Cardiovascular Risk Stratification in American Indians

Jason Deen, MD, FAAP, FAAC
Associate Professor of Pediatrics
Adjunct Associate Professor of Medicine
Divisions of Cardiology
University of Washington
Disclosures
Why this matters . . .

Source: 2020 United States Census, Summary File 1
*Includes 50 States, District of Columbia, and Puerto Rico

Top Five (%)
- Alaska: 17.03%
- Hawaii: 11.18%
- New Mexico: 10.13%
- South Dakota: 8.84%
- Oklahoma: 8.63%

Top Five (#)
- California: 790,842
- Oklahoma: 341,756
- Arizona: 336,479
- Texas: 313,168
- New Mexico: 214,548

In 2020, there were 4,447,431* Indigenous Americans in the U.S.
Total: 1.3%
Outline

• The scope of the problem
• The successes of primary prevention
• Challenges of cardiovascular risk screening in American Indians
• American Indian-specific cardiovascular disease risk calculators
• Future directions
The scope of the problem . . .

Rising Tide of Cardiovascular Disease in American Indians
The Strong Heart Study

Barbara V. Howard, PhD; Elisa T. Lee, PhD; Linda D. Cowan, PhD; Richard B. Devereux, MD; James M. Galloway, MD; Oscar T. Go, PhD; William James Howard, MD; Everett R. Rhoades, MD; David C. Robbins, MD; Maurice L. Sievers, MD; Thomas K. Welty, MD

Circulation. 1999;99:2389-2395
The scope of the problem . . .

- AIs have an exaggerated prevalence of obesity and diabetes mellitus compared to the general population.
  - The prevalence of obesity, DM, hypertension, dyslipidemia is increasing despite elevated public awareness of CVD in AI communities

*Circulation.* 2014;129:399-410  
*Ethn Dis.* 2006;16:647-652  
The scope of the problem . . .

- AIs have premature CVD mortality and morbidity
  - AI CVD mortality rate 20% greater than other US races
  - AIs die of CVD at younger ages
    - 36% will die before age 65 compared to 14.7% of non-Hispanic whites


Primary prevention

- Death
  - Coronary Disease
  - Heart Failure
  - Stroke
- Symptoms and Morbidity
- Subclinical Cardiovascular Disease
  - Hypertension
  - Diabetes Mellitus
  - Dyslipidemia
- Clinical Events
- CVD Risk Factors
  - Obesity
  - Endothelial Dysfunction
  - Insulin Resistance
  - Inflammation
- Lifestyle Factors
  - Poor Diet
  - Physical Inactivity
  - Smoking
Primary prevention

• Global CVD risk assessment and family history of CVD
  – Age, sex, smoking history, obesity, hypertension, dyslipidemia, glucose tolerance
  – These data via a global risk score estimate of CVD risk (usually a 10 year risk score)

*J Am Coll Cardiol.* 2010;56:e50-103
The successes of primary prevention

- From 2000 to 2010, annual CVD mortality declined 16.7% in the general US population
  - While the prevalence of CVD risk factors (particularly obesity and DM) have persisted or increased

_Circulation_. 2014;129:399-410
_JAMA_. 2014;311:806-814
_Ann Intern Med_. 2014;160:517-525
The successes of primary prevention

• Reduced CVD mortality likely due to a combination of improved primary prevention and secondary prevention.

• Best illustrated in coronary heart disease . . .
Explaining the Decrease in U.S. Deaths from Coronary Disease, 1980–2000

Risk Assessment Tool for Estimating Your 10-year Risk of Having a Heart Attack

The risk assessment tool below uses information from the Framingham Heart Study to predict a person's chance of having a heart attack in the next 10 years. This tool is designed for adults aged 20 and older who do not have heart disease or diabetes. To find your risk score, enter your information in the calculator below.

Age: __________ years

Gender: 
- Female
- Male

Total Cholesterol: __________ mg/dL

HDL Cholesterol: __________ mg/dL

Smoker: 
- No
- Yes

Systolic Blood Pressure: __________ mm/Hg

Are you currently on any medication to treat high blood pressure.

- No
- Yes

[Calculate Your 10-Year Risk]
The Framingham Heart Study

• Begun in 1947 in Framingham MA
• Generated >2000 publications
• 5,209 white men & women (mean age 49)
• FRS was applied to ethnically diverse study cohorts (including the Strong Heart Study)
• FRS does not accurately estimate CHD risk for AIs (particularly women) and required recalibration for accuracy
Table 2. Description of Studies Used in Evaluation*

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th></th>
<th></th>
<th>Women</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FHS</td>
<td>ARIC</td>
<td>PHS†</td>
<td>HHP</td>
<td>SHS</td>
</tr>
<tr>
<td></td>
<td>White (n = 2439)</td>
<td>White (n = 4705)</td>
<td>Black (n = 1428)</td>
<td>Japanese American (n = 2755)</td>
<td>Hispanic (n = 8713)</td>
</tr>
<tr>
<td>Age range, y</td>
<td>30-74</td>
<td>44-66</td>
<td>44-66</td>
<td>40-74</td>
<td>51-81</td>
</tr>
<tr>
<td>Mean age, y</td>
<td>48.3</td>
<td>54.6</td>
<td>53.7</td>
<td>57.6</td>
<td>61.9</td>
</tr>
<tr>
<td>Blood pressure, mm Hg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimal (S&lt;120, D&lt;80)</td>
<td>20</td>
<td>50</td>
<td>27</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>Normal (S&lt;130, D&lt;85)</td>
<td>24</td>
<td>23</td>
<td>21</td>
<td>34</td>
<td>18</td>
</tr>
<tr>
<td>High normal (S&lt;140, D&lt;90)</td>
<td>20</td>
<td>14</td>
<td>18</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Stage I Htn (S&lt;160, D&lt;100)</td>
<td>23</td>
<td>10</td>
<td>22</td>
<td>21</td>
<td>29</td>
</tr>
<tr>
<td>Stage II-IV Htn (S&gt;=160, D&gt;=100)</td>
<td>13</td>
<td>3</td>
<td>12</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Total cholesterol, mg/dL†</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;160</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>160-199</td>
<td>31</td>
<td>32</td>
<td>35</td>
<td>29</td>
<td>25</td>
</tr>
<tr>
<td>200-239</td>
<td>30</td>
<td>30</td>
<td>33</td>
<td>30</td>
<td>41</td>
</tr>
<tr>
<td>240-270</td>
<td>17</td>
<td>16</td>
<td>16</td>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>&gt;=280</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>HDL-C, mg/dL‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;35</td>
<td>19</td>
<td>25</td>
<td>13</td>
<td>18</td>
<td>15</td>
</tr>
<tr>
<td>35-44</td>
<td>36</td>
<td>36</td>
<td>28</td>
<td>31</td>
<td>36</td>
</tr>
<tr>
<td>45-49</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>50-59</td>
<td>10</td>
<td>16</td>
<td>24</td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>&gt;=60</td>
<td>11</td>
<td>9</td>
<td>22</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Diabetes</td>
<td>5</td>
<td>6</td>
<td>14</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Current smoking</td>
<td>40</td>
<td>24</td>
<td>38</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>5-Year CHD Rate</td>
<td>0.0373</td>
<td>0.0317</td>
<td>0.0322</td>
<td>0.0200</td>
<td>0.0279</td>
</tr>
</tbody>
</table>

*Table entries are percentages of sample with the exception of age. FHS indicates Framingham Heart Study; ARIC, Atherosclerosis Risk in Communities Study; PHS, Physicians’ Health Study; HHP, Honolulu Heart Program; PR, Puerto Rico Heart Health Program; SHS, Strong Heart Study; CHS, Cardiovascular Health Study; S, systolic; D, diastolic; Htn, hypertension; and HDL-C, high-density lipoprotein cholesterol.
†FHS is a nested case-control study with 1-to-4 matching of cases to controls.
‡To convert mg/dL to mmol/L, multiply values for total cholesterol and HDL-C by 0.0259.
<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FHS</td>
<td>ARIC</td>
</tr>
<tr>
<td>Age range, y</td>
<td>30-74</td>
<td>44-66</td>
</tr>
<tr>
<td>Mean age, y</td>
<td>48.3</td>
<td>54.6</td>
</tr>
<tr>
<td>Blood pressure, mm Hg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimal (S&lt;120, D&lt;80)</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Normal (S&lt;130, D&lt;85)</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>High normal (S&lt;140, D&lt;90)</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Stage I Htn (S&lt;160, D&lt;100)</td>
<td>23</td>
<td>10</td>
</tr>
<tr>
<td>Stage II-IV Htn (S≥160, D≥100)</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Total cholesterol, mg/dL†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;160</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>160-199</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td>200-299</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>240-279</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>≥280</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>HDL-C, mg/dL†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;35</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>35-44</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>45-49</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>50-59</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>≥60</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Diabetes</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Current smoking</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td>5-Year CHD Rate</td>
<td>0.0373</td>
<td>0.0317</td>
</tr>
</tbody>
</table>

*Table entries are percentages of sample with the exception of age. FHS indicates Framingham Heart Study; ARIC, Atherosclerosis Risk in Communities Study; PHS, Physicians’ Health Study; HHP, Honolulu Heart Program; PR, Puerto Rico Heart Health Program; SHS, Strong Heart Study; CHS, Cardiovascular Health Study; S, systolic; D, diastolic; Htn, hypertension; and HDL-C, high-density lipoprotein cholesterol.
†FHS is a nested case-control study with 1-to-4 matching of cases to controls.
‡To convert mg/dL to mmol/L, multiply values for total cholesterol and HDL-C by 0.0259.
### Table 2. Description of Studies Used in Evaluation*

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FHS</td>
<td>ARIC</td>
</tr>
<tr>
<td></td>
<td>White (n = 2439)</td>
<td>White (n = 4705)</td>
</tr>
<tr>
<td>Age range, y</td>
<td>30-74</td>
<td>44-66</td>
</tr>
<tr>
<td>Mean age, y</td>
<td>48.3</td>
<td>54.6</td>
</tr>
<tr>
<td>Blood pressure, mm Hg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimal (S&lt;120, D&lt;80)</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Normal (S&lt;130, D&lt;85)</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>High normal (S&lt;140, D&lt;90)</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Stage I Htn (S&lt;160, D&lt;100)</td>
<td>23</td>
<td>10</td>
</tr>
<tr>
<td>Stage II-IV Htn (S≥160, D≥100)</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Total cholesterol, mg/dL‡</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;160</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>160-199</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td>200-239</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>240-279</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>≥280</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>HDL-C, mg/dL‡</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;35</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>36-44</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>45-49</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>50-59</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>≥60</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Diabetes</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Current smoking</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td>5-Year CHD Rate</td>
<td>0.0373</td>
<td>0.0317</td>
</tr>
</tbody>
</table>

*Table entries are percentages of sample with the exception of age. FHS indicates Framingham Heart Study; ARIC, Atherosclerosis Risk in Communities Study; PHS, Physicians' Health Study; HHP, Honolulu Heart Program; PR, Puerto Rico Heart Health Program; SHS, Strong Heart Study; CHS, Cardiovascular Health Study; S, systolic; D, diastolic; Htn, hypertension; and HDL-C, high-density lipoprotein cholesterol.
†FHS is a nested case-control study with 1-to-4 matching of cases to controls.
‡To convert mg/dL to mmol/L, multiply values for total cholesterol and HDL-C by 0.0259.
AHA Scientific Statement

Identification of Obesity and Cardiovascular Risk in Ethnically and Racially Diverse Populations
A Scientific Statement From the American Heart Association

Goutham Rao, MD, FAHA; Tiffany M. Powell-Wiley, MD, MPH, FAHA; Irma Ancheta, PhD, FAHA; Kristen Hairston, MD; Katherine Kirley, MD, MS; Scott A. Lear, PhD; Kari E. North, PhD; Latha Palaniappan, MD, MS, FAHA; Milagros C. Rosal, PhD; on behalf of the American Heart Association Obesity Committee of the Council on Lifestyle and Cardiometabolic Health

Circulation. 2015;132:457–472
The Strong Heart Study
1988-2018

Circulation. 2015;132:457–472
The Strong Heart Study

• Large epidemiologic study if CVD and its risk factors in AIs
• Inception in 1988
• Includes 13 tribal communities from Arizona, Oklahoma and the Dakotas
• Phase I-VI completed with phase VII ongoing
  – Phase IV (Strong Heart Family Study) included adolescents

https://strongheartstudy.org
Unique CVD risk factors in AIs

- Albuminuria
- Elevated fibrinogen
- Left ventricular hypertrophy measured by echocardiogram
  
  Circulation. 1999;99:2389–2395

- Prolonged QRS duration on resting ECG in women
  
  AJC. 2017;119:1757-1762
Prediction of Coronary Heart Disease in a Population With High Prevalence of Diabetes and Albuminuria
The Strong Heart Study

Elisa T. Lee, PhD; Barbara V. Howard, PhD; Wenyu Wang, PhD; Thomas K. Welty, MD;
James M. Galloway, MD; Lyle G. Best, MD; Richard R. Fabsitz, PhD; Ying Zhang, MD, PhD;
Jeunliang Yeh, PhD; Richard B. Devereux, MD

• AI-specific, sex-stratified coronary heart disease risk calculator
• Designed for >30 years of age
• Estimated 10-year risk of developing CHD

Circulation. 2006;113(25):2897-905
## SHS CHD Risk Calculator

- **Prediction using (select one)**: LDL-C and HDL-C, TC and HDL-C

  - **Gender**
    - Male
    - Female

  - **Age**

  - **Are you currently taking hypertension medications for high blood pressure?**
    - No
    - Yes

  - **Systolic Blood Pressure (SBP)**

  - **LDL-C or TC (mg/dL)**

  - **HDL-C (mg/dL)**

  - **Do you have diabetes?**
    - No
    - Yes

  - **Are you a current smoker?**
    - No
    - Yes

  - **Do you have microalbuminuria?**
    - No
    - Yes

  - **Do you have macroalbuminuria?**
    - No
    - Yes

**Calculate Your Risk**

**Your Estimated Risk:** 0 %

[Link to Calculator](https://strongheart2.ouhsc.edu/CHDcalculator/calculator.html)
• AI-specific tool used to estimate the risk of developing diabetes
• Designed for >35 years of age
• Estimates risk of developing diabetes in the next 4 years

*Diabetes Care.* 2011;34:363–368
### SHS DMII Risk Calculator

Predicting risk of developing incident diabetes (DM) defined by either fasting plasma glucose (FPG) or hemoglobin A1c (HbA1c) (denoted as FPG/A1C-DM), or by HbA1c only (denoted as A1C-DM), or by FPG only (denoted as FPG-DM) in the next 4 years for a person who does not currently have FPG/A1C-DM, or A1C-DM, or FPG-DM, respectively (select one).

<table>
<thead>
<tr>
<th></th>
<th>FPG/A1C-DM</th>
<th>A1C-DM</th>
<th>FPG-DM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age (year)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Waist circumference (cm)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Taking hypertension medications for high blood pressure?</strong></td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Systolic blood pressure (SBP) (mmHg)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diastolic blood pressure (DBP) (mmHg)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Do you have any of sisters or brothers who had diabetes?</strong></td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fasting plasma glucose (FPG) (mg/dL)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hemoglobin A1c (HbA1c) (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Triglycerides (TG) (mg/dL)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Urinary albumin and creatinine ratio (UACR) (mg/g)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Gender**

- Male
- Female

**Age (year)**

**Waist circumference (cm)**

**Taking hypertension medications for high blood pressure?**

- No
- Yes

**Systolic blood pressure (SBP) (mmHg)**

**Diastolic blood pressure (DBP) (mmHg)**

**Do you have any of sisters or brothers who had diabetes?**

- No
- Yes

**Fasting plasma glucose (FPG) (mg/dL)**

**Hemoglobin A1c (HbA1c) (%)**

**Triglycerides (TG) (mg/dL)**

**Urinary albumin and creatinine ratio (UACR) (mg/g)**

**Calculate Your Risk**

**Reset**

**Your Estimated Risk:**

- **0 %**
• AI-specific tool used to estimate the risk of developing hypertension
• Designed for >35 years of age
• Estimates risk of developing hypertension in the next 4 years

Hypertension. 2006;47:403–409
# SHS HTN Risk Calculator

Predicting risk of developing incident hypertension in the next 4 years for a person who does not currently have hypertension.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Selections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td></td>
</tr>
<tr>
<td>Weight (lb)</td>
<td></td>
</tr>
<tr>
<td>Height (in)</td>
<td></td>
</tr>
<tr>
<td>Systolic blood pressure (SBP) (mmHg)</td>
<td></td>
</tr>
<tr>
<td>Diastolic blood pressure (DBP) (mmHg)</td>
<td></td>
</tr>
<tr>
<td>Do you currently drink more than two (if male) or one (if female) serving of alcohol per day?</td>
<td>No Yes</td>
</tr>
<tr>
<td>Do you have any parents who had hypertension?</td>
<td>No Yes</td>
</tr>
<tr>
<td>Are you currently on diabetes medications?</td>
<td>No Yes</td>
</tr>
<tr>
<td>Fasting plasma glucose (FPG) (mg/dL)</td>
<td></td>
</tr>
<tr>
<td>Do you have micro-albuminuria?</td>
<td>No Yes</td>
</tr>
<tr>
<td>Do you have macro-albuminuria?</td>
<td>No Yes</td>
</tr>
</tbody>
</table>

[Calculate Your Risk]

**Your Estimated Risk:** 0 %

https://strongheart2.ouhsc.edu/HTNcalculator/calculator.html
Future directions . . .
Future directions . . .

Atherosclerosis is a pediatric disease!
**Initial lesion**
- histologically "normal"
- macrophage infiltration
- isolated foam cells

**Fatty streak**
- mainly intracellular lipid accumulation

**Intermediate lesion**
- intracellular lipid accumulation
- small extracellular lipid pools

**Atheroma**
- intracellular lipid accumulation
- core of extracellular lipid

**Fibroatheroma**
- single or multiple lipid cores
- fibrotic/calcific layers

**Complicated lesion**
- surface defect
- hematoma-hemorrhage
- thrombosis

**Sequences in Progression of Atherosclerosis**

<table>
<thead>
<tr>
<th>EARLIEST ONSET</th>
<th>MAIN GROWTH MECHANISM</th>
<th>CLINICAL CORRELATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>from first decade</td>
<td>growth mainly by lipid addition</td>
<td>clinically silent</td>
</tr>
<tr>
<td>from third decade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>from fourth decade</td>
<td>increased smooth muscle and collagen increase</td>
<td>clinically silent or overt</td>
</tr>
</tbody>
</table>

**Endothelial Dysfunction**
ASSOCIATION BETWEEN MULTIPLE CARDIOVASCULAR RISK FACTORS AND ATHEROSCLEROSIS IN CHILDREN AND YOUNG ADULTS

Gerald S. Berenson, M.D., Sathanur R. Srinivasan, Ph.D., Weihang Bao, Ph.D., William P. Newman III, M.D., Richard E. Tracy, M.D., Ph.D., and Wendy A. Wattigney, M.S., for the Bogalusa Heart Study

- Autopsies performed on 204 patients aged 2–39 years
- Patients died of accidental causes
- Antemortem CV risk factors known in 93 subjects
- Risk factors correlated with extent of atherosclerosis present

*NEJM* 1998;338:1650-6
Overweight and Obesity Among North American Indian Infants, Children, and Youth

LAWRENCE M. SCHELL\textsuperscript{1,2,3} and MIA V. GALLO\textsuperscript{1,2}

\textsuperscript{1}Center for the Elimination of Minority Health Disparities, University at Albany, A&S 237, Albany, New York

\textsuperscript{2}Department of Anthropology, University at Albany, A&S 237, Albany, New York

\textsuperscript{3}Department of Epidemiology and Biostatistics, University at Albany, School of Public Health, One University Place, Rensselaer, New York

*Fig. 2.*
Prevalence of obesity trends among 2- to 5-year olds, by race/ethnicity.

\textit{Am J Hum Biol.} 2012;24(3):302-314
Obesity (with subsequent development of glucose intolerance and HTN) was associated with premature endogenous mortality

24.9% of AI adolescents have metabolic syndrome

- vs. 12.9% of Hispanic teens, 10.9% of white teens and 2.5% of African American teens

- Metabolic syndrome is associated with a 2x risk of CVD and a 5x risk of DM

*J Am Coll Cardiol.* 2008;52:932-938

*Circulation.* 2004;110:2494-2497

*Circulation.* 2005;112(20): p. 3066-3072

*J Am Coll Cardiol.* 2010;56(14)1113-1132

*J Am Coll Cardiol.* 2007;49(4):403-414
Early predictors of obesity and cardiovascular risk among American Indian children

Sara M Lindberg¹*, Alexandra K Adams², and Ronald J Prince²

Sara M Lindberg: smlindberg@wisc.edu

¹*UW Center for Women’s Health and Health Disparities Research, University of Wisconsin-Madison, 310 N. Midvale Blvd., Suite 201 Madison, WI 53705

²Department of Family Medicine, University of Wisconsin-Madison

• 471 AI children from Wisconsin, aged 5-8
• 47% were overweight or obese
• BMI largely determined by age 1

Matern Child Health J. 2012;16:1879-86
Early predictors of obesity and cardiovascular risk among American Indian children

Sara M Lindberg⁠¹*, Alexandra K Adams², and Ronald J Prince²

Sara M Lindberg: smlindberg@wisc.edu

¹ UW Center for Women’s Health and Health Disparities Research, University of Wisconsin-Madison, 310 N. Midvale Blvd., Suite 201 Madison, WI 53705

² Department of Family Medicine, University of Wisconsin-Madison

![Graph showing growth trajectories from birth to age 5 by BMI category at health screening.](image)

Figure 1.
Growth Trajectories from Birth to Age 5 by BMI Category at Health Screening

*Matern Child Health J. 2012;16:1879-86*
Early predictors of obesity and cardiovascular risk among American Indian children

Sara M Lindberg¹*, Alexandra K Adams², and Ronald J Prince²

Sara M Lindberg: smlindberg@wisc.edu

¹¹UW Center for Women’s Health and Health Disparities Research, University of Wisconsin-Madison, 310 N. Midvale Blvd., Suite 201 Madison, WI 53705

²²Department of Family Medicine, University of Wisconsin-Madison

• At 5-8 years old, overweight or obese infants had greater odds of:
  – Overweight (OR: 3.42)
  – Obesity (OR: 3.36)
  – Elevated low-density lipoprotein (OR: 1.64)

Matern Child Health J. 2012;16:1879-86
Early predictors of obesity and cardiovascular risk among American Indian children

Sara M Lindberg\textsuperscript{1*}, Alexandra K Adams\textsuperscript{2}, and Ronald J Prince\textsuperscript{2}
Sara M Lindberg: smlindberg@wisc.edu
\textsuperscript{1*}UW Center for Women’s Health and Health Disparities Research, University of Wisconsin-Madison, 310 N. Midvale Blvd., Suite 201 Madison, WI 53705
\textsuperscript{2}Department of Family Medicine, University of Wisconsin-Madison

- Significant predictors of BMI at age 1 year included:
  - Macrosomia (OR: 4.38)
  - Excess gestational weight gain (OR: 1.64)
  - Early termination of breastfeeding (OR: 1.66)

\textit{Matern Child Health J. 2012;16:1879-86}
Perinatal effects on adult CVD

- CV system seem susceptible to injury from gestation through adulthood
- Maternal effects linked to exaggerated offspring CVD:
  - Malnutrition
  - Chronic disease (obesity)
  - Smoking
  - Allostatic load

Nat Rev Cardiol. 2009;6:712-722
Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults

The Adverse Childhood Experiences (ACE) Study

Vincent J. Felitti, MD, FACP, Robert F. Anda, MD, MS, Dale Nordenberg, MD, David F. Williamson, MS, PhD, Alison M. Spitz, MS, MPH, Valerie Edwards, BA, Mary P. Koss, PhD, James S. Marks, MD, MPH

Adverse childhood experiences

• Physical abuse
• Emotional abuse
• Sexual abuse
• Family substance abuse
• Family mental illness
• Incarcerated family member

• Parental separation/divorce
• Seeing mother physically abused
• Physical neglect
• Emotional neglect

ACE score = number of categories experienced before age 18
ACEs can have lasting effects on . . .

- Health (CVD, obesity, DMII, depression, cancer, STIs)
- Behaviors (smoking, EtOH, drug use)
- SES (graduation rates, academic achievement)

![Graded Relationship Between ACE Score and Cardiovascular Disease](image-url)

Adapted from Deng et al., 2008
Mechanism by Which Adverse Childhood Experiences Influence Health and Well-being Throughout the Lifespan
Adverse Childhood Experiences among American Indian/Alaska Native Children: The 2011-2012 National Survey of Children’s Health

Mary Kay Kenney and Gopal K. Singh

- 2+ ACEs 40.3% (vs. 21.0%)
- 3+ ACEs 26.8% (vs. 11.5%)
- 4+ ACEs 16.8% (vs. 6.2%)
- 5+ ACEs 9.9% (vs. 3.3%)

Scientifica. 2016
In conclusion . . .

- American Indians have accelerated CVD mortality and morbidity
- American Indian-specific CVD risk calculators are available through the SHS website
In conclusion . . .

• AIs have early onset CVD mortality and morbidity
• CVD is a pathologic continuum which begins during gestation
• Traditional CVD risk factors are common in AI youth and are extremely prevalent with obesity
• AI youth with traditional CVD risk factors have demonstrable pathologic cardiovascular changes
Tips for family docs

- Discussions regarding pediatric obesity should begin during pre-pregnancy counseling and young well-woman visits
  - Smoking cessation
  - PHQ-9
  - Gestational diabetes/insulin resistance management
  - Focus on healthy weight gain during pregnancy
Tips for family docs

• Encourage breastfeeding
• Nutritional counseling
• Parenting skill groups/family intervention
• Assess ACE score
• Encourage physical activity/sports participation
CVD outcomes among obese children who became non-obese by adulthood were similar to those who were never obese

Clinical Practice Guideline for the Evaluation and Treatment of Children and Adolescents With Obesity

Sarah E. Hampi, MD, FAAP; Sandra G. Hassink, MD, FAAP; Ashley C. Skinner, PhD; Sarah C. Armstrong, MD, FAAP; Sarah E. Barlow, MD, MPH, FAAP; Christopher F. Bolling, MD, FAAP; Kimberly C. Avila Edwards, MD, FAAP; Ihuoma Eneli, MD, MS, FAAP; Robin Hamre, MPH; Madeline M. Joseph, MD, FAAP; Doug Lunsford, MEd; Eneida Mendonca, MD, PhD, FAAP; Marc P. Michalsky, MD, MBA, FAAP; Nazrat Mirza, MD, ScD, FAAP; Eduardo R. Ochoa, Jr, MD, FAAP; Mona Sharifi, MD, MPH, FAAP; Amanda E. Staiano, PhD, MPP; Ashley E. Weedn, MD, MPH, FAAP; Susan K. Flinn, MA; Jeanne Lindros, MPH; Kymika Okechukwu, MPA
Thank you!

jason.deen@seattlechildrens.org