Globalization of Diabetes

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Global Burden of Type 2 Diabetes

- Diabetes epidemic
  - Younger age of onset
  - Socioeconomic
  - Global spread
  - 438 million people affected by 2030

- Asia - Epicenter of Diabetes
  - 60% of world’s diabetic population
  - Develop diabetes at younger ages, lower degrees of obesity compared to western populations
Outline

● Diet Factors
  ○ Obesity and fat distribution
  ○ Nutrition (Local and Global Diet Trends)
  ○ Physical activity

● Risk Factors
  ○ Smoking
  ○ Alcohol Use
  ○ Inflammation

● Genetics
  ○ Gene-Environment interactions
  ○ Thrifty genotype
  ○ Thrifty phenotype
Contributing Factors: Obesity & Fat Distribution

- Overweight and obesity increasing in Asia
  - Economic development and rapid urbanization
- Obesity vs. diabetes rates
  - Low obesity rates, higher rates of type 2 diabetes
- “Metabolically Obese” Phenotype
  - Risk starts at a lower BMI than in europeans
- Asian populations - increased diabetes risk
  - tendency for:
    i. greater abdominal obesity and less muscle mass
    ii. more visceral fat than caucasians
  - increased propensity for insulin resistance
Contributing Factors: Local Diet

- Increased caloric intake
  - Higher dietary glycemic load (GL) and trans fats - increased diabetes risk
  - Whole grain intake - lowers risk
- Higher consumption of sugar-sweetened beverages
  - High blood glucose levels - higher insulin demand
  - Pancreatic beta cell exhaustion - type 2 diabetes and cardiovascular disease
- Basic cooking ingredients
  - Ghee - high trans fats
Contributing Factors: Global Diet

- Traditionally high GI and GL diets - more impactful with decreasing physical activity
- Rapid economic and social development
  - lifestyle and dietary shifts
  - overnutrition and sedentary living environments
- Globalization and economic development
  - Nutritional transitions
    i. more fats/energy dense foods/fast food
    ii. less fiber and whole grains
- Global trade
  - Unhealthy food is more accessible and cheaper
Contributing Factors: Physical Activity

- Increased physical activity reduces risk of diabetes while Sedentary behaviors increase the risk of diabetes
  - TV vs. brisk walking
- Television
  - 1) TV vs. physical activity - less energy expended
  - 2) Greater food and total energy intake
- Mechanization and Driving increases
  - China: automobiles vs. public transportation
    - Greater weight gain
  - Average weekly physical activity levels:
    - declined 32% between 1991 and 2006
    - urbanization/mechanization of jobs
Contributing Factors: Smoking

- Studies have shown that smokers have a 45% chance of developing diabetes in comparison to non-smokers.
  - Is dose-dependent: the risk of type II diabetes increases with the number of cigarettes smoked.
- Has been associated with increased abdominal fat.
  - Smoking has anti-estrogenic effects on women and leads to reduced plasma testosterone in men.
  - Smoking also leads to increased cortisol levels due to simulation of the sympathetic nervous system.
  - Visceral adipose tissue is an established factor for insulin resistance and diabetes.
Contributing Factors: Smoking Continued

- 50-60% of adult males smoke in developing countries.
- Numbers in Asia are increasing:
  - Due to advertisement by multinational companies.
  - 1 out of every 3 cigarettes produced is consumed in China.
  - India is the second largest consumer and producer of cigarettes.
  - Some of the cigarettes produced are nontaxable and as a result, provide employment for the urban poor.
Contributing Factor: Alcohol Use

- Light-to-Moderate consumption of alcohol leads to a 30-40% decrease in the risk of developing diabetes - 1-2 drinks/day
  - Alcohol can lead to improved insulin sensitivity and increased HDL cholesterol and decreased levels of inflammation.
- Heavy drinkers show the same risk as those who abstain from drinking alcohol.
  - Heavy alcohol intake does however lead to excess caloric intake and obesity, disturbance of liver function and glucose metabolism
- Heavy drinking, although usually attributed to poor rural regions, has been increasing in Asia as social marketing is pushing more people to adopt a Western lifestyle.
Contributing Factor: Inflammation

- A significant positive association exists between levels of inflammatory cytokines and the increased risk of diabetes.
- The consumption of red/processed meats, SSB’s and refined grains accompanied with a low consumption of wine, coffee and vegetables led to an increased risk of diabetes in a 14-year study.
- This type of diet is usually attributed to western-dietary eating patterns.
- With the increased adoption of western cultures in Asia, chronic inflammation plays an important role in increased risk of type II diabetes.
Genetic Susceptibility

- 40 genetic loci associated with type 2 diabetes
  - Modest effect- do not add to clinical prediction
  - Genetic factors can be amplified by environmental triggers
- Contribution of identified loci do not explain ethnic differences in diabetes risk
  - Combined effects of multiple variants using genetic scores based on number of risk alleles are similar across ethnic groups
The Thrifty Genotype Hypothesis

- **Hypothesis:** Obesity and type 2 diabetes are caused by positive selection of genotypes for efficiency in metabolism, energy, and fat storage
  - Genetic advantage when nutrients are scarce
- **Support:** High rates of diabetes among Pima Indians and other indigenous groups
  - Repeated fast and famine cycles favor thrifty genotypes
Thrifty vs. Drifty

- **Challenge:** No identification of the thrifty genes
  - No greater concentration of associated loci with certain ethnic groups
- **Alternative Hypothesis: Drifty Genotype Hypothesis**
  - Presence or absence of obesity and diabetes gene variants are due to genetic drift
- **Support:** Little evidence to suggest humans were under selective pressure by famine during evolutionary history
The Thrifty Phenotype Hypothesis

- **Hypothesis:** Adaptations due to fetal undernutrition lead to metabolic and structural changes that are beneficial for early survival
  - decreased β-cell mass and function, and increased insulin resistance
- **Support:** Studies show association between low birth weight and increased risk for type 2 diabetes
  - Low birth weight promotes a thrifty phenotype during intrauterine and early life that induces an insulin resistance state and low β-cell function
A Long List of Contributing Factors

Through many epidemiologic studies, some independent risk factors have been identified:

- **Asian populations at greater risk** (white rice, visceral fat content, insulin resistance, etc.)
- **Rapid Urbanization** (unhealthy Western diets, too much driving, etc.)
- **Increased intake of harmful foods** (high glycemic loads, less whole grain, more sugary beverages, etc)
- **Television** and sedentary time over physical activity
- **Smoking**
- **Alcohol abuse**
- **Elusive Genetic Factors** (Thrifty/Drifty gene debate)
Preventative Discussions

- Despite the present knowledge of risk factors, there have been few studies that link multiple risk factors together.

- Risk factors can be used to create a low-risk scenario for Type 2 Diabetes

- Nurses’ Health Study defined risk group based on 5 factors:
NHS’s Definition of a “Low-Risk” Group

1. BMI < 25 kg/m²
2. Diet high in cereal fiber & polyunsaturated fat, low in trans fats
3. Moderate to vigorous activity at least 30min/day
4. No smoking
5. Average of ½ serving of alcoholic beverage per day

It’s clear that lifestyle changes are necessary for one to lower their susceptibility to the disease.

-Clinical trials and case studies of individuals have proved these methods to be advantageous (as one might guess)
Tackling this Global Epidemic

- Chinese clinical trial: active lifestyle intervention lowered risk by 51% after 6 yrs, and after 20 yr follow-up, 43%
- Similar case studies in America and Finland proved that lifestyle intervention works for all races

But global Diabetes prevention needs to be more than individual behavioral changes:

- emphasis should be put on early adoption of healthy habits because practices track through adulthood
- more of a focus on the developing/impoverished areas
- A cultural re-thinking of health

- “High-quality” diets are energy efficient, but not if we severely over-eat!
Moving Forward

- Global public policy priority
  - Awareness
  - Lifestyle
  - Diet modification
- Prevention is key