Poverty and Cardiovascular Disease Risk in Children

Lisa Kakinami, Ph.D.
March 11, 2013
Background

• BA: Psychology, Cognitive Science (UCLA)
• PhD: Epidemiology (University of Rochester)
  – Dissertation: Risk of cardiovascular disease among people with HIV, Hepatitis C or coinfection
• Postdoc: Epidemiology (McGill)
Background

• Among adults, low socioeconomic status (SES) during childhood is associated with higher cardiovascular disease mortality
  – Even after controlling for current income and SES
• Among children, the association between childhood low SES and cardiovascular disease risk is less clear
  – Limited longitudinal data

Shrewsbury V and Wardle J. Obesity 2008; 16(2):275-284
Research Objectives

• Longitudinal analysis of a Quebec birth cohort:
  – Handling missing data in longitudinal studies
  – Defining overweight in youth
  – Effects of childhood poverty on nutrition
  – Childhood poverty experience and cardiovascular disease risk factors
Dataset

- Quebec Longitudinal Study of Child Development (ELDEQ) birth cohort (n=2,120)

- Eligible children identified through birth registry, randomly sampled from a multistage cluster sampling design

- Representative of singleton births in Québec (1998)
Data Collection

• Regular home interviews
  – Annual follow-up until 8 years old
  – Every two years after 8 years old

• Parental report
  – Child’s health and behaviours
  – Household income

• Health measurements
Participation Rates

• Wave 1 (n=2120)
• Wave 10 (n=1334)
# Descriptive Statistics

<table>
<thead>
<tr>
<th>Characteristics at baseline</th>
<th>Wave 1 (n=2120)</th>
<th>Wave 10 (n=1334)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor household</td>
<td>24%</td>
<td>20%</td>
</tr>
<tr>
<td>Mother’s an immigrant</td>
<td>12%</td>
<td>8%</td>
</tr>
<tr>
<td>≥ High school education</td>
<td>84%</td>
<td>86%</td>
</tr>
<tr>
<td>Single-parent household</td>
<td>8%</td>
<td>6%</td>
</tr>
</tbody>
</table>
1) Handling Missing Data

• Complete case
• Mean of the sample
• Last observation carried forward
• Imputation
Imputation

• Replaces missing values with predicted values from a regression using auxiliary variables
  – Auxiliary variables help to explain why data are missing

• Types of imputation
  – Single imputation
  – Multiple imputation
Objectives

• Compare parameter estimates of 1) imputed data or 2) complete cases to 3) ‘full’ sample

- n=2120
- n=1334
- ½ forced to missing
- ½ full data
- Missing data
- Imputed

‘Full’ sample n=1334

Complete cases n=667

Multiple Imputation n=1334
Analysis

• Scenario 1:
  – Data missing completely at random

• Scenario 2: Differential attrition
  – Poor households 2x more likely to be missing
Auxiliary variables

Children’s variables

• Age (age 5 months, 5 years, 10 years)
• Sex
• Puberty (age 10)
• Whether the child is overweight or obese (age 6, 8, 10, 12)
• Physical activity (age 10)
• TV use (age 10)
• Birth weight

Parental variables

• Income level at all ages
• Parental education at least highschool (baseline)
• Maternal age
• Family type (age 5 months, 5 years, 10 years)
• Mother’s immigration status
• Mother’s employment status (baseline)
• Whether mother is overweight or obese
Example

• Compare parameter estimates of 1) imputed data or 2) complete cases to 3) ‘full’ sample

n=1334

½ forced to missing

½ full data

‘Full’ sample

β 20

Data Imputed

Multiple Imputation

β 10

Complete cases

β 15

Results

• Data missing completely at random
  – Multiple imputation estimates were closer to the ‘true’ data 50% of the time

• With differential attrition
  – Multiple imputation estimates were closer to the ‘true’ data 75% of the time
Conclusions

• If there is differential attrition, using complete-case data will result in an analytic sample that is significantly different from the original sample
  – Incorporating data from multiple imputation may help to address this bias
Research Objectives

• Longitudinal analysis of a Quebec birth cohort:
  – Handling missing data in longitudinal studies
  – Defining overweight in youth
  – Effects of childhood poverty on nutrition
  – Childhood poverty experience and cardiovascular disease risk factors
2) Defining overweight in youth

1. In youth, BMI is compared to same-age and same-sex reference populations (growth curves/growth charts)

2. Numerous growth curves exist: the two most commonly used: CDC and WHO

3. No unified recommendations
   - European Obesity Task Force: WHO (0-5)
   - Canadian Pediatric Society: CDC (0-5), WHO (5-19)
   - CDC: WHO (0-2), CDC (2-19)
## Background

### BMI Growth Curves

<table>
<thead>
<tr>
<th></th>
<th>CDC</th>
<th>WHO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
<td>2000</td>
<td>2006</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>Represent typical growth</td>
<td>Represent optimal growth</td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>1963-1994 national US surveys (inc NHANES)</td>
<td>Brazil, Ghana, India, Norway, Oman, US</td>
</tr>
<tr>
<td><strong>Definitions</strong></td>
<td>Overweight: $\geq 85^{th}$ percentile</td>
<td>Overweight: $\geq 85^{th}$ percentile</td>
</tr>
<tr>
<td></td>
<td>Obese: $\geq 95^{th}$ percentile</td>
<td>Obese: $\geq 97.7^{th}$ percentile</td>
</tr>
</tbody>
</table>
## Background: WHO vs CDC

Comparison of prevalence estimates

<table>
<thead>
<tr>
<th>1st author</th>
<th>Age</th>
<th>Data</th>
<th>N</th>
<th>Overweight</th>
<th>Obese</th>
<th>Overweight</th>
<th>Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mei</td>
<td>0-5</td>
<td>NHANES 99-04</td>
<td>3920</td>
<td>8.5-13%</td>
<td>9.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shields</td>
<td>2-17</td>
<td>CCHS 2004</td>
<td>~10K</td>
<td>35%</td>
<td>28%</td>
<td>13%</td>
<td>12%</td>
</tr>
<tr>
<td>Khasnut-dinova</td>
<td>14-17</td>
<td>Russia</td>
<td>1066</td>
<td>10%</td>
<td>9%</td>
<td>5%</td>
<td>3%</td>
</tr>
</tbody>
</table>
**Scenario**

BMI 15.7

**CDC algorithm**

BMI percentile: 83.9

CDC: Normal weight, no action

≠

**WHO algorithm**

BMI percentile: 85.7

WHO: Overweight, Lipid profile
Objectives and Methods

- Assess how well BMI percentiles based on the CDC and the WHO growth curves predict cardiometabolic risk factors: ROC curves
- Assess how different definitions of overweight and obesity affect the prediction of cardiometabolic risk: Sensitivity/specificity
Association between different growth curve definitions of overweight and obesity and cardiometabolic risk in children

Lisa Kakinami PhD, Mélanie Henderson MD, Edgard E. Delvin PhD, Emile Levy MD PhD, Jennifer O’Loughlin PhD, Marie Lambert MD, Gilles Paradis MD
Methods: Dataset

1999 Québec Child and Adolescent Health and Social Survey (QCAHS)

• Multistage, stratified, cluster sampling
• Representative of 9, 13, 16 y.o. youth in and out of school in Québec (n=2,466)
• Outcomes assessed: lipids, glucose, insulin, blood pressure

## Results

### Compare BMI categorization

<table>
<thead>
<tr>
<th></th>
<th>Girls CDC</th>
<th>Girls WHO</th>
<th>Boys CDC</th>
<th>Boys WHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI percentiles, mean (SD)</td>
<td>51.2 (30.8)</td>
<td>54.8 (31.8)</td>
<td>53.3 (31.0)</td>
<td>56.6 (32.5)</td>
</tr>
<tr>
<td>Underweight</td>
<td>8%</td>
<td>6%</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>Normal BMI</td>
<td>72%</td>
<td>69%</td>
<td>70%</td>
<td>66%</td>
</tr>
<tr>
<td>Overweight</td>
<td>12%</td>
<td>15%</td>
<td>15%</td>
<td>17%</td>
</tr>
<tr>
<td>Obese</td>
<td>9%</td>
<td>9%</td>
<td>9%</td>
<td>11%</td>
</tr>
</tbody>
</table>
Results

ROC curves: Triglycerides (girls)
## Results

### Specificity for predicting CVD RF

<table>
<thead>
<tr>
<th></th>
<th>CDC: Overweight</th>
<th>WHO: Overweight</th>
<th>CDC: Obese</th>
<th>WHO: Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HDL-cholesterol &lt; 1.0 mmol/L</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>78.2</td>
<td>73.4</td>
<td>91.3</td>
<td>90.5</td>
</tr>
<tr>
<td>Girls</td>
<td>80</td>
<td>75.9</td>
<td>93</td>
<td>93</td>
</tr>
<tr>
<td><strong>Triglycerides &gt; 1.7 mmol/L</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>79</td>
<td>74.2</td>
<td>91.3</td>
<td>90.7</td>
</tr>
<tr>
<td>Girls</td>
<td>79.7</td>
<td>75.7</td>
<td>92.6</td>
<td>92.6</td>
</tr>
<tr>
<td><strong>Insulin ≥ 38 mmol/L (9yo)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>85.7</td>
<td>80.5</td>
<td>97.4</td>
<td>95.2</td>
</tr>
<tr>
<td>Girls</td>
<td>88.3</td>
<td>83.7</td>
<td>97.3</td>
<td>97.3</td>
</tr>
</tbody>
</table>
## Results

### Sensitivity for predicting CVD RF

<table>
<thead>
<tr>
<th></th>
<th>CDC: Overweight</th>
<th>WHO: Overweight</th>
<th>CDC: Obese</th>
<th>WHO: Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HDL-cholesterol &lt; 1.0 mmol/L</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>33.5</td>
<td>37.3</td>
<td>19.6</td>
<td>17.7</td>
</tr>
<tr>
<td>Girls</td>
<td>40.2</td>
<td>42.3</td>
<td>18.6</td>
<td>19.6</td>
</tr>
<tr>
<td><strong>Triglycerides &gt; 1.7 mmol/L</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>79.1</td>
<td>81.2</td>
<td>43.7</td>
<td>39.6</td>
</tr>
<tr>
<td>Girls</td>
<td>44.6</td>
<td>47.7</td>
<td>16.9</td>
<td>18.5</td>
</tr>
<tr>
<td><strong>Insulin ≥ 38 mmol/L (9yo)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>60.3</td>
<td>64.7</td>
<td>29.4</td>
<td>32.3</td>
</tr>
<tr>
<td>Girls</td>
<td>42.2</td>
<td>50</td>
<td>23.5</td>
<td>23.5</td>
</tr>
</tbody>
</table>
Conclusions

1. ROC curves nearly identical between CDC and WHO in predicting cardiometabolic risk factors

2. Marginal sensitivity/specificity differences between growth curves
Research Objectives

• Longitudinal analysis of a Quebec birth cohort:
  – Handling missing data in longitudinal studies
  – Defining overweight in youth
  – Effects of childhood poverty on nutrition
  – Childhood poverty experience and cardiovascular disease risk factors
3) Childhood poverty & nutrition

• Majority of children fail to meet Canada’s food guide recommendations on daily servings of major food groups

• Low SES associated with poorer diet quality among adolescents in cross-sectional studies
  – Association weaker in early adolescence
  – Association weakest with income

Objectives

• Determine association between poverty and nutrition
  – Does the association vary across different ages (age 6, 8, 10, 12)?
Dataset

• Quebec Longitudinal Study of Child Development (ELDEQ) birth cohort (n=2,120)

• Eligible children identified through birth registry, randomly sampled from a multistage cluster sampling design

• Representative of singleton births in Québec (1998)
Poverty

• Parental report of past year’s household income
  – Measured: 5, 17, 29, 41, 61, 74, 86, 98, 122, 145 months

• Compared to the low-income thresholds by Statistics Canada (adjusted for household size and geographic region)
Nutritional Behaviours

• Parental report: “In the past week, how many times has child eaten food X...”
  – None, 1-2/week, 3-4/w, 5-6/w, 1/day, 2/day, 3/day, 4/day

• Categories:
  – Milk, cheese (excluding milk desserts)
  – Fruit (excluding fruit drinks)
  – Vegetables
Analysis

Main Predictors:
• Longitudinal analysis:
  – Trajectory membership by Latent Class Growth Analysis

Outcomes:
• Logistic regression:
  – > 2 servings of dairy per day
  – > 2 servings of fruits per day
  – > 2 servings of veggies per day
• Covariates
  – Sex, child’s weight status (overweight or obese), parental education, family status
Latent Class Growth Analysis
Final Trajectories

<table>
<thead>
<tr>
<th>Trajectory group</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistently not in poverty</td>
<td>67%</td>
</tr>
<tr>
<td>Decreasing risk for poverty</td>
<td>7%</td>
</tr>
<tr>
<td>Increasing risk for poverty</td>
<td>10%</td>
</tr>
<tr>
<td>Consistently poor</td>
<td>16%</td>
</tr>
</tbody>
</table>
### Study Population Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Age 6</th>
<th>Age 8</th>
<th>Age 10</th>
<th>Age 12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anthropometric characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI percentile, mean (SD)</td>
<td>52.1 (30.1)</td>
<td>51.2 (29.4)</td>
<td>60.7 (27.8)</td>
<td>62.1 (27.8)</td>
</tr>
<tr>
<td>BMI overweight or obese</td>
<td>17%</td>
<td>17%</td>
<td>25%</td>
<td>29%</td>
</tr>
<tr>
<td><strong>Nutritional characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 2 servings of milk/cheese/day</td>
<td>73%</td>
<td>71%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>≥ 2 servings of fruits/day</td>
<td>33%</td>
<td>47%</td>
<td>42%</td>
<td>39%</td>
</tr>
<tr>
<td>≥ 2 servings of veggies/day</td>
<td>38%</td>
<td>44%</td>
<td>44%</td>
<td>42%</td>
</tr>
</tbody>
</table>
## Nutrition Behaviours

<table>
<thead>
<tr>
<th></th>
<th>≥ 2 /day (6 years)</th>
<th>≥ 2 /day (8 years)</th>
<th>≥ 2 /day (10 years)</th>
<th>≥ 2 /day (12 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (CI)</td>
<td>OR (CI)</td>
<td>OR (CI)</td>
<td>OR (CI)</td>
</tr>
<tr>
<td>Consistently poor</td>
<td>0.51 (0.4-0.7)***</td>
<td>0.51 (0.3-0.7)**</td>
<td>0.42 (0.3-0.6)***</td>
<td>0.50 (0.3-0.7)**</td>
</tr>
<tr>
<td>Increasing risk</td>
<td>0.68 (0.5-1.0)*</td>
<td>0.76 (0.5-1.2)</td>
<td>0.70 (0.5-1.0)</td>
<td>0.70 (0.5-0.9)*</td>
</tr>
<tr>
<td>Decreasing risk</td>
<td>0.70 (0.4-1.1)</td>
<td>0.72 (0.5-1.0)</td>
<td>0.73 (0.5-1.1)</td>
<td>0.81 (0.6-1.2)</td>
</tr>
<tr>
<td>Not poor</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Consistently poor</td>
<td>0.72 (0.5-1.0)*</td>
<td>0.53 (0.3-0.8)**</td>
<td>0.46 (0.3-0.7)***</td>
<td>0.47 (0.3-0.7)**</td>
</tr>
<tr>
<td>Increasing risk</td>
<td>0.82 (0.6-1.2)</td>
<td>0.76 (0.5-1.1)</td>
<td>0.56 (0.4-0.8)**</td>
<td>0.74 (0.5-1.0)</td>
</tr>
<tr>
<td>Decreasing risk</td>
<td>0.70 (0.4-1.1)</td>
<td>0.78 (0.5-1.1)</td>
<td>0.84 (0.5-1.3)</td>
<td>0.65 (0.4-0.9)*</td>
</tr>
<tr>
<td>Not poor</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Consistently poor</td>
<td>0.50 (0.3-0.7)***</td>
<td>0.39 (0.2-0.6)***</td>
<td>0.35 (0.2-0.5)***</td>
<td>0.40 (0.3-0.6)***</td>
</tr>
<tr>
<td>Increasing risk</td>
<td>0.65 (0.5-0.9)*</td>
<td>0.82 (0.5-1.2)</td>
<td>0.56 (0.4-0.8)**</td>
<td>0.67 (0.5-0.9)**</td>
</tr>
<tr>
<td>Decreasing risk</td>
<td>0.57 (0.4-0.9)*</td>
<td>0.61 (0.4-0.8)**</td>
<td>0.72 (0.5-1.0)</td>
<td>0.57 (0.4-0.8)**</td>
</tr>
<tr>
<td>Not poor</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
</tr>
</tbody>
</table>

* p<0.05, ** p<0.01, *** p<0.0001
Discussion

• Children from households that were consistently in poverty were:
  – 50% less likely to consume 2 dairy/day
  – 50% less likely to consume 2 fruits/day
  – 50-60% less likely to consume 2 veggies/day

• Children at increasing or decreasing risk for poverty were:
  – ~25% less likely to consume 2 dairy/fruits/veggies a day
Research Objectives

• Longitudinal analysis of a Quebec birth cohort:
  – Handling missing data in longitudinal studies
  – Defining overweight in youth
  – Effects of childhood poverty on nutrition
  – Childhood poverty experience and cardiovascular disease risk factors
4) Childhood poverty and CVD risk factors

• Lifecourse models of health
  – Timing: exposure during a critical period
  – Accumulation: effects of low SES are additive
  – Mobility: Changes are detrimental

• Gaps: Cross-sectional, proxies, limited data among children

Wells NM, Evans GW, Beavis A, et al. 2010. AJPH 100 (12): 2507-2512
Objectives

• To better understand the relationship between lifecourse models of poverty on health during childhood
  – Do the timing, accumulation, or mobility lifecourse models predict cardiovascular disease risk factors among youth?
Methods

• Quebec Longitudinal Study of Child Development (ELDEQ) birth cohort (n=2,120)

• Parental report of past year’s household income
  – Measured: 5, 17, 29, 41, 61, 74, 86, 98, 122, 145 months

• Compared to the low-income thresholds by Statistics Canada (adjusted for household size and geographic region)
Data Collection:
Health component (2008)

• Added to the regular interview to specifically assess health

• Home visit by a nurse
  – Blood pressure
  – Blood sample
Analysis

Main predictor: Poverty

• Timing
  – 0-2 years of age
  – 3-5 years of age
  – 6-9 years of age

• Accumulation

• Mobility
  – Any: Increasing or decreasing likelihood of poverty
  – Increasing likelihood of poverty

Outcomes:

• Total cholesterol (TC)
• HDL cholesterol
• LDL cholesterol
• Triglycerides (TG)
• Glucose
• Insulin
• Systolic blood pressure (SBP)
• Diastolic blood pressure (DBP)
Statistical Analysis

• Comparison of models: structural approach (Mishra et al.)
  – Saturated model includes all main effects, and possible interactions
  – Compares each life course model to the saturated model

• Adjusted for: sex, pubertal status, parental education, mother’s age, family status, child’s weight status, child’s physical activity levels, and family history

## Results (unadjusted)

<table>
<thead>
<tr>
<th>Timing:</th>
<th>HDL β</th>
<th>TG β</th>
<th>Insulin β</th>
<th>SBP β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure age 0-2</td>
<td>-0.05 (0.02)*</td>
<td>0.10 (0.03)**</td>
<td>7.59 (2.21)**</td>
<td>1.20 (0.7)</td>
</tr>
<tr>
<td>Exposure age 3-6</td>
<td>-0.06 (0.03)</td>
<td>0.11 (0.03)**</td>
<td>6.87 (2.13)**</td>
<td>1.65 (0.8)*</td>
</tr>
<tr>
<td>Exposure age 7-9</td>
<td>-0.05 (0.03)</td>
<td>0.08 (0.03)**</td>
<td>4.70 (2.17)*</td>
<td>1.73 (0.8)*</td>
</tr>
<tr>
<td>Accumulation</td>
<td>-0.02 (0.01)*</td>
<td>0.04 (0.01)**</td>
<td>2.95 (0.86)**</td>
<td>0.70 (0.3)*</td>
</tr>
<tr>
<td>Mobility</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any mobility</td>
<td>-0.01 (0.03)</td>
<td>-0.01 (0.04)</td>
<td>-2.98 (2.99)</td>
<td>0.83 (1.0)</td>
</tr>
<tr>
<td>Increasing risk</td>
<td>-0.02 (0.03)</td>
<td>-0.001 (0.04)</td>
<td>-2.55 (2.57)</td>
<td>0.43 (1.0)</td>
</tr>
</tbody>
</table>

* p<0.05, ** p<0.01, *** p<0.001
## Results (adjusted)

<table>
<thead>
<tr>
<th></th>
<th>Triglycerides β</th>
<th>Insulin β</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timing:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure age 0-2</td>
<td>0.09**</td>
<td>5.48*</td>
</tr>
<tr>
<td>Exposure age 3-6</td>
<td>0.10**</td>
<td>4.53*</td>
</tr>
<tr>
<td>Exposure age 7-9</td>
<td>0.07*</td>
<td>2.15</td>
</tr>
<tr>
<td>Accumulation</td>
<td>0.04**</td>
<td>1.97*</td>
</tr>
<tr>
<td><strong>Mobility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any mobility</td>
<td>-0.02</td>
<td>-3.47</td>
</tr>
<tr>
<td>Increasing risk</td>
<td>-0.01</td>
<td>-3.13</td>
</tr>
</tbody>
</table>

* p<0.05, ** p<0.01, *** p<0.0001

Adjusted for: sex, pubertal status, whether at least one parent had at least a high-school education, mother’s age, whether the household was a single-parent household, whether the child was overweight or obese, average number of days the child exercised at least 15 minutes at a time in an average week, and family history of either hypercholesterolemia or diabetes.
### Results

#### Model Comparisons

#### Triglycerides

<table>
<thead>
<tr>
<th>Model</th>
<th>F-stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2 years</td>
<td>2.6</td>
<td>0.01</td>
</tr>
<tr>
<td>3-5 years</td>
<td>2.4</td>
<td>0.02</td>
</tr>
<tr>
<td>6-9 years</td>
<td>5.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Accumulation</td>
<td>1.8</td>
<td>0.08</td>
</tr>
<tr>
<td>Mobility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any</td>
<td>7.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>↑ risk</td>
<td>7.4</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

#### Insulin

<table>
<thead>
<tr>
<th>Model</th>
<th>F-stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2 years</td>
<td>1.9</td>
<td>0.07</td>
</tr>
<tr>
<td>3-5 years</td>
<td>3.2</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>6-9 years</td>
<td>4.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Accumulation</td>
<td>2.7</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Mobility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any</td>
<td>6.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>↑ risk</td>
<td>7.0</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
Discussion

• Exposure according to the timing models and accumulation models are both significantly associated with elevated triglycerides and insulin among 10-year old youth
  – Model comparisons indicate accumulation of poverty has the largest effect on triglycerides, while there may be a critical period of exposure for insulin
Strengths and Limitations

• Birth cohort with 10+ years of follow-up
• Considerable study attrition
  – Multiple imputation
    • Bias from complete case greater than multiple imputation even up to 75% missing data (Newman 2003; Davey et al 2001.)
• Parental report

Strengths and Limitations

• Food frequency questionnaire
• Conservative definitions of Canada’s Food Guide recommendations
  – Excludes fruit juice, vegetable juice, and yogurt
  – ≥ 2 servings rather than age-specific cut-offs

Future Directions

• Methodological questions
  – BMI changes
  – Imputation methods

• Socio-familial determinants of cardiovascular disease risk factors
  – Body image
  – Weight loss strategies
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Thank you!

QUESTIONS?

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