

**Citation:**

Franko DL, Striegel-Moore RH, Thompson D, Affenito SG, Schreiber GB, Daniels SR, Crawford PB. The relationship between meal frequency and body mass index in black and white adolescent girls: More is less. *Int J Obes (Lond)*. 2008 Jan; 32 (1): 23-29.

**PubMed ID:** [17563764](#)

**Study Design:**

Prospective Cohort Study

**Class:**

B - [Click here](#) for explanation of classification scheme.

**Research Design and Implementation Rating:**

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

**Research Purpose:**

To document meal frequency and its relationship to body mass index (BMI) in a longitudinal sample of black and white girls ages nine to 19 years.

**Inclusion Criteria:**

- Ages nine to 10 years at enrollment
- Self-identified as white or black, non-Hispanic with racially concordant parents or guardians.

**Exclusion Criteria:**

None reported.

**Description of Study Protocol:****Recruitment**

Participants were from the *National Growth and Health Study* and were recruited at age nine to 10 years from three study sites:

- University of California at Berkeley
- University of Cincinnati/Cincinnati Children's Hospital Medical Center
- Westat, Inc., in Rockville, Maryland.

**Design**

Prospective cohort study.

**Dietary Intake/Dietary Assessment Methodology**

- The measure of meal frequency and other dietary intake data was collected using three-day food records
- Food records were collected annually for visits one to five, and then again at visits seven, eight and 10
- Records were kept on two weekdays and one weekend and all days were consecutive.

### **Blinding Used**

Not applicable.

### **Intervention**

Not applicable.

### **Statistical Analysis**

- The association between meal frequency and adiposity was estimated using linear regression or logistic regression. The models were adjusted for study site, parental education, race and indicators of energy intake and expenditure.
- All models included a random intercept representing girl-to-girl variation in year-three BMI z-scores and overweight
- Direct maximum likelihood was used for unbiased estimation in the presence of missing data
- Statistical significance was set at  $P < 0.05$ .

## **Data Collection Summary:**

### **Timing of Measurements**

- Girls were recruited at age nine to 10 years and followed for 10 years
- Three-day food records were collected annually for visits one to four and then again at visits seven, eight and 10
- Adiposity was measured annually
- Demographic information was defined by the subjects' self-report at baseline
- Physical activity was assessed in years one, three and five
- TV viewing was assessed at all visits except two and four.

### **Dependent Variables**

Adiposity was determined using measured height and weight and calculating BMI and BMI-for-age z-scores.

### **Independent Variables**

Meal frequency was determined using three-day food records.

### **Control Variables**

- Study site
- Parental education
- Race
- Indicators of energy intake and expenditure.

## **Description of Actual Data Sample:**

- *Initial N*: 2,379 girls were recruited
- *Attrition (final N)*: Retention rates at visits two to four were 96, 94 and 91% respectively, 82% at visit seven and 89% at visit 10
- *Age*: Nine to 10 years at baseline and followed annually for 10 years
- *Ethnicity*: Subjects were white or black, non-Hispanic
- *Other relevant demographics*: Not applicable
- *Anthropometrics*: Not applicable
- *Location*: United States.

### Summary of Results:

- Between visits three and 10, the percentage of girls eating three or more meals on all three days reduced by over half (15% vs. 6%), while the percentage of girls who ate three or more meals on none of the three days nearly doubled (26% vs. 51%)
- Girls who ate three or more meals on more days had lower BMI-for-age z-scores ( $P < 0.0001$ ). For each additional day of eating three or more meals, BMI-for-age z-scores were estimated to increase by -0.05 (95% CI -0.3, -0.6). However, the slope of this association tended to become less steep in the later visits ( $P < 0.0001$ )
- The main effect for meal frequency and overweight was not significant ( $P = 0.20$ ), but there was a significant race by meal frequency interaction ( $P = 0.02$ ). Black girls who ate three or more meals on more days exhibited a decreased likelihood of overweight; for each additional day consuming three or more meals, black girls were 1.23 (95% CI 1.05, 1.50) less likely to be overweight.

### Author Conclusion:

Meal frequency was negatively related to BMI.

### Reviewer Comments:

- *This study provided little details regarding the subject population*
- *The results were presented in terms of number of days with three or more meals, rather than looking at the number of meals per day in relation to adiposity, making it difficult to understand how many meals per day was related most strongly with reduced adiposity.*

### Research Design and Implementation Criteria Checklist: Primary Research

#### Relevance Questions

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|----|---|-----|
| 1. | Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies) | Yes |
| 2. | Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?   | Yes |

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|----|--|-----|
| 3. | Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice? | Yes |
| 4. | Is the intervention or procedure feasible? (NA for some epidemiological studies)   | Yes |

### Validity Questions

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|-----------|--|-----|
| <b>1.</b> | <b>Was the research question clearly stated?</b>   | Yes |
| 1.1.      | Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?  | Yes |
| 1.2.      | Was (were) the outcome(s) [dependent variable(s)] clearly indicated?   | Yes |
| 1.3.      | Were the target population and setting specified?  | Yes |
| <b>2.</b> | <b>Was the selection of study subjects/patients free from bias?</b>  | No  |
| 2.1.      | Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?  | No  |
| 2.2.      | Were criteria applied equally to all study groups?   | ??? |
| 2.3.      | Were health, demographics, and other characteristics of subjects described?  | No  |
| 2.4.      | Were the subjects/patients a representative sample of the relevant population?   | ??? |
| <b>3.</b> | <b>Were study groups comparable?</b>   | Yes |
| 3.1.      | Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)  | N/A |
| 3.2.      | Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?   | N/A |
| 3.3.      | Were concurrent controls used? (Concurrent preferred over historical controls.)  | Yes |
| 3.4.      | If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?  | ??? |
| 3.5.      | If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.) | N/A |

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| 3.6.      | If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?   | N/A        |
| <b>4.</b> | <b>Was method of handling withdrawals described?</b>  | <b>Yes</b> |
| 4.1.      | Were follow-up methods described and the same for all groups?   | Yes        |
| 4.2.      | Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.) | Yes        |
| 4.3.      | Were all enrolled subjects/patients (in the original sample) accounted for?   | Yes        |
| 4.4.      | Were reasons for withdrawals similar across groups?   | ???        |
| 4.5.      | If diagnostic test, was decision to perform reference test not dependent on results of test under study?  | N/A        |
| <b>5.</b> | <b>Was blinding used to prevent introduction of bias?</b>   | <b>Yes</b> |
| 5.1.      | In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?   | N/A        |
| 5.2.      | Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)   | N/A        |
| 5.3.      | In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?   | Yes        |
| 5.4.      | In case control study, was case definition explicit and case ascertainment not influenced by exposure status?   | N/A        |
| 5.5.      | In diagnostic study, were test results blinded to patient history and other test results?   | N/A        |
| <b>6.</b> | <b>Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were intervening factors described?</b>   | <b>Yes</b> |
| 6.1.      | In RCT or other intervention trial, were protocols described for all regimens studied?  | N/A        |
| 6.2.      | In observational study, were interventions, study settings, and clinicians/provider described?  | Yes        |
| 6.3.      | Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?  | Yes        |
| 6.4.      | Was the amount of exposure and, if relevant, subject/patient compliance measured?   | Yes        |
| 6.5.      | Were co-interventions (e.g., ancillary treatments, other therapies) described?  | Yes        |
| 6.6.      | Were extra or unplanned treatments described?   | Yes        |

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| 6.7.       | Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?  | Yes        |
| 6.8.       | In diagnostic study, were details of test administration and replication sufficient?   | N/A        |
| <b>7.</b>  | <b>Were outcomes clearly defined and the measurements valid and reliable?</b>  | <b>Yes</b> |
| 7.1.       | Were primary and secondary endpoints described and relevant to the question?   | Yes        |
| 7.2.       | Were nutrition measures appropriate to question and outcomes of concern?   | Yes        |
| 7.3.       | Was the period of follow-up long enough for important outcome(s) to occur?   | Yes        |
| 7.4.       | Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?                                      | Yes        |
| 7.5.       | Was the measurement of effect at an appropriate level of precision?  | Yes        |
| 7.6.       | Were other factors accounted for (measured) that could affect outcomes?  | Yes        |
| 7.7.       | Were the measurements conducted consistently across groups?  | Yes        |
| <b>8.</b>  | <b>Was the statistical analysis appropriate for the study design and type of outcome indicators?</b>   | <b>Yes</b> |
| 8.1.       | Were statistical analyses adequately described and the results reported appropriately?   | Yes        |
| 8.2.       | Were correct statistical tests used and assumptions of test not violated?  | Yes        |
| 8.3.       | Were statistics reported with levels of significance and/or confidence intervals?  | Yes        |
| 8.4.       | Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)? | No         |
| 8.5.       | Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?                           | Yes        |
| 8.6.       | Was clinical significance as well as statistical significance reported?  | Yes        |
| 8.7.       | If negative findings, was a power calculation reported to address type 2 error?  | No         |
| <b>9.</b>  | <b>Are conclusions supported by results with biases and limitations taken into consideration?</b>  | <b>Yes</b> |
| 9.1.       | Is there a discussion of findings?   | Yes        |
| 9.2.       | Are biases and study limitations identified and discussed?   | No         |
| <b>10.</b> | <b>Is bias due to study's funding or sponsorship unlikely?</b>   | <b>Yes</b> |

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|-------|--|-----|
| 10.1. | Were sources of funding and investigators' affiliations described? | Yes |
| 10.2. | Was the study free from apparent conflict of interest?             | Yes |