Is there an association between waist circumference and type 2 diabetes or impaired fasting glucose in US adolescents?

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Masters Thesis
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June 6, 2007

Background

- Rising incidence of type 2 diabetes
- 85 – 96% overweight/obese
- Up to 45% diabetes = type 2
- Total body fat influence
- Abdominal (visceral) body fat influence
- 1/3 of children will develop type 2 diabetes

Background

- Type 2 Diabetes
  - “Adult-onset diabetes”
  - Insulin resistance
  - Reduced insulin sensitivity
  - Elevated fasting glucose levels

Background

- Impaired Fasting Glucose (IFG)
  - “Pre-diabetes”
  - Type 2 diabetes predictor
  - Associated with insulin resistance
  - Fasting glucose levels:
    - ≥100 mg/dl and <126 mg/dl

Background

- Waist circumference
  - Predicts abdominal fat distribution
  - Associated with insulin resistance
  - Associated with cardiovascular disease
  - Better than body mass index (BMI)

Study Purpose

- To determine if an association exists between waist circumference and *type 2 diabetes* among US adolescents 12-19 years

- To determine if an association exists between waist circumference and *impaired fasting glucose* among US adolescents 12-19 years

Data Source

- 2001-2002 and 2003-2004 National Health and Nutrition Examination Survey (NHANES)
- Interview, physical exam, lab tests

Subjects

- Initial sample
  - 4,653 adolescents 12-19 years
- Exclusions
  - Pregnant adolescents
  - “Other-Hispanic” & “Multi-racial/Other” races
  - Subjects without complete data
- Final sample
  - 923 adolescents 12-19 years

Subjects-Demographics

Characteristics	Total No. Subjects (N=923)	IFG Cases: 139 (15.06) (%)	IFG Controls: 784 (84.94) (%)
Gender			
Male	463	102 (73.38)	361 (46.05)
Female	460	37 (26.62)	423 (53.95)
Race-ethnicity			
Mexican-American	303	64 (46.04)	239 (30.48)
Non-Hisp. White	302	40 (28.78)	262 (33.42)
Non-Hisp. Black	318	35 (25.18)	283 (36.10)
Age, years			
12-14	359	55 (39.57)	304 (38.78)
15-19	564	84 (60.43)	480 (61.22)

Subjects-Demographics

Characteristics	Total No. Subjects (N=923)	IFG Cases: (%)	IFG Controls: (%)
BMI percentile			
Normal (<85th)	605	77 (55.40)	528 (67.35)
At-risk for overweight (85th-95th)	146	23 (16.55)	123 (15.69)
Overweight (≥95th)	172	39 (28.06)	133 (16.96)
Waist Circumference			
<75th percentile	714	625 (79.72)	89 (64.03)
>= 75th and < 90th percentile	126	94 (11.99)	32 (23.02)
>=90th percentile	83	65 (8.29)	18 (12.95)

Methods & Statistical Analysis

- Case-control design
- Logistic regression
- Multiple linear regression
- Crude and adjusted parameter/odds ratios
- 95% confidence intervals (CI)
- Results statistically significant at $p<0.05$

Methods-Variables

- Independent variable
  - Waist circumference
    - Continuous
    - Categorical (75^{th}-90^{th} percentile, >90^{th} percentile)
- Dependent (outcome) variable
  - Impaired fasting glucose
    - Continuous
    - Categorical

Results

Odds ratios for waist circumference percentile and IFG

Waist Circumference	**Crude OR (95% CI)**	**Adjusted OR* (95% CI)**
<75th percentile	Reference	Reference
≥75th and < 90th percentile	**2.025 (1.267, 3.238) P<0.0032**	1.353 (0.413, 4.433) P<0.6180
≥90th percentile	1.041 (0.368, 2.949) P<0.9390	0.874 (0.087, 8.769) P<0.9092

*Adjusted for age, gender, race-ethnicity, poverty index, BMI category, skinfolds; CI = confidence interval

Results

Parameter estimates for waist circumference (categorical variable) and fasting glucose value*

Variables	ß Coefficient	Standard Error	P-Value	95% CI
Intercept	96.837	0.867	<0.0001	94.989, 98.685
WC ≥75th and < 90th percentile	0.255	1.686	0.8819	-3.338, 3.848
WC ≥90th percentile	1.531	3.090	0.6274	-5.055, 8.117
Non-Hispanic Black	**-3.964**	**1.022**	**0.0015**	**-6.143, -1.786**
Age	**-1.850**	**0.533**	**0.0034**	**-2.987, -0.713**

*Waist circumference dummy variables, sex, age, race/ethnicity, poverty, BMI category, and skinfolds in model; CI = confidence interval

Results

Parameter estimates for waist circumference (continuous variable) and fasting glucose value*

Variables	ß Coefficient	Standard Error	P-Value	95% CI
Intercept	94.265	4.308	<.0001	85.083, 103.448
Waist circumference	0.039	0.073	0.6001	-0.116, 0.194
Gender	**-3.906**	**0.783**	**0.0002**	**-5.575, -2.237**
Non-Hisp. Black	**-3.925**	**0.923**	**0.0007**	**-5.893, -1.956**
Mexican American	1.182	0.613	0.0730	-0.125, 2.489
Age	**-2.007**	**0.699**	**0.0116**	**-3.495, -0.519**

*Waist circumference as continuous variable, gender, race/ethnicity, age, poverty, BMI category, and skinfolds in model; CI = confidence interval

Results Summary

- Logistic regression analysis: no data on the association between WC and IFG were statistically significant
- Multiple linear regression analysis: only race, age and gender were independently associated with fasting plasma glucose levels

Discussion

- WC may not be predictor of IFG
- Consistent findings
  - Black youth
  - Boys

Limitations

- Internal WC percentile cut-offs
- Racial/ethnic WC differential
- Cross-sectional data
- Genetics

Conclusion

- Type 2 diabetes a public health concern
- Prevention essential
  - IFG identification and monitoring
  - Simple methods
  - Cost effective
- Goal: improve adolescent population health outcomes

Acknowledgements

- Thesis Committee:
  - Jane Rees, PhD, MS, RD
  - Jonathan Gorstein, PhD
- Statistical Guru and Savior:
  - Nathaniel D. Mercaldo

Supported in part by Project #T76 MC 00011 from the Maternal and Child Health Bureau (Title V, Social Security Act), Health Resources and Services Administration, US Department of Health and Human Services

Thank You!

Questions?