Life-course double burden of malnutrition

Prof. C.S. Yajnik  MD,FRCP
KEM HOSPITAL, PUNE, INDIA
MRC LEU, Southampton, UK
University of Exeter, UK
IISER, Pune
SDU, Odense, DK
www.kemdiabetes.org
India the Capital of Two

Undernutrition: LBW, under 5y

Diabetes

www.worldmapper.org
• Type 2 diabetes is the outcome of the fetus and early infant having to be nutritionally thrifty
  • Hales & Barker, Diabetologia, 1992

• Thrifty - careful and diligent in the use of resources
Children born small who became big
- more adipose, centrally adipose
- higher glucose, insulin resistant
- BP, lipids
Birth weight and Type 2 DM

PH Whincup et al, JAMA. 2008;300:2886-2897
Birth weight, height and Risk of GDM

Pima Indians  Norwegian women  African-American  New York


H. C. Jang et al.: Short stature in gestational diabetes mellitus

• U shaped relation BW
• Inverse with height
Plasticity & Programming

- Intrauterine exposure, lifelong effects
- Restriction of ‘plasticity’ (freedom of growth and development)
- Windows of vulnerability / opportunity
- Pre- and peri-conceptional period most crucial
- ‘Genetic’ & ‘Epigenetic’ mechanisms

Effect of In Utero and Early-Life Conditions on Adult Health and Disease, P Gluckman et al, NEJM 2008
Thin-fat Indian

Newly diagnosed Type 2 DM
(Indian vs UK white)

Yajnik CS, Nutr Rev 2001
Thin-fat Indian

Newly diagnosed Type 2 DM
(Indian vs UK white)

Clinical picture
The Y-Y paradox
Chitrajan S Yajnik, John S Yudkin

The two authors share a near identical body-mass index (BMI), but as dual X-ray absorptiometry imagery shows that's where the similarity ends. The first author (figure, right) has substantially more body fat than the second author (figure, left). Lifestyle may be relevant, the second author runs marathons whereas the first author's main exercise is running to beat the clocking doors of the elevator in the hospital every morning. The contribution of genes to such adiposity is yet to be determined, although the possible relevance of intrauterine under-nutrition is supported by the first author's low birthweight. The image is a useful reminder of the limitations of BMI as a measure of adiposity across populations.

Diabetes Unit, KEM Hospital Research Centre, Rasta Peth, Pune 411011, India (S Yajnik) | International Health and Medical Education Centre, University College London, UK (J S Yudkin)
Pune Maternal Nutrition Study

Mothers

- 42 kg, 1.52m, 18.1 kg/m²
- Smoking-0, alcohol-0
- 1700 cals, 45g pro, 35g fats
- 320g CHO (73% cals)
- 1 pre-GDM, 3 IGT, 5 PIH
- Physically fit, active


Babies

- Gestation 39.5 wks
- 2.65kg, 47.5cm, 24.1kg/m³
- Exclusively breast fed
- Perinatal mortality 21/1000

Pune Maternal Nutrition Study

Mothers

- 42 kg, 1.52m, 18.1 kg/m²
- Smoking-0, alcohol-0
- 1700 cals, 45g pro, 35g fats
- 320g CHO (73% cals)
- 1 pre-GDM, 3 IGT, 5 PIH
- Physically fit, active

Pune Maternal Nutrition Study

Indian Thin-Fat Baby (vs. white Caucasian)

Yajnik et al, JCEM, 2002
Lubree et al, Paed Res 2005

N Modi, Ped Res 2009
Pune Maternal Nutrition Study
18y follow up

<table>
<thead>
<tr>
<th>N</th>
<th>307</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight %</td>
<td>55</td>
</tr>
<tr>
<td>Over wt and Obese %</td>
<td>4</td>
</tr>
<tr>
<td>Stunted %</td>
<td>10</td>
</tr>
<tr>
<td>IFG %</td>
<td>8</td>
</tr>
<tr>
<td>IGT %</td>
<td>9</td>
</tr>
<tr>
<td>DM (n)</td>
<td>2</td>
</tr>
</tbody>
</table>

Hyperglycemic (190, 28.7%)
Males: 133, 37%, Females: 57, 18.5%
Rapid Transition & Intergenerational Double Burden
Maternal Characteristics at 28wk Gestation (F0 & F1 PMNS)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>F0 All (N=814) 1993-96</th>
<th>F0 (N=104) 1993-96</th>
<th>F1 (N=104) 2013-17</th>
<th>F1-F0 [N=104] 20 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marriage Age (years)</td>
<td>18.0</td>
<td>17.0</td>
<td>18.6***</td>
<td>+ 1.5 yrs</td>
</tr>
<tr>
<td>Education (years)</td>
<td>7.0</td>
<td>5.0</td>
<td>12.0***</td>
<td>+ 6 yrs</td>
</tr>
<tr>
<td>Primips (%)</td>
<td>31</td>
<td>35</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Height (cm)</td>
<td>152.0</td>
<td>152.1</td>
<td>157.4***</td>
<td>+ 5 cm</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>20.3</td>
<td>20.3</td>
<td>21.1**</td>
<td>+ 0.6 kg/m2</td>
</tr>
<tr>
<td>GDM (%)</td>
<td>&lt;1</td>
<td>3</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>F Glucose (mg%)</td>
<td>71.0</td>
<td>71.0</td>
<td>81.0***</td>
<td>+ 10 mg%</td>
</tr>
<tr>
<td>2hr Glucose (mg%)</td>
<td>77.0</td>
<td>77.0</td>
<td>113.0***</td>
<td>+ 32 mg%</td>
</tr>
<tr>
<td>F Insulin (mU/L)</td>
<td>2.7</td>
<td>2.7</td>
<td>6.2***</td>
<td>+ 3.4 mU/L</td>
</tr>
<tr>
<td>2hr Insulin (mU/L)</td>
<td>12.8</td>
<td>11.7</td>
<td>51.5***</td>
<td>+ 42.2 mU/L</td>
</tr>
<tr>
<td>Cholesterol (mg%)</td>
<td>185.0</td>
<td>182.0</td>
<td>190.5**</td>
<td>+ 8 mg%</td>
</tr>
<tr>
<td>HDL (mg%)</td>
<td>40.0</td>
<td>42.0</td>
<td>58.5***</td>
<td>+ 16 mg%</td>
</tr>
<tr>
<td>Triglycerides (mg%)</td>
<td>128.0</td>
<td>133.0</td>
<td>112.5*</td>
<td>- 11 mg%</td>
</tr>
<tr>
<td>HOMA IR</td>
<td>0.3</td>
<td>0.3</td>
<td>0.6</td>
<td>+ 0.2</td>
</tr>
<tr>
<td>Disposition index</td>
<td>232.0</td>
<td>236.8</td>
<td>135.5***</td>
<td>- 90.7</td>
</tr>
</tbody>
</table>

Median or %, * p<0.05, ** p<0.01, *** p<0.001

Yajnik CS, unpublished
### Birth characteristics (F1 & F2 PMNS)

<table>
<thead>
<tr>
<th>Neonate characteristics</th>
<th>F1 All (N=746) 1993-96</th>
<th>F1 (Female) [N=103] 1993-96</th>
<th>F2 (Female) [N=41] 2013-17</th>
<th>F2 (Male) [N=42] 2013-17</th>
<th>(F2-F1) Female [N=40] 20 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight (gm)</td>
<td>2625 [M=2700, F=2550]</td>
<td>2550</td>
<td>2760 *</td>
<td>2695</td>
<td>+220 gm</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>47.5</td>
<td>47.4</td>
<td>48.3</td>
<td>48.0</td>
<td>+0.8 cm</td>
</tr>
<tr>
<td>Head circ (cm)</td>
<td>33.0</td>
<td>32.6</td>
<td>33.0 **</td>
<td>33.3</td>
<td>+0.6 cm</td>
</tr>
<tr>
<td>Abd circ (cm)</td>
<td>28.5</td>
<td>28.8</td>
<td>29.6 *</td>
<td>29.5</td>
<td>+1.0 cm</td>
</tr>
<tr>
<td>Sum of skinfolds (mm)</td>
<td>8.2</td>
<td>8.4</td>
<td>7.8</td>
<td>7.5</td>
<td>-0.7 mm</td>
</tr>
</tbody>
</table>

*Median or %, * p<0.05, ** p<0.01, *** p<0.001*

Yajnik CS, unpublished
Dual - Teratogenesis
Thank u