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An assessment of pre-diabetes in south Indian population: A case of Telangana State

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Abstract
Pre-diabetes (comprise of IFG and IGT) is the state that occurs when a person's blood glucose levels are higher than normal but not high enough for a diagnosis of diabetes. The terms IFG and IGT refer to an intermediate metabolic stage between normal glucose and diabetes.
The cross-sectional study was carried out in various locations of Telangana. The Researcher followed American Diabetic Association (ADA) criteria for defining the IFG and IGT. 1650 eligible subjects were selected for the study. Laboratory Investigations were done on subjects related to Fasting blood glucose and 2 h after Blood Glucose. Anthropometric Measurements also done to know BMI and Waist/Hip Ratio (WHR) on subjects.
The data was analyzed by using Chi square test using SAS version 8.2.Demographic background and baseline data was presented descriptively. All continuous variables like height, weight and laboratory data was represented by mean +SD (Standard Deviation).
Overall prevalence rate of IFG in Telangana state is around 2.75% and IGT is around 6.11%.The data proves that BMI and WHR are highly significant statistically in IFG population. The result proves that IFG population is more prone to develop obesity. This data proves that BMI and WHR is highly significant statistically in IGT population. It is true that IGT population is more prone to develop obesity.
Pre diabetes can prevent or delay the development of type 2 diabetes by through changes to their lifestyle that include modest weight loss, regular exercise and proper diet.
Keywords: *Assessment, pre-diabetes, Impaired fasting glucose (IFG), Impaired glucose tolerance (IGT).*

Background

Pre-diabetes (comprise of IFG and IGT) is the state that occurs when a person's blood glucose levels are higher than normal but not high enough for a diagnosis of diabetes. The terms IFG and IGT refer to an intermediate metabolic stage between normal glucose and diabetes. The concept of IFG was introduced by Charles et al. to refer at fasting plasma glucose levels > 6.1 and < 7.8 mmol/L[1]. Impaired glucose tolerance is a more advanced stage of alteration in the glucose metabolism than impaired fasting glucose[2].

These fasting plasma glucose limits correspond to the level above which acute phase insulin secretion is lost in response to intravenous administration of glucose[3]. About 11 percent of people with pre-diabetes in the Diabetes Prevention Program standard or control group developed type 2 diabetes each year during the average three years of follow-up. Other studies show, that many people with pre-diabetes develop type 2 diabetes in 10 years.

To maintain serum glucose under 7.8 mmol/L, subjects with IFG show a significant hyperinsuli-

nemia post glucose load, whereas the IGT subjects exhibit low insulin secretion unable to maintain the serum glucose within the normal referenced range values, findings that suggest different stages of impaired insulin secretion. On the same way, our findings show that IGT is a more advanced stage of alteration in the glucose metabolism than the IFG. On the basis of this statement, the lack of concordance between IFG and IGT criteria that has been reported[4-8].

IGT is a common condition that greatly increases risk for the subsequent development of type 2 diabetes. Individuals with IGT manifest abnormalities in both insulin action and early insulin secretion similar to those seen in patients with type 2 diabetes. These abnormalities not only precede diabetes, they predict it as well. Furthermore, the progression from IGT to diabetes is characterized by a dramatic decline in early insulin secretion. It is now evident that early insulin secretion plays an important role in the rapid and efficient suppression of endogenous glucose production following a meal. Loss of early insulin secretion initially leads to postprandial hyperglycemia which, as the disease progresses, worsens to clinical hyperglycemia.

Studies have shown that people with pre-diabetes can prevent or delay the development of type 2 diabetes by up to 58 percent through changes to their lifestyle that include modest weight loss and regular exercise.

The expert panel recommends, that people with pre-diabetes reduce their weight by 5-10 percent and participate in some type of modest physical activity for 30 minutes daily. For some people with prediabetes, intervening early can actually turn back the clock and return elevated blood glucose levels to the normal range.

There is strong evidence that a structured programme of diet and exercise can reduce the risk of progression to type 2 diabetes in patients with IGT. Patients with IFG and IGT should be advised on the benefits of modest weight loss, good dietary habits and regular physical activity.

Materials and Methods

The cross-sectional study was carried out in various locations of Telangana. The Researcher followed American Diabetic Association (ADA) criteria for defining the IFG and IGT.

Impaired Fasting Glucose (IFG) was defined as a fasting plasma glucose value of 100- 125 mg/dl (5.6-6.9 mmol/L) in the absence of a previous diagnosis of diabetes [9].

Impaired Glucose Tolerance (IGT) was defined as a plasma glucose concentration of 140-200 mg/dl (7.8 to 11.0 mmol/L) two hours after oral administration 75 gm of glucose in subjects, whose plasma glucose concentration after overnight fasting was less than 140 mg/dl [9].

Study documents preparation:

Protocol, ICF and CRF were prepared in consultation with the experts, Dr. B.S Reddy and Dr. C.R Reddy. Declaration of Helsinki principle was followed in the study. After the preparation of the documents, quality check was performed. The required copies were prepared and submitted to the ethics committee of OPJS University, Churu for its approval. An Informed consent form was prepared as per the regulatory requirement.

Case Record Form

A survey questionnaire was administered to all the participating subjects to collect the detailed information.

Demographic Information

Following demographic Information was collected from all the participating subjects.

1) Age 2) Sex 3) Height 4) Weight 5) BMI 6) Waist to Hip ratio

Inclusion Criteria

- Age > 20 years

Exclusion Criteria

- Diabetic Patients and Who are following diet, exercise and Oral hypoglycemic agents and Insulin also.

To obtain 1650 eligible subjects, approximately 1750 individuals (considering the drop out ratio of around 10%, for many reasons) more than > 20 years of age were screened from the different areas of Telangana. We also ensured that, we get

the equal distribution from all the socio economic class, education class, field workers and office workers.

Laboratory Investigations: Following laboratory investigations were performed for all the individuals at the central laboratory. A qualified and trained doctor/phlebotomist collected the blood samples.

a. Fasting blood glucose b. 2 h after Blood Glucose

Methodology followed during the Screening

Activities carried out before camps (2 weeks before)

- Meeting with Local Community /School management.
- Meeting with Local medical doctor
- Registration of subjects for the purpose of study

Activities carried out during Camps:

- Validate the registration of subjects
- Taking the consent from subjects
- Collect the blood for investigations (Fasting stage)
- Administration of 75 gm Glucose dissolved in water
- After 2 hours blood collection

Anthropometric Measurement

Body weight was measured with the subject standing still on weighing scale and weight equally distributed on each leg. Subjects were instructed to wear minimum outerwear and no footwear, while their weight was being measured.

Height was measured using a non stretchable tape with the subject in an erect position against a vertical surface and the head positioned so that the top of the external auditory meat us was in the level with the inferior margin of the body orbit.

Body mass index was calculated by dividing the weight (in kilograms) with the square of height (in meters). Waist circumference was measured using a tailor's tape at a point mid way between tip of iliac crest and last costal margin in the back and at umbilicus in the front.

Laboratory Analysis

After 10–12 hr of an overnight fast, each subject voided, and then the fasting blood sample was collected. A 75 gm anhydrous glucose dissolved in 250 ml of water was given orally over the course of 5 min and a second blood sample was drawn exactly 2 h later for glucose estimation. Blood for glucose determination was collected into tubes containing fluoride and EDTA. Throughout the study only one technician was allocated to avoid interpersonal error. These blood samples were immediately centrifuged and processed further.

Data entry

CRFs were collected and stored at secured and access controlled place. After that, all the CRFs were reviewed second time for any discrepancies. Once check is over, the data entry was performed. Data entry was performed by using Microsoft Excel 2003

Statistical Analysis

All statistical tests were considered significant at 5% level of significance. All data was analyzed by using Chi square test using SAS version 8.2.

Demographic background and baseline data was presented descriptively. All continuous variables like height, weight and laboratory data was represented by mean +SD (Standard Deviation). All the categorical variables were presented as counts and percentages.

Results

Researcher has collected data from 1652 subjects during the period of May 2017 to March 2018 from different areas of Telangana state in South India.

Table1. Overall prevalence of IFG and IGT

Gender	IFG	%	IGT	%
N=	1454	100%	1453	100%
prevalence	40	2.751	89	6.111
Age adjusted prevalence		2.72%		4.672

The above table depict that, overall prevalence of IFG in Telangana is around 2.751% and IGT is around 6.111%. But when it is calculated to age related prevalence, it is found the prevalence of IFG is 2.721% and IGT is around 4.672%.

Characteristics of the Population

In this present study, Researcher also characterised the population, based on their BMI and Waist/Hip Ratio for both the sub groups (IFG and IGT) as given in below table.

Table 2: Characteristics of IFG Population

Category	Statistical tool	BMI (Kg/m2)	Waist/Hip Ratio
Normoglycemic (< 110 mg/dl)	N	1246	1208
	MIN-MAX	13.77-57.57	0.55-1.64
	MEAN±SD	25.65±5.22	0.92± 0.09
IFG(>110 – <126 mg/dl)	N	38	35
	MIN-MAX	19.95-35.44	0.80-1.13
	MEAN±SD	26.71± 4.21	0.95 ± 0.07
Newly Diagnosed Diabetes (>126 mg/dl)	N	79	68
	MIN-MAX	17.15-36.00	0.82-1.60
	MEAN±SD	26.61 ± 3.61	0.97± 0.11

In IFG population, the mean value of Body-Mass-Index (BMI) is 26.71 + 4.21 kg/m2, Waist/Hip Ratio (WHR) is 0.95 + 0.07.

The above data proves that Body-Mass-Index (BMI) and Waist/Hip Ratio (WHR) are highly significant statistically in IFG population. The result proves that IFG population is more prone to develop obesity. The observation in IFG population was correlated with newly diagnosed subjects. It means the probability of risk for prediabetes is as high as diabetes population.

Table 3: Characteristics of IGT Population

Category	Statistical Tool	BMI Kg/m^2	Waist/Hip Ratio
I: 2h Post Glucose <140 mg/dl *	N	1229	1189
	MIN-MAX	13.76-85.22	0.54-1.60
	MEAN±SD	25.57± 5.21	0.91±0.09
II: Impaired Glucose Tolerance(IGT) (2 h post glucose 140-200 mg/dl)	N	84	74
	MIN-MAX	16.23-57.67	0.55-1.62
	MEAN±SD	29.37± 6.49	0.94±0.13

Category I: Subjects, 2 hr post glucose value < 140 mg/dl Category II: Subjects with 2 hr post glucose value 140-200 mg/dl (Impaired glucose Tolerance)

*76 subjects with blood glucose value more than 200 mg/dl were excluded from the analysis. In IGT population, the mean value of BMI is 29.37 + 6.49 kg/m2, Waist/Hip Ratio (WHR) is 0.94 + 0.13. This data proves that BMI and WHR is highly significant statistically in IGT population. It is true that IGT population is more prone to develop obesity. And therefore, the findings of this study strongly suggest that the BMI, WHR are very important risk factors in IFG and IGT population.

Discussion

The present study is designed to estimate the real picture of pre-diabetes prevalence in Telangana state of south India. Various epidemiological studies conducted in India during year 2000 to 2016 have shown the varied prevalence of Diabetes in Indian population. Out of these if, we review the studies conducted in southern part of India (Yagnik et al from Pune in 2004 & Iyer et al from Dombivali in 2004, as per WHO guidelines) has shown the prevalence of 4.3% and 4.01% respectively[10]. According to findings of the present study the crude prevalence of IFG in Telangana population is about 2.76% and IGT is around 6.12%. But the age adjusted prevalence of IFG is around 2.72% and IGT is around 4.67%, which is comparable to the similar studies which were conducted in the past across the globe.

As obesity or an increase in intra abdominal adipose tissue is associated with insulin resistance in the absence of diabetes, it is believed by some that, insulin resistance in type 2 diabetes is entirely due to the coexistence of increased adiposity [11].

From this present study the researcher also noticed higher BMI and WHR in IFG and IGT population in our study. Obesity has an effect of on insulin resistance and hence weight loss is an important therapeutic objective for overweight or obese individuals with prediabetes or diabetes [12]. Obesity and a high fat diet may contribute to the development of both insulin resistance and insulin secretary dysfunction in susceptible individuals. Strategies that improve insulin resistance and enhance early insulin secretion may prevent the progression from IGT to diabetes. Already, there is substantial evidence the weight loss and exercise may reduce the risk of developing diabetes by up to 58%[13].

In our study, we have also noticed the higher mean BMI 26.81 + 4.21 kg/m2 and waist to hip ration 0.96 + 0.07 in IFG population. Similarly for IGT population, where BMI mean is 29.36 + 6.49 kg/m2, WHR is 0.94 + 0.12. This is more than the normoglycemic population. Hence, it proves that IFG and IGT population is more prone to develop obesity. Patients with impaired glucose tolerance or impaired fasting glucose have a significant risk of diabetes and thus are important target group for primary prevention[14].

At present, India is in the threshold of a rapid epidemiological transition with increased urbanization. Present urbanization rate is 38% compared to 15% in the 1950's and this could have major implications on the present and future disease patterns in India with context to diabetes and coronary artery disease.

Socio-economic development over the last 40-50 years has resulted in a dramatic change in lifestyle towards more westernization, leading to physical inactivity due to technological advancement, affluence leading to consumption of fat rich diet, sugar and high level of mental stress. All these could adversely influence insulin sensitivity and lead to obesity [15].

In nutshell, prediabetes population has high probability for getting converted into Diabetes in the long run (may be 3-5 years) [16]. In any given year, 5% to 10% of glucose-intolerant patients progress to type 2 diabetics[17].

Conclusion

People with pre-diabetes can prevent or delay the development of type 2 diabetes through changes to their lifestyle that include modest weight loss, regular exercise and diet. A variety of strategies and techniques should be used to provide adequate education and development of problem-solving skills in the various aspects of prediabetes management early stage.

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