# Reproduction and Analysis of association between stature-related and adiposity, insulin resistance, and glucose intolerance

CHIA-YUN LI

# Overview

- Conducted from 1988 to 1994 (NHANES III).
- Combine 3 datasets.
  - Household Adult Data
  - Examination Data
  - Laboratory Data

# Data Preparation

- Exclude pregnant individuals (5 cases)
- Include ages 40-74
- Focus on three racial groups
- Exclude diabetes diagnosis before age 40 (151 cases)

# Inclusion Criteria

- Parental history of diabetes (if either parent had diabetes)
- Education level (dichotomized at 12 years, 43 cases unknown)
- Annual household income (dichotomized at $20,000, 148 cases unknown or no income)
- Smoking status (classified in dataset)

# Physical Activity Classification Adjustment

- Adapt weekly activity criteria to monthly

| Classification | Times of MET>=6 (vigorous activity) | Times of MET<6 (moderate activity) | Age |
|---|---|---|---|
| **Vigorously active** | >=12 | - | 60 up |
| **Vigorously active** | >=28 | - | < 60 |
| **Moderately active** | <=8 | >=20 | - |
| **Lightly active** | not “vigorously active” or “moderately active” | | |
| **Sedentary** | engaging in no leisure-time physical activity | | |

# Anthropometric Measurements

- Calculate leg length:

  Standing height - Sitting height

- Calculate leg length-to-height ratio:

  (Standing height - Sitting height)/ Standing height

# Calculation of Target Variables

- **Body Fat (from NHANES III by Chumlea WC et.al.)**
- **Different formulas for FFM for males and females**
  - Male: FFM = -10.678 + 0.262 weight + 0.652 height^2 / resistance + 0.015 resistance
  - Female: FFM = -9.529 + 0.168 weight + 0.696 height^2 / resistance + 0.016 resistance
  - Total Body Fat = weight – FFM
  - Percent Body Fat = TBF / weight
- **HOMA-IR (using HOMA2 Calculator v2.2)**
- **Classify glucose tolerance (normal, IGT, diabetes)**

# Data Eligibility and Cleaning

- 90% eligibility for body fat analysis
- Exclude diabetic individuals for HOMA-IR analysis (6661 subjects remaining)
- Ensure plasma glucose (3-25 mmol/L) and serum Insulin (20-400 pmol/L) within range
- Exclude inapplicable data for height, weight, and sitting height

# Table 3-1

| Anthropometric measurements | Percent body fat (Difference) | | | |
|---|---|---|---|---|
| | Published Data | | My Work | |
| | Men | Women | Men | Women |
| **Height** | | | | |
| **Model 1** | +0.27 (-0.07-0.61) | +0.65(0.31-0.99)* | -0.67(-0.93 – -0.41)* | -1.03(-1.36 – -0.71) * |
| **Model 2** | +0.21 (-0.13-0.56) | +0.40 (0.06-0.73)* | -0.61(-0.88 – -0.34) * | -0.68(-1.01 – -0.35) * |
| **Model 3** | — | — | — | — |
| **Leg length** | | | | |
| **Model 1** | +0.29 (-0.37-0.62) | +0.88 (0.57-1.18)* | -0.75(-0.98 – -0.53) * | -0.86(-1.15 – -0.58) * |
| **Model 2** | +0.23(-0.11-0.57) | +0.64 (0.35-0.93)* | -0.7(-0.93 – -0.48) * | -0.65(-0.93 – -0.36) * |
| **Model 3** | — | — | — | — |
| **Leg length-to-height ratio** | | | | |
| **Model 1** | +0.21 (-0.13-0.55) | +0.88 (0.55-1.21)* | -0.54(-0.72 – -0.35) * | -0.37(-0.59 – -0.15) * |
| **Model 2** | +0.16(-0.17-0.50) | +0.74 (0.42-1.05)* | -0.53(-0.71 – -0.35) * | -0.37(-0.58 – -0.15) * |
| **Model 3** | — | — | — | — |

# Table 3-2

| Anthropometric measurements | Multiplicative factor | | Prevalence Ratio | | | |
|---|---|---|---|---|---|---|
| | HOMA-IR | | IGT | Diabetes | IGT | Diabetes |
| | Published Data | My Work | Published Data | | My Work | |
| **Height** | | | | | | |
| **Model 1** | 1.00 (0.97-1.02) | 1.00(0.98 – 1.01) | 1.12 (1.03-1.23)* | 1.19 (1.04-1.35)* | 1.02(0.94 – 1.10) | 1.00(0.91 – 1.09) |
| **Model 2** | 0.98(0.96-1.01) | 1.02(1.01 – 1.04) | 1.10(1.00-1.21) | 1.11 (0.96-1.29) | 0.99(0.92 – 1.08) | 0.97(0.88 – 1.06) |
| **Model 3** | 0.97(0.95-0.99)* | 1.03(1.01 – 1.05)* | 1.10(0.99-1.22) | 1.10 (0.94-1.29) | 0.99(0.89 – 1.11) | 0.97(0.85 – 1.11) |
| **Leg length** | | | | | | |
| **Model 1** | 1.03 (1.01-1.06)* | 0.98(0.97 – 1.00)* | 1.11 (1.00-1.22)* | 1.25 (1.08-1.45)* | 0.96(0.89 – 1.03) | 0.92(0.84 – 1.00) |
| **Model 2** | 1.02 (1.00-1.05) | 1.00(0.99 – 1.01) | 1.09 (0.98-1.21) | 1.19 (1.01-1.40)* | 0.94(0.87 – 1.02) | 0.90(0.82 – 0.98)* |
| **Model 3** | 1.00(0.98-1.02) | 1.00(0.99 – 1.02) | 1.09 (0.97-1.22) | 1.17 (0.98-1.39) | 0.93(0.84 – 1.02) | 0.87(0.78 – 0.98)* |
| **Leg length-to-height ratio** | | | | | | |
| **Model 1** | 1.07(1.04-1.10)* | 0.97(0.95 – 0.98)* | 1.05 (0.95-1.16) | 1.22 (1.07-1.40)* | 0.88(0.82 – 0.95)* | 0.83(0.76 – 0.90)* |
| **Model 2** | 1.07(1.04-1.10)* | 0.97(0.96 – 0.98)* | 1.04 (0.94-1.16) | 1.22 (1.05-1.40)* | 0.89(0.83 – 0.96)* | 0.84(0.77 – 0.91)* |
| **Model 3** | 1.05(1.02-1.07)* | 0.99(0.97 – 0.99)* | 1.04 (0.94-1.16) | 1.19(1.02-1.39)* | 0.83(0.76 – 0.91)* | 0.90(0.84 – 0.97)* |

# Comparison to Published Data

- **Sample Variability**
  - Possible use of different population samples
- **Data Processing**
  - Different approaches in handling missing or outlier data during cleaning and preprocessing
- **Statistical Model Variations**
  - Use of distinct covariates or adjustments even within the same model type (e.g., Model 1, Model 2, Model 3)
- **Mathematical Formulas**
  - Variations in precision and technique of body measurements
  - Possible differences in the formulas for calculating IGT and diabetes risk (Prevalence Ratio)
  - Inclusion of diverse predictive factors or statistical methods (e.g., logistic regression, life table analysis)

# Table 2: Comparison of Results

| Group(Odds ratio [95% CI]) | | Low birth weight | my analysis | High birth weight | my analysis |
|---|---|---|---|---|---|
| Model 1 | All adolescents (n=1396) (n=1402) | 2.01 (1.13,3.57)* | 1.62 (1.08, 2.43)*** | 0.81 (0.48, 1.37) | 0.92 (0.60, 1.39)*** |
| Model 2 | | 1.96 (1.12, 3.44)* | 1.64 (1.09, 2.46)*** | 0.79 (0.46,1.35) | 0.87 (0.57, 1.33)*** |
| Model 3 | | 1.93 (1.10, 3.38)* | 1.62 (1.07, 2.44)*** | 0.72(0.43,1.20) | 0.85 (0.55, 1.30)*** |
| Model 4 | Males (n=732) (n=734) | 2.55 (1.05, 6.20)* | 1.60 (0.91, 2.82)*** | 0.87 (0.48,1.59) | 1.01 (0.62, 1.66) |
| Model 5 | | 2.44 (1.02, 5.83)* | 1.61 (0.91, 2.83)*** | 0.85 (0.46,1.58) | 1.01 (0.62, 1.67)* |
| Model 6 | | 2.40 (1.02, 5.67)* | 1.56 (0.89, 2.76)*** | 0.84 (0.46, 1.56) | 1.01 (0.61, 1.66)* |
| Model 4 | Females (n=664) (n=668) | 1.39 (0.62, 3.13) | 1.62 (0.89, 2.93) | 0.66 (0.22, 1.93) | 0.71 (0.31, 1.65) |
| Model 5 | | 1.38 (0.60, 3.16) | 1.65 (0.91, 3.01)** | 0.64 (0.21,1.96) | 0.55 (0.23, 1.33)* |
| Model 6 | | 1.37 (0.60, 3.13) | 1.68 (0.92, 3.07)** | 0.38 (0.14, 1.08) | 0.48 (0.19, 1.22)** |

# Table 3: Comparison of Results

| Group(Odds ratio [95% CI]) | BMI Percentile (<85th percentile)n=861 | my analysis n=864 | BMI Percentile (≥85th percentile)n=532 | my analysis n=535 |
|---|---|---|---|---|
| Low birth weight | 1.76 (0.76, 4.05) | 1.54 (0.90, 2.63)*** | 2.13 (1.01, 4.49)* | 1.73 (0.91, 3.27)** |
| High birth weight | 1.11 (0.57, 2.18) | 1.11 (0.64, 1.92)*** | 0.48 (0.22, 1.06) | 0.67 (0.35, 1.30)** |
| | Waist-to-Height Ratio (≤0.5)n=893 | n=895 | Waist-to-Height Ratio (>0.5)n=494 | n=498 |
| Low birth weight | 1.58 (0.67, 3.71) | 1.50 (0.87, 2.59)*** | 2.35 (1.15, 4.82)* | 1.82 (0.96, 3.44)** |
| High birth weight | 0.93 (0.50, 1.71) | 0.96 (0.56, 1.64)*** | 0.41 (0.15, 1.12) | 0.75 (0.37, 1.51)* |