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RESEARCH ARTICLE

Impaired fasting glucose and impaired glucose tolerance in rural central India: A study of prediabetes in the first degree relatives of patients with type 2 diabetes mellitus in a rural region of Malwa in Madhya Pradesh

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ABSTRACT

Background: Prediabetes is a category of glucose tolerance representing an intermediate stage between normal glucose tolerance and diabetes and is characterized by impaired fasting glucose (IFG) and impaired glucose tolerance (IGT). People with prediabetes eventually progress to diabetes over a period, and this factor becomes a more important when first-degree relatives (FDRs) of patients with Type 2 diabetes are concerned as genetics is an unmodifiable risk factor. **Aims and Objectives:** To determine the prevalence of IFG and IGT in the FDRs of patients with Type 2 diabetes mellitus (T2DM) in a rural population of central India. **Materials and Methods:** A total of 200 subjects (134 males and 66 females), over the age of 20 years from village Hatpiplia, Dist Dewas, Madhya Pradesh who were FDRs of patients with T2DM were evaluated. Blood samples for fasting blood sugar (FBS) and 2 h postglucose blood sugar were taken and analyzed on fully automated analyzer MERCK Microlab 300 LX by enzymatic colorimetric method. **Results:** The prevalence of IFG was found to be almost 14.5% (95% confidence interval [CI] 10.29-20.05) in the FDRs of relatives with T2DM and 10% (95% CI 6.5-14.9) had newly diagnosed DM on the basis of their fasting sugar levels. Only 13% (95% CI 9.0-18.3) of the subjects had impaired glucose levels on 2 h postglucose loading blood sugar and DM by this method came to be very similar to the FBS method. **Conclusion:** Diabetes is a rapidly developing condition even in rural sectors of our nation and necessary measures should be taken to bring down the prevalence of this disease.

KEY WORDS: Impaired Fasting Glucose; Impaired Glucose Tolerance; Prediabetes; First Degree Relatives

INTRODUCTION

Diabetes mellitus (DM), a globally occurring health condition is a constellation of heterogeneous chronic metabolic disorders. It is a relative or absolute deficiency of insulin due to impairment of insulin action and/or moderate to gross inadequacy of insulin secretion.[1] In the past diabetes was thought to be a concern of mainly the western world. However, now with changing trends and lifestyle pattern, it is occurring enormously in Asian countries mainly India and China.[2] It has been observed that Asians develop diabetes at younger ages, at lower degrees of obesity, and at much higher rates given the same amount of weight gain.[3] Diabetes unfortunately is a condition where a number of patients remain asymptomatic and therefore are undiagnosed for a long time. It has been observed that a typical patient with a new onset Type 2 DM (T2DM) has DM for 4-7 years before it gets diagnosed[4] which then

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results in an increase in its complications. To avoid this, it is a must that the screening should take place during the asymptomatic period known as prediabetes. Prediabetes[5] as per the American diabetic association is defined as that state in which the blood glucose levels are more than normal but not high enough to be diagnosed as DM. It includes two parameters, impaired fasting glucose (IFG) and impaired glucose tolerance (IGT).

We already are aware that the growing rise in the number of diabetics is due to its multifactorial etiology where hereditary represents an important unmodifiable risk factor in the occurrence of the disease with approximately 40% risk of an individual to develop the disease if one of the parents is affected and almost 70% if both the parents are affected.[6] This goes to show that if the first-degree relatives (FDRs) (parent or siblings of the patient) are screened for prediabetes and if found to have IFG or IGT then the modifiable changes which include change in diet, exercise, lifestyle changes can be done so as to delay or stop the progression of prediabetes to DM.

It is a popular belief that T2DM is mainly a disease affecting the urban society of our country, but due to its genetic etiology, it surely does affect individuals from the rural background too. Lack of awareness, poor medical and research facilities, financial restraints, etc., serve as a common ground for lack of assessing the prevalence of prediabetes in the rural belt of our country. Although a few studies have been done in rural India,[7-9] unfortunately, none have been done in Madhya Pradesh. Therefore, this study was taken up to contribute to the humongous task of assessing the number of prediabetics in the FDR of patients with T2DM in the rural region (village Hatpiplia) of central India.

Objective

To determine the prevalence of IFG and IGT in the FDRs of patients with T2DM in a rural population of central India.

MATERIALS AND METHODS

The study was conducted at a rural mission hospital in a remote village Hatpiplia of District Dewas, Madhya Pradesh beginning from January 2016 to April 2016. It was a cross-sectional study which was done as per the declaration of Helsinki. The study had a sample size of 200 subjects (95% confidence level) as calculated from Open Epi, version 2, open source calculator. The subjects chosen for the study were >20 years in age, FDRs of patients with T2DM.

Informed consent was taken before the initiation of survey. On receiving the consent, we collected the basic vital data which included age, gender, education, and occupation.

The investigations done were as follows:

- Fasting blood sugar (FBS). After an overnight fasting of 10 h, venous blood samples were taken and the FBS was estimated.
- 2 h postglucose loading blood sugar (PLBS). 75 g of anhydrous glucose was given in 200 ml of water to the patient after taking the venous blood sample for FBS. After 2 h, venous blood samples were taken again to measure the 2 h PLBS.

The blood samples were sent immediately to the biochemistry lab for glucose levels to be analyzed on fully automated analyzer MERCK Microlab 300 LX by enzymatic colorimetric method. (Manufacturer Vital Scientific N.V, Netherlands).

The collected data were tabulated and analyzed. Glucose tolerance was assessed as according to the American Diabetic Association and World Health Organization criteria.

Selection of Cases

Inclusion criteria

Age >20 years who were FDRs of T2DM patients.

Exclusion criteria

Included patients with known diabetes, chronic renal failure, liver cell diseases, endocrine disorders such as insulinoma, postpancreatectomy, patients on drugs such as somatostatin, beta blockers, diazoxide, thiazide diuretics, phenytoin, alloxan, and steroids pregnant women, post-menopausal women, people with fever, people who had edema, patient with osteoporosis with very low bone density, body builders or professional athletes, patients undergoing dialysis, and persons with pacemaker were excluded from the study.

Criteria for diagnosis of new cases of DM, IFG and IGT were as per the American Diabetic Association and World Health Organization criteria.

DM:

- Symptoms of diabetes and random plasma glucose concentration >200 mg/dl OR
- FBS >126 mg/dl OR
- 2 h PLBS >200 mg/dl.

Prediabetes was defined as:

- IFG included fasting venous plasma glucose ≥100 mg/dl <126 mg/dl, irrespective of the 2 h values
- IGT is 2 h PLBS ≥140 mg/dl < 200 mg/dl after 75 g glucose loading.

Statistics

The entire data were computed in Microsoft Excel 2010. All other statistical analyses were performed in OpenEpi, version 2, open source calculator.

RESULTS

The entire study population was permanent residents of village Hatpiplia. Out of the 200 study population, the majority were males (67%). Table 1 describes the age and gender distribution of the study population. Majority belonged to the age group 40-49 years (26%) closely followed by 30-39 years (25.5%).

The majority of the people including women worked in the fields (51.16%) while some worked in the local shops or were owners (20%) while only very few women were housewives (2 %). Around half (34%) had no formal education and 25% people had completed high school and only 15% people had ever attended college. 91% of the subjects were pure vegetarians. 85% of the population were early risers, waking up around 6 am and almost all had their dinner before 7 pm.

Table 2 shows the prevalence of IFG and newly detected DM in the FDRs of our study population. A total of 29 (14.5%) (95% confidence interval [CI] 10.29-20.05, $P < 0.0000001$), subjects had prediabetes based on their FBS levels alone which included almost 18% of women and 12. 6% of the men (Table 2). Newly detected DM was present in 10% (95% CI 6.5-14.9), of the entire study population, which was found to be highly significant ($P < 0.0000001$).

Table 3 IGT was present in 13% (95% CI 9.0-18.3, $P < 0.0000001$) of the entire study population affecting mainly women (18.1%) as compared to only 10.4% of all the males (Table 3). Interestingly, only 8% of the individuals had newly detected DM by this method which again was highly significant ($P < 0.0000001$).

Table 1: Demographic profile of the study population

Agegroup (in years)	Males (%)	Females (%)	Total (%)
20-29	19 (9.5)	9 (4.5)	28 (14)
30-39	38 (19)	13 (6.5)	51 (25.5)
40-49	32 (16)	20 (10)	52 (26)
50-59	25 (12.5)	17 (8.5)	42 (21)
60-69	8 (4)	3 (1.5)	11 (5.5)
70-79	10 (5)	4 (2)	14 (7)
80-89	2 (1)	0	2 (1)
Total	134 (67)	66 (33)	200 (100)

Table 2: Gender differences in FBS levels

FBS (in mg/dl)	Males *n*=134 (%)	Females (*n*=66) (%)	Total *n*=200 (%)
<100 (normal) (*n*=151)	103 (76.8)	48 (72.7)	151 (75.5)
≥100<126 (IFG) (*n*=29)	17 (12.6)	12 (18.1)	29 (14.5)
≥126 (diabetes) (*n*=20)	14 (10.4)	6 (9)	20 (10)

IFG: Impaired fasting glucose, FBS: Fasting blood sugar

Table 3: Gender comparison of 2 h postloading blood sugar levels

2 h postloading blood sugar (in mg/dl)	Males *n*=134 (%)	Females *n*=66 (%)	Total *n*=200 (%)
<140 (normal) (*n*=158)	113 (84.3)	45 (68.1)	158 (79)
≥140<200 (IGT) (*n*=26)	14 (10.4)	12 (18.1)	26 (13)
≥200 (diabetes) (*n*=16)	07 (5.2)	09 (13.6)	16 (8)

IGT: Impaired glucose tolerance

DISCUSSION

T2DM is drawing attention at the world level at a speeding pace and is reaching epidemic proportions in India. However, this is one of the first studies done on the FDR of DM patients in the rural region of central India even though the number of diabetics in rural India has quadrupled.[10] Family history represents an important unchangeable risk factor in the occurrence of diabetes. Our study aimed at finding the prevalence of prediabetes in FDR of DM in a village in central India.

The previous studies on the FDR of DM in other rural communities have pointed out that the prevalence of DM is now increasing worldwide. The International Diabetes Federation estimated the diabetes prevalence to be 8% of the general population in India aged 20-79 years.[11] Preliminary results from a large community study conducted by the Indian Council of Medical Research revealed that a lower proportion of the population is affected in states of Northern India (Chandigarh 0.12 million, Jharkhand 0.96 million) as compared to Maharashtra (9.2 million) and Tamil Nadu (4.8 million).[12] In fact, A major survey National Urban Diabetes Survey was successfully carried out in 6 major cities in India in 2001 which agreed to the increasing prevalence, but unfortunately, it had no rural counterpart.[13] Moreover, this became the major driving force for us to be conducting this study.

In our study, the prevalence of IFG was found to be almost 14.5% (95% CI 10.29-20.05), in the FDR of relatives with T2DM and 10% (95% CI 6.5-14.9), of the study population was found to have new diagnosed DM on the basis of their fasting sugar levels. Interestingly, 13% (95% CI 9.0-18.3), of the subjects had impaired glucose levels on 2 h PLBS and DM by this method came to be very similar to the FBS method.

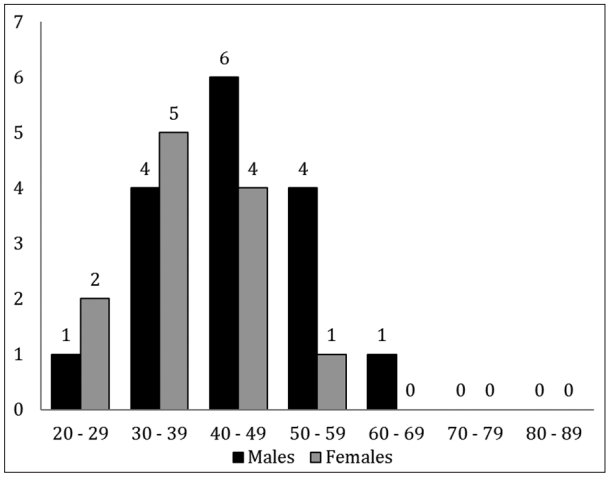

Figure 1: Gender distribution of impaired fasting glucose in different age groups

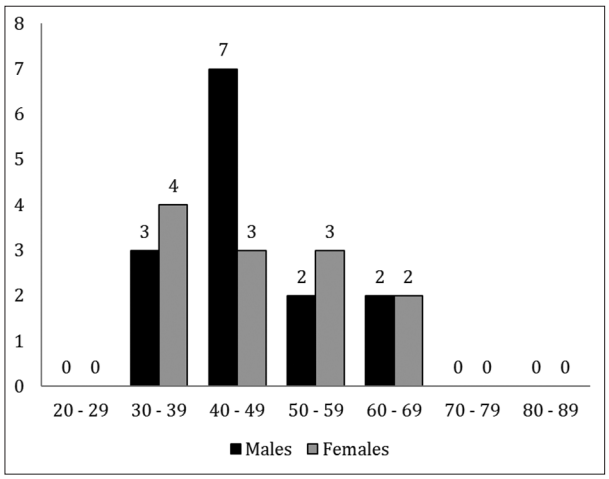

Figure 2: Gender distribution of impaired glucose tolerance in different age groups

The prevalence of IFG was higher in women (18.1%; 95% CI: 10.72-29.14) than men (12.6%; 95% CI: 8.07-19.33), whereas the prevalence of IGT was also higher in women (18.1%; 95% CI: 10.72-29.14) than men (10.4%; 95% CI: 6.3-16.7).

One of the studies done in 20 villages in Andra Pradesh[8] reported an overall prevalence of prediabetes by IFG to be 15.5 which is comparable to the prevalence reported in our study. However, the Andra study reported an overall prevalence whereas we specifically studied a vulnerable population. Similarly, in another study done in a rural community of South India,[9] 15.6% of individuals had prediabetes who had a positive family history of T2DM. Our results are also comparable to the urban pattern of association between IFG or IGT in the FDRs of patients with T2DM[14] and it also very similar to the results found in other rural communities in Asia.[15,16]

Looking at the lack of studies done on DM and prediabetes in rural and urban MP,[12] this study explored the genetic epidemiology of T2DM and has indeed been an eye opener to the prevalence of the condition and serves as a guide to further researchers mainly because more than 70% of the country's population resides in the villages.

CONCLUSION

Several trials have demonstrated reductions in the risk of developing diabetes among prediabetic individuals after lifestyle and drug-based interventions.[17] Diabetes is traditionally known as a "silent disease," exhibiting no symptoms until it progresses to severe target organ damage.[18] Despite a growing rise in medical care in India, the rural areas are still suffering in Madhya Pradesh where lack of knowledge and resources is making it almost impossible for the detection of prediabetes.

Our effort in detecting the occurrence of prediabetes in a susceptible group showed that rural India is also having an increasing a number of diabetics despite their healthy lifestyle. Definitely, these data do not represent the entire rural India but it indeed is a representation of the ever rising prevalence of undetected prediabetics in rural India, Keeping this in mind, we should increase health-care facilities and promote awareness in our rural community.

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