Diabetes in Asian-Americans
Do the clinical differences affect treatment?

George L. King MD
Joslin Diabetes Center
Harvard Medical School
Diabetes prevalence in Asian Americans is very high!

<table>
<thead>
<tr>
<th></th>
<th>Total (%)</th>
<th>Diagnosed (%)</th>
<th>Undiagnosed (%)</th>
<th>Prediabetes (%)</th>
<th>Mean BMI (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>14.3</td>
<td>9.1</td>
<td>5.2</td>
<td>38.0</td>
<td>28.7</td>
</tr>
<tr>
<td>White</td>
<td>11.3</td>
<td>7.5</td>
<td>3.8</td>
<td>38.2</td>
<td>28.4</td>
</tr>
<tr>
<td>Asian</td>
<td>20.6</td>
<td>10.0</td>
<td>10.6</td>
<td>32.2</td>
<td>24.6</td>
</tr>
<tr>
<td>Black</td>
<td>21.8</td>
<td>14.9</td>
<td>7.0</td>
<td>39.6</td>
<td>30.8</td>
</tr>
<tr>
<td>Hispanic</td>
<td>22.6</td>
<td>12.5</td>
<td>10.1</td>
<td>36.8</td>
<td>29.7</td>
</tr>
</tbody>
</table>

About 4 million AA with Diabetes and 6 millions with pre-diabetes!
Two Main Types of Diabetes

**Type 1 diabetes**
- 5-10% of total
  (Rare in Asians)
- Common in children
  *(A Minority in East Asian Children)*
- Insulin Requiring
- Auto-immune Destruction of the Islets, HLA DR3/4 or LADA
  *(Only 1/3 of AA’s have auto-Islet antibodies to islets)*

**Type 2 diabetes**
- >90% of total (>95% in AA)
- Mostly in adults,
  but increasing in children
- Not insulin requiring
- Insulin resistant (IR)
  associated with obesity, inflammation and inactivity
  *(Different definition of obesity and IR more severe in AA with normal BMI and NDM)*
Preventing or Reversing Type 1 Diabetes

Normal state → Auto-immunity → Clinical diabetes → β-cell Regeneration/Replacement

- Proliferation
- Apoptosis

PREVENT
STOP PROGRESSION
REVERT

- Immature β cell
- Endocrine precursor
- Pancreatic precursor
- Adult stem/progenitor cell
- Stem cell
Auto-Antibodies to Islet and GAD in Type 1 Diabetes

Chinese: 30%
N. Amer. Caucasian: 85%

Diabetes Media, 17(295) 2000
Patient profiles

Subject A is a 17 yo Chinese-American young man from LA referred to Joslin for evaluation of recent onset of diabetes with glucose at diagnosis >400mg% and BMI of 21 and + FH of T2DM. Patient was treated with insulin.

Outcome: C-peptide >2 ng/ml and auto-antibodies to pancreas were negative. Patient was taken off insulin and initially treated with metformin and later maintained only with lifestyle and exercise for 10 years.
Subject B is a 18 yo Chinese-American young woman from San Francisco with recent onset diabetes, glucose >300mg% and BMI=21 and treated with insulin. No FH of diabetes

Outcome: C-peptide level was <0.5 ng/ml and autoantibodies to pancreas were negative. Patient stayed on insulin.
Rate of new cases of type 1 and type 2 diabetes among people younger than 20 years, by age and race/ethnicity, 2008–2009

The American Indian/Alaska Native (AI/AN) youth who participated in the SEARCH study are not representative of all AI/AN youth in the United States. Thus, these rates cannot be generalized to all AI/AN youth nationwide.

Source: SEARCH for Diabetes in Youth Study
NHW=non-Hispanic whites; NHB=non-Hispanic blacks; H=Hispanics; API=Asians/Pacific Islanders; AIAN=American Indians/Alaska Natives.
Prevalence of T1DM among Children and Youth from 2001 to 2009 is Increasing.

Table 1. Prevalence of Type 1 Diabetes by Demographic Characteristics

<table>
<thead>
<tr>
<th>Race/ethnicity</th>
<th>2001 Population</th>
<th></th>
<th>2009 Population</th>
<th></th>
<th>Difference in Prevalence (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Youth</td>
<td>General Population</td>
<td>Prevalence per 1000 (95% CI)</td>
<td>No. of Youth</td>
<td>General Population</td>
<td>Prevalence per 1000 (95% CI)</td>
</tr>
<tr>
<td></td>
<td>Cases With Diabetes</td>
<td></td>
<td></td>
<td>Cases With Diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totala</td>
<td>4958</td>
<td>3345783</td>
<td>1.48 (1.44 to 1.52)</td>
<td>6666</td>
<td>3458974</td>
<td>1.93 (1.88 to 1.97)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>2420</td>
<td>1635589</td>
<td>1.48 (1.42 to 1.54)</td>
<td>3263</td>
<td>1692112</td>
<td>1.93 (1.86 to 2.00)</td>
</tr>
<tr>
<td>Males</td>
<td>2538</td>
<td>1710194</td>
<td>1.48 (1.43 to 1.54)</td>
<td>3403</td>
<td>1766862</td>
<td>1.93 (1.86 to 1.99)</td>
</tr>
<tr>
<td>Age, yb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-4</td>
<td>217</td>
<td>787251</td>
<td>0.28 (0.24 to 0.31)</td>
<td>241</td>
<td>832791</td>
<td>0.29 (0.26 to 0.33)</td>
</tr>
<tr>
<td>5-9</td>
<td>977</td>
<td>832686</td>
<td>1.17 (1.10 to 1.25)</td>
<td>1143</td>
<td>844923</td>
<td>1.35 (1.28 to 1.43)</td>
</tr>
<tr>
<td>10-14</td>
<td>1727</td>
<td>885604</td>
<td>1.95 (1.86 to 2.04)</td>
<td>2335</td>
<td>867403</td>
<td>2.69 (2.59 to 2.80)</td>
</tr>
<tr>
<td>15-19</td>
<td>2037</td>
<td>840242</td>
<td>2.42 (2.32 to 2.53)</td>
<td>2947</td>
<td>913857</td>
<td>3.22 (3.11 to 3.34)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>3718</td>
<td>1996971</td>
<td>1.86 (1.80 to 1.92)</td>
<td>4804</td>
<td>1885451</td>
<td>2.55 (2.48 to 2.62)</td>
</tr>
<tr>
<td>Black</td>
<td>471</td>
<td>365146</td>
<td>1.29 (1.18 to 1.41)</td>
<td>621</td>
<td>383198</td>
<td>1.62 (1.50 to 1.75)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>625</td>
<td>647656</td>
<td>0.96 (0.89 to 1.04)</td>
<td>1042</td>
<td>809267</td>
<td>1.29 (1.21 to 1.37)</td>
</tr>
<tr>
<td>Asian Pacific Islander</td>
<td>107</td>
<td>212708</td>
<td>0.50 (0.42 to 0.61)</td>
<td>156</td>
<td>260846</td>
<td>0.60 (0.51 to 0.70)</td>
</tr>
<tr>
<td>American Indian</td>
<td>37</td>
<td>123303</td>
<td>0.30 (0.22 to 0.42)</td>
<td>42</td>
<td>120212</td>
<td>0.35 (0.26 to 0.47)</td>
</tr>
</tbody>
</table>

a Differences in the number of youth reported with type 1 diabetes in 2001 and in this report are due to exclusion of 1 prior study site in both years (Hawaii) and continued data cleaning.

Annual incident of Type 1 diabetes in 0-19 yrs. in Zhejiang, China between 2007-2013

**FIGURE 1** Age-specific annual incidence and trends of diabetes for boys (a) and girls (b) using a logarithmic vertical scale. Point = observed annual incidence. Lines = trends in incidence predicted by the Poisson regression model.

# Table 1. Baseline characteristics, separated by group.

<table>
<thead>
<tr>
<th></th>
<th>Type 1 Diabetes (n = 10)</th>
<th>Type 2 Diabetes (n = 9)</th>
<th>Controls (n = 11)</th>
<th>ANOVA p value</th>
<th>Wilcoxon p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>25.4 ± 4.5</td>
<td>31.7 ± 6.3</td>
<td>26.3 ± 4.3</td>
<td>0.023</td>
<td>0.0331</td>
</tr>
<tr>
<td>Gender male (%)</td>
<td>3 (30%)</td>
<td>3 (33.3%)</td>
<td>5 (45.5%)</td>
<td>0.74</td>
<td>0.876</td>
</tr>
<tr>
<td>Years with DM (yrs)</td>
<td>6.1 ± 4.0</td>
<td>3.0 ± 3.4</td>
<td>N/A</td>
<td>N/A</td>
<td>0.0764</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.4 ± 1.7</td>
<td>24.5 ± 3.6</td>
<td>23.3 ± 3.9</td>
<td>0.650</td>
<td>0.4965</td>
</tr>
<tr>
<td>A1C%</td>
<td>6.9 ± 1.1</td>
<td>7.0 ± 1.6</td>
<td>5.2 ± 0.3</td>
<td>0.001</td>
<td>0.1877</td>
</tr>
<tr>
<td>Waist Circumference (cm)</td>
<td>76.7 ± 5.1</td>
<td>84.1 ± 9.8</td>
<td>79.8 ± 10.5</td>
<td>0.200</td>
<td>0.1110</td>
</tr>
<tr>
<td>Waist to Hip Ratio</td>
<td>0.85 ± 0.02</td>
<td>0.89 ± 0.53</td>
<td>0.89 ± 0.07</td>
<td>0.150</td>
<td>0.055</td>
</tr>
<tr>
<td>Adiponectin (µg/ml)</td>
<td>16.6 ± 5.6</td>
<td>7.3 ± 3.5</td>
<td>8.6 ± 5.1</td>
<td>&lt;0.0001</td>
<td>0.0003</td>
</tr>
<tr>
<td>A-FABP (ng/ml)</td>
<td>12.2 ± 3</td>
<td>14.3 ± 3</td>
<td>13.1 ± 6</td>
<td>0.63</td>
<td>0.19</td>
</tr>
<tr>
<td>Alb/Creat Ratio (µg/mg)</td>
<td>9.8 ± 15.3</td>
<td>11.3 ± 11.5</td>
<td>9.2 ± 8.6</td>
<td>0.438</td>
<td>0.4140</td>
</tr>
<tr>
<td>Alkaline Phosphate (IU/l)</td>
<td>52.2 ± 16.9</td>
<td>41.2 ± 8.6</td>
<td>45.4 ± 9.2</td>
<td>0.157</td>
<td>0.1306</td>
</tr>
<tr>
<td>ALT (IU/l)</td>
<td>18.2 ± 4.2</td>
<td>21.2 ± 9.2</td>
<td>20.8 ± 14.9</td>
<td>0.794</td>
<td>0.6521</td>
</tr>
<tr>
<td>AST (IU/l)</td>
<td>21.2 ± 6.0</td>
<td>20.3 ± 5.4</td>
<td>20.9 ± 5.0</td>
<td>0.941</td>
<td>0.8694</td>
</tr>
<tr>
<td>Diastolic Pressure (mmHg)</td>
<td>76.8 ± 9.1</td>
<td>76.9 ± 7.6</td>
<td>73.9 ± 8.4</td>
<td>0.660</td>
<td>0.68</td>
</tr>
<tr>
<td>Systolic Pressure (mmHg)</td>
<td>117.2 ± 17.3</td>
<td>116.2 ± 11.6</td>
<td>109.6 ± 11.6</td>
<td>0.400</td>
<td>0.90</td>
</tr>
<tr>
<td>Cholesterol Total (mg/dl)</td>
<td>164.0 ± 43.4</td>
<td>168.1 ± 32.7</td>
<td>167.2 ± 29.4</td>
<td>0.965</td>
<td>0.3911</td>
</tr>
<tr>
<td>Cholesterol LDL (mg/dl)</td>
<td>91.6 ± 41.1</td>
<td>103.3 ± 24.2</td>
<td>102.5 ± 24.6</td>
<td>0.648</td>
<td>0.21</td>
</tr>
<tr>
<td>Cholesterol HDL (mg/dl)</td>
<td>60.8 ± 10.6</td>
<td>47.8 ± 16.1</td>
<td>47.5 ± 10.7</td>
<td>0.038</td>
<td>0.045</td>
</tr>
<tr>
<td>Triglycerides (mg/dl)</td>
<td>65.8 ± 34.7</td>
<td>84.8 ± 44.2</td>
<td>91.6 ± 56.8</td>
<td>0.440</td>
<td>0.2360</td>
</tr>
</tbody>
</table>
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<th>Wilcoxon p value</th>
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</thead>
<tbody>
<tr>
<td>C-peptide (ng/ml)</td>
<td>0.14±0.15</td>
<td>2.29±1.57</td>
<td>1.35±1.21</td>
<td>0.001</td>
<td>0.0003</td>
</tr>
<tr>
<td>Creatinine (mg/dl)</td>
<td>0.82±0.13</td>
<td>0.73±0.14</td>
<td>0.79±0.14</td>
<td>0.403</td>
<td>0.2415</td>
</tr>
<tr>
<td>CRP (µg/ml)</td>
<td>2.68±2.35</td>
<td>1.31±1.11</td>
<td>0.814±1.02</td>
<td>0.048</td>
<td>0.3074</td>
</tr>
<tr>
<td>FFA (mEq/l)</td>
<td>0.54±0.19</td>
<td>1.09±0.35</td>
<td>0.77±0.26</td>
<td>0.0003</td>
<td>0.0373</td>
</tr>
<tr>
<td>GDR (mg/min/kg)</td>
<td>7.62±2.59</td>
<td>5.43±2.7</td>
<td>8.61±2.37</td>
<td>0.032</td>
<td>0.0942</td>
</tr>
<tr>
<td>GFR (mL/min/1.73 m²)</td>
<td>101.0±14.7</td>
<td>112.2±21.1</td>
<td>111.0±22.1</td>
<td>0.391</td>
<td>0.1910</td>
</tr>
<tr>
<td>HOMA-IR</td>
<td>N/A</td>
<td>2.15±1.95</td>
<td>1.43±0.75</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Leptin (ng/ml)</td>
<td>10.7±8.4</td>
<td>11.2±7.4</td>
<td>10.2±5.8</td>
<td>0.953</td>
<td>0.9674</td>
</tr>
<tr>
<td>RBP-4 (µg/ml)</td>
<td>14.8±4</td>
<td>18.6±6</td>
<td>22.2±8</td>
<td>0.02</td>
<td>0.13</td>
</tr>
<tr>
<td>Total Body Fat (%)</td>
<td>23.8±8.4</td>
<td>27.5±5.4</td>
<td>25.9±5.4</td>
<td>0.476</td>
<td>0.6830</td>
</tr>
<tr>
<td>Total Body Fat (kg)</td>
<td>14.4±4.7</td>
<td>19.2±6.3</td>
<td>16.8±5.7</td>
<td>0.193</td>
<td>0.0942</td>
</tr>
<tr>
<td>Total Body Lean (kg)</td>
<td>45.7±8.7</td>
<td>47.7±9.7</td>
<td>45.7±11.1</td>
<td>0.607</td>
<td>0.4965</td>
</tr>
<tr>
<td>Trunk Fat (%)</td>
<td>21.5±8.0</td>
<td>28.8±6.7</td>
<td>25.3±6.2</td>
<td>0.094</td>
<td>0.0942</td>
</tr>
<tr>
<td>Trunk Fat (kg)</td>
<td>6.1±2.1</td>
<td>10.3±4.3</td>
<td>8.0±3.7</td>
<td>0.046</td>
<td>0.016</td>
</tr>
<tr>
<td>Trunk Lean (kg)</td>
<td>22.4±3.9</td>
<td>23.9±4.8</td>
<td>22.4±5.7</td>
<td>0.691</td>
<td>0.3913</td>
</tr>
<tr>
<td>Urea Nitrogen (mg/dl)</td>
<td>14.8±2.5</td>
<td>12.6±3.2</td>
<td>14.1±4.4</td>
<td>0.384</td>
<td>0.1002</td>
</tr>
<tr>
<td>GAD Ab+ Subjects*</td>
<td>3(30%)</td>
<td>0%</td>
<td>0%</td>
<td>0.079†</td>
<td>0.9024</td>
</tr>
<tr>
<td>IA2 Ab+ Subjects*</td>
<td>3(20%)</td>
<td>0%</td>
<td>0%</td>
<td>0.23†</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Data are means ± SD or n (%). ANOVA performed between all 3 groups: Type 1 Diabetes, Type 2 Diabetes, and Controls.

*Auto-antibody positivity to islet cell antigens was determined by serum concentration >0.1 nU/ml for GAD & IA2, expressed as number of individuals (percent positive).
†Chi-Square tests were performed in these categories.

doi:10.1371/journal.pone.0028311.t001
Type 1 Diabetes in AANHPI

Common in children
(Much lower in Asian and AA Children)
Insulin Requiring and Sensitive
Auto-immune Destruction of the Islets, HLA DR3/4
(Only 1/3 of AA’s?)
Is autoimmunity the main cause of Type 1 DM in AANHPI and is it increasing?

We need more data to know what are the causes of diabetes in Asian youth. At this time, minimally, plasma insulin levels at fasting and 2 hrs. postprandial and autoantibodies to islets, GAD and insulin are needed for deciding on treatments.
## Two Main Types of Diabetes

<table>
<thead>
<tr>
<th>Type 1 diabetes</th>
<th>Type 2 diabetes</th>
</tr>
</thead>
</table>
| **5-10% of total**  
(Rare in Asians) | **>90% of total**  
(>95% in AA) |
| Common in children  
(A Minority in East Asian Children) | Mostly in adults,  
but increasing in children |
| Insulin Requiring  
Auto-immune Destruction of the Islets, HLA DR3/4 or LADA  
(Only 1/3 of AA’s) | Not insulin requiring |
| Rare fulminating type in Asians | Insulin resistant (IR)  
associated with obesity,  
inflammation and inactivity  
(Different definition of obesity and IR more severe in AA with normal BMI and NDM) |
Mr. HS is a 62 yo Chinese American with diabetes for 15 yrs. He has BMI of 22, fasting c-peptide of 3.2 ng/ml and negatives for all Autoantibodies. He is being treated with oral agents.

Mr. SL is a 49 yo Chinese American with diabetes diagnosed at age 32 and initially treated with oral agents. We found his random C-peptide levels were < 0.3 ng/ml and negative for Autoantibodies. He is treated now with insulin and HbA1C=6.6%
Patient profile: Type 2 Diabetes

Dr. K developed Type 2 DM at age 72 with BMI=20 and plasma glucose of 650mg%. He was treated with insulin and sulfonylurea and recommended diet change, exercise and weight loss. Since his weight was only 126lb, we changed to Traditional Asian diet And walking 30 min in AM and PM. He was off all diabetic meds for 15 yrs.

T2DM is reversible.
5 Year Follow up Shows Some reversal of T2DM with maintenance of weight loss.

**Sustained Weight Loss**

![Graph showing sustained weight loss over time](image)

**Diabetes Remission**

- **MED**: 0%
- **RYGB**: 37% at 5 years!

**Diabetes Medications**

- **Medical treatment**
  - Baseline: 47%, 2 years: 53%, 5 years: 40%
- **Roux-en-Y gastric bypass**
  - Baseline: 32%, 2 years: 100%, 5 years: 79%
  - 2 years: 16% OHA, 5 years: 5%

* A1c <6.5% & 100-125 mg/dl on no Rx

*Mingrone et al Lancet 2015*
Causes of Type 2 Diabetes is Very Complex Involving Both Genes and the Environment

- Appetite Regulation & Nutrition
- Adipose Biology
- Dietary Excess
- Intrauterine Environment
- Obesity
- Inactivity
- Aging
- Mitochondrial Dysfunction
- Stress response
- Inflammation
- Lipids
- Muscle Metabolism
- Macrovascular Complications

Diabetes Risk Changes in Gene & Protein Function

- Genetics
- Epigenetic Changes
- Gut Microbiome
- Glucose Sensing
- Incretins

Insulin Resistance

- ↓ Insulin Secretion
- β-cell growth & survival

Type 2 DM
Diabetes Incidence Rates by Ethnicity

The DPP Research Group, *NEJM* 346:393-403, 2002
Figure 1. Relationship between BMI and diabetes prevalence in different ethnicities from the DECODA Study compared to a European population.
Estimated percent body fat at three levels of BMI: Whites and Asians

<table>
<thead>
<tr>
<th></th>
<th>BMI=15 (lean)</th>
<th>BMI=25 (normal)</th>
<th>BMI=35 (obese)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whites</td>
<td>6.5</td>
<td>19.2</td>
<td>31.9</td>
</tr>
<tr>
<td>Asians</td>
<td>10.0</td>
<td>23.6</td>
<td>37.2</td>
</tr>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whites</td>
<td>15.0</td>
<td>34.2</td>
<td>53.5</td>
</tr>
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<td>Asians</td>
<td>20.4</td>
<td>36.8</td>
<td>53.0</td>
</tr>
</tbody>
</table>
Figure 3. Ethnic differences in the relationship between insulin sensitivity and insulin response across glucose tolerance subgroups.
CRP in Asian Americans

Albert MA et al. C-reactive protein levels among women of various ethnic groups living in the United States (from the Women’s Health Study). Am J Cardiol 2004; 93:1238-1242

FIGURE 1. Median CRP levels and associated IQR according to race/ethnic group among participants in the Women’s Health Study (all participants).

FIGURE 2. (A) Median CRP levels and associated IQR according to race/ethnic group among participants in the Women’s Health Study (non-hormone replacement therapy users). (B) Median CRP levels and associated IQR according to race/ethnic group among participants in the Women’s Health Study (hormone replacement therapy users).
Plasma glucose, insulin, and NEFA concentrations during OGTT are compared for Asian Indians and Caucasians.

Abate. JCEM 2004;89(6):2750-2755
Correlation of new biomarkers with Glucose Disposal Rate (GDR)

Hsu, WC. et al. PLoS ONE, December 2011 | Volume 6 | Issue 12 | e28311
Ethnic Disparities in Diabetic Complications


Myocardial Infarction
- Black
- Asian
- Latino

Stroke
- Black
- Asian
- Latino

Congestive Heart Failure
- Black
- Asian
- Latino

Lower Extremity Amputation
- Black
- Asian
- Latino

End-stage Renal Disease
- Black
- Asian
- Latino

Hazard Ratio 95% Confidence Interval

Age- and sex-adjusted model
Fully adjusted model
T2DM in East Asian Americans

• Increased risk at low BMI >23
• Low inflammatory cytokines but elevated visceral fat and insulin resistance
• Reversal is possible, similarly to other ethnic groups
• High risks of renal failure
• Measure plasma insulin or c-peptide levels and Auto-antibodies to insulin or islets to help in deciding treatments.
Screening for Diabetes in Asian-Americans at BMI of 23

Thanks to The Asian-American Native Hawaiian and Pacific Islanders Diabetes Coalition with leadership
By Dr. Tran Ho and Edward Chow.
What to do after the screening?

The Eight Strategies

For Avoiding, Controlling, or Reversing Diabetes
Strategy 1: The Rural Asian Diet (RAD)
Eating Plan: Cut Your Fat Intake in Half and Double Your Fiber
Nutrients Distribution in a Traditional Rural Asian Diet and Typical Western Diet

**Tradition Asian Diet**
- 40-45 kcal/kg
- 70% Carbohydrates
- 15% protein
  - 20% animal protein
- 15% Fat

**Typical Western Diet**
- 33 kcal/kg
- 50% Carbohydrates
- 16% protein
  - 60-80% animal protein
- 34% Fat
## Asian 10 day Menus
(Several meals are subject to change)

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breakfast</strong></td>
<td><strong>Breakfast</strong></td>
<td><strong>Breakfast</strong></td>
<td><strong>Breakfast</strong></td>
<td><strong>Breakfast</strong></td>
</tr>
<tr>
<td>Miso Soup</td>
<td>Seaweed</td>
<td>Soy Milk</td>
<td>Tofu Udon Soup</td>
<td>Seaweed</td>
</tr>
<tr>
<td>Brown Rice</td>
<td>Teriyaki Chicken</td>
<td>High fiber Cereals</td>
<td>Brown Rice</td>
<td>Teriyaki Chicken</td>
</tr>
<tr>
<td>Apple</td>
<td>Brown Rice</td>
<td>Yogurt</td>
<td>Vegetable Juice</td>
<td>Brown Rice</td>
</tr>
<tr>
<td>Vegetable Juice</td>
<td>Grapes</td>
<td>Grapes</td>
<td>Tangerines</td>
<td>Vegetable Juice</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lunch</strong></td>
<td><strong>Lunch</strong></td>
<td><strong>Lunch</strong></td>
<td><strong>Lunch</strong></td>
<td><strong>Lunch</strong></td>
</tr>
<tr>
<td>Hoisin Pork</td>
<td>Pork Lo Mein</td>
<td>Garlic Tofu &amp; Bell Peppers</td>
<td>Sesame Peanut Chicken with</td>
<td>Garlic Chicken</td>
</tr>
<tr>
<td>Chinese Broccoli</td>
<td>Tangerines</td>
<td>Peppers</td>
<td>Asparagus</td>
<td>Snap Peas</td>
</tr>
<tr>
<td>Brown Rice</td>
<td></td>
<td></td>
<td>Brown Rice</td>
<td>Carrot Juice</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td></td>
<td></td>
<td>Grapes</td>
<td></td>
</tr>
<tr>
<td>Grapes</td>
<td></td>
<td></td>
<td>Vegetable Juice</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dinner/Snack</strong></td>
<td><strong>Dinner/Snack</strong></td>
<td><strong>Dinner/Snack</strong></td>
<td><strong>Dinner/Snack</strong></td>
<td><strong>Dinner/Snack</strong></td>
</tr>
<tr>
<td>Chicken</td>
<td>Fried Rice</td>
<td>Chicken Soba Soup</td>
<td>Shrimp Teriyaki Soba Noodles</td>
<td>Curry Shrimp</td>
</tr>
<tr>
<td>Soba Noodles</td>
<td></td>
<td>Soba Noodles</td>
<td>Grapes</td>
<td>Stir fried Noodles</td>
</tr>
<tr>
<td>Soba Dipping Sauce</td>
<td></td>
<td>Chinese Broccoli</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Snack</strong></td>
<td><strong>Snack</strong></td>
<td><strong>Snack</strong></td>
<td><strong>Snack</strong></td>
<td><strong>Snack</strong></td>
</tr>
<tr>
<td>Tangerines</td>
<td>Apple</td>
<td>Raisins &amp; Melons</td>
<td>Pears</td>
<td>Apple</td>
</tr>
<tr>
<td>Carrot Juice</td>
<td></td>
<td>Vegetable Juice</td>
<td>Carrot Juice</td>
<td>Vegetable Juice</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Intake of the Intervention Group - Macronutrient Breakdown

<table>
<thead>
<tr>
<th>Daily dietary constituent</th>
<th>Offered</th>
<th>Consumed</th>
<th>Nutrient composition</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First 8 weeks – Traditional Asian Diet (TAD): Macronutrient Breakdown, Adherence and Weight Change for Completers (N=40)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calories (kcal)</td>
<td>2309.5 ± 466.3</td>
<td>2207.0 ± 473.2</td>
<td>--</td>
<td>0.299</td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>404.2 ± 81.6</td>
<td>390.7 ± 86.3</td>
<td>70.8%&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.453</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>86.6 ± 17.5</td>
<td>84.9 ± 18.3</td>
<td>15.3%&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.630</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>38.5 ± 7.8</td>
<td>38.9 ± 8.4</td>
<td>15.9%&lt;sup&gt;3&lt;/sup&gt;</td>
<td>0.893</td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>34.7 ± 7.0</td>
<td>35.5 ± 8.7</td>
<td>16.1 g/1000 kcal&lt;sup&gt;4&lt;/sup&gt;</td>
<td>0.810</td>
</tr>
<tr>
<td>Adherence</td>
<td></td>
<td>95.6%&lt;sup&gt;5&lt;/sup&gt;</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Weight change (kg)</td>
<td></td>
<td>-1.9 ± 1.5&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**Second 8 weeks – Typical Western Diet (TWD): Macronutrient Breakdown, Adherence and Weight Change in Intervention Group (N=33)**

<table>
<thead>
<tr>
<th>Daily dietary constituent</th>
<th>Offered</th>
<th>Consumed</th>
<th>Nutrient composition</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories (kcal)</td>
<td>2381.1 ± 468.4</td>
<td>2280.0 ± 476.6</td>
<td>--</td>
<td>0.295</td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>298.9 ± 58.6</td>
<td>291.0 ± 58.9</td>
<td>51.1%&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.705</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>95.2 ± 18.8</td>
<td>89.1 ± 18.3</td>
<td>15.6%&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.184</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>89.4 ± 18.1</td>
<td>85.7 ± 19.1</td>
<td>33.8%&lt;sup&gt;3&lt;/sup&gt;</td>
<td>0.359</td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>14.5 ± 3.0</td>
<td>17.7 ± 3.4</td>
<td>7.8 g/1000 kcal&lt;sup&gt;4&lt;/sup&gt;</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Adherence</td>
<td></td>
<td>95.8%&lt;sup&gt;5&lt;/sup&gt;</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Weight change (kg)</td>
<td></td>
<td>0.7 ± 1.3&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td>0.009</td>
</tr>
</tbody>
</table>

<sup>1</sup> Nutrient composition of carbohydrate = carbohydrate consumed (g) x 4 (kcal/g) / total calories consumed (kcal) x 100

<sup>2</sup> Nutrient composition of protein = protein consumed (g) x 4 (kcal/g) / total calories consumed (kcal) x 100

<sup>3</sup> Nutrient composition of fat = carbohydrate consumed (g) x 4 (kcal/g) / total calories consumed (kcal) x 100

<sup>4</sup> Nutrient composition of fiber = fiber (g) / total calories consumed (kcal) x 1000

<sup>5</sup> Adherence = calories consumed (kcal) / calories offered (kcal) x 1000

<sup>6</sup> Weight change (kg) was analyzed for completers only.
## Physiological Responses to Different Diets among Asian Americans (N=23)

<table>
<thead>
<tr>
<th></th>
<th>Asian Diet</th>
<th>P-value(^1)</th>
<th>Western Diet</th>
<th>P-value(^2)</th>
<th>P-value(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ΔV3-V2</td>
<td></td>
<td>ΔV4-V3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>-1.8 ± 1.6</td>
<td>&lt;0.001</td>
<td>0.3 ± 0.9</td>
<td>0.131</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body Mass Index (BMI) (kg/m(^2))</td>
<td>-0.6 ± 0.6</td>
<td>&lt;0.001</td>
<td>0.1 ± 0.3</td>
<td>0.283</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body Fat %</td>
<td>-1.5 ± 1.6</td>
<td>&lt;0.001</td>
<td>0.7 ± 1.2</td>
<td>0.016</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Trunk Fat %</td>
<td>-2.1 ± 2.0</td>
<td>&lt;0.001</td>
<td>0.9 ± 1.8</td>
<td>0.019</td>
<td>0.001</td>
</tr>
<tr>
<td>Insulin AUC (μU/mL•120 min)</td>
<td>-1402.4 ± 2320.8</td>
<td>0.017</td>
<td>606.2 ± 1898.9</td>
<td>0.232</td>
<td>0.015</td>
</tr>
<tr>
<td>HOMA-IR</td>
<td>-0.3 ± 0.8</td>
<td>0.099</td>
<td>0.2 ± 0.7</td>
<td>0.232</td>
<td>0.042</td>
</tr>
<tr>
<td>Total Cholesterol (mg/dL)</td>
<td>-23.9 ± 23.7</td>
<td>0.001</td>
<td>17.9 ± 20.5</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>HDL (mg/dL)</td>
<td>-9.5 ± 9.4</td>
<td>0.001</td>
<td>6.2 ± 7.1</td>
<td>0.002</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LDL (mg/dL)</td>
<td>-14.0 ± 21.3</td>
<td>0.005</td>
<td>5.8 ± 14.8</td>
<td>0.054</td>
<td>0.014</td>
</tr>
<tr>
<td>Adiponectin (ng/mL)</td>
<td>-1071.8 ± 5947.3</td>
<td>0.520</td>
<td>1344.7 ± 7465.1</td>
<td>0.370</td>
<td>0.205</td>
</tr>
<tr>
<td>Leptin (ng/mL)</td>
<td>-2.2 ± 3.7</td>
<td>0.014</td>
<td>1.6 ± 3.3</td>
<td>0.016</td>
<td>0.012</td>
</tr>
<tr>
<td>PAI-1 (ng/mL)</td>
<td>-13.4 ± 30.4</td>
<td>0.012</td>
<td>-8.7 ± 53.0</td>
<td>0.218</td>
<td>0.027</td>
</tr>
<tr>
<td>Isoprostone (ng/mL)</td>
<td>0.1 ± 1.8</td>
<td>0.664</td>
<td>0.9 ± 1.7</td>
<td>0.014</td>
<td>0.590</td>
</tr>
</tbody>
</table>

\(^1\) P-value of the changes observed before and after 8 weeks of TAD (v3-v2)
\(^2\) P-value of the changes observed before and after 8 weeks of TWD (v4-v3)
\(^3\) P-value of the v4-v3 and v3-v2
**Available at:** [www.aadi.joslin.org](http://www.aadi.joslin.org)

**Recipes**

---

### AADI Recipe

**– Shrimp Fried Rice**

White rice is typically used in making fried rice. This recipe uses a healthier alternative, brown rice, which gives more nutrients and more fiber.

**Ingredients:**
- 2 tablespoons oyster sauce
- 1 tablespoon low sodium soy sauce
- 1 large egg, lightly beaten
- 3 cups cooked brown rice
- 2/3 cup frozen peas and carrots, defrosted
- 1 pound shrimp, precooked
- 2 tablespoons scallions, minced

**Nutrition Facts**

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th>% Daily Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories: 280</td>
<td>5%</td>
</tr>
<tr>
<td>Total Fat: 14g</td>
<td>21%</td>
</tr>
<tr>
<td>Sodium: 750mg</td>
<td>31%</td>
</tr>
<tr>
<td>Total Carbohydrate: 43g</td>
<td>15%</td>
</tr>
<tr>
<td>Dietary Fiber: 4g</td>
<td>16%</td>
</tr>
<tr>
<td>Sugars: 2g</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Directions:**

1. In a small bowl, mix the oyster sauce and soy sauce together. Set aside.
2. In a large frying pan or wok over high heat, heat the oil. Add the egg, and scramble with a spatula or wooden spoon.
3. Lower the heat to medium and add the rice, peas and carrots, stirring to break up any grains of rice that stick together.
4. After a few minutes, when the rice and vegetables are hot, add the shrimp, and then drizzle in the oyster-soy sauce mixture.
5. Add the scallions, stir to distribute the ingredients. Serve immediately.

**Servings:** 4

---

Visit Joslin Asian American Diabetes Initiative (AADI) at [aadi.joslin.org](http://aadi.joslin.org).

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Strategy 2: Reduce Your Body Weight by 5 to 7 Percent
Figure 2

Figure shows mean (±SE) weight losses over 8 years for participants randomly assigned to an intensive lifestyle intervention (ILI) or diabetes support and education (DSE; usual care group). Differences between groups were significant (p<0.001) at all years.
Diabetes Prevention Program among Chinese

Strategy 3: Increase Your Muscles’ Glucose-Absorbing Ability Through Aerobic Exercise and Strength Training
“Ed is in a study involving diabetes and lack of exercise. This is his remote control group.”

© 2006 Diabetes Health
Regular Physical Exercise Has Numerous Health Benefits

- Improved liver function
- Reduced fat stores
- Pulmonary function
- Increased lung capacity
- Improved sleep
- Increased blood volume
- Improved pancreatic function
- Prevention of Type 2 Diabetes
- Increased glucose tolerance
- Increased insulin sensitivity
- Increased muscle glucose uptake
- Increased mitochondrial function

Decreased Rates of Cancer
- Colon, breast, ovarian, prostate

Decreased depression, anxiety
- Decreased Alzheimer's
- Decreased stroke
- Decreased appetite

Improved cardiac function
- Improved lipid profile
- Lower blood pressure
- Increased bone density
- Increased muscle strength
- Increased flexibility

Increased muscle strength
- Increased bone density
- Increased flexibility
- Decreased Rates of Cancer
- Colon, breast, ovarian, prostate

Increased blood volume
- Improved sleep
- Improved pancreatic function
- Prevention of Type 2 Diabetes
- Increased glucose tolerance
- Increased insulin sensitivity
- Increased muscle glucose uptake
- Increased mitochondrial function
Effect of Exercise on Blood Glucose Concentrations in Subjects with Type 2 Diabetes

Exercise at 70% VO$_2$max
A Single Bout of Exercise Increases Post-Exercise Insulin Sensitivity.
Strategy 4: Activate Your Brown Fat (Why Not All Fat Is Bad For You)
Not all fat are bad
There are white fat, brown fat
And beige fat.
Two Types of Fat – and Brown is “Good”

Energy storage
50g contains 300-500 kcal

- Cold-induced [NST]
- Diet-induced [DIT]

Energy expenditure
50g consumes 100-300 kcal/day (max)

Where are the brown and beige fat depots?

Jespersen NZ et al. Cell Metabolism 2013;17:798

Outline from http://selfcarerevival.blogspot.com/2012_05_01_archive.html
In Summary

- Pediatric BAT activity peaks in adolescence and, like adult BAT, may have a role in obesity.
- BAT can be found in a substantial proportion of adult humans (≤100%), and preliminary data suggest that it could consume up to 100-200 kcal per day with activation.
- Treating obesity and diabetes by increasing BAT energy expenditure has great potential.
- BAT and beige fat are activated and induced by cold temperature around 62 °F.
- May be we should exercise in room around 62-65 °F.
Strategy 5: Become an Inflammation Fighter
Inflammation Is Associated with:

- Obesity
- Hypertension
- Metabolic Syndrome
- Nonalcoholic Steatosis
- Type 2 Diabetes Mellitus
- Cardiovascular Disease

Can inflammation be targeted to reduce disease risk?
Therapeutic Interventions Which Modulate Inflammation

- Low Fat Diet/ Weight Loss
- Insulin Sensitizers
- Insulin
- Statin Therapy
- TNF Receptor Antagonist
- IL1 Receptor Antagonist
- Salicylates
Anti-inflammatory Foods
TINSAL-T2D Stage 2: Salsalate Trial
HbA1c (primary endpoint)

Mean change in HbA1c (%)

Trial week

Placebo
Salsalate

P < 0.001

Goldfine et al, Ann Int Med, 2010
Strategy 6: Get 7 to 8 Hours of High-Quality Sleep Every Night
Table 3. Multivariate associations between sleep duration and the metabolic syndrome.¹

<table>
<thead>
<tr>
<th></th>
<th>≤6 h per night (n=90)</th>
<th>7–8 h per night (n=571)</th>
<th>≥9 hours per night (n=149)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
<td>Reference</td>
</tr>
<tr>
<td>Model 1</td>
<td>2.02</td>
<td>1.32–3.23</td>
<td>1.00</td>
</tr>
<tr>
<td>Model 2</td>
<td>1.80</td>
<td>1.15–2.98</td>
<td>1.00</td>
</tr>
<tr>
<td>Model 3</td>
<td>1.76</td>
<td>1.08–2.84</td>
<td>1.00</td>
</tr>
</tbody>
</table>

¹Metabolic syndrome defined according to the American Heart Association/National Heart, Lung, and Blood Institute's criteria [31].
Model 1: unadjusted odds ratio.
Model 2: adjusted for age, sex, smoking habits, highest education level, total annual family income, alcohol consumption, coffee intake, and menopausal status.
Model 3: adjusted for daily caloric intake and moderate-to-vigorous physical activity in addition to age, sex, smoking habits, highest education level, total annual family income, alcohol consumption, coffee intake, and menopausal status.
Abbreviations: OR, odds ratio; CI, confidence interval.
doi:10.1371/journal.pone.0072832.t003
Strategy 7: Reduce Stress and Manage Your Mental Health
DM prevalence and Traditional Mode of Acculturation in Kanaka `Oiwi

![Bar chart showing prevalence of diabetes in different acculturation modes.]

- Integrated: 15.4%
- Traditional: 27.9%
- Assimilated: 12.5%
- Marginalized: 10.5%
Strategy 8: Boost Your Own Natural Antioxidants
Activate Nrf2: Switch on endogenous antioxidant system

Geismann, et al. 2014
Onco Targets Ther. 7:1497-518.
Anti-oxidant Foods

- Berries
- Tea
- Herbs
- Legumes
- Vegetables
• Personalize these steps into your life and they will enhance your life’s enjoyments.
GEORGE L. KING, M.D.
with ROYCE FLIPPIN

THE DIABETES RESET

AVOID IT. CONTROL IT. EVEN REVERSE IT.
A DOCTOR’S SCIENTIFIC PROGRAM

FROM THE CHIEF SCIENCE OFFICER OF
HARVARD’S JOSLIN DIABETES CENTER

TO BE PUBLISHED FEBRUARY 15

2015
Screening for Diabetes in Asian-Americans at BMI of 23
Useful website and App

www.aadi.joslin.org

中、英、日語

Drag ‘n Cook™
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Chihiro Hernandez
Claudia Vierra

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