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Changing trend in one decade in the profile of newly diagnosed subjects with type 2 diabetes in India

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Abstract
The aim was to assess the profile of newly diagnosed subjects with type 2 diabetes and to compare with the cases diagnosed a decade earlier. A total of 840 newly diagnosed subjects with type 2 diabetes were included in this analysis. 589 were consecutively diagnosed with diabetes from a tertiary care centre in the year 2009. Data of 251 new cases diagnosed a decade earlier (1999) was obtained retrospectively from the medical records. Demographic, anthropometric, blood pressure, glycemic and lipid parameters, signs and symptoms, presence of complications were noted.The age at onset of diabetes was much younger in 2009 compared to 1999 (45±10.6 vs 49.9±9.8, p<0.0001). BMI was lower in 2009 than 1999 whereas mean waist circumference was higher in 2009. Prevalence of central obesity was significantly higher (84.6%) in 2009 compared to 1999 (56.6%).Educational and socioeconomic status improved in 2009.Dietary assessment revealed that consumption of calories increased in 2009. Mean HbA1c was higher in 2009 compared to 1999. About 79.3% were tested for diabetic complications in 1999 and it was 91.3% in 2009. Among the complications tested, neuropathy was highly prevalent in 1999 and in 2009 complications were less or similar to that reported in 1999. More than 20% had microalbuminuria in both the groups. Lipid abnormalities also varied between the study groups. The population is undergoing life style transition due to socioeconomic growth. Time related changes are noted in the profile of newly diagnosed subjects with type 2 diabetes in India.

Keywords: *changing trend, profile, type2 diabetes, India.*

Introduction

Non communicable diseases are rapidly emerging as an epidemic in the developing countries like India. Diabetes is a major healthcare burden especially in India. The risk factors associated with diabetes are mostly similar in all countries, but its expressions and intensities vary widely between races and countries.[1] Even though the prevalence of diabetes varies between the countries; in general an increase in the global prevalence of diabetes has been observed.[2] The huge burden of the mortality and morbidity associated with diabetes in the near future is a greater threat to the developing countries.[3,4] A close look at the prevalence of diabetes and pre-diabetes reported by successive studies from various major cities in India substantiate the expansion in the proportion of population with diabetes as well as future diabetes.[5]

A long asymptomatic stage of diabetes is known to exist causing cellular damage and complications prior to clinical diagnosis. Due to the gradual onset of diabetes and its asymptomatic nature people are more likely to develop complications even at the time of diagnosis.[6,7,8,9] The development of complications of diabetes is directly associated with the duration of the disease and poor glycemic control. Considering the huge cost involved in the management of diabetes and its complications, undertaking primary prevention and screening for diabetes as a whole is a cost effective measure. Thus screening for diabetes is an important strategy to prevent diabetes. Although there is an increasing awareness of and screening for diabetes, the number of people with undiagnosed diabetes remains high.[10] The opportunistic screening for diabetes would be required for the early diagnosis of the disorder.[11]

Understanding the current profile of newly diagnosed type 2 diabetes can help in identifying the risk group as well as the associated risk factors and complications of diabetes. Results of such studies assist in defining the risk group and identifying the vital chain in the web of causation, in addition they can also indicate the necessary changes to be made in the mass screening programme for diabetes at the community level to receive the maximum benefits. The aim of this study was to assess the profile of newly diagnosed subjects with type 2 diabetes and to compare with the profile of new cases diagnosed a decade earlier.

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Patients and Methods

The present study is an analysis of newly diagnosed subjects with type 2 diabetes at a tertiary care centre in India. A total of 840 newly diagnosed subjects with type 2 diabetes were included in this analysis. Five hundred and eighty nine (M: F 385:204) subjects were diagnosed for diabetes in the year 2009 consecutively from outpatient department and the remaining 251 (M: F 164:87) were newly diagnosed cases in the same centre in the year 1999. Their data was obtained retrospectively from medical records section. Ethics committee of the institution has approved the study. We defined type 2 diabetes by lack of absolute requirement for insulin, absence of ketonuria, treatment without insulin.

The socio demographic, anthropometric details such as height, weight and waist circumference were recorded. Body mass index (BMI Kg/m^2) was calculated. Blood pressure was recorded as the mean of two readings taken five minutes apart using mercury sphygmomanometer. Blood pressure measurements and history of hypertension, glycemic and lipid parameters, presenting signs and the symptoms, reasons for medical examination which resulted in diagnosis of diabetes and the presence of complications and any other associated illness at the time of diagnosis were noted. Monthly income, their personal habits and total calorie consumption by 24 hours recall method were recorded.

All the asymptomatic subjects had undergone standard OGTT and diagnosis of diabetes was based on the WHO classification.[12] Fasting and postprandial samples were collected from the symptomatic subjects. Plasma glucose was estimated by glucose oxidase peroxidase method. Glycosylated haemoglobin ($HbA1_C$) was measured by immuno turbidimetric method in 1999 and it was estimated by HPLC method in 2009. Lipid profile including total cholesterol, triglycerides, high density lipoprotein cholesterol (HDL-C) and low density lipoprotein (LDL-C) were estimated by using standard enzymatic procedures. Very low density lipoprotein cholesterol (VLDL-C) was calculated by Friedwald's formula. Renal parameters such as urea and creatinine were estimated by standard methods.

A BMI of $\geq 25kg/m^2$ has been considered to indicate obesity.[13] Waist circumference more than or equal to 90 cms in male and 85 cms in female was considered as having central obesity. Presence of hypertension was confirmed if they were known hypertensives or if they had a systolic blood pressure value of $\geq$ 130mm Hg and diastolic blood pressure value of $\geq$ 85mm Hg. A subject was classified as having abnormal lipids if they had any of the following characteristics: total cholesterol value of more than or equal to 5.2 mmol/l, LDL-C > 2.6 mmol/l, and HDL-C less than 1.29 mmol/l in female and 1.03mmol/l in male, triglycerides $\geq$ 1.7 mmol/l.

Retinopathy was diagnosed on the basis of the presence of cotton wool spots, micro aneurysms, hemorrhages and neovascularization in the retina on direct ophthalmoscopic examination. Presence of Neuropathy was diagnosed using biothesiometer, if the vibration perception threshold was $\geq$ 25 volts in both feet when tested on the bony prominences. Nephropathy was diagnosed on the basis of the presence of microalbuminuria as assessed by calculating albumin to creatinine ratio (A/C ratio) on the first voided urine. Presence of microalbuminuria was confirmed if the A/C ratio is between 30 -300 μg /mg of creatinine and more than 300 μg/mg of creatinine was considered as proteinuria. Presence of microalbuminuria was confirmed by repeating the test within three months excluding other causes like urinary tract infection and presence of casts in urine.

Subjects underwent a standard 12 lead electro cardiogram (ECG) which was graded using Minnesota code. CVD was recorded if there was a history of MI, angina, stroke or on the basis of ECG changes (Q waves or ST segment changes).

Peripheral vascular disease **(**PVD) was diagnosed if the ankle-brachial index, ABI was $\leq$ 0.8 with symptoms of claudication.

Statistical analysis

Mean and standard deviations are reported for continuous variables. Prevalence was reported in percentages. Group comparisons of continuous variables were done using Students't' test and categorical variables were compared by Chi square test. A p-value of less than 0.05 was considered as statistically significant. SPSS statistical package (ver 16.0) was used for doing statistical analysis.

Results

Table 1 shows the demographic, anthropometric and socioeconomic details of the study groups. The mean age at the onset of diabetes was comparatively much less among 2009 subjects than 1999 subjects (45±10.6 Vs 49.9±9.8, $p<0.001$). The age at the onset of diabetes was less than 40 years in 32% of subjects in 2009 whereas it was approximately 20% in 1999. The mean BMI at the time of diagnosis was comparatively lesser in 2009 than those diagnosed in 1999 whereas the mean waist circumference was higher in 2009 subjects. Both systolic and diastolic blood pressure values were lower in 2009 compared to 1999 ($p<0.01$). Presence of positive family history of diabetes did not differ between the study groups ($p = 0.224$). Educational status and socio economic status improved among the subjects in 2009 compared to 1999. There was no significant time related change in alcohol consumption and smoking habits. Dietary assessment revealed that 2009 subjects had higher consumption of calories than that of 1999 subjects (1839.3 ± 468.1 vs. 1686.7 ± 372.9; $p<0.001$). Table 2 shows the biochemical details of the study groups. Both the fasting and 2 hour plasma glucose values and $HbA1_C$ were significantly higher among subjects in 2009 than subjects in 1999. The results indicate a greater degree of hyperglycemia among the newly diagnosed patients in 2009 subjects compared to 1999 subjects. There was a higher mean urinary albumin concentration in 2009 subjects. All the lipid parameters were elevated in 2009 compared to 1999, except HDL-C.

Table 1: Demographic, anthropometric and socioeconomic details of the study groups

Characteristics	**1999 –Profile**	**2009 -Profile**	**p-value**
No of study subjects (M: F)	251 (164:87)	589 (385:204)	
Age (years)*	49 .9 ± 9.8	45 ± 10.6	< 0.0001
BMI (kg/m^2)*	28.3±3.5	26.7 ± 4.5	< 0.0001
Waist circumference (cm)* Men	89.3±9.6	96.6±8.8	<0.0001
Waist circumference (cm)* Women	87.5±11.5	89.9 ±9.6	<0.0001
Blood pressure (mm/Hg)* Systolic	130.1 ± 13.9	127.4 ±15	0.011
Blood pressure (mm/Hg)* Diastolic	84.4 ± 8.6	82.6 ±8.8	0.009
	Values are n (%)		
FH-DM	155 (61.7)	335 (56.9)	0.224
Age at onset of diabetes			
(yrs) < 40	49 (19.5)	190 (32.3)	
(yrs) > 40	202 (80.5)	399 (67.7)	<0.001
Educational status			
Illiterate	147 (58.6)	48 (8.2)	
School	47 (18.7)	350 (59.4)	
College	39 (15.5)	111 (18.8)	< 0.001
Professional	39 (15.5)	57 (9.7)	
Technical	5 (2.0)	23 (3.9)	
Income			
(Monthly) (INR) <10, 000	114 (45.3)	206 (35)	
(Monthly) (INR) 10,000-20,000	132 (52.7)	348 (59.1)	0.002
(Monthly) (INR) > 20,000	5 (2)	35 (5.9)	
Habits			
Smoking	32 (12.7)	80 (13.6)	0.810
Alcohol	39 (15.5)	108 (18.3)	0.379
Tobacco (other forms)	9 (3.6)	10 (1.7)	0.150
Diet (calories)	1686.7 ± 372.9	1839.3 ± 468.1	< 0.0001

*Values are mean± SD FH-DM-Positive family history of diabetes

Table 2: Biochemical details of the study groups

Biochemical Parameters	**1999 n =251**	**2009 n = 589**	**p-value**
Plasma glucose (mmol/l)			
Fasting	8.7 ± 2.6	10.3 ± 3.7	<0.0001
2 hr	15.1± 3.8	17.1 ± 5.3	<0.0001
$HbA1_C$ (%)	8.0 ± 2.1	9.8 ± 2.5	<0.0001
Urea (mmol/l)	3.4 ± 1.6	3.6 ± 1.1	0.016
Creatinine (μmol/l)	55.7 ± 25.6	63.6 ± 15.0	< 0.0001
Total cholesterol (mmol/l)	4.9 ± 1.8	5.2 ± 1.2	0.037
Triglycerides (mmol/l)	1.8 ± 1.2	2.2 ± 1.7	0.001
HDL-Cholesterol (mmol/l)	1.1 ± 0.4	1.1 ± 0.5	0.498
LDL-Cholesterol (mmol/l)	3.1 ± 1.1	3.3 ± 1.0	0.282
VLDL-Cholesterol (mmol/l)	1.0± 0.6	0.8 ± 0.8	0.344
Albumin/ Creatinine Ratio (μg/mg creatinine)	4.7 ± 11.8	28.7 ± 74.2	<0.0001

Values are mean ± SD

Table 3 shows the presenting signs and symptoms at the time of diagnosis which persuaded the study subjects to undergo screening for diabetes. Most of them reported the eventual finding of accidentally diagnosed without any symptoms as the major reason in both the groups (60% and 48%). This clearly denotes an asymptomatic period runs in majority of population with diabetes in India. Among the 840 subjects, approximately 30% were symptomatic for diabetes in the year 2009 whereas it was only 20% in the year 1999. The remaining cases were diagnosed during investigations for nonspecific complaints such as aches and pains or presence of infections.

Table 4 shows the details of diabetic complications and

Table 3: Presentation of signs and symptoms at the time of diagnosis among study groups

Signs and symptoms	1999 n =251	2009 n = 589	p-value
Polys	48 (19.1)	192 (32.6)	<0.001
Weight loss	3 (1.2)	2 (0.3)	0.277
Pruiritis/ Balanitis	2 (0.8)	4 (0.7)	0.774
Giddiness	1 (0.4)	3 (0.5)	0.721
Tiredness/Pain	3 (1.2)	5 (0.9)	0.984
Unhealed wound	1 (0.4)	1 (0.2)	0.827
Diagnosed accidentally	151 (60.2)	284 (48.2)	0.002
Other reported reasons	42 (16.7)	98 (16.6)	0.948

Values are n (%)

Table 4: Presence of diabetic complications and other associated illness among study subjects at the time of diagnosis

A. Complications	**1999 n = 251**	**2009 n = 589**
Tested for the presence of complications	199 (79.3)	538 (91.3)
Retinopathy	2 (1.0)	4 (0.74)
Neuropathy	9 (4.5)	5 (0.93)
Nephropathy	1 (0.5)	3 (0.56)
CVD	4 (2.0)	11 (2.0)
PVD	0 (0)	1 (0.18)
Presence of more than one complication	1(0.5)	2 (0.37)
B. Other associated illness		
Thyroid problem	15 (5.97)	26 (4.4)
Tuberculosis	5(2.0)	2 (0.34)
Urinary tract infection	3(1.2)	6 (1.0)
Cancer	2 (0.8)	2 (0.34)
Skin problem	4(1.6)	3 (0.51)
Other problems	10(3.98)	20 (3.39)

Values are n (%)

Table 5: Comparison of prevalence of abnormalities among the study groups

Characteristics	1999 n=251	2009 n=589	p-value
BMI ≥ 25(Kg/m^2)	203 (80.9)	413 (70.1)	0.002
Central obesity			
(Men ≥ 90 cm; Women ≥ 85 cm)	142 (56.6)	498 (84.6)	<0.001
Systolic/Diastolic Blood Pressure			
≥130/ ≥ 85 mm/Hg	87 (34.7)	129 (21.9)	<0.001
Total cholesterol ≥ 5.2 mmol/l	137 (54.6)	269 (45.7)	0.022
Triglycerides ≥ 1.7 mmol/l	152 (60.6)	310 (52.6)	0.040
LDL-cholesterol ≥ 2.6 mmol/l	182(72.5)	470(79.8%)	0.026
HDL- Cholesterol			
(Men < 1.03 mmol/l; Women < 1.29 mmol/l)	131 (52.2)	342 (58.1)	0.133
Microalbuminuria (A/C ratio ≥ 30 μg/mg Creatinine)	71 (28.3)	126 (21.4)	0.044
Proteinuria (>500 mg/day)	1 (0.40)	3 (0.51)	0.721

Values are n (%)

other associated illness among the study subjects at the time of diagnosis. About 79.3% of subjects were screened for the presence of diabetic complications in 1999 whereas 91.3% of 2009 group underwent complete screening for complications of diabetes. Neuropathy was the predominantly associated complication among 1999 subjects whereas in 2009 subjects the prevalence of complications was low or similar to that reported in 1999. A small proportion of subjects had other associated illness also at the time of diagnosis in both the groups.

Table 5 shows the comparison of prevalence of individual abnormalities in the study groups. The prevalence of general obesity was lower and prevalence of central obesity was significantly higher in 2009. The percentage of subjects with elevated blood pressure values was lower in 2009 in comparison with 1999. Prevalence of total cholesterol and triglycerides abnormality was high in 1999 whereas it was high for LDL-C in 2009. Prevalence of HDL-C abnormality was similar between groups. More than 20% of subjects had the presence of microalbuminuria in both the groups.

Discussion

A comparison of the profile of the newly diagnosed subjects with type 2 diabetes in India in 2009 with that of a decade earlier revealed the changing scenario in the profile of newly detected cases of type 2 diabetes. Significant changes were apparent in this comparative analysis. The early onset of diabetes, lower BMI and increased waist circumference, higher consumption of calories and improved socio economic status are the key findings among the subjects diagnosed in 2009.

Changing trend noted is a shift in age at onset of diabetes to a younger age. The mean age at the onset of diabetes was much less in 2009 in comparison with 1999 (45± 10.6 Vs 49.9 ± 9.8 years). Development of diabetes at a younger age is an important issue, as these patients are at higher risk of developing complications due to longer exposure to hyperglycemia. This scenario poses a challenge to the healthcare system because people in this productive age group will have an excess risk of morbidity and mortality compared to normal individuals. Earlier reports also had shown that diabetes appears to present at a younger age in South Asians residing in UK compared to Europeans.[14,15] Mean age at diagnosis for white Europeans was 52.3 years and for South Asians it was 47 years. Another study conducted in the North Indian population in the year 2007 showed a mean age at diagnosis of diabetes of 48.6±10.3 which reiterates that there is a gradual fall in the age at the onset of diabetes in Indians.[16] A recently published report from India showed a high prevalence of diabetes in the age group of 18-34 years in 2004 compared to 1994.[17] The most rapid increase in the prevalence of diabetes in China has occurred in the 35-44 year age group.[18] The early onset of diabetes and involvement of productive age group strongly recommend a new strategy to be formulated in primary prevention and management of diabetes and its complications. Certain challenges in treating the young diabetes, reported by few studies should be considered while formulating guidelines.[19,20]

Improvement in socioeconomic conditions had occurred as shown by increased family income and improved educational status. Indians have been identified as an ethnic group with a high prevalence of diabetes and familial aggregation of type 2 diabetes. Although presence of positive family history of diabetes did not differ between the study groups in the present study, about 60% of the subjects with type 2 diabetes had one or both parents affected which shows high familial aggregation.

It was evident from this study that Indians have a higher degree of central obesity which may predispose insulin resistance. The reported prevalence of both general obesity and central obesity was significantly higher in this study. The mean BMI was lesser in 2009 compared to 1999. The prevalence of central obesity was higher than that of general obesity in 2009. In non obese Asian population, the android pattern of body fat, typified by more upper body adiposity measured as waist to hip ratio was found to be a greater risk factor for type 2 diabetes than general obesity.[21]

Changes occurred in the pattern of dyslipidemia also. Total cholesterol and triglycerides abnormality was more common in 1999 whereas LDL-cholesterol abnormality was high in 2009.

Majority of the subjects had undergone screening for the presence of diabetic complications in 2009 than 1999. Presence of neuropathy and microalbuminuria was common in the subjects from the profile of 1999 whereas presence of diabetic complications were less or similar in 2009 as compared to that of 1999.

It was reported that complications were common at diagnosis in South Asians and they also had a higher prevalence of cardiovascular risk factors compared to Europeans.[22] However, Asian subjects did not have more complications at diagnosis of diabetes compared to Europeans in the UKPDS study,[23] but UKPDS excluded patients with CVD. The prevalence of CVD among newly diagnosed cases in this study was similar to that reported in Iran population but they showed higher prevalence of other complications of diabetes among the newly diagnosed subjects.[24] In our study, 28.3% of the subjects in 1999 and 21.4% of subjects in 2009 had the presence of microalbuminuria. The Hoorn screening study conducted between 1999 and 2001 also reported 26.7% with microalbuminuria in patients newly diagnosed in general practice.[9]

A large proportion of the subjects had the presence of cardiovascular risk factors such as obesity, central adiposity, elevated blood pressure and dyslipidemia at the time of diagnosis in the present study. These results indicate the impending greater burden of CVD among the South Indians. Majority of those diagnosed in both the periods presented with eventual finding of being diagnosed accidentally without any symptoms which confirms the asymptomatic period. Asymptomatic stage was also evident by the presence of severe hyperglycemia and higher $HbA1_C$ level in 2009 compared to 1999. Screening for diabetes is required for the high risk group in order to implement the preventive strategy. It also emphasizes the need of community screening programmes for the timely detection of diabetes, since earlier detection accompanied by the tight control of diabetes thereafter will be of greater benefit for Indian diabetic population to facilitate the experience of legacy effect as reported in UKPDS.[25]

The results were based on hospital data which is a limitation of this study. However this comparative study highlighted the need for early screening of diabetes and its complications, correction of hyperglycemia and dyslipidemia.

In conclusion, the important points which have been brought out in this study are as follows; in one decade there appears to be a shift in onset of diabetes to a younger age, higher degree of central obesity, improvement in socio economic conditions, increased consumption of calories and presence of severe hyperglycemia at the time of diagnosis. The results indicate that lifestyle transition is occurring due to socioeconomic growth in India. Diabetes is no longer an

elderly disease; a targeted screening programme in place with adjusted lower limit in the age criteria and strengthening the health system for a standard care delivery for diabetes and its complications will resolve the burden of devastating disorder such as diabetes and CVD in India.

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