The Ad Hoc Group for Medical Research
Luncheon Briefing for Senate and House Staff

The Growing Epidemic of Diabetes
and What the NIH Is Doing About It

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NIDDK’s Integrated Research Programs

- **Obesity**
  - Approx. 2/3 of U.S. adults overweight or obese
  - Approx. 1/3 of U.S. adults obese
  - Increasing in the young
  - Annual cost: $147B

- **Type 2 Diabetes**
  - Approx. 25.8 million U.S. cases (8.3% of population)
  - Projected to ~50 million by 2050
  - Increasing in the young
  - Annual cost: $174B

- **Chronic Kidney Disease**
  - Approx. 23 million U.S. cases of CKD
  - Major causes: diabetes, hypertension
  - ESRD annual cost: $27B
Obesity Fuels Multiple Medical Problems

- Pulmonary disease
  - abnormal function
  - obstructive sleep apnea
  - hypoventilation syndrome
- Stroke
- Idiopathic intracranial hypertension
- Cataracts
- Coronary heart disease
- Diabetes
- Dyslipidemia
- Hypertension
- Nonalcoholic fatty liver disease
  - steatosis
  - steatohepatitis
  - cirrhosis
- Pancreatitis
- Gall bladder disease
- Cancer
  - breast, uterus, cervix, prostate, kidney, colon, esophagus, pancreas, liver
- Gynecologic abnormalities
  - abnormal menses
  - infertility
  - polycystic ovarian syndrome
- Osteoarthritis
- Phlebitis
  - venous stasis

Sex: Female
Age: 36
Weight: 230 lbs.
Height: 5'5"
BMI: 20.8

Images courtesy of Dr. Steven B. Heymsfield
Age-adjusted Percentage of Obese and Diabetic U.S. Adults

**Obesity**
- 1994
  - 10-14%
  - 15-19%
  - 20-24%
  - 25-29%
  - ≥30%
- 2000
- 2009

**Diabetes (diagnosed)**
- <4.5%
- 4.5-5.9%
- 6.0-7.4%
- 7.5-8.9%
- ≥9.0%

Source: Centers for Disease Control and Prevention
Research Progress at All Stages of Type 1 Diabetes

- **Prevent onset of autoimmunity**
- **Stop autoimmune attack**
- **Preserve Risk, triggers**
- **Auto-antibody +**
- **Dysglycemia**
- **Improve glucose control**
- **Restore β-cell function**
- **Prevent, arrest, reverse complications**

**Recent-onset Complications**

**Established**

**Complications**

**Artificial Pancreas**

**Clinical Islet Transplantation Consortium**

**Beta Cell Biology Consortium**

**Immune Tolerance Network**

**Type 1 Diabetes Trial Net**

**T1DGC**

**TEDDY**

**NIDDK**

NATIONAL INSTITUTE OF DIABETES AND DIGESTIVE AND KIDNEY DISEASES
The Diabetes Prevention Program: Collaborative and Transformative

Percent Reduction in Diabetes Incidence Compared to Placebo

Diabetes Prevention Program (DPP)
3,234 individuals at risk for type 2 diabetes

- Lifestyle modification lowered risk by 58% (modest weight loss, from exercise and reduced fat and caloric intake)
- Metformin medication lowered risk by 31%
Common Genetics, but Environmental Differences

Pima Indian Family in Mexico

Pima Indian Family in the U.S.

Lifestyle Interventions in Overweight and Obese Pregnant Women

A New NIH research initiative

To test lifestyle interventions for overweight or obese pregnant women, in order to improve weight and metabolic outcomes in both the pregnant women and their offspring.
Genes and Environment Initiative

http://genesandenvironment.nih.gov/

EXPOSURE BIOLOGY PROGRAM

- Develop technology and biomarkers
  - Nutrition
  - Physical Activity
  - Environmental Exposures

GENETICS PROGRAM

- Identify genetic variants
  - GWA Studies
  - Data Analysis
  - Replication
  - Sequencing

GXE

- Database
- Function
- Translation

EXPOSURE BIOLOGY

NIDDK
NATIONAL INSTITUTE OF DIABETES AND DIGESTIVE AND KIDNEY DISEASES
In a Nutshell...

\[
\frac{dBW}{dt} = ?
\]
Model Equations

\[ \rho_c \frac{dG}{dt} = CI - DNL + GNG_p + GNG_p - G3P - CarbOx \]

\[ \rho_F \frac{dF}{dt} = 3M_{FFM}F1/M_{TG} + \varepsilon_d DNL - \kappa_U \text{excr} - (1 - \varepsilon_k) K T G - \text{FatOx} \]

\[ \rho_P \frac{dP}{dt} = PI - GNG_p - ProtOx \]

THE LANCET

Quantification of the effect of energy imbalance on bodyweight

Kevin D Hall, Gary Sacks, Dhruva Chandramohan, Carson C Chow, Y Claire Wang, Steven L Gottmalk, Boyd A Swinburn


http://bwsimulator.niddk.nih.gov/
Physical Activity has Become a “To Do” Item, Rather than a Lifestyle...