Diabetes – A Rising Public Health Challenge

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Diabetes

• A disease in which the body does not produce or properly use insulin

• Insulin
  – Is a protein hormone synthesized in the pancreas by the beta cells of the islets of Langerhans
  – is essential for the metabolism of carbohydrates, lipids, and proteins
Insulin

– regulates blood sugar levels
  • by facilitating the uptake of glucose into tissues
  • by promoting its conversion into glycogen, fatty acids, and triglycerides
  • by reducing the release of glucose from the liver
Insulin’s role in transporting glucose

The binding of insulin to its receptor triggers a four-step signaling pathway within the cell. A defect at any of the four steps can produce diabetes. Juvenile diabetes results from a lack of insulin, subverting step 1 of the pathway. Current attempts to cure type 2 diabetes are focused on step 2, although defects in steps 3 and 4 have not been ruled out.

1. Insulin binds to insulin receptor
2. Receptor adds a chemical to IRS proteins
3. IRS protein activates kinase enzyme
4. Kinase enzyme activates glucose transporter

Source: G. Johnson
The Role of Insulin

red blood cell

receptor

insulin

glucose

bloodstream

Type 1 Diabetes

• Beta-cell destruction (autoimmune or idiopathy)

• Absolute deficiency of insulin that leads to
  – Hyperglycemia
  – Marked tendency toward ketoacidosis

• Can occur at any age, but commonly < 30 yrs
Type 1 Diabetes

- Affects 5-10% of Americans with diabetes

- Symptoms
  - Increased thirst and urination
  - Constant hunger
  - Weight loss
  - Blurred vision
  - Extreme fatigue
  - Diabetic coma
Type 2 Diabetes

• Insulin resistance with relative insulin deficiency → predominantly an insulin secretory defect with insulin resistance

• Affects 90-95% of people with diabetes

• Usually occurs after age 30

• Relatively few classic symptoms of diabetes
Type 2 Diabetes

- Little likelihood of diabetic ketoacidosis
- Is more common among African Americans, Native Americans, Hispanics, Asians, and Pacific Islanders.
- About 50% of men and 70% of women with type 2 diabetes are obese
Gestational Diabetes (GDM)

• Glucose intolerance first detected during pregnancy

• Affects about 4% of all pregnant women
  – About 135,000 cases of GDM in the US each year
Gestational Diabetes

• Risk to mothers
  – Short term
    • Caesarean section
    • Urinary tract infection
    • High blood pressure during pregnancy
  – Long term
    • Type 2 diabetes
Gestational Diabetes

• Risk to children
  – Short term
    • Macrosomia
    • Shoulder dystocia
    • Neonatal hypoglycemia
    • Neonatal low blood calcium
    • Neonatal respiratory distress syndrome
  – Long term
    • Childhood obesity
    • Adulthood diabetes
Diagnosis of Diabetes

• Symptoms + casual plasma glucose ≥ 200mg/dl, or

• FPG ≥ 126 mg/dl, or

• 2-h postload glucose ≥ 200 mg/dl during an OGTT

* OGTT: WHO method, 75 g glucose load
* In the absence of unequivocal hyperglycemia, these criteria should be confirmed by repeat testing on a different day.
* OGTT is not recommended for routine clinical use.
Diagnosis of GDM

• 100-g Glucose load
  – Fasting 95 mg/dl
  – 1 h 180 mg/dl
  – 2 h 155 mg/dl
  – 3 h 140 mg/dl

• 75-g Glucose load
  – Fasting 95 mg/dl
  – 1 h 180 mg/dl
  – 2 h 155 mg/dl

• 2+ venous plasma concentration must be met or exceeded.
• The test should be done in the morning after an overnight fast of 8-14 h and
• After at least 3 days of unrestricted diet (≥ 150 g CHO per day) and
• Unlimited physical activity.
• The subject should be remain seated and should not smoke throughout the test.
Prediabetes (PD)

• Blood glucose levels: normal < PD < Type 2 diabetes
  – Impaired fasting glucose (IFG)
    • Fasting plasma glucose: 100 to 125 mg/dl.
  – Impaired glucose tolerance (IGT)
    • Glucose level: 140 to 199 mg/dl, 2 hours after 75g of glucose.
Prediabetes (PD)

• Persons with PD are at increased risk for the development of
  – Diabetes
  – Other adverse health outcomes, such as heart diseases and stroke

• Progression to diabetes can be prevented or delayed by
  – Increasing physical activity
  – Losing weight
  – Taking medication
Diabetes Is on the Rise

Prevalence of diabetes among US adults
Diabetes Prevalence Among Adults in Missouri, by Races, 1990-2004

Graph showing the prevalence of diabetes among adults in Missouri from 1990 to 2004, differentiated by race. The x-axis represents the years from 1990 to 2004, and the y-axis represents the prevalence (%). Two lines are shown: one for White individuals and one for Black individuals.
Diabetes Hospitalization Rates* in Missouri, 1993-2003

* Diabetes as the principal diagnosis
Diabetes Emergency Room Visit Rates* in Missouri, 1993-2003

* Diabetes as the principal diagnosis
Diabetes Mortality Rates* in Missouri, 1990-2003

* Diabetes as the underlying cause of death
Diabetes Inpatient Hospital Charges* in Missouri, 1993-2003

* Diabetes as the principal diagnosis
Diabetes Emergency Room Charges* in Missouri, 1993-2003

* Diabetes as the principal diagnosis
Diabetes Is Disabling

• Diabetes is the leading cause of
  – End-stage renal disease (ESRD)
  – Adult blindness
  – Non-traumatic lower-extremity amputation
  – Impotence

• Diabetes increases the risk of
  – Heart disease
  – Stroke
  – Complications from influenza and pneumonia
  – Hypertension
The Leading Causes of Death in Missouri, 2003

<table>
<thead>
<tr>
<th>Cause</th>
<th>Deaths</th>
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<tbody>
<tr>
<td>Heart disease</td>
<td>16,310</td>
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<tr>
<td>Cancer</td>
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<td>Cerebrovascular disease</td>
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<td>Chronic lower respiratory diseases</td>
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<td>Unintentional injury</td>
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<td>Pneumonia &amp; influenza</td>
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<td>Septicemia</td>
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</tbody>
</table>
Diabetes: A Challenge for Public Health

What is the lifetime risk for diabetes for people born in the United States in 2000?

1 of 3 Americans

1 of 2 Hispanic females

2 of 5 African Americans and Hispanics

Control diabetes. For life.
Risk Factors for Type 1 Diabetes

• Largely unknown

• Race: whites > non-whites

• Exposure to cow’s milk during infancy?

• Virus infection?
  – Coxsackie B4 virus
  – Human cytomegalovirus (CMV)
  – Rubivirus
Risk Factors for Type 2 Diabetes

- Age
- Race/ethnicity
- Family history
- Previous GDM or gave birth to a baby weighing > 9 lbs
Risk Factors for Type 2 Diabetes

• Overweight and obesity
• Inactive lifestyle
• Hypertension
• Abnormal lipid levels
Risk Factors for Type 2 Diabetes

- Cigarette smoking
- IGI or IFG on previous testing
- History of vascular disease
- Polycystic ovary syndrome
Twin Epidemics

Prevalence of self-reported obesity and diabetes among adults in Missouri, 1990-2004
Intervention Strategies for Diabetes

• Primary Prevention
  – identifies and protects susceptible individuals from developing diabetes.
  – Diabetes Prevention Program
    • Type 2 diabetes is preventable
    • Prevention is cost-effective
Intervention Strategies for Diabetes

• Secondary Prevention
  – Early detection of pre-diabetes and diabetes through screening
    • Is not recommended by ADA for type 1 diabetes
    • Is recommended by ADA for type 2 diabetes if certain criteria are met
    • Is recommended for all pregnancies except for women with low-risk status
Intervention Strategies for Diabetes

• Tertiary Prevention
  – Preventing or delaying the complications of Diabetes
    • Ongoing patient-centered care
    • Glycemic control
    • Medical nutrition therapy
    • Physical activity
    • Psychosocial assessment and care
**Intervention Strategies for Diabetes**

- **Tertiary prevention**
  - Hypertension control
  - Dislipidemia management
  - Anti-platelet agents use
  - Smoking cessation
  - CHD screening and treatment
  - Nephropathy screening and treatment
  - Retinopathy screening and treatment
Intervention Strategies for Diabetes

• Tertiary prevention
  – Foot care
  – Dental Care
  – Vaccinations
  – Diabetes self-management education