To Assess the Prevalence of Impaired Glucose Tolerance and Impaired Fasting Glucose in Western Indian Population

Chirag Shah1, Navin R Sheth2, Bhagirath Solanki3, Nimisha Shah4

Abstract

Objectives: The objective of the study to determine the prevalence of Impaired Glucose Tolerance and Impaired Fasting Glucose (both combined termed as Pre Diabetes) in the population of Gujarat.

Methods: In year 2007 and 2008, a cross sectional survey was conducted via mode of camps at various urban and rural part of Gujarat. After obtaining an informed consent, comprehensive questionnaire was used to collect the various anthropological details, physical examination and blood collection was performed from around 1700 subjects ≥ 20 years of age from the different areas of Gujarat. Chi square test was used for all categorical comparisons. Also multiple logistic regression was used for detailed exploratory analysis.

Results: The crude prevalence of IFG in Gujarati population is around 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 %.

If we extrapolate these to population of Gujarat, it indicates that around 1.3 million people are having impaired fasting glucose and around 2.3 million people have impaired glucose tolerance. The prevalence of IGT found more after age of 40 years. For IFG, there is increase after age of 40 years, but not significant statistically.

Conclusions: High prevalence of IGT validates that there are chances of the pandemic trend in Gujarat, as eventually IGT may get converted into Diabetes in near future. These results need urgent attention to develop a public awareness programme.

Introduction

Prevalence of Type II diabetes is increasing globally as well as in India day by day. Urban India is getting industrialized rapidly and is now one of the most common non-communicable diseases globally. The country is already being dubbed as the “Diabetes Capital of the World.”

Governments and medical fraternity across the world have acknowledged that diabetes is increasing at epidemic rates and affecting all countries. For the first time non-infectious disease has been seen as posing as serious a global health threat as infectious epidemics such as HIV/AIDS. Today, diabetes has affected 250 million people or around 6 % of the world’s adult population.

The urban population in developing countries is projected to double between 2000 and 2030 and with this urbanization there will be a significant rise in the diabetic population. And it indicates that the “diabetes epidemic” will continue even, if levels of obesity remain constant.

The World Health Organization (WHO) has projected that the global prevalence of type 2 diabetes mellitus will be more than double from 135 millions in 1995 to 300 millions by 2025.

Prevalence of Diabetes in the world is 5.1 % in 2003 and by 2025 is around 6.5 %. IGT prevalence in the world is 8.2 % in 2003 and projected to be 9.0 % in 2025. (Age group 20-79 years).

International Diabetes Federation estimates that the number of diabetic patients in India is more than doubled from 19 million in 1995 to 40.9 million in 2007. It is projected to increase by 69.9 million by 2025. This means by 2025 there will be nearly around 7 crore people who will have diabetes.

Currently up to 11 % of India’s urban population and 3 % of rural population above the age of 15 have diabetes. The WHO estimates the mortality from diabetes and heart disease cost India about $ 210 billion and expected to increase to $335 billion in next 10 years. (by year 2019).

This rising prevalence and incidence of Type II diabetes has stimulated research on the genetic, environmental, behavioral, socio-economic and cultural factors contributing to the epidemic.

It has been demonstrated that, industrialization and modernization lead to sedentary lifestyle, obesity and 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. This is because of the different dietary pattern, physical activity and mental status.

Many districts of Gujarat have undergone a drastic change in living standards and lifestyles in the span of last 10 years, on account of the influx of money in recent years. 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 Gujarat.
In this study, we have analyzed the prevalence of prediabetes in the population of Gujarat. We have focused mainly on prediabetes covering both Impaired Fasting Glucose (IFG) and Impaired Glucose Tolerance (IGT). We also identified the major risk factors for the increase in this incidence.

**Material and Methods**

Various camps were conducted during May 2007 till March 2008 in the urban and rural part of Gujarat i.e Ahmedabad, Sabarkantha, Panchmahal and Rajkot District. The selection of Ahmedabad and Rajkot districts was primarily due to nearness and Sabarkantha and Panchmahal was mainly because of its rural population. Cluster sampling was used randomly in all the areas.

**Ethics**

Prior to initiation of the study; the protocol, the informed consent form, the patient information sheet, and other relevant study documents were submitted to the Institutional ethics committee and after receiving the approval, study was initiated. The study was conducted as per ICH GCP guidelines.

**Patient Information and Consent**

No patient is subjected to any study-related examination or activity before that patient and/or legal guardian has given informed consent. Written consent was obtained from all the subjects.

We have followed the diagnostic criteria for IFG and IGT as per ADA.

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.

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.

To get around 1650 eligible subjects, approximately 1700 individuals (considering the drop out ratio of around 15%, for any reasons) more than ≥20 years of age were screened from the different areas of Gujarat. We also ensured that, we get the equal distribution from all the socio economic class, education class, field workers and office workers.

**Inclusion Criteria**

- Men and Women of age ≥ 20 years.
- Having strong family history of Diabetes mellitus.
- Subjects who are willing to participate in the study.

**Exclusion Criteria**

- Patients who are diabetics and pursuing diet, exercise and Oral Hypoglycemic agents and Insulin also.
- We have focused on the family members of diabetic patients

because they are very much keen to undergo risk stratification and they comply with the camp activities.

A survey questionnaire was administered to all the participating subjects to get their complete profile. Following demographic details were collected from all the participating subjects.

- a) Age b) Sex c) Height d) Weight e) BMI f) Waist to Hip ratio g) Systolic Blood pressure h) Diastolic Blood pressure

Laboratory investigations for fasting plasma venous glucose and 2 hr plasma venous glucose (after administration of 75 gm glucose) was performed for all the individuals in the laboratory. A qualified and trained technician has collected the blood samples.

**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 age, height, weight and laboratory data was represented by mean ±SD (Standard Deviation). All the categorical variables were presented as counts and percentages.

Missing Data and Omitted Data: At various stages of the study, we did observe missing of the data. We also noticed that some data was not captured and CRFs were kept blank for those particular fields.

**Results**

We have randomly collected data from 1652 subjects during the period of May 2007 to March 2008 from Urban and Rural areas of Ahmedabad, Sabarkantha, Rajkot and Panchmahal district of Gujarat.

The collected data suggest that overall prevalence of IFG in Gujarat is around 2.76% and IGT is around 6.12%. There are around 10 subjects, who were common in both IFG and IGT groups.

But when we applied age related prevalence, we found the prevalence of IFG is 2.72% and IGT is around 4.67%.

**Gender-wise presentation of IFG and IGT**

If we further evaluate the prevalence, IFG (Impaired Fasting Glucose) in Male is around 2.06% and in Female population is around 0.69%.

The prevalence of IGT (Impaired Glucose Tolerance) in male is around 3.09% and in female is around 2.94%.

Table 1: Gender wise distribution of IFG and IGT population

<table>
<thead>
<tr>
<th>Gender</th>
<th>IFG</th>
<th>IGT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=1454</td>
<td>n=1453</td>
</tr>
<tr>
<td>Male</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>44</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>89</td>
</tr>
</tbody>
</table>

Age adjusted prevalence 2.72% 4.67%

Total crude prevalence 40 2.75 89 6.11

Male 30 2.06 45 3.16
Female 10 0.69 44 2.95

Fig. 1: Graphical presentation of IFG and IGT Population
Distribution of IFG and IGT population in Urban and Rural area

The below mentioned data suggest that prevalence of IFG in Urban area is 4.32 % and in rural area is also 2.18 %. But the prevalence of IGT in urban area is 5.84% and in rural is also 4.26 %. Prevalence of IFG and IGT is higher in urban area and it proves with other published literature.

From the above data we can conclude that the prevalence of IFG and IGT increases, as the age progresses. From these data, it can be also proven that, prediabetes prevalence significantly increases as the age crosses more than 41 years. And hence, we need to educate the people about precautions to be taken after age of 40 years.

The above mentioned data suggest that BMI is higher in IFG population as compare to normoglycemic.

Table 2: Distribution of IFG and IGT population in urban and rural area

<table>
<thead>
<tr>
<th>Area</th>
<th>IFG (%)</th>
<th>IGT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural (N=797)</td>
<td>18 (2.18%)</td>
<td>34 (4.26%)</td>
</tr>
<tr>
<td>Urban (N=855)</td>
<td>20 (4.32%)</td>
<td>50 (5.84%)</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>84</td>
</tr>
</tbody>
</table>

IFG population has more Waist to hip ratio (WHR), as compare to normoglycemic population. The result from both the data proves our assumptions that IFG population is more prone to develop obesity. We could not establish the correlation of BMI and WHR in newly diagnosed diabetics.

Similarly for blood pressure, mean systolic and diastolic pressure is more in IFG population as compare to normoglycemic population. Again for newly diagnosed diabetes the relationship could not be established.

Above table shows that, Subjects with BMI greater than equal to 25 have more chances of becoming diabetic, 25 (1.83%) versus 13 (0.95%).

Also in this category more no. of newly diagnosed diabetes has been identified, 54 (3.96%) versus 25 (1.83%). A p-value of 0.0023, obtained using chi-square test, indicates this association to be statistically significant.

For waist to hip ratio, Male subjects with waist to hip ratio greater than equal 0.95 have more chances of becoming diabetic, 16 (2.01%) versus 10 (1.26%).

Also in this category more no. of newly diagnosed diabetes have been identified, 25 (3.14%) versus 14 (1.76%). A p-value of <0.0001, obtained using chi-square test, indicates this association is statistically significant.

For Female subjects with waist to hip ratio greater than equal 0.85 have more chances of becoming diabetic, 7 (1.36%) versus 2 (0.39%). Also in this category more no. of newly diagnosed diabetes have been identified, 22 (4.26%) versus 7 (1.36%) A p-value of 0.0233, obtained using chi-square test, indicates this association is statistically significant.

Subjects with systolic blood pressure greater than 120 have

Table 3: Age wise Distribution of IFG and IGT

<table>
<thead>
<tr>
<th>Category (Age in years)</th>
<th>IGT (N=984)</th>
<th>IFG (N=985)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (&lt;=30)</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>II (31-40)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>III (41-50)</td>
<td>9</td>
<td>34</td>
</tr>
<tr>
<td>IV (51-60)</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>V (&gt;60)</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 4 : Characteristics of subjects with normoglycemic, IFG and newly diagnosed diabetes population

<table>
<thead>
<tr>
<th>Category</th>
<th>Statistical tool</th>
<th>BMI (kg/m²)</th>
<th>Waist/Hip Ratio</th>
<th>Systolic Blood Pressure (mm of Hg)</th>
<th>Diastolic Blood Pressure (mm of Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normoglycemic (&lt; 110 mg/dl)</td>
<td>MIN-MAX</td>
<td>13.76-57.67</td>
<td>0.54-1.62</td>
<td>70.00-220.00</td>
<td>48.00-170.00</td>
</tr>
<tr>
<td>IFG (&gt;110 - &lt;126 mg/dl)</td>
<td>MIN-MAX</td>
<td>19.95-35.44</td>
<td>0.80-1.13</td>
<td>100.00-196.00</td>
<td>60.00-100.00</td>
</tr>
<tr>
<td>Newly Diagnosed Diabetes (&gt;126 mg/dl)</td>
<td>MIN-MAX</td>
<td>17.15-36.00</td>
<td>0.82-1.60</td>
<td>96.00-200.00</td>
<td>58.00-110.00</td>
</tr>
</tbody>
</table>

Table 5 : Summary of proportion of subjects with normoglycemic, IFG and newly diagnosed diabetes population by BMI, WHR, Systolic and Diastolic blood pressure

<table>
<thead>
<tr>
<th>Category</th>
<th>BMI (kg/m²)</th>
<th>Waist to Hip Ratio</th>
<th>Systolic Blood Pressure (mm of Hg)</th>
<th>Diastolic Blood Pressure (mm of Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>711</td>
<td>711</td>
<td>711</td>
<td>711</td>
</tr>
<tr>
<td>Male</td>
<td>1363</td>
<td>1363</td>
<td>1363</td>
<td>1363</td>
</tr>
<tr>
<td>Female</td>
<td>652</td>
<td>652</td>
<td>652</td>
<td>652</td>
</tr>
<tr>
<td>Fasting Blood Glucose</td>
<td>MIN-MAX</td>
<td>MIN-MAX</td>
<td>MIN-MAX</td>
<td>MIN-MAX</td>
</tr>
<tr>
<td>Normoglycemic (&lt;110 mg/dl)</td>
<td>MIN-MAX</td>
<td>13.76-57.67</td>
<td>0.54-1.62</td>
<td>70.00-220.00</td>
</tr>
<tr>
<td>IFG (&gt;110 - &lt;126 mg/dl)</td>
<td>MIN-MAX</td>
<td>19.95-35.44</td>
<td>0.80-1.13</td>
<td>100.00-196.00</td>
</tr>
<tr>
<td>Newly Diagnosed Diabetes (&gt;126 mg/dl)</td>
<td>MIN-MAX</td>
<td>17.15-36.00</td>
<td>0.82-1.60</td>
<td>96.00-200.00</td>
</tr>
</tbody>
</table>

Note: P-value obtained using chi-square test.
more chances of becoming diabetic, 25 (1.84%) versus 14 (1.03%).
Also in this category more no. of newly diagnosed diabetes has
been identified.53 (3.91%) versus 24 (1.77%). A p-value of <0.0001,
obtained using chi-square test, indicates this association to be
statistically significant.

While for diastolic blood pressure there is inverse relationship
noted.

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)

In this category, 78 subjects with 2hr blood glucose value
more than 200 mg/dl were excluded from the analysis.

The above mentioned data suggest that, there is significant
difference in the BMI value in Category I compared to IGT
population.

IGT population also has more Waist to Hip ratio (WHR),
as compared to category I. The result from above proves our
hypothesis that IGT population is more prone to develop obesity.
Similarly for blood pressure, mean systolic and diastolic pressure
is more in IGT population as compare to category I population.

And hence, the above findings strongly propose that the BMI,
WHR, systolic blood pressure and diastolic blood pressure are risk factors in IFG and IGT population.

Above table shows that, Subjects with BMI greater than equal
to 25 have more chances for development of Impaired Glucose Tolerance 65 (4.95%) versus 19 (1.45%).

A p-value of <0.0001, obtained using chi-square test, indicates this association to be statistically significant.

For waist to hip ratio, Male subjects with waist to hip ratio
greater than equal to 0.95 have more chances of development of Impaired Glucose Tolerance,28 (3.70%) versus 12 (1.59%). A
p-value of <0.0001, obtained using chi-square test, indicates this association is statistically significant.

For Female subjects with waist to hip ratio greater than equal
to 0.85 have more chances of development of Impaired Glucose Tolerance,21 (4.15%) versus 13 (2.57%). A p-value of 0.2003,
obtained using chi-square test, indicates this association is not statistically significant.

Subjects with systolic blood pressure greater than 120 have
more chances of development of Impaired Glucose Tolerance, 51
(3.91%) versus 32 (2.46%). A p-value of 0.0098 obtained using chi-
square test, indicates this association to be statistically significant.

Subjects with diastolic blood pressure greater than 80 have
more chances of development of Impaired Glucose Tolerance, 46
(3.53%) versus 37 (2.84%). A p-value of 0.0067 obtained using chi-
square test, indicates this association to be statistically significant.

Discussion

The present study provides the first representative,
population based estimates of Prediabetes (IFG and IGT) in
Urban and Rural Gujarati community.

This study was designed to give the reliable state wise
estimates of diabetes prevalence, as commonly people believes
that Gujarati community have high affinity to Diabetes because
of their food habit and lifestyle.

Various epidemiological studies conducted in India during
year 2000- 2005 have shown the varied prevalence of Diabetes
in Indian population. Out of these if, we review the studies
conducted in Western part of India(Yagnik et al from Pune in 2004
and Iyer et al from Dombivali in 2004, as per WHO guidelines)
has shown the prevalence of 4.3% and 4.01% respectively.9

Our study has also shown the prevalence of Prediabetes (IFG
and IGT); the crude prevalence of IFG in Gujarati population is

Table 6: Characteristics of subjects with IGT population

<table>
<thead>
<tr>
<th>Category</th>
<th>BMI (kg/m²)</th>
<th>Waist/Hip Ratio</th>
<th>Systolic Blood Pressure</th>
<th>Diastolic Blood Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>&lt; 25</td>
<td>≥ 25</td>
<td>Total</td>
</tr>
<tr>
<td>I: 2h Post Glucose (&lt;140 mg/dl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>1229</td>
<td>1189</td>
<td>1220</td>
</tr>
<tr>
<td>II: Impaired Glucose Tolerance (IGT) (2 h post glucose 140-200 mg/dl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MIN-MAX</td>
<td>13.76-85.22</td>
<td>0.54-1.60</td>
<td>44.00-368.00</td>
</tr>
<tr>
<td></td>
<td>MEAN±SD</td>
<td>25.57±5.21</td>
<td>0.91±0.09</td>
<td>123.94±17.18</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>84</td>
<td>74</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>MIN-MAX</td>
<td>16.23-57.67</td>
<td>0.55-1.62</td>
<td>86.00-196.00</td>
</tr>
<tr>
<td></td>
<td>MEAN±SD</td>
<td>29.36±6.49</td>
<td>0.94±0.12</td>
<td>130.19±17.66</td>
</tr>
</tbody>
</table>

* 78 subjects with blood glucose value of more than 200 mg/dl were excluded from the analysis.

Table 7: Summary of proportion of subjects with IGT by BMI, WHR, systolic and diastolic blood pressure

<table>
<thead>
<tr>
<th>Category</th>
<th>BMI (kg/m²)</th>
<th>Waist to Hip Ratio</th>
<th>Systolic Blood Pressure</th>
<th>Diastolic Blood Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
<td>Male</td>
</tr>
<tr>
<td>2h Post Glucose (&lt;140 mg/dl or &gt;200 mg/dl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>84</td>
<td>19</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td>&lt; 0.0001</td>
<td>&lt; 0.0001</td>
<td>0.2003</td>
</tr>
</tbody>
</table>

Note: P-value obtained using chi-square test.

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182
around 2.75 % and IGT is around 6.11 %. But the age adjusted prevalence of IFG is around 2.72% and IGT is around 4.67%, which is comparable to the prevalence observed in the previous conducted studies.

Lifestyle changes due to urbanisation and aging of the population are two important determinant of rising prevalence of prediabetes (IFG and IGT) in developing countries such as India.

A multiple logistic regression was build considering fasting blood glucose categories as dependent variable and BMI category, Waist to Hip ratio category, Systolic Blood Pressure category and Diastolic blood pressure category as independent predictors.

BMI, Waist to Hip Ratio and Systolic Blood Pressure are statistically significant predictor and have significant association with fasting blood glucose categories. The wald chi-square probability for these independent significant predictors is 0.0139, 0.0013 and 0.0002 respectively. However, diastolic blood pressure is not statistically significant predictor with wald chi-square probability 0.5969.

Based on odds ratio estimates, we can infer the following:

Point estimate of odds ratio for BMI category is 0.585. Hence, subjects with BMI category less than 25 have 41.5% less chances, as compared to subjects with BMI category greater than or equal to 25, of converting from normoglycemic to IFG and from IFG to newly diagnosed diabetic keeping all other parameters constant.

Point estimate of odds ratio for waist to hip ratio category is 0.320. Hence, subjects with BMI category less than 25 have 68% less chances, as compared to subjects with BMI category greater than or equal to 25, of converting from normoglycemic to IFG and from IFG to newly diagnosed diabetic keeping all other parameters constant.

Point estimate of odds ratio for systolic blood pressure category is 0.405. Hence, subjects with BMI category less than 25 have 59.5% less chances, as compared to subjects with BMI category greater than or equal to 25, of converting from Normoglycemic to IFG and from IFG to newly diagnosed diabetic keeping all other parameters constant.

This proves that the higher BMI, WHR, higher systolic blood pressure and diastolic pressure are the risk factors for IFG and IGT.

In this study, we have also concluded that men have higher prevalence of IFG and IGT than female. This also matches with the observations from other international studies. The probable hypothesis for this development could be disturbances in glucose metabolism accelerate the process of endothelial dysfunction.

Studies have also confirmed that prevalence of IFG and IGT is increasing as the age progresses. Our study has also proven the same.

Patients with impaired glucose tolerance or impaired fasting glucose have a significant risk of diabetes and thus are important target for primary prevention.

At present, India is on the verge of a rapid epidemiological transition with increased urbanization. Present urbanization rate is 35% 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.

Since 1970, several studies have been done comparing urban and rural populations in India, which have shown higher prevalence of diabetes among urban residents compared to their rural counterparts both in southern and northern parts of India.

A study conducted by Diabetes Research Centre in Chennai, India reported a prevalence of diabetes to be about 5.9% in semi-urban areas which is midway between urban (11.6%) and the rural (2.4%). A recent survey in a rural area of Kerala in 2009 showed indications of transition in the lifestyle of rural population and striking increase in the rate of prevalence of Impaired fasting glucose was noted (5.1%). Our study has shown that the prevalence of IFG in Rural area is around 2.18 % and IGT is around 4.32%.

Studies have also confirmed that circulating endothelium factors (mainly PAI-I) are more in IGT and IFG population. This leads to the damage in the endothelial cells.

Systolic and Diastolic blood pressures were only positively correlated by PAI-I activity. PAI-I (Plasminogen Activating Inhibitor -1) activity is significantly increased in the IGT population and these factors are affected by blood pressure.

In nutshell, prediabetes population has high probability for getting converted into Diabetes in the long run (may be 3-5 years). And they also develop diabetes dyslipidemia and lead to morbidity and mortality. Therefore, public attention to the high prevalence of IFG and Diabetes is requested.

Lifestyle modification is the most cost-effective intervention for prevention of diabetes in high-risk groups in India. However, control of diabetes with diet, weight control and physical activity has been difficult and will not be sufficient for most of the patients. Moreover, the steady increase in the incidence of type 2 diabetes has significant socioeconomic implications.

Our study also endorses the fact that established risk factors, such as ageing and hypertension in Western Indian population has strong relationship and concurs with the studies in the western populations.

Summarising, present study shows that IFG and IGT are associated for developing diabetes and they are associated with cardiovascular risk factors in the Indian population.

Thus the findings of present study have important public health implications. Both IFG and IGT is not a clinical entity but rather a risk factor for future diabetes and cardiovascular disease.

The result of the study indicates that, public attention is required to curb the conversion of diabetes. The prediction by WHO, that India is likely to be the country having the largest number of diabetic subjects by the year 2025 seems to be true.

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