-24.9 kg/m^2.[19] The normal cut-off values for Asian Indians are below 23 kg/m^2. A BMI of ≥25 kg/m^2 has been considered to indicate different grades of obesity. In the present study, the hospitalized patients had a mean BMI of 25.9 and 23.6 among the non-hospitalized subjects.[7] A peculiar pattern was observed among the study population that, there was no significant association between BMI and PPBS in the hospitalized subjects while, non-hospitalized subjects had significant association with only FBS. Studies show that the factors, which influence the BMI and the WHR have also frequently lacked specificity with respect to women.[7,13]

Central obesity is common among Indians despite low rates of general obesity and this android pattern of body fat typified by more upper body adiposity measured as WHR was found to be a greater risk factor as compared to general obesity. The cut-off values for normal waist circumference are 80 cm and 0.8 for WHR in women.[20-22] Asian Indians have higher upper body

adiposity measured as WHR. This has been suggested to be a superior predictor of CVD risk because it includes a measurement of hip circumference, which is inversely associated with dysglycemia, dyslipidemia, diabetes, hypertension, CVD and death.[23-27] The present study population also exhibited higher WHR as compared to the Asian standards. This could be one of the major causes for dyslipidemia exhibited by the subjects. Increasing evidence suggests that waist and hip circumferences have independent and opposite associations with glucose and lipid levels and risk of diabetes and CVD.[28,29]

Study by Ramachandran et al[17] has reported that Asian Indians require higher levels of plasma insulin to maintain normoglycemia; they also have other features of insulin resistance such as central obesity and high percentage of body fat in comparison to many other populations. Significant association was found between various lipid profile parameters and blood sugar levels in hospitalized subjects, while for non-hospitalized subjects PPBS was strongly associated with HDL and TG with TC and LDL. Based on the available published data there is a paucity of reliable data on diabetes related complications among people worldwide. A common complication of diabetes and the most common cause of mortality in people with diabetes is CVD.[18] This was prominently seen among hospitalized subjects who had blood sugar levels of >300 mg% on admission. The most common complications seen was myocardial infarction followed by COPD and CKD. Among the subjects majority were hospitalized on an average of at least 3 times a year. The reason for hospitalization included; myocardial infraction, COPD and/or nephropathy. More than 90% of the subjects exhibited blood sugar >300 mg on admission despite being on oral hypoglycemic agents. Evaluation of elevated blood sugar revealed-poor dietary habits, irregular meal timings, festive occasions, physical inactivity and poor morbidity status.

CONCLUSION

The main findings of the study were that, majority of the subjects had onset of diabetes mellitus at the mean age of 35 years. This early onset of diabetes will result in higher diabetes related complications at an earlier age, which can lead to increased mortality in the productive years of life. There is an urgent need to prevent diabetes and its complications rather than simply treat it once established. Patients should be educated for lifestyle changes such as weight control, increased physical exercise and smoking cessation, which are potentially beneficial in preventing diabetes mellitus and CAD. The limited data available on gender-wise, region-wise diabetes complication rates highlight the need for nation-specific and population-specific studies. Furthermore, the morbidity and mortality caused by diabetes mellitus can be reduced by secondary prevention through regular screening, early detection and appropriate treatment of chronic complications.

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