Breakfast consumption in black and white girls correlates positively with calcium and fiber intake and negatively with body mass index

Ruth Striegel Weissman
Breakfast Consumption by African-American and White Adolescent Girls Correlates Positively with Calcium and Fiber Intake and Negatively with Body Mass Index

SANDRA G. AFFENITO, PhD, RD; DOUGLAS R. THOMPSON, PhD; BRUCE A. BARTON, PhD; DEBRA L. FRANKO, PhD; STEPHEN R. DANIELS, MD; EVA OBARZANEK, PhD, MPH, RD; GEORGE B. SCHREIBER, PhD; RUTH H. STRIEGEL-MOORE, PhD

ABSTRACT

Objective To describe age- and race-related differences in breakfast consumption and to examine the association of breakfast intake with dietary calcium and fiber and body mass index (BMI).

Design Data from the National Heart, Lung, and Blood Institute Growth and Health Study, a 9-year, longitudinal biracial cohort study with annual 3-day food records.

Subjects/setting The National Heart, Lung, and Blood Institute Growth and Health Study recruited 2,379 girls (1,166 white and 1,213 African American), aged 9 or 10 years at baseline for an observational study. Retention rates were very high at visits two through four (96%, 94%, and 91%), but declined to a low of 82% at visit seven, and increased to 89% at visit 10.

Main outcome measures Frequency of breakfast consumption, dietary calcium and fiber, and BMI.

Statistical analyses Generalized estimation equations methodology was used to examine differences in the frequency of breakfast eating by age and race. Generalized estimation equations analyses were also conducted to test whether breakfast consumption was predictive of intake of dietary calcium and fiber, and BMI, adjusting for potentially confounding effects of site, age, race, parental education, physical activity, and total energy intake.

Results Frequency of breakfast eating declined with age, white girls reported more frequent breakfast consumption than African-American girls, and the racial difference decreased with increasing age. Days eating breakfast were associated with higher calcium and fiber intake in all models, regardless of adjustment variables. Days eating breakfast were predictive of lower BMI in models that adjusted for basic demographics (ie, site, age, and race), but the independent effect of breakfast was no longer significant after parental education, energy intake, and physical activity were added to the model.

Conclusions Dietetics professionals need to promote the importance of consuming breakfast to all children and adolescents, especially African-American girls.


It is well established that breakfast consumption is associated with favorable nutrient intake (1-3), more healthful food choices and regular eating patterns throughout the day (4,5), and other health-related behaviors such as physical activity (6,7). Moreover, adolescents who routinely eat breakfast have been shown to have a lower body mass index (BMI) compared with adolescents who frequently omitted this meal (8,9). Despite the benefits of eating breakfast, it is the meal most often skipped...
by children and adolescents (10,11), and this becomes more common as children grow older (12-15). Trend analysis of breakfast patterns among adolescents in the United States demonstrated that approximately one third of young women aged 15 to 18 years skipped breakfast on a frequent basis (3). Compared with white girls, skipping breakfast is more common in nonwhite girls (5,14).

Although previous research has described breakfast patterns among children and adolescents, many of these studies have been cross-sectional in design (5,16) and have sampled a small number of children and adolescents from racial/ethnic minority groups (13,16-18). The goals of our study were to describe age- and race-related differences in the consumption of breakfast, and examine the association of breakfast intake with calcium and fiber intake and BMI, after adjusting for potential confounding factors, such as total energy intake, physical activity, and socioeconomic status. We hypothesized a decrease in breakfast eating with age and that African-American girls would eat breakfast less frequently than white girls. Given the types of foods typically eaten at breakfast, we expected that dietary calcium and fiber intake would be positively associated with breakfast consumption. Further, we predicted that eating breakfast would be negatively associated with BMI. Longitudinal data from the National Heart, Lung, and Blood Institute (NHLBI) Growth and Health Study cohort provided an opportunity to investigate these hypotheses.

METHODS
Participants and Recruitment
As previously reported (19), the NHLBI Growth and Health Study recruited 2,379 African-American and white girls who were 9 or 10 years old at study entry at three study sites: University of California at Berkeley; University of Cincinnati/Cincinnati Children’s Hospital Medical Center; and Westat, Inc/Group Health Association, Rockville, MD. Berkeley recruited participants from public and parochial schools in the Richmond Unified School District. The area was chosen based on census tract data showing approximately equal percentages of African-American and white children with the least degree of income disparity between the race groups. Cincinnati recruited girls from all public and parochial schools in greater Cincinnati to have race and socioeconomic representation for Hamilton County (which includes inner city, urban residential, and suburban areas). The Westat cohort was randomly drawn from a membership listing of families who were enrolled in a large Washington, DC, area health maintenance organization and, because the membership did not include a sufficient number of white families with age-eligible girls, girls from several local Girl Scout troops in the same geographic area were recruited for study participation. Eligible participants identified themselves (using census categories for race/ethnicity) as black or white, non-Hispanic, with racially concordant parents or guardians. All girls who entered the NHLBI Growth and Health Study assented, and their parents (or guardian) consented to their participation. On average, the African-American households had lower family incomes and lower educational levels than the white households. Nevertheless, in each race group, wide ranges of income (<$10,000 to ≥$75,000) and educational levels (less than high school diploma to graduate degree) were represented.

Due to variable annual participation rates, sample sizes varied from visit to visit. Retention rates (defined in relation to the sample size of 2,379 at baseline) were very high at visits two through four (96%, 94%, and 91%), declined to a low of 82% at visit seven, and increased to 89% at visit 10.

Measurements and Procedure
A complete description of NHLBI Growth and Health Study procedures and measures has been reported (19). Briefly, data were collected annually at participating sites or, if the girl was unable to travel to the site, at her home. The study protocol was approved by the Institutional Review Boards of all participating sites. Only instruments of relevance to our report are described here.

Demographic information. Data regarding race and highest level of parental education were collected at study entry from girls and their parents (or guardians). Race (African American or white) was defined by the participant’s self-report at baseline. For this report, parental education was categorized as 4 or more years of college vs less than 4 years of college. Education was chosen over income as a proxy of socioeconomic status in part because NHLBI Growth and Health Study data were collected at three distinct geographic locations in the United States with different average household income and different price indexes (eg, the same amount of income has different purchasing power in Cincinnati compared with Washington, DC). Also, previous research has shown that education is a better predictor of health-related outcomes than income (20).

Participants’ age was recorded as age at last birthday. A small number of girls who were 8 years old during the initial interview were grouped with the 9-year-olds, and a few who were older than age 19 years at the last interview were grouped with the 19-year-olds. In rare cases, a girl was the same age during two consecutive interviews; in such cases, only data from the first interview were used in the analyses (this resulted in exclusion of data from approximately 2% of all interviews).

Anthropometric measurements/BMI. Annually, centrally trained examiners obtained height and weight measurements (all visits). BMI was calculated as kg/m².

Dietary measurement methods. Three-day food records that had been previously validated compared with observed intakes during school lunch (21) were collected annually for visits one to five and then again at visits seven, eight, and 10. Dietetics professionals used age-appropriate materials to instruct girls to record all food and drink, type of meal (eg, breakfast, snack, and lunch), and time of intake for 3 consecutive days that included 2 weekdays and 1 weekend day. Breakfast was defined as any eating that occurred between 5 AM and 10 AM weekdays or between 5 AM and 11 AM during weekends.

Dietetics professionals, who were trained and certified by the University of Minnesota Nutrition Coordinating Center, reviewed the completed food records individually with the girls. Supplementary information was not
sought from parents, as confidentiality was given a higher priority than additional details on foods or food preparation. Standard probes were used to respond to girls’ questions and to clarify incomplete responses. Default values adapted from the Nutrition Coordinating Center were used for missing information on food amounts, types, and preparation methods. To minimize the use of defaults, NHLBI Growth and Health Study dietary staff had a notebook of labels and label pictures to help girls describe foods. Food records were coded and analyzed for nutrients using Food Table Version 19 of the Nutrition Coordinating Center nutrient database (22).

Dietary calcium (milligrams) and fiber intake (grams) were calculated from the nutrient compositional analysis of the 3-day food records, and the intake was averaged for the 3 days. Diaries covering fewer than 3 days (3.9%) were excluded to ensure that every diary had the same number of days to observe breakfast eating.

**Assessment of physical activity.** The Habitual Activity Questionnaire adapted from Ku and colleagues (23) was used to measure the physical activity of subjects, and it was administered as a structured interview in years 1, 3, and 5, and self-administered in years 7 to 10 of the study. The Habitual Activity Questionnaire assesses the type and frequency of participation in activities (sports, physical activities, and classes/lessons) outside of school and detailed validation information (using Caltrac activity monitor assessment) has been reported (24). Participants were asked to estimate the weekly frequency of each activity for the school year and summer months. A summary weekly activity score was calculated by multiplying the metabolic equivalents value of energy expended for each recorded activity by the weekly frequency and the fraction of the year during which each activity was performed. For scoring purposes, the following fractions were assigned to a given time frame: classes/lessons during the year (‘most’ of the year=1, ‘half’=0.5, and ‘small part’=0.25); sports/physical activities during the school year (‘most’ of the school year=0.75, ‘half’=0.375, and ‘small part’=0.1875); and sports/physical activities during the summer (‘most’ of the summer=0.25, ‘half’=0.125, and ‘small part’=0.0625). The final Habitual Activity Questionnaire score (metabolic equivalent times wk⁻¹) was the sum of the weekly score for all activity categories (ie, school sports, summer sports, and class/lessons) for the previous year. The generalized estimated equation model provided an estimate of the linear slope of the relation between physical activity and breakfast, based on the visits where both physical activity and breakfast data were collected.

**Data Analysis**

To test differences in the frequency of breakfast eating by age and race, a model using the generalized estimating equations method (25) was constructed, entering age, race, and the age×race interaction as the predictors. Generalized estimation equation model estimates appropriately account for the nonindependence among girls’ measurements across study years. In all models, it was assumed that the within-girl, year-to-year correlation of the outcome variable decreases as the distance between years increases. Therefore, an autoregressive structure (type=AR[1]) was used for the working correlation matrix, ordered by year of age. Generalized estimation equation model estimates are based on associations between different variables measured at the same age (eg, breakfast consumption and BMI measured during the same year of age). Generalized estimation equation uses the associations at individual ages to create estimates applicable to all ages (eg, an estimated association between breakfast and BMI that applies to ages 9 through 19 years). The significance tests reported below were Type III Wald χ² tests. For continuous variables (eg, average daily energy consumed), the null hypothesis is that the coefficient (slope) is 0, whereas for categorical variables (eg, ethnicity), the null hypothesis is that there are no differences among any of the levels of the variable. Age and days eating breakfast were treated as sets of dummy variables, because they may be related to the outcome variables in a nonlinear fashion. In all analyses, the same cohort of girls was compared at different ages. The age comparisons were longitudinal, with the exception that some girls failed to contribute data at some ages due to missing data. To test the hypothesis that breakfast eating was associated with increased calcium and fiber intake and lower BMI, separate generalized estimation equation models were constructed for each outcome. A basic model included the primary variable of interest (days eating breakfast) and adjusted only for site, race, and age, and all two-way interactions. Significant interactions were retained in an expanded model that also adjusted for parental education, physical activity, and total daily energy intake. Due to the scale of the total energy intake and physical activity measures (making the model estimate appear very small, even if significant), the models used total daily energy intake divided by 1,000 and physical activity divided by 100. Breakfast eating was the main predictor of interest and the other independent variables were included as control variables, thus all effects are reported but only the effect of breakfast is discussed in detail.

**RESULTS**

**Breakfast Consumption in African-American and White Girls Aged 9 to 19 Years**

The frequency of breakfast consumption in the NHLBI Growth and Health Study sample by race and age is reported in Table 1. The number of days breakfast was eaten tended to decrease with increasing age (Wald test of the age main effect in the generalized estimation equation model: χ²[10]=1,579.38, P<.0001). As illustrated in the Figure, at age 9 years, approximately 77% of white girls and 57% of African-American girls ate breakfast on all 3 days, compared with approximately 32% and 22% respectively, by age 19 years. White girls reported greater frequency of breakfast consumption than African-American girls did (χ²[1]=203.42, P<.0001) on all 3 days measured, with the greatest racial difference occurring at age 12 years and differences declining with increasing age (age by race interaction, χ²[10]=19.52, P=.03). Table 2 shows means and standard deviations of the three outcome variables of interest (daily calcium intake, daily fiber intake, and BMI) by age and race. Table 3 summarizes the results of analyses examining the relationships between frequency of breakfast eating and BMI that applies to ages 9 through 19 years. The significance tests reported below were Type III Wald χ² tests. For continuous variables (eg, average daily energy consumed), the null hypothesis is that the coefficient (slope) is 0, whereas for categorical variables (eg, ethnicity), the null hypothesis is that there are no differences among any of the levels of the variable. Age and years eating breakfast were treated as sets of dummy variables, because they may be related to the outcome variables in a nonlinear fashion. In all analyses, the same cohort of girls was compared at different ages. The age comparisons were longitudinal, with the exception that some girls failed to contribute data at some ages due to missing data. To test the hypothesis that breakfast eating was associated with increased calcium and fiber intake and lower BMI, separate generalized estimation equation models were constructed for each outcome. A basic model included the primary variable of interest (days eating breakfast) and adjusted only for site, race, and age, and all two-way interactions. Significant interactions were retained in an expanded model that also adjusted for parental education, physical activity, and total daily energy intake. Due to the scale of the total energy intake and physical activity measures (making the model estimate appear very small, even if significant), the models used total daily energy intake divided by 1,000 and physical activity divided by 100. Breakfast eating was the main predictor of interest and the other independent variables were included as control variables, thus all effects are reported but only the effect of breakfast is discussed in detail.

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eating and calcium, fiber, and BMI. The significance tests reported in Table 3 and discussed here are Type III Wald $\chi^2$ tests. For each outcome, a basic model was first constructed, followed by an expanded, final model. For calcium and fiber intake, only the final models are described, because the variables that were significant in the basic models were also significant in the final ones. In contrast, for BMI, days eating breakfast was only significant in the basic model, therefore both models are described.

**Daily calcium intake.** Frequency of breakfast eating was found to be significantly associated with calcium intake ($\chi^2 [3] = 81.29, P < .0001$). More frequent breakfast eating was associated with higher calcium intake. The greatest difference in average daily calcium intake was found between girls who did not report any breakfast consumption and those eating 3 days of breakfast: girls who ate breakfast on 3 days consumed 75.6 mg more calcium per day than girls who did not eat breakfast on any of the 3 days (adjusted for the other variables in the model). The model adjusted for the potentially confounding effects of race ($\chi^2 [1] = 644.42, P < .0001$), age ($\chi^2 [10] = 30.86, P < .001$), study site ($\chi^2 [2] = 0.74, P = .69$), parental education ($\chi^2 [1] = 14.19, P < .0005$), total energy intake ($\chi^2 [1] = 3035.62, P < .0001$), physical activity ($\chi^2 [1] = 8.34, P < .005$), and the race by site interaction ($\chi^2 [2] = 29.73, P < .0001$).

**Daily fiber intake.** Number of days of eating breakfast was significantly associated with an increase in fiber intake ($\chi^2 [3] = 86.53, P < .001$). More frequent breakfast consumption was associated with more fiber intake, with the greatest difference (adjusted estimate of 1.13 g) between girls who ate breakfast all 3 days and those who reported no breakfast eating. The model adjusted for race ($\chi^2 [1] = 63.05, P < .0001$), age ($\chi^2 [10] = 87.77, P < .0001$), site ($\chi^2 [2] = 93.76, P < .0001$), parental education ($\chi^2 [1] = 70.49, P < .0001$), total energy intake ($\chi^2 [3] = 1666.71, P < .0001$), and physical activity ($\chi^2 [1] = 53.41, P < .0001$), as well as interactions between race and site ($\chi^2 [2] = 10.96, P < .005$), site and age ($\chi^2 [20] = 47.68, P < .0005$), and race and age ($\chi^2 [10] = 105.19, P < .0001$), due to an ethnic difference that increased with age, reflecting the fact that older white girls consumed significantly more fiber than African-American girls did.

**BMI.** In the basic model (adjusting for site, race, age, and the race-by-age and site-by-age interactions), number of days of breakfast consumption was a significant predictor of BMI ($\chi^2 [1] = 14.05, P < .005$). Girls who ate breakfast more consistently had lower BMI. Girls who ate cereal all 3 days had a BMI about 0.1 point lower than did girls who ate cereal 0, 1, or 2 days ($\chi^2$ ranging from 6.21 to 5884.77, $P < .05$).

In the final model, breakfast did not make a significant independent contribution to the prediction of BMI ($\chi^2 [3] = 3.10, P = .38$). The effect of breakfast fell below significance after parental education ($\chi^2 [1] = 16.06, P < .0001$), physical activity ($\chi^2 [1] = 21.00, P < .0001$), and energy intake ($\chi^2 [1] = 12.03, P < .001$) were added to the model. Like the basic model, the final model also included

| Table 1. Frequency of breakfast consumption by age in white and African-American girls in the NHLBI Growth and Health Study |
|---|---|---|---|---|
| Age (y) | White Girls | | African-American Girls | |
|       | 0 Days | 1 Day | 2 Days | 3 Days | 0 Days | 1 Day | 2 Days | 3 Days |
|       | n | % | n | % | n | % | n | % | n | % | n | % |
| 9    | 5 | 0.9 | 23 | 3.9 | 108 | 18.5 | 447 | 76.7 | 11 | 2.5 | 50 | 11.6 | 124 | 28.7 | 247 | 57.2 |
| 10   | 8 | 0.8 | 46 | 4.4 | 191 | 18.4 | 792 | 76.4 | 33 | 3.3 | 120 | 12.0 | 301 | 30.2 | 543 | 54.5 |
| 11   | 22 | 2.4 | 72 | 7.7 | 223 | 23.9 | 617 | 66.1 | 41 | 4.3 | 160 | 16.9 | 284 | 30.1 | 460 | 48.7 |
| 12   | 27 | 3.0 | 99 | 11.0 | 210 | 23.4 | 560 | 62.5 | 94 | 10.2 | 194 | 21.1 | 278 | 30.3 | 353 | 38.4 |
| 13   | 51 | 6.1 | 117 | 14.0 | 227 | 27.2 | 441 | 52.8 | 103 | 11.5 | 225 | 25.1 | 254 | 28.4 | 313 | 35.0 |
| 14   | 35 | 8.8 | 64 | 16.0 | 119 | 29.8 | 181 | 45.4 | 88 | 18.4 | 108 | 22.6 | 147 | 30.8 | 135 | 28.2 |
| 15   | 44 | 9.9 | 68 | 15.3 | 118 | 26.6 | 213 | 48.1 | 53 | 13.7 | 87 | 22.5 | 111 | 28.8 | 135 | 35.0 |
| 16   | 66 | 9.5 | 124 | 17.8 | 192 | 27.5 | 315 | 45.2 | 132 | 17.4 | 201 | 26.6 | 206 | 27.2 | 218 | 28.8 |
| 17   | 41 | 11.4 | 67 | 18.6 | 98 | 27.2 | 154 | 42.8 | 67 | 16.5 | 110 | 27.0 | 111 | 27.3 | 119 | 29.2 |
| 18   | 84 | 17.9 | 112 | 23.9 | 126 | 26.9 | 146 | 31.2 | 108 | 26.5 | 107 | 26.2 | 93 | 22.8 | 100 | 24.5 |
| 19   | 80 | 19.1 | 89 | 21.3 | 116 | 27.8 | 133 | 31.8 | 132 | 24.2 | 155 | 28.4 | 140 | 25.6 | 119 | 21.8 |

*At study entry (the first visit in the NHLBI Growth and Health Study), approximately half of the girls were aged 9 years and half were aged 10 years. The data for 9-year-olds represent the first visit, and the data for age 10 years represent the first visit for approximately half of the girls and the second visit for the remainder. The data for ages 11 years and older represent follow-up visits. Frequency of breakfast consumption was ascertained using 3-day food diaries (covering two weekdays and one weekend day) that were administered in study years 1 through 5, 7, 8, and 10. Breakfast was defined as any eating episode that occurred between 5 AM and 10 AM on weekdays and 5 AM to 11 AM on weekend days.

**Note:**

- Table 3: Type III Wald $\chi^2$ tests for each outcome, adjusted for race, age, and BMI.
- Table 4: Results comparing white and African-American girls.

**DISCUSSION**

There has been increased awareness of the beneficial effects of eating breakfast as a means to promote healthful eating patterns among adolescents. Our results show that breakfast eating decreases with increasing age, frequency of breakfast eating is lower in African-American girls than white girls, and breakfast eating is associated with higher calcium and fiber intake, as well as lower BMI, in a simple model that ignores the potentially confounding effect of total energy intake or physical activity.

The finding of a decrease in breakfast consumption from childhood to adolescence confirms and extends results of previous studies, which demonstrated an overall decline in breakfast intake in adolescents (5,8,13,14). In our study, at age 9 years, only 0.9% of white girls and 2.5% of African-American girls skipped breakfast on all days covered in the dietary assessment. However, by age 19 years, 19.1% of white girls and 24.2% of African-American girls did not eat breakfast on any of the 3 days of the dietary intake record. Our data are consistent with the findings of previous studies indicating that 2% to 17% of young children omit breakfast (13,17) and skipping breakfast ranges from about 15% to 19% among adolescents (13,14), based on 24-hour dietary intake methodology. Future studies are needed to examine the personal, familial, or cultural factors that may contribute to the age-related decline in breakfast eating. For example, experts have attributed this decrease to the increasing autonomy in making food choices and greater accessibility to food as children grow older (19). Other factors may include the earlier start time of school as children enter middle or high school, making it difficult for adolescents to rise early enough to have time for breakfast. Conversely, about a quarter of African-American girls and one third of white girls still reported eating breakfast on all 3 days. Research also needs to focus on factors that might be conducive to maintaining a habit of regular breakfast consumption.

**At a given level of energy intake, those who reported eating breakfast had increased intakes of calcium and fiber.**

A second finding was that African-American girls consistently consumed breakfast less often than white girls did. Previous studies, based on cross-sectional data and, in some cases, much smaller minority samples, also have found similar differences in breakfast consumption, with more white than African-American children or adolescents eating breakfast (5,14-16). Although longitudinal studies have reported a steady decrease in eating breakfast over time (3,13), data were not always examined by race. In one longitudinal study, African-American girls and boys were less likely to omit breakfast, compared with white girls and boys (26). Conflicting findings may be due to sample composition, definitions used, and differences in dietary intake methodologies. Third, our data point to an association between breakfast consumption and nutrient intake. In our study, the frequency of breakfast consumption was positively associated with calcium and fiber intake, offering further evidence of the beneficial influence of breakfast eating on nutrient intake. This association was significant even when adjusting for the potentially confounding effect of total energy intake. At a given level of energy intake, those who reported eating

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**Table 2. White and African-American girls’ daily calcium intake, daily fiber intake, and body mass index (BMI) by age and race in the NHLBI Growth and Health Study**

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Calcium (mg)</th>
<th>Fiber (g)</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Median</td>
<td>Mean±SD(^b)</td>
<td>Median</td>
</tr>
<tr>
<td>10</td>
<td>841.2</td>
<td>889.0±341.7</td>
<td>860.9</td>
</tr>
<tr>
<td>11</td>
<td>842.9</td>
<td>885.7±354.8</td>
<td>719.4</td>
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<tr>
<td>12</td>
<td>828.4</td>
<td>868.9±363.7</td>
<td>636.9</td>
</tr>
<tr>
<td>13</td>
<td>787.7</td>
<td>849.0±396.7</td>
<td>635.2</td>
</tr>
<tr>
<td>14</td>
<td>818.2</td>
<td>865.7±419.7</td>
<td>554.7</td>
</tr>
<tr>
<td>15</td>
<td>796.7</td>
<td>864.6±466.6</td>
<td>593.2</td>
</tr>
<tr>
<td>16</td>
<td>760.2</td>
<td>828.5±410.5</td>
<td>594.8</td>
</tr>
<tr>
<td>17</td>
<td>726.2</td>
<td>825.6±453.5</td>
<td>575.9</td>
</tr>
<tr>
<td>18</td>
<td>756.1</td>
<td>822.1±389.7</td>
<td>589.9</td>
</tr>
<tr>
<td>19</td>
<td>770.4</td>
<td>857.8±493.5</td>
<td>599.2</td>
</tr>
</tbody>
</table>

\(^a\)NHLBI—National Heart, Lung, and Blood Institute.  
\(^b\)SD—standard deviation.
breakfast had increased intakes of calcium and fiber. This finding is most likely due to the types of foods typically eaten at breakfast, such as milk and cereal. Previous research has shown that adolescents who skip breakfast have lower calcium intakes (14,18,27) than those who ate breakfast. The models included total energy intake as a control variable; therefore, the association between breakfast and nutrient intake is not simply a result of breakfast eaters consuming more food and consequently more nutrients. The results indicate that those who consistently eat breakfast tend to have a diet that is relatively rich in calcium and fiber, regardless of the total amount of energy consumed.

Finally, our results suggest that less frequent breakfast consumption is related to increased BMI. Past cross-sectional research has shown that adolescents who skip breakfast have a greater BMI (3,9) compared with those who ate breakfast. Routinely eating breakfast may lead to more regular eating habits and exercise patterns, healthful food choices, and consistent energy intake, which when taken together contribute to a reduced BMI. This is consistent with the finding that breakfast was associated with BMI in a basic model that adjusted for demographic variables, but not in the final model that also controlled for parental education, physical activity, and energy intake. If breakfast influences BMI indirectly, through its association with a healthful lifestyle, then one would expect the independent effect of breakfast to become nonsignificant when key aspects of a healthful lifestyle are taken into account.

Future analyses on breakfast eating patterns will examine specific foods eaten at breakfast and throughout the day by the NHLBI Growth and Health Study subjects. Foods consumed as part of the breakfast meal (eg,
fruit, fortified cereal, whole grains) are particularly likely to be associated with positive health behaviors and may favorably influence total daily nutrient intake.

Our findings need to be viewed in consideration of several limitations. Due to variable annual participation rates, data were not available for all girls through the entire study period. Because varying time periods were used to define the breakfast meal on weekdays and weekends, this may have resulted in missing some eating occasions that may have been viewed as the breakfast meal by subjects. Self-reported dietary intake data are open to reporting biases and errors (28). These weaknesses are offset by several strengths. Our study included a large sample of African-American and white girls recruited across three different geographic areas in the United States. Overall, the NHLBI Growth and Health Study achieved an exceptionally high participant retention rate despite the 9 years of follow-up study. Moreover, the use of a validated (21), 3-day food intake record should lead to more reliable estimates of dietary intake than single-day recalls, which have been used in large surveys (29).

**CONCLUSIONS**

Based on the results of our study, we conclude that skipping breakfast becomes more frequent as children grow older and may predispose adolescent girls to diets that are inadequate in calcium and fiber intake. Also, girls who routinely eat breakfast have a reduced BMI compared with those girls who are infrequent breakfast eaters. Eating breakfast may be associated with healthful behaviors, such as physical activity, which assist in control of body weight.

In community-based settings, dietetics professionals should promote the importance of eating a healthful breakfast meal to children and adolescents, and be aware that African-American girls may be particularly likely to omit breakfast.

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Promoting Meal Consumption among Teens

The dietary intake of most adolescent females fails to meet national nutrition guidelines like the Dietary Guidelines for Americans or the Food Guide Pyramid. Findings from the 1994-1996 Continuing Survey of Food Intakes by Individuals (CSFII) showed that less than 5% of adolescents aged nine to 18 years ate the recommended number of servings from four of the five major food groups as outlined in the Food Guide Pyramid, with only 1% meeting recommendations for all five groups (1). This trend was more pronounced among females than males. Less than 1% of female adolescents met the recommendations for all five food groups and 18% of female teens failed to meet any of the food group recommendations (1).

Predictably, a majority of adolescent females also fail to consume adequate amounts of vitamins and minerals. Nutrient level data from CSFII found that the diets of teens are inadequate in many vitamins and minerals, including folate; vitamins A, B, and E; iron; zinc; and calcium (2). Among teens surveyed in the CSFII, two out of every 10 females met calcium recommendations and only 10% met recommendations for folate (1), a nutrient needed to prevent neural tube defects in developing babies and to help produce red blood cells.

This article was written by Jess Haines, MHSc, RD, doctoral student, and Jamie Stang, PhD, MPH, RD, project director and continuing education specialist, Division of Epidemiology and Community Health, University of Minnesota, Minneapolis. doi: 10.1016/j.jada.2005.04.020

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APPLICATIONS

Promoting Meal Consumption among Teens

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