Screening among Male Industrial Workers in India Shows High Prevalence of Impaired Glucose Tolerance, Undetected Diabetes and Cardiovascular Risk Clustering

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Abstract

**Objective:** To study the magnitude of undetected diabetes, impaired glucose tolerance (IGT) and clustering of cardiometabolic risk factors among male industrial workers.

**Methods:** Measurements of 2h post glucose blood glucose (2h PG), blood pressure, body mass index (BMI) and waist circumference (WC) were done in 8741 non-diabetic men of 35-55 years. Presence of family history of diabetes (FH) was noted. Risk associations with diabetes and IGT were studied using multiple logistic regression analysis. Clustering of overweight/obesity, abdominal obesity, hypertension was noted.

**Results:** Prevalence of undetected diabetes (14.9%) and IGT (31.4%) were high. FH, age, hypertension and BMI showed strong associations with diabetes and IGT. More than 40% had clustering of risk factors.

**Conclusion:** High prevalence of undetected diabetes, IGT and clustering of cardiometabolic risk factors among young industrial workers mandates that regular screening for metabolic disorders should be undertaken to prevent development of severe morbidity in the productive years of life.

Introduction

The escalating prevalence of type 2 diabetes mellitus (T2DM) poses a worldwide public health crisis. The challenge is immense in developing countries like India, which are undergoing rapid socio-economic transition. 1 Economic growth and transition to modern lifestyle among the Indian population which have occurred in the last four decades have resulted in a steady increase in the prevalence of T2DM.2-5 The prevalence of Impaired Glucose Tolerance (IGT) is high 1 suggesting the presence of a large pool of people with the potential to develop T2DM. As IGT is also associated with cardiovascular risk factors, its identification is of paramount importance for prevention and control of T2DM and cardiovascular diseases (CVD). Simple screening procedures among non-diabetic persons can detect undiagnosed diabetes, IGT and also the presence of multiple risk factors for diabetes and CVD.

In this study, in a large group of male industrial workers, association of the potential modifiable risk factors (body mass index (BMI), waist circumference (WC) and hypertension) for dysglycaemia were assessed. The prevalence of cardiovascular risk clustering and its association with dysglycaemia were also studied. The screening was done for selecting IGT subjects for a prospective diabetes prevention study.
Material and Methods

Sample selection

Study subjects were recruited from middle-class populations working in various public and private sector industrial units in Chennai, Tamil Nadu and Visakhapatnam, Andhra Pradesh, India. Following agreement from the selected employers and written consent from the employees, details of the programme were explained and all the staff were screened. Non-diabetic subjects with no major illness, aged 35-55 years, were screened from August 2009 to November 2010. The study protocol was approved by the Institutional Ethical Review Committee of the India Diabetes Research Foundation (IDRF).

Among the 9160 non-diabetic subjects (men: women 8801:359) invited, 9079 (men: women 8741:338) subjects consented to undergo the screening test. As the number of women was small, the analysis was done only for men (n=8741, response rate 99.3%). Weight and height were measured with the participants wearing light clothes without shoes. BMI was calculated (kg/m^2). Waist circumference was measured midway between the lower rib margin and iliac crest. Blood pressure was measured using a standard mercury sphygmomanometer after a 5-minute rest. An average of the two readings was used for the analysis. Demography, family history of diabetes, heart disease, and stroke were recorded in a structured questionnaire. Screening was carried out at the work place. Capillary blood glucose was measured using a glucometer (Accu-check Sensor, Roche Diagnostics, Mannheim, Germany), 2h after glucose intake (75 gms). The participants were advised not to do any strenuous work during the screening period.

Definition of variables and outcomes

Glucose tolerance was classified according to the 1999 World Health Organisation (WHO) criteria. type 2 diabetes mellitus (T2DM) was defined as 2 hr OGTT plasma glucose levels ≥ 200 mg/dl (≥ 11.1 mmol/l) and impaired glucose tolerance (IGT) as a plasma glucose concentration of 140 to 199 mg/dl (7.8 to 11.0 mmol/l). BMI between ≥ 23.0 and 24.9 kg/m^2 was considered as overweight, and BMI ≥ 25.0 kg/m^2 was defined as obese. Central obesity was indicated by waist circumference of ≥ 90 cm. Subjects with a history of hypertension and newly diagnosed cases with blood pressure readings ≥ 130/85 mmHg were categorised as hypertensive.

For this study, only persons with IGT were selected. Presence of impaired fasting glucose (IFG) was not a selection criterion. However, a few of the IGT subjects could also have had IFG.

Data Analysis

Statistical analyses were carried out using SPSS 19.0 statistical software system (IBM statistics). Continuous variables were expressed as mean ± SD and evaluated using one way analysis of variance (ANOVA) with Bonferroni correction post hoc. The $\chi^2$ statistic test was applied for categorical variables. Multiple logistic regression analysis with forward stepwise addition was used to determine the
0.05) when compared with NGT and IGT subjects (p < 0.05). Positive family history of diabetes, and blood pressure showed progressive increase from NGT to DM (p < 0.0001 for all).

Significant risk associations for IGT and T2DM are shown in Table 2. Positive family history of diabetes, BMI, age and hypertension were associated with diabetes and IGT. WC also showed an association with diabetes.

Figure 1 shows the prevalence of risk clusters, in the prediabetic and diabetic subjects. Clustering of risk factors (2 or more) were present in many subjects, the most frequent cluster was overweight / obesity (BMI ≥ 23 kg/m²) and hypertension (46.2%), followed by abdominal obesity + hypertension (34.8%) (Figure 1, Panel-1). Clustering of 3 risk factors occurred in 15.1% (Figure 1, Panel-1). As expected, prevalence of risk clusters increased with degree of hyperglycaemia, the percentages gradiently increased from NGT to diabetes. (IGT > NGT, DM > IGT(p < 0.0001 in all groups)) (Figure 1, Panel-2).

Discussion

The screening results showed that among Indian industrial workers aged 35-55 years, prevalence of undetected diabetes (14.9%) and IGT (31.4%) were high. We had chosen men working in varied industrial organisations, comprising of unskilled and skilled labourers, clerical and executive personnel.

Nearly 80% of the study participants were overweight or obese (24% overweight and 55.7% obese) and 58.4% had abdominal obesity. This proportion was higher when compared with data collected in 2006 in a similar city population in the same age group (total 71.5%: 28.5% overweight and 43% obese). It is likely that the prevalence of obesity has increased in urban Indian men. It is also possible that, overweight persons would have volunteered for this programme, being aware of their high risk for diabetes and other lifestyle disease. A positive

Table 2: Results of multiple logistic regression analyses, variables significantly associated with impaired glucose tolerance (IGT) (Panel-1) and Diabetes (Panel-2) are shown

<table>
<thead>
<tr>
<th>Variables</th>
<th>β</th>
<th>SE β</th>
<th>p value</th>
<th>Odds Ratio (OR)</th>
<th>95% CI (OR)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel 1: Dependent variable: Impaired glucose tolerance Vs Normal glucose tolerance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes Family history</td>
<td>0.335</td>
<td>0.059</td>
<td>0.000</td>
<td>1.398</td>
<td>1.247 - 1.56</td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.261</td>
<td>0.055</td>
<td>0.000</td>
<td>1.298</td>
<td>1.165 - 1.44</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>0.055</td>
<td>0.008</td>
<td>0.000</td>
<td>1.056</td>
<td>1.039 - 1.07</td>
</tr>
<tr>
<td>Age (Years)</td>
<td>0.019</td>
<td>0.006</td>
<td>0.003</td>
<td>1.019</td>
<td>1.007 - 1.03</td>
</tr>
<tr>
<td><strong>Panel 2: Dependent variable: Diabetes Vs Normal glucose tolerance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.57</td>
<td>0.074</td>
<td>0.000</td>
<td>1.768</td>
<td>1.529 - 2.04</td>
</tr>
<tr>
<td>Diabetes Family history</td>
<td>0.49</td>
<td>0.078</td>
<td>0.000</td>
<td>1.633</td>
<td>1.402 - 1.9</td>
</tr>
<tr>
<td>Age (Years)</td>
<td>0.059</td>
<td>0.008</td>
<td>0.000</td>
<td>1.061</td>
<td>1.043 - 1.07</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>0.038</td>
<td>0.017</td>
<td>0.028</td>
<td>1.039</td>
<td>1.004 - 1.07</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>0.029</td>
<td>0.007</td>
<td>0.000</td>
<td>1.029</td>
<td>1.014 - 1.04</td>
</tr>
</tbody>
</table>
Delhi, 8 reported high prevalence of diabetes (15%) setting (n=2122, mean age of 42 years), in New and WC were independently associated with diabetes. Hypertension with IGT and diabetes were similar. BMI factor both for IGT and diabetes. Risk associations of study, 55.5% of the study subjects had hypertension (44%). Prevalence of overweight (BMI > 23 kg/m²) on anti hypertensive treatment) and pre hypertension (30%, blood pressure >139/89 mmHg or ≥ 90 cm). Our study cohort had higher prevalence of overweight and abdominal obesity than in the above report. Prevalence of IGT was similar in both the studies. We had assessed the prevalence of only newly diagnosed diabetes, and it was as high as the total prevalence reported in the above study. The total prevalence of known and new diabetic cases in Chennai would be higher. In a previous urban study, prevalence of known and newly diagnosed T2DM in men of 35-55 years was 24.5% and 8.6% respectively. However, prevalence of IGT was only 11.0% in this group.

A higher percentage of hypertension (55.5%) seen in the present study could be partly due to the lower cut-off values of blood pressure used and partly due to the higher prevalence of hypertension associated with diabetes.

Although, not a community-based epidemiological survey, the study shows a high prevalence of undetected diabetes and IGT among male industrial workers in southern India. Screening with 2h blood glucose is a highly sensitive method to identify diabetes and IGT in Indians. However, a few cases of diabetes and IFG could be missed as fasting glucose is not measured. Multiple risk factors and their clusters were present in many of them. Several studies in India have shown that clustering of risk factors or metabolic syndrome is highly prevalent in the population. The association of risk factors for IGT and diabetes were similar. These risk factors also contribute to the development of CVD. Development of complications of diabetes can be reduced by early diagnosis and management of diabetes and also by appropriate intervention in the prediabetic stage itself. Periodic screening for dysglycaemia should be conducted among the industrial workers to reduce the burden of metabolic diseases.

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References