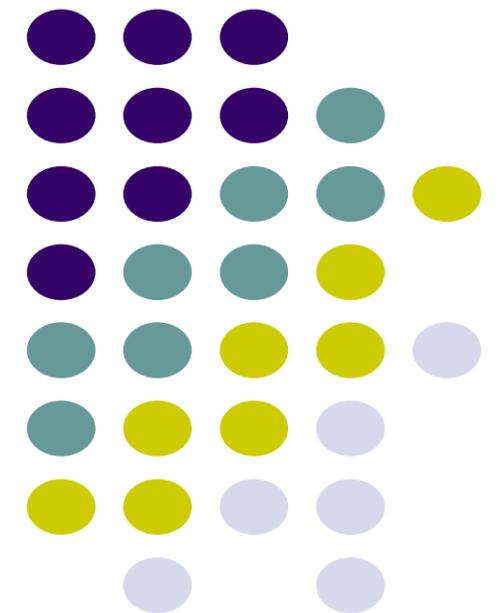


A family history of diabetes is related to abnormal insulin sensitivity in African-Caribbean girls of low birth weight: Is catch-up weight important?

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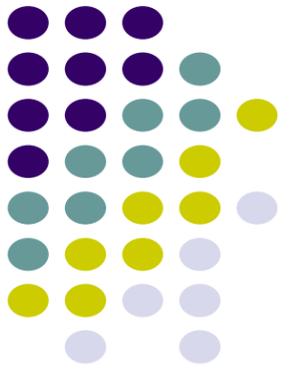
Abstract

This study examined the relationship of birth weight, family history of diabetes (FamHx) and current weight to insulin resistance in black girls and boys on the Caribbean island of Barbados. A cohort of 56 low birth weight (LBW) and 120 normal birth weight (NBW) adolescents were recruited for study participation. FamHx was ascertained by questionnaire. Body mass index (BMI) and waist circumference (WC) were used to assess fat distribution. Fasting blood glucose and insulin were measured from blood samples drawn from each adolescent participant. Insulin resistance was estimated by the HOMA technique. These data show that only among LBW girls was a positive (+) FamHx associated with higher HOMA (FamHx "Yes" = 1.22 ± 0.298 vs. "No" = 0.811 ± 0.452 ; $p=0.032$). No significant relationships were observed among boys. LBW girls without FamHx had a smaller WC compared to their NBW counterparts ($69.70 \pm 9.88\text{cm}$ vs. $76.70 \pm 15.64\text{cm}$, respectively; $p=0.055$). In contrast, LBW girls with a (+) FamHx had similar mean WC ($77.71 \pm 16.46\text{cm}$) to those of NBW girls with (+) FamHx (WC = $71.50 \pm 10.38\text{cm}$; $p=0.405$). These data indicate that along with a family history of diabetes, catch-up weight may be important in assessing diabetes risk in black Caribbean LBW adolescent girls.

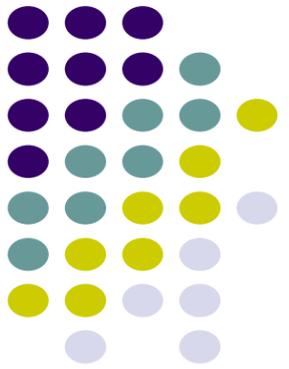
Background

A positive family history of diabetes increases an individual's risk for developing Type 2 diabetes in their lifetime. Among African American youth this relationship is more profound and may be compounded by the increased risk of low birth weight in this population.

Among children, it has been shown that the association of low-birth weight with metabolic abnormalities is greatest for low-birth weight individuals who experience weight gain that allows them to “catch-up” in body weight to their normal-birth weight counterparts. The underlying genetic contribution to the ability to “catch-up” in body weight or to diabetes risk among low birth weight individuals is not well understood.

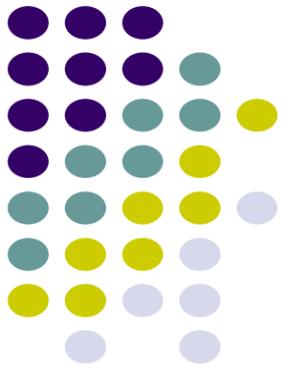


Specific Aim



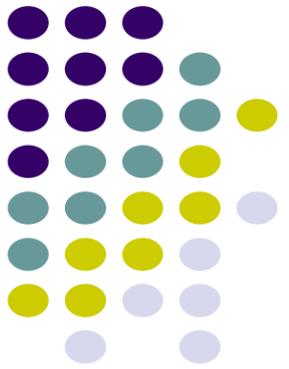
To examine the relationship of family history of diabetes, birth weight and current body size in adolescence to insulin resistance in African Caribbean adolescent boys and girls age 14-16 on the island of Barbados.

Study Design



The current retrospective study was conducted between June 2002 and February 2003 on the island of Barbados in the Caribbean. The study sample consisted of 176 adolescents age 14-16 years old including 56 persons who were born with low birth weight (LBW) and 120 persons who were of normal weight (NBW) at birth. Recruitment of the study sample entailed a list of women who gave birth to a singleton at the Queen Elizabeth Hospital on the island of Barbados generated with the assistance of local physicians. All women giving birth between January 1, 1986 and December 31, 1988 were eligible for the study.

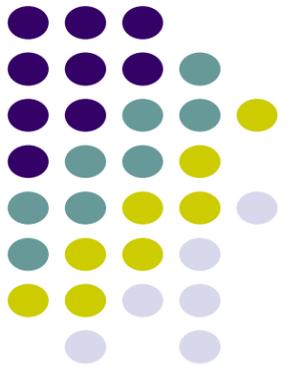
Methods



Demographic data, including household income, and information about family history of diabetes were collected from the sample of mothers by questionnaire. An adolescent participant was considered 'positive' for a family history of diabetes (FamHx) if either his/her mother or the father has diabetes. Physical activity level was determined with the Modifiable Activity Questionnaire[12] which measures the metabolic cost in MET-hours of time engaged in leisure time physical activity each week over the past year.

Methods

Weight at birth in grams (g) and gestational age in weeks was confirmed by review of medical records. Low birth weight was classified as weight at birth below 2.5kg. Current weight of each adolescent participant was measured twice using a balance beam scale. Waist circumference (WC), an estimate of abdominal fat, was measured twice at the level of the umbilicus to the nearest centimeter (cm) using a standard tape measure. Height was measured to the nearest cm using a wall-mounted stadiometer. Body mass index (BMI) was calculated using a ratio of weight in kilograms to height in meters (kg/m^2).

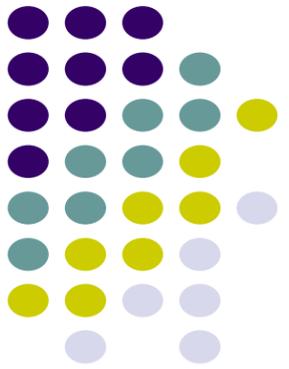


Methods



Fasting blood glucose and insulin were measured from blood samples drawn from each adolescent participant after an overnight fast of 10-12 hours. Insulin resistance was calculated using the homeostasis model assessment (HOMA) (insulin resistance = [fasting insulin (μ U/ml) * fasting glucose (mmol/l)]/22.5).

Statistical Analyses



The differences between variable means were assessed using the t-test. The Chi Square was used to compare the frequency of categorical variables. Since the distribution of HOMA scores are skewed, the log transformed ($\text{Ln}[\text{HOMA}]$) values were used in analyses. The nonparametric Mann-Whitney U test of two independent samples was used for mean analyses of subgroups. Spearman correlation analyses were used in order to determine if gestational age and current age was significantly associated with $\text{Ln}[\text{HOMA}]$. Partial correlation analysis was used to determine if these relationships were independent of birth weight.

| Characteristics of Study Variables by Family History of Diabetes | | | |
|------------------------------------------------------------------|---------------|---------------|----------|
| | FamHx (+) | FamHx (-) | |
| | (N=26) | (N=150) | P- value |
| Age (years) | 15.30 (0.78) | 15.24 (0.80) | 0.690 |
| Female (%) | 53.8% | 52.0% | 0.862 |
| Low birth weight (%) | 46.2% | 29.3% | 0.089 |
| Gestational age* (weeks) | 36.61 (3.07) | 37.38 (2.92) | 0.252 |
| Waist Circumference (cm) | 75.15 (12.63) | 74.20 (13.39) | 0.736 |
| BMI (kg/m ²) | 23.25 (6.03) | 21.93 (5.46) | 0.264 |
| Fasting Glucose (mg/dl) | 79.88 (10.83) | 79.81 (7.91) | 0.968 |
| Fasting Insulin (μ U/ml) | 13.48 (6.31) | 12.96 (6.28) | 0.697 |
| Ln[Homa] | 0.878 (0.51) | 0.822 (0.51) | 0.608 |
| Physical Activity (Met-Hrs) | 14.82 (9.93) | 13.34 (12.11) | 0.556 |
| Income (<US\$2500) | 23.1% | 12.0% | 0.129 |

Mean Values of Metabolic and Anthropometric variables by Family History of Diabetes (FamHx) in Low Birth Weight Adolescents.

| | Girls (N=29) | | | Boys (N=27) | | |
|--------------------------|----------------|----------------|------|----------------|----------------|------|
| | FamHx (+) | FamHx (-) | | FamHx (+) | FamHx (-) | |
| | (N=7) | (N=22) | p | (N=5) | (N=22) | p |
| Insulin (μU/ml) | 16.20 (3.60) | 12.72 (5.42) | .074 | 10.12 (5.35) | 11.11 (5.50) | .827 |
| Glucose (mg/dl) | 87.57 (7.25) | 78.27 (5.47) | .005 | 75.80 (14.70) | 81.73 (7.96) | .399 |
| HOMA | 1.22 (.298) | 0.811 (0.452) | .032 | 0.535 (0.603) | 0.603 (0.269) | .417 |
| Waist (cm) | 77.71 (16.46) | 69.70 (9.88) | .202 | 70.90 (9.12) | 69.31 (5.60) | .827 |
| Weight (lbs) | 143.71 (54.33) | 120.56 (29.07) | .429 | 124.00 (26.49) | 125.68 (23.28) | .876 |
| BMI (kg/m ²) | 25.89 (9.38) | 20.93 (4.54) | .333 | 20.78 (3.14) | 19.61 (2.46) | .417 |

Mean Values of Metabolic and Anthropometric variables by Family History of Diabetes (FamHx) in Normal Birth Weight Adolescents. .

| | Girls (N=63) | | | Boys (N=57) | | |
|--------------------------|----------------|----------------|------|----------------|----------------|------|
| | FamHx (+) | FamHx (-) | | FamHx (+) | FamHx (-) | |
| | (N=7) | (N=56) | p | (N=7) | (N=50) | p |
| Insulin (μU/ml) | 12.83 (5.49) | 14.37 (6.95) | .654 | 13.81 (9.21) | 12.30 (6.00) | .894 |
| Glucose (mg/dl) | 77.14 (13.31) | 78.52 (9.09) | .895 | 77.86 (4.33) | 81.10 (7.15) | .128 |
| HOMA | 0.798 (0.542) | 0.890 (0.708) | .555 | 0.855 (.460) | 0.803 (.434) | .836 |
| Waist (cm) | 71.50 (10.38) | 76.70 (15.64) | .375 | 79.28 (13.13) | 75.52 (13.68) | .268 |
| Weight (lbs) | 130.21 (31.54) | 138.48 (41.04) | .607 | 159.78 (57.24) | 141.74 (40.33) | .181 |
| BMI (kg/m ²) | 22.18 (4.17) | 23.29 (6.54) | .827 | 23.45 (5.01) | 21.86 (5.13) | .253 |

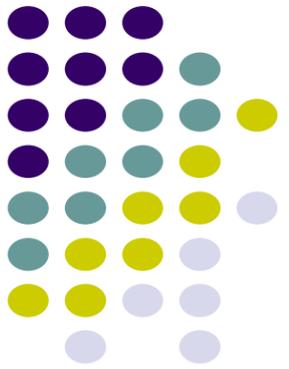
Mean Values for Anthropometric Variables by Family History of Diabetes in Girls.

| | FamHx (+) (N=14) | | | FamHx (-) (N=78) | | |
|--------------------------|------------------|----------------|------|------------------|----------------|------|
| | LBW (N=7) | NBW (N=7) | | LBW (N=22) | NBW (N=56) | |
| | Mean (SD) | Mean (SD) | p | Mean (SD) | Mean (SD) | p |
| BMI (kg/m ²) | 25.89 (9.38) | 22.12 (4.17) | .482 | 20.93 (4.54) | 23.29 (6.54) | .125 |
| Waist (cm) | 77.71 (16.46) | 71.50 (10.38) | .405 | 69.70 (9.88) | 76.70 (15.64) | .055 |
| Weight (lbs) | 143.71 (54.33) | 130.21 (31.54) | .949 | 120.56 (29.07) | 138.48 (41.04) | .066 |
| Insulin (μU/ml) | 16.20 (3.60) | 12.83 (5.49) | .180 | 12.72 (5.42) | 14.37 (6.95) | .322 |
| Glucose (mg/dl) | 87.57 (7.25) | 77.14 (13.31) | .109 | 78.27 (5.47) | 78.52 (9.09) | .906 |
| HOMA | 1.22 (0.298) | 0.798 (0.542) | .085 | 0.811 (0.452) | 0.890 (0.608) | .582 |

Mean Values for Anthropometric Variables by Family History of Diabetes in Boys.

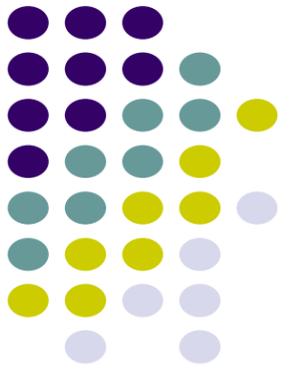
| | FamHx (+) (N=12) | | | FamHx (-) (N=72) | | |
|--------------------------|------------------|----------------|------|------------------|----------------|------|
| | LBW (N=5) | NBW (N=7) | | LBW (N=22) | NBW (N=50) | |
| | Mean (SD) | Mean (SD) | p | Mean (SD) | Mean (SD) | p |
| BMI (kg/m ²) | 20.78 (3.14) | 23.45 (5.01) | .570 | 20.12 (3.81) | 21.86 (5.13) | .055 |
| Waist (cm) | 70.90 (9.12) | 79.28 (13.13) | .222 | 70.54 (8.89) | 75.52 (13.68) | .045 |
| Weight (lbs) | 124.00 (26.49) | 159.78 (37.24) | .104 | 128.59 (29.70) | 141.74 (40.33) | .086 |
| Insulin (μU/ml) | 10.12 (5.35) | 13.81 (9.21) | .088 | 12.09 (9.35) | 12.30 (6.00) | .433 |
| Glucose (mg/dl) | 75.81 (14.70) | 77.86 (4.33) | .569 | 81.68 (7.94) | 81.10 (7.15) | .742 |
| HOMA | 0.535 (0.603) | 0.855 (0.460) | .123 | 0.700 (0.505) | 0.803 (0.434) | .381 |

Discussion



There is a significant relationship between positive family history of diabetes and greater insulin resistance only in LBW girls. It may be that the apparent gender differential in this effect reflects a greater influence of protective lifestyle behaviors such as physical activity among adolescent LBW boys. Another possibility is that a positive FamHx might indicate familial risk factors that operate independent of genetic predisposition to differentially influence weight gain and metabolic risk in girls compared to boys with LBW.

Discussion



In the current study, LBW girls with a family history of diabetes have a similar body size compared to those with a NBW, suggesting they may have experienced “catch-up” weight gain. This is consistent with higher insulin and glucose levels observed in this subset of girls. While there is also no statistically significant difference in current body weight between LBW and NBW boys with a positive FamHx, the trend in boys appear to favor lower levels of fasting insulin and glucose and smaller body size in the LBW groups.