Type 2 Diabetes in Adolescents
Disclosures

• Paid consultant, Eli Lilly, Inc, Pediatric Type 2 Diabetes Clinical Trials
Outline

• The burden of diabetes

• Treatment and Prevention

• Youth Diabetes Prevention Clinic

• PowerHouse

• Recommendations for clinical care
# T2D Epidemiology: Adults versus Kids

<table>
<thead>
<tr>
<th></th>
<th>ADULTS</th>
<th>YOUTH (≤19 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incidence (new cases/y)</strong></td>
<td>~1,469,000 per year</td>
<td>~5,100 per year</td>
</tr>
<tr>
<td><strong>Prevalence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>12.3 per 100 (12.3%)</td>
<td>0.5 per 1,000 (~1 in 370 obese)</td>
</tr>
<tr>
<td>10 - ≤14 years</td>
<td>4.1 per 100 (4.1%)</td>
<td>0.23 per 1,000 (0.023%)</td>
</tr>
<tr>
<td>15 - ≤19 years</td>
<td>16.2 per 100 (16.2%)</td>
<td>0.68 per 1,000 (0.068%)</td>
</tr>
<tr>
<td>20 - ≤44 years</td>
<td>25.9 per 100 (25.9%)</td>
<td></td>
</tr>
<tr>
<td>45 - ≤64 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65 and older</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Prevalence by Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>13.6 per 100 (13.6%)</td>
<td>0.35 per 1,000 (0.035%)</td>
</tr>
<tr>
<td>Female</td>
<td>11.2 per 100 (11.2%)</td>
<td>0.58 per 1,000 (0.058%)</td>
</tr>
</tbody>
</table>
## T2D Epidemiology: *Kids versus Adults*

<table>
<thead>
<tr>
<th>Prevalence by Race / Ethnicity</th>
<th>ADULTS</th>
<th>YOUTH (≤19 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian</td>
<td>15.9 per 100 <em>15.9%</em></td>
<td>1.2 per 1,000 <em>0.120%</em></td>
</tr>
<tr>
<td>Black</td>
<td>13.2 per 100 <em>13.2%</em></td>
<td>1.1 per 1,000 <em>0.106%</em></td>
</tr>
<tr>
<td>Hispanic</td>
<td>12.8 per 100 <em>12.8%</em></td>
<td>0.79 per 1,000 <em>0.079%</em></td>
</tr>
<tr>
<td>Asian Pacific Islander</td>
<td>9.0 per 100 <em>9.0%</em></td>
<td>0.34 per 1,000 <em>0.034%</em></td>
</tr>
<tr>
<td>White</td>
<td>7.6 per 100 <em>7.6%</em></td>
<td>0.17 per 1,000 <em>0.017%</em></td>
</tr>
</tbody>
</table>

**Adjusted Prevalence Increase**
(adults 1995-2010; youth 2001-2009)

<table>
<thead>
<tr>
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<th>ADULTS</th>
<th>YOUTH (≤19 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>82.2%</td>
<td>30.0%</td>
</tr>
</tbody>
</table>

- Projections based on 2.3% increase per year --- quadruples the number in next 4 decades.
- *We must collaborate broadly to serve youth with T2D.*
Rates of New Cases of Type 1 & Type 2 Diabetes in Youth, 2008–2009

Source: SEARCH for Diabetes in Youth Study
Development of Diabetes

Genetic predisposition / Beta-cell defect

Environmental influence / Puberty

Insulin Resistance

Normal GT

IGT

↓1st phase insulin

IFG

B-Cell Failure

DM
Puberty Increases Risk for Type 2 Diabetes
Longitudinal Study of Insulin Sensitivity

- Insulin Sensitivity
  - Pre-pubertal
  - Pubertal

- $P < 0.001$

- 1st Phase Insulin
  - $P < 0.05$

- Longitudinal Study

- Pre-pubertal
- Pubertal
Insulin Sensitivity and β-cell Function in TODAY

Insulin Sensitivity (1/fasting insulin)  Oral Disposition Index

(A) Insulin sensitivity vs. Months since randomization

(P = NS)

(B) Oral Disposition Index vs. Months since randomization

(P < 0.0001)
Disease Progression With Treatment: *Kids versus Adults*

- **Metformin Fail Rate (%)**
- **Met + Rosi Fail Rate (%)**
- **Change in IS (%)**
- **Change in B-Cell Function (%)**

![Graph showing disease progression with treatment for kids versus adults.]
# Comorbidities

<table>
<thead>
<tr>
<th>Condition</th>
<th>TODAY Study Prevalence (%) (Baseline, End of Study)</th>
<th>CDC Estimated Prevalence (%) in Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>11.6, 33.8</td>
<td>71</td>
</tr>
<tr>
<td>Microalbuminuria</td>
<td>6.3, 16.6</td>
<td></td>
</tr>
<tr>
<td>LDL ≥ 130 mg/dl or LLM</td>
<td>4.5, 10.7</td>
<td>65</td>
</tr>
<tr>
<td>Triglycerides ≥ 150 mg/dl or LLM</td>
<td>21.0, 23.3</td>
<td></td>
</tr>
<tr>
<td>hsCRP &gt; 0.3 mg/dl</td>
<td>41.2, 46.3</td>
<td></td>
</tr>
<tr>
<td>Retinopathy, diabetes 4.9±1.5 y</td>
<td>13.7</td>
<td>28.5</td>
</tr>
</tbody>
</table>
Summary

- Numbers of youth < numbers of adults, but projected to continue to increase.
- Non-modifiable factors (puberty, genetics, epigenetics) and modifiable factors (obesity, environmental, social) contribute to the increase in youth T2D.
- Youth T2D is characterized by significant insulin resistance
- \(\beta\)-cell deficiency is evident early (even in obese NGT); progressively worsens.
- Treatment failure appears to be more rapid in youth versus adults.
- Microvascular complications and risk markers for macrovascular complications are present early and rapidly progress.
Case History

- Mother had gestational diabetes
- Maternal grandparents have T2D and CVD
- Patient with high BP for age and height
- “High insulin level”
- HbA1C 6.5%
Risk Factors for T2DM

- **Obese**
- **Family History of T2DM**
- **Minority Race / Ethnic Background**
  - Native Americans, African-Americans, Hispanic Americans, Asians/South Pacific Islanders
- **Signs of Insulin Resistance**
  - puberty, acanthosis nigricans, high blood pressure, dyslipidemia, PCOS
- **Exposure to Hyperglycemia *In Utero***

Evaluation and Treatment

Can we help to prevent diabetes progression?

• Does she have pre-diabetes?
• Does she have diabetes?
What to DO?

• DON’T delay the diagnosis

• Diagnosis is often delayed until complications present

• Treatment prevents / delays complications
The Treatment of Diabetes in Adolescents and Youth Trial
“TODAY” Study Cohort

- 65% female; 80% racial/ethnic minority
- Mean age 14.0 y
- 60% with 1st degree relative with T2DM
- 90% with 1st or 2nd degree relative with T2DM
- 30% had gestation complicated by diabetes
For Your Patient…
What to DO?

• Diabetes – start treatment
  – Metformin
  – Diabetes education
    • SMBG, pediatric diabetes education
  – Lifestyle modification
  – Medical Nutrition Therapy
  – Prevent pregnancy

• Insulin is often needed
  – A1c ≥9%
  – Presentation in DKA
PREVENTION

• T2DM can be delayed / prevented in adults
  – Da Qing IGT and Diabetes Study
  – Finnish Diabetes Prevention Study
  – U.S. Diabetes Prevention Program
Incidence of Diabetes in the U.S. DPP

Knowler et al. NEJM 2002;346(6)393
Weight / Physical Activity Changes

Knowler et al. NEJM 2002;346(6)393
FOR IMMEDIATE RELEASE
March 23, 2016

Independent experts confirm that diabetes prevention model supported by the Affordable Care Act saves money and improves health

First ever preventive service model eligible for expansion under Medicare holds promise for employers, private insurers and patients
Rationale and design of a comparative effectiveness trial to prevent type 2 diabetes in mothers and children: The ENCOURAGE healthy families study

Tamara S. Hannon\textsuperscript{a,*}, Aaron E. Carroll\textsuperscript{a}, Kelly N. Palmer\textsuperscript{b}, Chandan Saha\textsuperscript{c}, Wendy K. Childers\textsuperscript{d}, David G. Marrero\textsuperscript{b}
Nobody was paying attention!

Cause of boring program

A big puddle of water

A boring crowd with a lame presentation
No eating
Seek ways to create positive reinforcement

- Be someone positive!
- What defines “being someone positive” to you?
- What would be bad?
- Reinforce de value
- Goal!

Key questions:
- client defines
- defines to you?
- What would be bad?

Key questions:
- What defines “being someone positive” to you?
- What would be bad?
- Reinforce de value
- Goal!

Role models
- Peers
- Peers

GROCERY  COMMUNITY CENTERS  SCHOOL
- PE  Lunches  Cafeteria
- (public transportation)  BAS

- healthy food/meals
- play/activity space
- policies (e.g., education)
- support for young people

CHURCH
WE ARE POWER HOUSE

FOR YOUTH:
PowerHouse is a place for you to make new friends. You’ll join a team of people your age to hang out, have fun, make a difference, and celebrate good health. At the end, you’ll have a group of friends who will help you stay powerful.

FOR PARENTS:
PowerHouse is a place for you and your kids to meet new people and learn how to make health a real habit. You’ll get support and tips to get you moving and cooking food that fuels your family.

GET IN TOUCH WITH US FOR MORE INFORMATION:
(317) 278-9641
PowerHouseIU
PowerHouseIU@gmail.com
WeArePowerHouse
www.WeArePowerHouse.org
WeArePowerHouse
SECONDARY PREVENTION

Procedures to detect and treat pre-clinical pathology and control disease progression

Individual

- Pediatric
  - Screening

Population-based

- Community level programs
Can this intervention improve health outcomes in youth diagnosed with prediabetes or T2D?
WHAT IS DIABETES?

A LOT OF THE FOOD YOU EAT GETS TURNED INTO SUGAR

YOUR BLOOD DELIVERS THAT SUGAR TO ALL THE CELLS IN YOUR BODY TO USE AS ENERGY

YOUR PANCREAS THAT’S ME!! CREATES A HORMONE CALLED INSULIN THAT YOUR CELLS NEED TO USE THE SUGAR

WITHOUT INSULIN THE SUGAR JUST BUILDS UP IN YOUR BLOOD. WHEN YOU HAVE TOO MUCH SUGAR IN YOUR BLOOD, YOU HAVE DIABETES.

Want to know more? go to: www.diabetes.org/diabetes-basics/type-2

THERE ARE TWO TYPES OF DIABETES:

(this book is about type 2)

1. Type 1 diabetes can’t be prevented. People with type 1 diabetes can’t make insulin. They need to take insulin shots or use an insulin pump.

2. People with type 2 diabetes can make insulin, but it doesn’t work effectively. They need to take diabetes pills and/or insulin shots.
Healthy
Keeping a healthy weight, moving your body every day, and eating a balanced diet keep the pancreas happy and working well.

At Risk
Having a family history of diabetes, being overweight, and sitting around too much put you at risk for developing diabetes. It is important to make lifestyle changes to decrease your risk for diabetes.

High Risk
All that stuff from the “at risk” category, plus an A1C of 5.7-6.4% and high triglycerides (fat in the blood) puts you in the high risk category. There are things you need to do right now to keep from developing diabetes.

Diabetes
A1C 6.5% or greater means that you have diabetes. It is important to work with your doctor and make lifestyle changes to manage type 2 diabetes.

**Welcome to Pancreas Hill**

**What do all these tests mean?**

- **A1C**: A blood test that shows what your blood sugar is on average.
- **FBS**: Fasting Blood Sugar, or how much sugar is in your blood.
- **OGTT**: 2 hr Glucose Tolerance Test, a test to see what your blood sugar does after drinking a large dose of sugar.
- **BMI**: Body Mass Index, or the relationship between your height & weight.

### Tests that don’t help:
- BMI: 85% or higher
- Sedentary lifestyle
- Family history of diabetes

### Tests that do help:
- A1C: 5.7-6.4%
- FBS: 100-125
- OGTT: 140-199

### One or more of:
- A1C: 6.5% or greater
- FBS: 126 or more
- OGTT: 200 or more

### Are you going to...
- Push your pancreas uphill?
- Watch it roll down?
- Kick it to the bottom?

Ledge of no return!
Recommendations for Clinical Care

• Identify risk and do not delay diagnosis

• Treatment of children at highest risk with treatments shown to have some efficacy
  – Obesity programs
  – ? Metformin for PCOS, pre-diabetes

• Address other modifiable risk factors

• Prospective studies of children at highest risk
Recommendations for Clinical Care

• Currently, there is insufficient evidence to recommend treatment with metformin in obese children without pre-diabetes, PCOS, or T2D

• Lifestyle intervention should be more strongly supported