RESEARCH ARTICLE

# Prevalence of Prediabetes at the Tertiary Healthcare Center, McGann Teaching District Hospital, Shivamogga, Karnataka, India

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## Abstract

**Aim:** The aim of this study was to assess the prevalence of prediabetic state among the people with no clinical symptoms of hyperglycemia and factors underlying the risk of prediabetes.

**Materials and methods:** Patients visiting medicine outpatient department (OPD) were recruited for the study at the tertiary healthcare center, McGann Teaching District Hospital, Shivamogga. Data regarding the health-related status and other risk factors were collected between May 2016 and April 2017. In this cross-sectional study, factors related to the risk of diabetes were analyzed and tabulated.

Results: The prevalence of prediabetes was 0.17%, out of which 36.36 % were male, and 63.64% were females, respectively. Participants had a mean age of 47.45 ± 9.95 years, with a higher percentage of people under IFG (39%). The average BMI was 24.44 ± 3.89 with more percent of subjects in impaired fasting glucose (IFG) are having a BMI 25–29.9.

**Conclusion:** Future intervention should include strategies to address social isolation and also focus on middle-aged subjects with the low socioeconomic state. Knowledge enhancement program is warranted for the prevention of prediabetes in this population.

**Keywords**: Combined, Isolated impaired fasting glucose, Prediabetic.

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## Introduction

Diabetes mellitus is a metabolic disorder, which has become one of the major public health concerns worldwide. Prevalence of diabetes mellitus is growing rapidly in both rural and urban areas. Persistent increase in the prevalence of diabetes and its complications have great implications for the nation's health and economic progress, excellence and anticipation of human life.

Prevalence of type II diabetes is increasing in India and worldwide. Today, millions of peoples suffer from diabetes. There will be a significant rise in the diabetic population between 2000 and 2030.[1] In the age group between 20–79 years the prevalence of impaired glucose tolerance (IGT) in the world is 8.2% in 2003 and predictable to be 9.0% in 2025. Currently, up to 11% of India's urban population and 3% of the rural population above the age of 15 years have diabetes.[2] This rising prevalence and incidence of type II diabetes has stimulated research on the genetic, environmental, behavioral, socioeconomic and cultural factors contributing to the epidemic.[3] It has been demonstrated that industrialization and modernization lead to a sedentary lifestyle, obesity and a higher risk of metabolic disorders. The risk variables associated with diabetes are almost similar in all nations, but its expressions and intensities vary widely between different races and countries. The prevalence of diabetes mellitus differs in all the states of India across the rural and urban area, and this is because of the different dietary pattern, physical activity and due to stress. Many districts of Karnataka have undergone a drastic change in living standards and lifestyles in the span of last 2–5 years, on account of the influx of money and the ratio between low and high socioeconomic status (SES) was found to be 1:1.5.[4] The change in disease profiles brought about by this sudden affluence, and its differential impact on different social classes, largely remain unstudied till today. This was the main point of our exploration into the prevalence of prediabetes and related factors in a community in Karnataka using IGT. In rural areas, the diabetes prevalence is 16.0 % in Karnataka.[5] There are not many studies on the prediabetic prevalence in Karnataka.

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In this present study, we have analyzed the prevalence of prediabetes in the people visiting tertiary healthcare center, McGann teaching district hospital Shivamogga of Karnataka. We have focused mainly on prediabetes on impaired fasting glucose (IFG) and impaired glucose tolerance (IGT).

If the fasting plasma glucose level is 100 to 125 mg/dL and 2-hour post glucose load of 75 gm is less than 200 mg/dL is called IFG. If fasting plasma glucose is <126 mg/dL and after 2-hour post glucose load of 75 gm is between 140 to 199 mg/dl, it is called IGT.[6]

## Materials and Methods

This cross-sectional study enrolled subjects visiting tertiary health care center, McGann teaching district hospital Shivamogga. In

the present study, 249 willing study participants were screened. Patients with a family history of diabetes mellitus increased thirst and frequent urination aged between 30–65 years of both genders were enrolled. In these patients fasting plasma glucose was estimated, and then if necessary they were subjected for glucose tolerance test procedure. Informed consent was obtained from all participants before initiating the study. The study was approved by the ethics committee of our institution. Venous blood (2 mL) was drawn from patients in fasting state (FBG) and two hours post glucose load. Fasting blood glucose was estimated by glucose-oxidase peroxidase (GOD–POD) method. OGTT was performed as follows.

### Glucose Tolerance Test Procedure

The patient was advised to come to the laboratory in a fasting state, where after taking a fasting blood sample, the patient was given 75 g of glucose in 150 mL of water. Postglucose load sample was taken after 2 hours and analyzed for glucose by GOD–POD method.[6] Height and weight was measured using standard procedure, body mass index (BMI) was calculated using formula–weight in kg/height in meter square. A detailed patient's history like a family history of T2DM, other associated disease with medication, anthropometric measurement and blood pressure were recorded.

### Exclusion Criteria

- Persons with frank diabetes.
- Pregnant/lactating lady.
- On treatment for any bone-related disorders.
- History of liver and thyroid disease.
- Hyperparathyroidism.

### Inclusion Criteria

- Persons with impaired glucose tolerance
- Confirmed IGT persons with a family history of diabetes mellitus.

### Classification of Glucose Tolerance Status[7]

- IFG = 100–125 mg/dL and 2-hours plasma glucose in OGTT is <200 mg/dL.
- IGT = <126 mg/dL and 2-hour plasma glucose in OGTT is 140–199 mg/dL.
- Isolated Impaired fasting glucose = 100–125 mg/dL and 2 hour plasma glucose in OGTT is <140 mg/dL.
- Isolated Impaired glucose tolerance = <100 mg/dl and 2 hour plasma glucose in OGTT is 140–199 mg/dL.
- Combined IFG/IGT = 100–125 mg/dL and 2 hours plasma glucose in OGTT is 140–199 mg/dL.

### Statistical Analysis

The statistical analysis was carried out with statistical package for socialsciences for Windows version 11.0.

## Results

Based on GTT status the groups were classified as IFG, isolated IFG, IGT, isolated IGT and combined. In this study isolated IFG and isolated IGT were selected based on the classification of Nathan et al.[7]

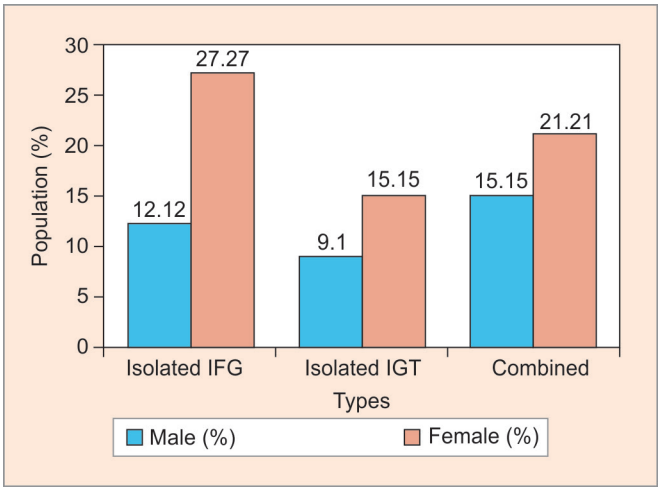
Though isolated IFG and isolated IGT are under the broad definitions of IFG and IGT respectively, to study the separate characteristic like the prevalence of isolated IFG and isolated IGT, these were selected for the study.

### Prevalence of Isolated IFG, Isolated IGT and Combined with respect to Gender

Based on GGT status the prediabetes groups were classified as isolated IFG, isolated IGT and combined. The overall presentation is 36.4% of the study population is categorized as combined state and only 24.25% were in isolated IGT state. The evaluation showed that the prevalence of isolated IFG in male is around 12.12% and in the female population is around 27.27%. The prevalence of isolated IGT in male is around 9.1% and in the female is around 15.15% (Graph 1)

### Prevalence of Isolated IFG, Isolated IGT and Combined with Respect to Age

In our study population, only 12.12% of the subjects were <45 years and had isolated IGT but older subjects between 55-65 years were only 9.1 % (Table 1). However, the advancement of the age in males has increased the prevalence of isolated IFG in our study population. In isolated IFG group, nearly 15.15% of the population were between the age of 55–65 years, 15.15% (45–55 years) and only 9.1% in <45 years of age.




**Graph 1:** Prevalence of isolated IFG, isolated IGT and combined with respect to gender

**Table 1:** Prevalence of isolated IGT, isolated IFG and combined, with respect to age

| *Age (Years)* | *<45* | | *45–55* | | *55–65* | |
|---|---|---|---|---|---|---|
| *Gender* | *Male (%)* | *Female (%)* | *Male (%)* | *Female (%)* | *Male (%)* | *Female (%)* |
| Isolated IFG | — | 9.1 | 3.03 | 12.11 | 9.1 | 6.06 |
| Isolated IGT | — | 12.12 | — | 3.03 | 9.1 | — |
| Combined | 12.12 | 12.12 | — | 9.1 | 3.03 | — |

**Table 2:** Prevalence of isolated IFG, isolated IGT and combined based on BMI in males and females with respect to FBS

| *BMI* | | *Male (%)* | *Female(%)* |
|---|---|---|---|
| 18.5–22.9 | Isolated IFG | 6.06 | 6.06 |
| | Isolated IGT | 3.03 | 3.03 |
| | Combined | 3.03 | 6.06 |
| 23–24.9 | Isolated IFG | – | 9.1 |
| | Isolated IGT | – | 9.1 |
| | Combined | – | 6.06 |
| 25–29.9 | Isolated IFG | 6.06 | 12.12 |
| | Isolated IGT | 6.06 | – |
| | Combined | 9.1 | 6.06 |
| 30–40 | Isolated IFG | – | – |
| | Isolated IGT | – | 3.03 |
| | Combined | 3.03 | 3.03 |

### Prevalence of Isolated IFG based on BMI in Males and Females with Respect to FBS

Our results showed that despite the BMI was >25, only 18.2% were grouped under isolated IFG whereas 21.2% of the isolated IFG population had a BMI <25 (Table 2).

## Discussion

Since, not much of data is available with respect to isolated IFG and isolated IGT, our results of isolated IFG and isolated IGT were compared with the observations made on IFG and IGT in the previous studies.

Distribution of IGT and IFG with regard to gender is well known.[8] An important observation made in the study is females were more in the pre-diabetic state than males (Graph 1), but the results were in controversial with Shah et al. study.[2] Further evaluation showed that the prevalence of IFG in male was less than the female population. The prevalence of IGT in male is also less than in female (15.15%). A major percentage of people were in the combined state followed by IGT state. These alterations seen in females may be due to the altered plasma sex steroid hormone ratio or the metabolic consequences of the central fat distribution.[9,10] It was observed that subjects with combined glucose intolerance contribute to the metabolic characteristics of IGT and IFG with noticeable fasting hyperinsulinemia, decreased insulin sensitivity during insulin clamp (similar to isolated IGT), and elevated HOMA-IR (similar to isolated IFG).[11-15]

Fundamentally, as of now screening for IFG/IGT is not different from the screening of diabetes mellitus. So, as currently recommended for screening of diabetes mellitus should be the same for the screening of IFG/IGT also. The majority of people with IFG or IGT appear to develop progressive hyperglycemia and eventually to diabetes mellitus. In our study population higher percentage of the subjects were <45 years and had IGT but older subjects between 55–65 years were less (Table 1). However a higher prevalence of IGT of 6.4% in subjects of 20–44 years and 22% in subjects of 65–74 years was seen in Harris et al., study and also 13.1% (<40 years) and 15.7% (>40 years) in a study conducted in India by Snehalatha et al.[16,17] Further advancement of the age in males has increased the prevalence of IFG in our study population. In IFG group nearly similar percentage of the population was between the age 55-65 years, 45-55 years and only a few were in <45 years of age which was in accordance with Shah et al. study.[2]

Our results showed a contradicting state with the study by Shah et al.[2] of having more subjects in BMI <25 than BMI >25. It is well-accepted fact BMI can be independently associated with the risk or prediction of prediabetes and in the diagnosis of T2DM.[18] An incremental relationship of BMI on the possibility of having T2DM is stronger in people with a higher BMI than to people with a lower BMI this was obvious in our IFG study group.[19]

Patients with IFG/IGT may be advised lifestyle modifications, i.e., 5 to 10% weight loss, moderate-intensity physical activity for 30 minutes per day because of advancing age and obesity observed in pre-diabetes.[7,20] Detection of IFG/IGT in the early age group is of much value for intensive lifestyle interventions. This will have a substantial effect on the prevention or delay in progression to diabetes and also reduce the potential to develop long term increased risk of CVD associated with diabetes. Patients with IFG/IGT with a family history of diabetes in first-degree relative or less than 60 years of age are recommended of the intervention of lifestyle modification and/or therapeutic intervention like Metformin under a physicians supervision.

## Conclusion

One of the etiologic consequence of IFG, IGT and combined is secretion of insulin. However, the remarkable unanswered question is an underlying defect which may be primary or secondary has to be identified.

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