Diabetes Management and Considerations for the Indian Culture
How many people have diabetes in India?

A. > 10 million
B. > 20 million
C. > 40 million
D. > 60 million
Number of people 20–79 years old with diabetes in 2013. 6th edition of the IDF Diabetes Atlas.2
Estimates for diabetes and impaired glucose tolerance for 2012 for people of 20–79 years in South Asia

<table>
<thead>
<tr>
<th>Country</th>
<th>Cases of diabetes (in thousands)</th>
<th>Diabetes national prevalence (%)</th>
<th>Number with diabetes (in thousands)</th>
<th>Number with undiagnosed diabetes (in thousands)</th>
<th>Impaired glucose tolerance national prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rural setting</td>
<td>Urban setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afghanistan</td>
<td>849.09</td>
<td>5.95</td>
<td>603.15</td>
<td>245.94</td>
<td>424.55</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>5521.41</td>
<td>6.14</td>
<td>1614.48</td>
<td>3906.93</td>
<td>2760.71</td>
</tr>
<tr>
<td>Bhutan</td>
<td>22.36</td>
<td>4.89</td>
<td>10.55</td>
<td>11.81</td>
<td>11.42</td>
</tr>
<tr>
<td>India</td>
<td>63013.87</td>
<td>8.37</td>
<td>34,433.22</td>
<td>28,580.65</td>
<td>32,184.34</td>
</tr>
<tr>
<td>Maldives</td>
<td>15.91</td>
<td>7.74</td>
<td>6.56</td>
<td>9.34</td>
<td>8.13</td>
</tr>
<tr>
<td>Mauritius</td>
<td>141.64</td>
<td>15.53</td>
<td>68.40</td>
<td>73.25</td>
<td>72.34</td>
</tr>
<tr>
<td>Nepal</td>
<td>506.73</td>
<td>3.05</td>
<td>191.01</td>
<td>315.71</td>
<td>253.36</td>
</tr>
<tr>
<td>Pakistan</td>
<td>6550.18</td>
<td>6.74</td>
<td>3710.76</td>
<td>2839.41</td>
<td>3650.74</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>1100.21</td>
<td>7.84</td>
<td>793.45</td>
<td>306.76</td>
<td>561.93</td>
</tr>
</tbody>
</table>

Adapted from the International Diabetes Federation (2013)
Changing Epidemiology of Diabetes in India
ICMR - INDIA DIABETES [ICMR-INDIAB] STUDY

PRIMARY OBJECTIVE – To determine the national prevalence of diabetes mellitus & prediabetes (IFG/IGT) in India, by estimating the state-wise prevalence of the same

STUDY DESIGN:
- Cross-sectional, door to door survey

STUDY SUBJECTS:
- Individuals aged 20 years and above were recruited for the study

Aimed at studying
All 28 states + 2 union territories (UT) + National Capital Territory of Delhi

4000 representative samples from each State/UT
(1,200 Urban & 2,800 Rural)

TOTAL SAMPLE SIZE
1,24,000

Weighted prevalence of diabetes in urban and rural population

* P < 0.05 compared to rural population

Anjana RM et al for ICMR – INDIAB Study Group, Diabetologia, 2011; 54: 3022-7
Diabetes in India (2011)

~ 62.4 million people have diabetes in India

Anjana RM et al for ICMR – INDIAB Study Group, Diabetologia, 2011; 54: 3022-7
Self-reported to newly diagnosed diabetes ratio in urban and rural population

Self-reported diabetes: Newly diagnosed diabetes

<table>
<thead>
<tr>
<th>State</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maharashtra</td>
<td>1 : 2</td>
<td>1 : 3</td>
</tr>
<tr>
<td>Tamilnadu</td>
<td>2 : 1</td>
<td>1 : 1</td>
</tr>
<tr>
<td>Jharkhand</td>
<td>2 : 1</td>
<td>1 : 3</td>
</tr>
<tr>
<td>Chandigarh</td>
<td>1 : 1</td>
<td>1 : 2</td>
</tr>
</tbody>
</table>

Adapted from the International Diabetes Federation (2013)

Anjana RM et al for ICMR – INDIAB Study Group, Diabetologia, 2011; 54: 3022-7
Area-wise age-and gender-specific weighted prevalence of diabetes in 3 states and 1 union territory

Anjana RM et al for ICMR – INDIAB Study group, Diabetologia, 2011; 54: 3022-7
Prevalence* of prediabetes in urban and rural population

**Tamilnadu**
- Urban: 9.8%
- Rural: 7.1%
- Weighted prevalence: **p=0.005**

**Jharkhand**
- Urban: 10.7%
- Rural: 7.4%
- Weighted prevalence: **p=0.001**

**Chandigarh**
- Urban: 14.5%
- Rural: 14.7%
- Weighted prevalence: **p=0.945**

**Maharashtra**
- Urban: 15.2%
- Rural: 11.1%
- Weighted prevalence: **p<0.001**

*Weighted prevalence

Anjana RM et al for ICMR – INDIAB Study group, Diabetologia, 2011; 54: 3022-7
The prevalence of prediabetes in India is greater than the number of patients diagnosed with diabetes.

A. True
B. False
Prediabetes in India (2011)

~ 77.2 million people have prediabetes in India

The epidemic is not yet over and we can expect further increases in the short term.

Anjana RM et al for ICMR – INDIAB Study Group, Diabetologia, 2011; 54: 3022-7
Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: Phase I results of the Indian Council of Medical Research–INDIA DIABetes (ICMR–INDIAB) study

R. M. Anjana • R. Pradeepa • M. Deepa • M. Datta • V. Sudha • R. Unnikrishnan • A. Bhansali • S. R. Joshi • P. P. Joshi • C. S. Yajnik • V. K. Dhandhania • L. M. Nath • A. K. Das • P. V. Rao • S. V. Madhu • D. K. Shukla • T. Kaur • M. Priya • E. Nirmal • S. J. Parvathi • S. Subhashini • R. Subashini • M. K. Ali • V. Mohan
on behalf of the ICMR–INDIAB Collaborative Study Group

Received: 3 June 2011 / Accepted: 28 July 2011
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~ 62.4 million people have diabetes in India
~ 77.2 million people have prediabetes in India
Diabetes in South Asians

Panel-1 Rising prevalence of diabetes

Panel-2 Diabetes in young population (<44 years)

Panel-3 Mean age (years) of diabetic population

(a) Urban population

(b) Rural population

(c) Increase
Burden Due to Diabetes

Diabetes Complications

- Coronary Artery Disease (CAD)
  - Urban: 21.4%
  - Rural: 10.8%
  - 11.5 Million (2011)

- Peripheral Vascular Disease (PVD)
  - Urban: 6.3%
  - Rural: 7.3%
  - 4.4 Million (2011)

- Retinopathy
  - Urban: 17.6%
  - Rural: 18.2%
  - 11.1 Million (2011)

- Nephropathy (microalbuminuria)
  - Urban: 26.9%
  - Rural: 24.3%
  - 16.8 Million (2011)

- Neuropathy
  - Urban: 26.1%
  - Rural: 30.9%
  - 17.3 Million (2011)

U = Urban  |  R = Rural

Mohan V et al, J Am Coll Cardiol. 38; 682-687, 2001
Premalatha G et al, Diabetes Care, 23: 1295-1300, 2000
Diabetes in South Asians

Kaplan–Meier survival plots of Indo-Asian, African-Caribbean and white patients with type 2 diabetes showing doubling of serum creatinine (as endpoint) on the y-axis and follow-up (months) on the x-axis.
Complex interactions of perinatal, nutritional, and other acquired factors in development of type 2 diabetes and coronary heart disease (CHD) in Asian Indians. BMI (body mass index); CRP (C-reactive protein); T2DM (type 2 diabetes mellitus)
The criteria for abdominal obesity and body mass index are lower for Asian Indians than international criteria.

A. True
B. False
## Cut-offs of obesity and abdominal obesity for Asian Indians vs. International criteria

<table>
<thead>
<tr>
<th>Variable</th>
<th>Consensus Guidelines for Asian Indians&lt;sup&gt;a&lt;/sup&gt;</th>
<th>International Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal BMI</td>
<td>18.0 - 22.9 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>18.5 - 24.9 kg/m&lt;sup&gt;2b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Overweight</td>
<td>23.0 - 24.9 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>25.0 - 29.9 kg/m&lt;sup&gt;2b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Generalized obesity</td>
<td>Obesity: ≥ 25 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Obesity: ≥ 30 kg/m&lt;sup&gt;2b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Abdominal obesity-waist circumference cut-offs (cm)</td>
<td>Men: ≥ 90 cm&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Men: ≥ 102 cm&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Women: ≥ 80 cm&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Women: ≥ 88 cm&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

1. <sup>a</sup>From Consensus guidelines for Asian Indians [Misra A, et al, 2009]
2. <sup>b</sup>According to World Health Organization guidelines [2014]
3. <sup>c</sup>Both as per Consensus Guidelines for Asian Indians [Misra A, et al, 2009] and the International Diabetes Federation [2013]
4. <sup>d</sup>According to the Modified National Cholesterol Education Program, Adult Treatment Panel III guidelines [NCEP] [2002]
5. Adapted from Misra & Khurana (2011), Nature Publishing Group
The pathway from obesity to prediabetes, the metabolic syndrome, and diabetes: Opportunities for prevention have been indicated in filled rectangles; upward arrow indicates increase; downward arrow indicates decrease. CHD (coronary heart disease); HDL (high-density lipoprotein cholesterol); IFG (impaired fasting glucose); IGT (impaired glucose tolerance); LBW (low birth weight).
### The Diabetes Prevention Program (DPP)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>Multi-ethnic in United States</td>
</tr>
<tr>
<td>Participants</td>
<td>1,079</td>
</tr>
<tr>
<td>Study Duration</td>
<td>3 years</td>
</tr>
<tr>
<td>Study Commencement</td>
<td>1996</td>
</tr>
<tr>
<td>Centers</td>
<td>27</td>
</tr>
<tr>
<td>Weight Loss</td>
<td>7% in initial 6 months and then maintain</td>
</tr>
<tr>
<td>Diet</td>
<td>Calories less than 500-1000 calories/day from initial level</td>
</tr>
<tr>
<td>Fat intake</td>
<td>25% of calories</td>
</tr>
<tr>
<td>Physical Activity</td>
<td>700 calories/week, at least 150 min. of moderate physical activity similar in intensity to brisk walking</td>
</tr>
<tr>
<td>Compliance</td>
<td>Initial sessions, individual coaches-continued contact</td>
</tr>
<tr>
<td>Incidence of Diabetes</td>
<td>Placebo, 11%; metformin, 7.8%; and lifestyle, 4.8%</td>
</tr>
<tr>
<td>Reduction in Incidence of Diabetes</td>
<td>58% in lifestyle modification, 38% in metformin</td>
</tr>
<tr>
<td>Cost of Intervention</td>
<td>Metformin, $2,191; lifestyle modification, $2,269 per participant over 3 years</td>
</tr>
</tbody>
</table>
### Intervention Studies on Asian Indians - 1

<table>
<thead>
<tr>
<th>Age group, reference (year)</th>
<th>n</th>
<th>Type of trial</th>
<th>Age range (years)</th>
<th>Type of population</th>
<th>Type of subjects</th>
<th>Intervention period</th>
<th>Type of intervention</th>
<th>Cardiometabolic effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramachandran et al.(^{37,38}) (2006, 2007)</td>
<td>531 (M 421, F 110)</td>
<td>RCT</td>
<td>35–55</td>
<td>South India (urban)</td>
<td>IGT</td>
<td>3 years</td>
<td>Weight maintenance by diet low in refined carbohydrates and fats+30 min of exercise per day and metformin</td>
<td>28.5% reduction in incidence of with LSM, 26.4% with metformin, and 28.2% with a combination of LSM and metformin</td>
</tr>
<tr>
<td>Rush et al.(^{40}) (2007)</td>
<td>41 (21 M, 20 F)</td>
<td>RCT</td>
<td>50</td>
<td>Asian Indian migrants in New Zealand</td>
<td>Healthy</td>
<td>5 months</td>
<td>Weight maintenance by diet low in refined carbohydrates and fats+30 min of exercise per day</td>
<td>Reduction in total body fat, abdominal fat, and blood lipids</td>
</tr>
<tr>
<td>Balgopal et al.(^{41}) (2008)</td>
<td>731</td>
<td>RCT</td>
<td>10–92</td>
<td>South India (rural)</td>
<td>Healthy</td>
<td>7 months</td>
<td>Weight maintenance by diet low in refined carbohydrates and fats and 30 min exercise per day with trained trainers</td>
<td>Reduction in FBG levels in those with prediabetes by 11% and in adults with T2DM by 25%</td>
</tr>
</tbody>
</table>
## Intervention Studies on Asian Indians - 2

<table>
<thead>
<tr>
<th>Age group, reference (year)</th>
<th>n</th>
<th>Type of trial</th>
<th>Age range (years)</th>
<th>Type of population</th>
<th>Type of subjects</th>
<th>Intervention period</th>
<th>Type of intervention</th>
<th>Cardiometabolic effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misra et al.42 (2008)</td>
<td>30</td>
<td>Observational</td>
<td>Adults (mean age, 40.8)</td>
<td>North India (urban)</td>
<td>Patients with T2DM</td>
<td>3 months</td>
<td>Effect of supervised progressive resistance muscle exercises in nonobese patients with T2DM</td>
<td>Significant decrease in FBG and HbA1c, increase in insulin sensitivity, and decrease in truncal and peripheral subcutaneous adipose tissue</td>
</tr>
<tr>
<td>Gulati et al.43 (2014)</td>
<td>60</td>
<td>RCT</td>
<td>Adults</td>
<td>North India (urban)</td>
<td>Metabolic syndrome</td>
<td>6 months</td>
<td>Intervention with pistachio nuts in diets</td>
<td>Improvement in WC, FBG, TC, LDL-c, hs-CRP, FFAs, and oxidative stress</td>
</tr>
<tr>
<td>Nigam et al.44 (2013)</td>
<td>93</td>
<td>RCT</td>
<td>20-50</td>
<td>North Indian males</td>
<td>NAFLD</td>
<td>6 months</td>
<td>Canola oil or olive oil</td>
<td>Significant improvements in grading of fatty liver, liver span, insulin resistance, and lipids with use of canola and olive oil</td>
</tr>
</tbody>
</table>
## Intervention Studies on Asian Indians - 3

<table>
<thead>
<tr>
<th>Age group, reference (year)</th>
<th>n</th>
<th>Type of trial</th>
<th>Age range (years)</th>
<th>Type of population</th>
<th>Type of subjects</th>
<th>Intervention period</th>
<th>Type of intervention</th>
<th>Cardiometabolic effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nagpal et al.45(2009)</td>
<td>100</td>
<td>RCT</td>
<td>≥35</td>
<td>North Indian males</td>
<td>Healthy centrally obese (≥78 cm)</td>
<td>6 weeks</td>
<td>Vitamin D (oral cholecalciferol, 3 doses of 120,000 IU)</td>
<td>Significant change in OGIS</td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shah et al.46,47(2010)</td>
<td>2,500</td>
<td>Case control</td>
<td>8–18</td>
<td>North India (urban school children)</td>
<td>Healthy</td>
<td>6 months</td>
<td>Educatve and participatory Interventions</td>
<td>Significant improvement in knowledge and practices</td>
</tr>
<tr>
<td>Singhal et al.48,49(2010)</td>
<td>101</td>
<td>Case control</td>
<td>15–17</td>
<td>North India (urban school children)</td>
<td>Healthy</td>
<td>6 months</td>
<td>Educatve and participatory Interventions</td>
<td>Decrease in waist–hip ratio, better insulin sensitivity, and significantly lower hs-CRP values in the intervention group</td>
</tr>
</tbody>
</table>
Asian Indian Adolescents:
a controlled intervention study (nutrition education and lifestyle intervention)

Percentage change in fasting insulin levels and measures of insulin resistance and β-cell function after intervention. HOMA-BCF, homeostasis model of assessment for β-cell function; HOMA-IR, homeostasis model of assessment for insulin resistance. Singhal, et al, 2011

Published in Diabetes Technology & Therapeutics. August 2014, 16(8): 531-541.
DOI: 10.1089/dia.2013.0373 © Mary Ann Liebert, Inc.
Gestational Diabetes Mellitus Clinical Pathway - India

**Conception**

- Pregnancy Confirmed

**Antenatal**

- Fasting + PP Glucose Test
  - **PP > 200**
    - Yes
      - **HbA1C confirmatory test**
        - **A1c > 6**
          - Yes
            - GDM confirmed, Need to manage GDM
          - No
            - PP High*
              - No
    - No

- **OGTT / GCT (Screening + Diagnostics)**
  - **24 – 28th week**
    - Non-fasting Random
    - 75gm oral load
    - 2 hr venous blood test
  - **32 – 34th week**
    - Non-fasting Random
    - 75gm oral load
    - 2 hr venous blood test

- Specific week not defined

**Post Partum**

- Glucose Test as a part of CBC / Post partum testing

<table>
<thead>
<tr>
<th>Plasma Glucose (2hr)</th>
<th>Diagnosis*</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;120mg/dl</td>
<td>Normal</td>
</tr>
<tr>
<td>120 – 139mg/dl</td>
<td>Gestational Glucose Intolerance (GGI)</td>
</tr>
<tr>
<td>140 - 199mg/dl</td>
<td>GDM</td>
</tr>
<tr>
<td>&gt;200mg/dl</td>
<td>Diabetes</td>
</tr>
</tbody>
</table>

* Ref FOGSI, DIPSI
Benefits Accrued from Intervention Trials in Asian Indians

- Simple and culturally-sensitive interventions have proved to be effective in prevention/amelioration of diabetes/other cardiovascular risk factors in multiple settings, among urban, rural, and migrant Asian Indians, and among those who are healthy, obese, or have the metabolic syndrome or diabetes. It is important that mobile text messaging of health-related messages could be an important tool for prevention of diabetes.
- Short-term intensive lifestyle intervention in children improves anthropometric and metabolic parameters.
- Specific nutrient modulation in Indian diets has now been shown to produce multiple benefits.
Key Takeaways - 1

- Economic, dietary and other lifestyle transitions have been occurring rapidly in most South Asian countries, making their populations more vulnerable to developing type 2 diabetes and cardiovascular diseases.
- Recent data show an increasing prevalence of type 2 diabetes in urban areas as well as in semi-urban and rural areas, inclusive of people belonging to middle and low socio-economic strata.
Key Takeaways - 2

- Prime determinants for type 2 diabetes in South Asians include physical inactivity, imbalanced diets, abdominal obesity, excess hepatic fat and, possibly, adverse perinatal and early life nutrition and intra-country migration.
- It is reported that type 2 diabetes affects South Asians a decade earlier and some complications, for example nephropathy, are more prevalent and progressive than in other races.
- Further, prevalence of pre-diabetes is high, and so is conversion to diabetes, while more than 50% of those who are affected remain undiagnosed.
Key Takeaways - 3

• Attitudes, cultural differences and religious and social beliefs pose barriers in effective prevention and management of type 2 diabetes in South Asians

• Inadequate resources, insufficient healthcare budgets, lack of medical reimbursement and socio-economic factors contribute to the cost of diabetes management

• The challenge is to develop new translational strategies, which are pragmatic, cost-effective and scalable and can be adopted by the South Asian countries with limited resources
The key areas that need focus are:

- Generation of awareness, prioritizing health care for vulnerable subgroups (children, women, pregnant women and the underprivileged)
- Screening of high-risk groups
- Maximum coverage of the population with essential medicines
- Strengthening primary care

An effective national diabetes control program in each South Asian country should be formulated, with these issues in mind
THANK YOU