

# Association of candy consumption with body weight measures, other health risk factors for cardiovascular disease, and diet quality in US children and adolescents: NHANES 1999–2004

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## Abstract

**Objective:** The purpose of this study was to determine the effects of total, chocolate, or sugar candy consumption on intakes of total energy, fat, and added sugars; diet quality; weight/adiposity parameters; and risk factors for cardiovascular disease in children 2–13 years of age ( $n = 7,049$ ) and adolescents 14–18 years ( $n = 4,132$ ) participating in the 1999–2004 National Health and Nutrition Examination Survey.

**Methods:** Twenty-four hour dietary recalls were used to determine intake. Diet quality was determined using the Healthy Eating Index-2005 (HEI-2005). Covariate-adjusted means, standard errors, and prevalence rates were determined for each candy consumption group. Odds ratios were used to determine the likelihood of associations with weight status and diet quality.

**Results:** In younger children, total, chocolate, and sugar candy consumption was  $11.4 \text{ g} \pm 1.61$ ,  $4.8 \text{ g} \pm 0.35$ , and  $6.6 \text{ g} \pm 0.46$ , respectively. In adolescents, total, chocolate, and sugar candy consumption was  $13.0 \text{ g} \pm 0.87$ ,  $7.0 \text{ g} \pm 0.56$ , and  $5.9 \text{ g} \pm 0.56$ , respectively. Total candy consumers had higher intakes of total energy ( $2248.9 \text{ kcal} \pm 26.8$  vs  $1993.1 \text{ kcal} \pm 15.1$ ,  $p < 0.0001$ ) and added sugars ( $27.7 \text{ g} \pm 0.44$  vs  $23.4 \text{ g} \pm 0.38$ ,  $p < 0.0001$ ) than non-consumers. Mean HEI-2005 score was not different in total candy and sugar candy consumers as compared to non-consumers, but was significantly lower in chocolate candy consumers ( $46.7 \pm 0.8$  vs  $48.3 \pm 0.4$ ,  $p = 0.0337$ ). Weight, body mass index (BMI), waist circumference, percentiles/z-score for weight-for-age and BMI-for-age were lower for candy consumers as compared to non-consumers. Candy consumers were 22 and 26%, respectively, less likely to be overweight and obese than non-candy consumers. Blood pressure, blood lipid levels, and cardiovascular risk factors were not different between total, chocolate, and sugar candy consumers and non-consumers (except that sugar candy consumers had lower C-reactive protein levels than non-consumers).

**Conclusion:** This study suggests that candy consumption did not adversely affect health risk markers in children and adolescents.

**Keywords:** children; adolescents; candy; chocolate; sugar candy; added sugars; discretionary calories; nutrient intake; dietary adequacy; health risk factors; healthy eating index; NHANES

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The prevalence of overweight and obesity in pediatric populations remains high; in 2007–2008, 16.9% of children were obese (Body Mass Index [BMI]-for-age percentile  $\geq 95$ ) and 31.7% of children were overweight (BMI-for-age percentile  $\geq 85$  to  $< 95$ ) (1). No statistically significant linear trends in high BMI

were found over the time periods 1999–2000, 2001–2002, 2003–2004, 2005–2006, and 2007–2008 except among the heaviest males 6–19 years of age. Current cutoffs for BMI in children can be used as an indication of adiposity (2).

Obesity in children increases the risk of diseases previously seen mostly in adults, including hyperlipidemia

(3), hypertension (3), metabolic syndrome (4), and type 2 diabetes (4). Overweight children also suffer from diminished health-related quality of life (5), bullying/teasing (6), and low self-esteem (7). Body mass index and waist circumference (WC) can also identify children and adolescents with a clustering of cardiovascular risk factors (8). Although studies are contradictory, overweight in children may serve as a harbinger of adult disease (9). Overweight/obesity in childhood tracks into adulthood (10). Thus, it is important to understand the factors associated with pediatric obesity.

One factor that may contribute to excess energy intake is the consumption of discretionary calories (11, 12). The 2005 Dietary Guidelines for Americans (DGA) included a recommendation for discretionary calories that were defined as the difference between energy requirements and essential energy needed to meet recommended intakes (13). The concept of discretionary calories was translated into MyPyramid recommendations for consumers (14). The maximum number of discretionary calories recommended ranges from 100 to 300 kcals depending on age, gender, and physical activity level. The Healthy Eating Index-2005 (HEI) (15), which measures diet quality and adherence to the 2005 DGA, also includes discretionary calories. Solid fats, alcohol, and added sugars (AS) are major sources of discretionary calories. The 2010 Dietary Guidelines Advisory Committee, however, suggested moving away from the concept of discretionary calories (16). Regardless, candy is a food source of calories.

Intake of candy in US children is not well defined. Bachman et al. (17), did not provide the absolute intake of candy but showed using data from the National Health and Nutrition Examination Survey (NHANES) 2001–2002 that candy was the fifth highest contributor of AS to the diet (6.2% of total AS) and was the sixth highest contributor of oils (4.6% of total oils). In 2008, per capita domestic disappearance of all candy/confectionery products was 21.7 pounds (18). Per capita food availability data do not account for waste in the marketing system or the home; thus, data typically overestimate actual consumption. Candy has been shown to be the second most frequently purchased category of items (21.3% of all items) by children from ‘corner stores’ (19). It has also been shown that the percentage of children consuming candy fell from 94% in 1973 to 71% in 1994, and that in that time, the gram amount of candy consumed fell from 45 g to approximately 35 g (20).

Candy consumption has been associated with dental caries in children (21, 22), although caries development is dependent on factors other than just fermentable carbohydrate substrate in the mouth. These include oral hygiene, dental care, and fluoride use (23, 24). The effect of candy on weight and other health indicators is not well

established, although it is intuitive that candy consumption would be positively associated with weight. Consumption of ‘sweets,’ including, but not limited to candy, has been shown to be positively associated with weight (25) in children. In contrast, candy intake was inversely associated with weight in a longitudinal study of Swedish children (26). The goal of this study was to examine further the association between intake of candy and weight/adiposity, diet quality, and health risk indicators using a nationally representative sample of children.

## Subjects and methods

### *Study population*

Data from children and adolescents 2–18 years of age ( $n=11,182$ ) participating in the NHANES 1999–2000, 2001–2002, and 2003–2004 were combined for these analyses to increase sample size. Groups excluded from the analyses were females who were pregnant and/or lactating ( $n=91$ ), and those with 24-hour recall data judged to be incomplete or unreliable by the USDA's Food Surveys Research Group. This study was exempted by the Louisiana State University Agricultural Center's Institutional Review Board.

### *Collection of dietary intake data*

Dietary intake data were obtained from in-person 24-hour dietary recall interviews administered using an automated multiple-pass method (27, 28). Parents/guardians of children 2–5 years provided the 24-hour dietary recalls; children (6–11 years) were assisted by an adult; and all others provided their own recall. For data collection years 1999–2002, only a single 24-hour dietary recall was collected. Beginning in 2003–2004, two 24-hour dietary recalls were collected; however, to ensure consistency within this study only data from the in-person interview (first recall) were used. Descriptions of the dietary interview methods are provided in the NHANES Dietary Interviewer's Training Manual; these include pictures of the Computer-Assisted Dietary Interview system screens, measurement guides, and charts that were used to collect dietary information (29).

### *Candy consumption and nutrient intake data*

The survey food codes in USDA 1994–1998 Survey Nutrient Database (30) and the Food and Nutrient Database for Dietary Studies (FNDDS), Versions 1.0 (31) and 2.0 (32) were used in NHANES 1999–2002 and 2003–2004, respectively, to determine intake of candy. Candy consumers were defined as those participants consuming any amounts of candy/confection except gum and were placed in one of three consumption groups: (a) any candy/confection (chocolate candy, sugar candy), (b) chocolate candy only, and (c) sugar candy

only. To assess intake of energy, total fat, saturated fatty acids (SFA), and AS, the Food and Nutrient Database for Dietary Studies, versions 1 (31) and 2 (32) were used in NHANES, 2001–2002 and 2003–2004, respectively. The USDA 1994–1998 Survey Nutrient Database was used to process the dietary interview data in NHANES 1999–2000 (30).

#### *The healthy eating index (HEI-2005)*

The HEI-2005 was used to determine diet quality (15, 33, 34). The SAS code used to calculate HEI-2005 scores was downloaded from the Center for Nutrition Policy and Promotion website (35).

#### *Physiologic measures*

Height and weight were obtained according to NHANES protocols (36). Body Mass Index was calculated as body weight (kilogram) divided by height (meters) squared. The percentile and *z*-score of BMI-for-age was calculated using the Statistical Analysis Software (SAS) program for Growth Charts available from the Centers for Disease Control and Prevention (CDC) (37). Overweight was defined as a gender-and-specific BMI between the 85th and <95th percentile and obese was defined as a BMI  $\geq$  95th percentile (38). Several measures of weight and adiposity were used in this study to look at the reliability in the results. The measures included BMI, BMI-percentile of weight for age, BMI-percentile of BMI for age, BMI *z*-score of BMI for age, *z*-score of weight for age, and triceps skinfolds.

Waist circumference (36), blood pressure (39), laboratory values of serum lipids (40), and other cardiovascular risk factors were determined according to NHANES protocols.

#### *Statistical analysis*

Sample-weighted data were used and all analyses were performed using SAS and SUDAAN Release 9.0.1 (Research Triangle Institute, Research Triangle Park, NC) to adjust the variance for the complex sample design. For the years 1999–2004, a 6-year weight variable was created by assigning two-thirds of the 4-year weight for 1999–2002 if the person was sampled in 1999–2002 and assigning one-third of the 2-year weight for 2003–2004 if the person was sampled in 2003–2004. The 6-year sample weights were used in analyses of intake, body measurements, blood pressure, and laboratory data.

Analyses of health parameters were adjusted for gender, ethnicity, age, and other relevant covariates (see footnote in tables for specifics). For certain analyses, self-reported exercise levels were used as a covariate; when inclusion of exercise in the regression models reduced the significance of the relationship of candy consumption with dependent variables of interest, the relationship was

considered attenuated. Logistic regression was used to assess the risk of lower HEI-2005 scores, overweight, and obesity for candy consumers and non-consumers. Data are presented as means  $\pm$  standard errors, and a *p*-value of  $<0.05$  was deemed significant. To further evaluate the association of candy intake with food/nutrient intake and health, we used methods of Huang et al. (41) to determine implausible energy intakes and certain analyses were re-run to assess the impact of eliminating subjects with energy intakes too high or too low as related to expected energy requirements.

## **Results**

#### *Demographics*

Table 1 shows the demographics of the sample for children 2–13 years ( $n=7,049$ ) and adolescents 14–18 years ( $n=4,132$ ). In children, a higher percentage of females than males consumed total candy ( $p=0.0024$ ); there was also a race/ethnicity difference among total candy ( $p=0.0064$ ), chocolate candy ( $p=0.0125$ ), and sugar candy ( $p=0.0001$ ) consumers compared with non-consumers. Chocolate candy consumers were also older ( $8.0 \pm 1.6$  vs  $7.6 \pm 0.05$  years,  $p=0.0222$ ) than non-chocolate consumers. In adolescents, a higher percentage of females than males consumed total candy ( $p=0.0007$ ), chocolate candy ( $p=0.0024$ ), and sugar candy ( $p=0.0234$ ). There was a race/ethnicity difference among total ( $p<0.0001$ ), chocolate ( $p=0.0064$ ), and sugar candy ( $p=0.0001$ ) consumers when compared with non-consumers.

#### *Candy consumption*

In children 2–13 years, the total ( $11.4 \text{ g} \pm 1.61$  vs  $35.2 \text{ g} \pm 1.4$ ), chocolate ( $4.8 \text{ g} \pm 0.35$  vs  $35.8 \text{ g} \pm 1.7$ ), and sugar ( $6.6 \text{ g} \pm 0.46$  vs  $29.0 \text{ g} \pm 1.3$ ) candy consumption for the total population and candy consumers only, respectively (Table 2). In adolescents, per capita and candy consumer intake was  $13.0 \text{ g} \pm 0.87$  vs  $46.2 \text{ g} \pm 1.4$ ,  $7.0 \text{ g} \pm 0.56$  vs  $48.4 \text{ g} \pm 2.0$ , and  $5.9 \text{ g} \pm 0.56$  vs  $36.1 \text{ g} \pm 3.2$  for total candy, chocolate candy, and sugar candy, respectively (Table 2).

#### *Nutrient intake and HEI-2005 scores*

Total candy consumers had higher intakes of energy ( $2248.9 \text{ kcal} \pm 26.8$  vs  $1993.1 \text{ kcal} \pm 15.1$ ,  $p<0.0001$ ) and AS ( $27.7 \pm 0.44$  vs  $23.4 \pm 0.38$ ,  $p<0.0001$ ) than non-consumers (Table 3). Chocolate candy consumers had higher intakes of energy ( $2333.8 \text{ kcal} \pm 52.2$  vs  $2031.2 \text{ kcal} \pm 13.3$ ,  $p<0.0001$ ), total fat ( $79.0 \text{ g} \pm 0.85$  vs  $75.2 \text{ g} \pm 0.40$ ,  $p=0.0001$ ), SFA ( $28.8 \text{ g} \pm 0.37$  vs  $26.5 \text{ g} \pm 0.16$ ,  $p<0.0001$ ), and AS ( $27.7 \text{ g} \pm 0.71$  vs  $24.3 \text{ g} \pm 0.34$ ,  $p<0.0001$ ) than non-consumers. Sugar candy consumers had higher intakes of energy ( $2254.3 \pm 29.4$  vs  $2024.4 \pm 13.4$ ,  $p<0.0001$ ) and AS ( $28.4 \pm 0.51$  vs  $23.8 \pm 0.34$ ,

**Table 1.** Demographics of total, chocolate, and sugar candy consumers and non-consumers 2–13 years and 14–18 years: National Health and Nutrition Examination Survey 1999–2004

| Age group          | Total candy-gum            |                                |                 | Chocolate candy            |                                |                 | Sugar candy                |                                |                 |
|--------------------|----------------------------|--------------------------------|-----------------|----------------------------|--------------------------------|-----------------|----------------------------|--------------------------------|-----------------|
|                    | Consumers<br>Mean $\pm$ SE | Non-consumers<br>Mean $\pm$ SE | <i>p</i> -value | Consumers<br>Mean $\pm$ SE | Non-consumers<br>Mean $\pm$ SE | <i>p</i> -value | Consumers<br>Mean $\pm$ SE | Non-consumers<br>Mean $\pm$ SE | <i>p</i> -value |
| <i>2–13 years</i>  |                            |                                |                 |                            |                                |                 |                            |                                |                 |
| Numbers            | <i>n</i> = 2,234           | <i>n</i> = 4,815               |                 | <i>n</i> = 857             | <i>n</i> = 6,192               |                 | <i>n</i> = 1,594           | <i>n</i> = 5,455               |                 |
| Gender             |                            |                                | 0.0024          |                            |                                | 0.4983          |                            |                                | 0.9928          |
| Males              | 41.1 $\pm$ 3.4             | 52.7 $\pm$ 1.1                 |                 | 49.3 $\pm$ 2.9             | 51.3 $\pm$ 0.88                |                 | 51.3 $\pm$ 2.2             | 51.0 $\pm$ 0.92                |                 |
| Females            | 58.9 $\pm$ 3.4             | 47.3 $\pm$ 1.1                 |                 | 50.7 $\pm$ 2.9             | 48.7 $\pm$ 0.88                |                 | 48.8 $\pm$ 2.2             | 49.0 $\pm$ 0.92                |                 |
| Race/ethnicity     |                            |                                | 0.0064          |                            |                                | 0.0125          |                            |                                | 0.0001          |
| NH-White           | 71.8 $\pm$ 2.6             | 70.8 $\pm$ 2.1                 |                 | 76.7 $\pm$ 2.8             | 68.8 $\pm$ 2.0                 |                 | 69.8 $\pm$ 2.4             | 68.8 $\pm$ 2.1                 |                 |
| NH-Black           | 18.6 $\pm$ 2.2             | 16.2 $\pm$ 1.5                 |                 | 11.8 $\pm$ 1.8             | 17.2 $\pm$ 1.7                 |                 | 18.9 $\pm$ 2.0             | 15.7 $\pm$ 1.6                 |                 |
| Mexican Hispanic   | 9.6 $\pm$ 1.7              | 13.0 $\pm$ 1.6                 |                 | 11.4 $\pm$ 1.8             | 15.0 $\pm$ 1.6                 |                 | 11.3 $\pm$ 1.5             | 15.5 $\pm$ 1.7                 |                 |
| Age (years)        | 7.8 $\pm$ 0.10             | 7.6 $\pm$ 0.05                 | 0.0619          | 8.0 $\pm$ 0.16             | 7.6 $\pm$ 0.05                 | 0.0222          | 7.8 $\pm$ 0.11             | 7.6 $\pm$ 0.05                 | 0.1077          |
| % $\leq$ PIR 1.85  | 46.9 $\pm$ 3.2             | 44.7 $\pm$ 2.0                 | 0.5474          | 48.3 $\pm$ 3.5             | 51.2 $\pm$ 1.7                 | 0.4245          | 47.6 $\pm$ 2.6             | 51.7 $\pm$ 1.7                 | 0.1155          |
| <i>14–18 years</i> |                            |                                |                 |                            |                                |                 |                            |                                |                 |
| Numbers            | <i>n</i> = 1,224           | <i>n</i> = 2,908               |                 | <i>n</i> = 587             | <i>n</i> = 3,545               |                 | <i>n</i> = 745             | <i>n</i> = 3,387               |                 |
| Gender             |                            |                                | 0.0007          |                            |                                | 0.0024          |                            |                                | 0.0234          |
| Males              | 44.2 $\pm$ 2.2             | 53.6 $\pm$ 1.2                 |                 | 41.1 $\pm$ 3.4             | 52.7 $\pm$ 1.1                 |                 | 45.0 $\pm$ 2.8             | 52.1 $\pm$ 1.2                 |                 |
| Females            | 55.8 $\pm$ 2.2             | 46.4 $\pm$ 1.2                 |                 | 58.9 $\pm$ 3.4             | 47.3 $\pm$ 1.1                 |                 | 55.0 $\pm$ 2.8             | 47.9 $\pm$ 1.2                 |                 |
| Race/ethnicity     |                            |                                | <0.0001         |                            |                                | 0.0064          |                            |                                | 0.0001          |
| NH-White           | 67.8 $\pm$ 2.3             | 72.3 $\pm$ 2.1                 |                 | 71.8 $\pm$ 2.6             | 70.8 $\pm$ 2.1                 |                 | 64.7 $\pm$ 2.6             | 72.3 $\pm$ 2.0                 |                 |
| NH-Black           | 20.9 $\pm$ 2.2             | 14.8 $\pm$ 1.5                 |                 | 18.6 $\pm$ 2.2             | 16.2 $\pm$ 1.5                 |                 | 23.6 $\pm$ 2.5             | 15.2 $\pm$ 1.5                 |                 |
| Mexican Hispanic   | 11.4 $\pm$ 1.5             | 12.9 $\pm$ 1.6                 |                 | 9.6 $\pm$ 1.7              | 13.0 $\pm$ 1.6                 |                 | 11.7 $\pm$ 1.6             | 12.6 $\pm$ 1.6                 |                 |
| Age (years)        | 16.0 $\pm$ 0.06            | 16.0 $\pm$ 0.03                | 0.9551          | 16.1 $\pm$ 0.9             | 16.0 $\pm$ 0.03                | 0.1726          | 15.9 $\pm$ 0.07            | 16.0 $\pm$ 0.04                | 0.4047          |
| % $\leq$ PIR 1.85  | 46.3 $\pm$ 2.3             | 44.5 $\pm$ 2.1                 | 0.5184          | 46.9 $\pm$ 3.2             | 44.7 $\pm$ 2.0                 | 0.5474          | 44.4 $\pm$ 2.6             | 45.1 $\pm$ 1.9                 | 0.8021          |

Data are presented as sample-weighted means  $\pm$  SD.

Abbreviations: NH, non-Hispanic; PIR, poverty income ratio.

**Table 2.** Mean amount of candy consumed in grams by children 2–13 years and adolescents 14–18 years in candy consumption groups

| Age group   | Total candy |             | Chocolate candy |            | Sugar candy |            |
|-------------|-------------|-------------|-----------------|------------|-------------|------------|
|             | Consumers   | Per capita  | Consumers       | Per capita | Consumers   | Per capita |
| 2–13 years  | 35.2 ± 1.4  | 11.4 ± 1.61 | 35.8 ± 1.7      | 4.8 ± 0.35 | 29.0 ± 1.3  | 6.6 ± 0.46 |
| Number      | 2,234       | 7,049       | 857             | 7,049      | 1,594       | 7,049      |
| 14–18 years | 46.2 ± 2.2  | 13.0 ± 0.87 | 48.4 ± 2.0      | 7.0 ± 0.56 | 36.1 ± 3.2  | 5.9 ± 0.56 |
| Number      | 1,224       | 4,132       | 587             | 4,132      | 745         | 4,132      |

Data are presented as sample-weighted means ± SD and numbers.

$p < 0.0001$ ), and lower intakes of total fat ( $72.8 \pm 0.55$  vs  $76.4 \pm 0.43$ ,  $p < 0.0001$ ) and SFA ( $25.6 \pm 0.28$  vs  $27.1 \pm 0.17$ ,  $p < 0.0001$ ) than non-consumers.

Mean HEI-2005 score was not different in total candy or sugar candy consumers as compared to non-consumers. However, the mean HEI-2005 score was significantly lower in chocolate candy consumers as compared to non-consumers ( $46.7 \pm 0.8$  vs  $48.3 \pm 0.4$ ,  $p = 0.0337$ ) (Table 3). Results using reduced data set eliminating implausible intake provided similar results to those above.

#### Anthropometrics, blood pressure, and laboratory values

Mean adjusted levels of adiposity measures by candy consumption category are presented in Table 4. Total candy consumers had a significantly lower weight ( $42.1 \text{ kg} \pm 0.32$  vs  $43.5 \text{ kg} \pm 0.27$ ;  $p = 0.0001$ ), BMI ( $19.5 \pm 0.12$  vs  $20.1 \pm 0.10$ ;  $p < 0.0001$ ), WC ( $67.7 \text{ cm} \pm 0.35$  vs  $68.9 \text{ cm} \pm 0.28$ ;  $p = 0.0001$ ), triceps skinfolds ( $13.6 \text{ mm} \pm 0.25$  vs  $14.0 \text{ mm} \pm 0.13$ ;  $p = 0.0334$ ), percentiles/z-scores for weight-for-age ( $59.1 \pm 0.71$  vs  $63.5 \pm 0.77$ ,  $0.35 \pm 0.03$  vs  $0.51 \pm 0.03$ , respectively; both  $p < 0.0001$ ), and percentiles/z-scores for BMI-for-age ( $57.8 \pm 0.92$  vs  $62.7 \pm 0.76$ ,  $0.28 \pm 0.03$  vs  $0.47 \pm 0.03$ ; both  $p < 0.0001$ ) than non-consumers. Weight, BMI, and WC analyses were re-run adjusting for self-reported moderate/vigorous or vigorous physical activity and this did not change the results (data not shown). Chocolate candy consumers had a lower weight ( $41.9 \text{ kg} \pm 0.46$  vs  $43.3 \text{ kg} \pm 0.27$ ,  $p = 0.0147$ ), shorter stature ( $140.1 \text{ cm} \pm 0.29$  vs  $141.0 \text{ cm} \pm 0.17$ ,  $p = 0.0295$ ), lower WC ( $67.8 \text{ cm} \pm 0.42$  vs  $68.6 \text{ cm} \pm 0.29$ ,  $p = 0.0448$ ), and lower percentile BMI-for-age ( $58.9 \pm 1.3$  vs  $61.6 \pm 0.79$ ,  $p = 0.0352$ ) than non-consumers. Sugar candy consumers had a lower weight ( $41.9 \text{ kg} \pm 0.39$  vs  $43.4 \text{ kg} \pm 0.25$ ,  $p = 0.0004$ ), BMI ( $19.5 \pm 0.13$  vs  $20.1 \pm 0.10$ ,  $p < 0.0001$ ), WC ( $67.6 \text{ cm} \pm 0.38$  vs  $68.8 \text{ cm} \pm 0.27$ ,  $p = 0.0004$ ), triceps skinfold ( $13.5 \text{ mm} \pm 0.28$  vs  $14.0 \text{ mm} \pm 0.14$ ,  $p = 0.0356$ ), and percentile/z-score for BMI-for-age ( $58.7 \pm 1.3$  vs  $62.8 \pm 0.99$ ,  $p = 0.0167$ ;  $0.31 \pm 0.05$  vs  $0.48 \pm 0.03$ ,  $p = 0.0164$ , respectively) than non-consumers.

There were no differences in children regarding the likelihood to have a high quality diet, defined by HEI (80th percentile or better), among all three groups of candy consumers and non-consumers (Table 5). Using

CDC growth charts to assess weight status, candy consumers were 22% less likely ( $p < 0.0001$ ) to be overweight and 26% less likely to be obese ( $p < 0.0001$ ) than non-consumers (Table 5). Sugar candy consumers were 21% less likely ( $p = 0.0015$ ) to be overweight and 20% less likely to be obese ( $p = 0.0150$ ) than non-consumers.

The only physiologic parameter that was different was a lower C-reactive protein level of sugar candy consumers and non-consumers ( $0.12 \text{ mg/dL} \pm 0.01$  vs  $0.15 \text{ mg/dL} \pm 0.01$ ,  $p = 0.0085$ ) (Table 6).

#### Discussion

These data showed that nearly 32% of children and 30% of adolescents reported consuming candy the day of the recall. These figures are much lower than those shown in the Bogalusa Heart Study (BHS) (20) potentially showing that candy consumption decreased from 1993–1994 to 1999–2004. That study, which also used 24-hour diet recall methodology, showed that in 1973–1974, 94% of 10-year-old children consumed candy and in 1993–1994, 71% of 10-year-old children consumed candy. In that study, the diets of children of one age only were examined, a limited geographic range was examined, and participants were limited to black/white. Although we were unable to find a study examining geographic differences in candy intake in children, a recent study of adults showed that energy intake from candy was higher in Southeast Louisiana than in Los Angeles County (12). Additional studies assessing geographic variation in candy consumption are needed.

Consumption of candy in this study was modest. There are few studies with which to compare these results. For the BHS study, Nicklas et al. (20) showed that in 1973–1974, intake in 10-year-old children was 45.0 g and in 1993–1994, intake was 34.8 g; however, it was not clear if this was per capita consumption or reflected the intake of consumers only. Dietary data were obtained using 24-hour recalls; although the multiple pass method used in NHANES provides more accurate data than other recall methods (27, 28), over- and under-reporting may still occur. Individuals may selectively under-report foods generally known to be high in fats, carbohydrates, and sugars (42). Foods with a ‘negative health image’ may be



**Table 3.** Covariate-adjusted mean daily intake of energy, total, and saturated fatty acids, added sugars and healthy eating index by consumption of candy type in children 2–18 years of age: NHANES 1999–2004

| Nutrients <sup>a</sup>        | Total candy-gum                       |   |         | Chocolate candy                       |   |         | Sugar candy                           |   |         |
|-------------------------------|---------------------------------------|---|---------|---------------------------------------|---|---------|---------------------------------------|---|---------|
|                               | Consumers<br>(n = 3,458)<br>Mean ± SE | Non-consumers<br>(n = 7,724)<br>Mean ± SE | p-value | Consumers<br>(n = 1,444)<br>Mean ± SE | Non-consumers<br>(n = 9,737)<br>Mean ± SE | p-value | Consumers<br>(n = 2,339)<br>Mean ± SE | Non-consumers<br>(n = 8,842)<br>Mean ± SE | p-value |
| Energy (kcal) <sup>a</sup>    | 2248.9 ± 26.8                         | 1993.1 ± 15.1                             | <0.0001 | 2333.8 ± 52.2                         | 2031.2 ± 13.3                             | <0.0001 | 2254.3 ± 29.4                         | 2024.4 ± 13.4                             | <0.0001 |
| Energy (kJ) <sup>a</sup>      | 9415.7 ± 112.2                        | 8344.7 ± 63.2                             | <0.0001 | 9771.2 ± 218.6                        | 8504.2 ± 55.7                             | <0.0001 | 9438.3 ± 123.1                        | 8475.8 ± 56.1                             | <0.0001 |
| Total fat (g) <sup>b</sup>    | 75.2 ± 0.52                           | 75.9 ± 0.47                               | 0.2799  | 79.0 ± 0.85                           | 75.2 ± 0.40                               | 0.0001  | 72.8 ± 0.55                           | 76.4 ± 0.43                               | <0.0001 |
| SFA (g) <sup>b</sup>          | 26.8 ± 0.27                           | 26.8 ± 0.17                               | 0.8799  | 28.8 ± 0.37                           | 26.5 ± 0.16                               | <0.0001 | 25.6 ± 0.28                           | 27.1 ± 0.17                               | <0.0001 |
| Added Sugars (g) <sup>b</sup> | 27.7 ± 0.44                           | 23.4 ± 0.38                               | <0.0001 | 27.7 ± 0.71                           | 24.3 ± 0.34                               | <0.0001 | 28.4 ± 0.51                           | 23.8 ± 0.34                               | <0.0001 |
| HEI <sup>b</sup>              | 47.4 ± 0.58                           | 48.3 ± 0.36                               | 0.1009  | 46.7 ± 0.79                           | 48.3 ± 0.35                               | 0.0337  | 47.5 ± 0.59                           | 48.2 ± 0.36                               | 0.1879  |

Data are presented as sample-weighted means ± SE using PROC DESCRIPT of SUDDAN.

Abbreviations: Kcal, kilocalories; kJ, kilojoule; g, gram; SFA, saturated fatty acids; HEI, healthy eating index.

<sup>a</sup>Adjusted for gender, ethnicity, and age.

<sup>b</sup>Adjusted for gender, ethnicity, age, and energy.

subject to higher levels of under-reporting than other foods (43). Since candy is a food potentially influenced by reporting errors, individuals with implausible intakes (41) were excluded from the data set and the reported relationships remained.

This study showed that in total, chocolate, and sugar candy consumers, total energy intake was higher when compared with non-consumers. Using nationally representative data sets, from 1977 to 2006, energy from candy consumed as snacks by children increased from 5.7 to 8.5%, although values were modest when compared with other snack foods such as desserts and sweetened beverages (44). Despite the higher intake of energy by candy consumers, consumption was not associated with higher levels of any weight parameter, but was associated with a lower risk of overweight and obesity. Future studies should include assessment of overall dietary and physical activity patterns of candy consumers, but longitudinal studies are needed to understand more fully the relationship between higher energy intake and its association with weight in candy consumers.

The Institute of Medicine (IOM) recommends that the population consume no more than 25% of energy from AS (45). Overall, candy consumers also had higher intakes of AS than non-consumers; however, mean energy from AS in consumers of total, chocolate, and sugar candy was only 4.9%, 4.7%, and 6.3%, respectively. Candy contributed very low levels of AS to the diet.

The IOM recommendation for AS was based, in part, on the finding that AS in excess of 25% showed the greatest decline in micronutrient dilution (45). The majority of studies have suggested that consumption of foods high in AS were associated with poor overall diet quality (46–50), whereas two reviews have failed to provide conclusive evidence that AS affects diet quality (51, 52). Overall, diet quality in this study was very poor in all groups, whether or not candy was consumed. Diet quality was lower only in chocolate candy consumers. This may be because of the increased intake of SFA, a component in calculating the HEI-2005 (15), in chocolate candy consumers. That SFA intake was higher in chocolate candy consumers was not surprising since SFA are found in higher proportions than unsaturated fatty acids in cocoa butter. Cacao seeds contain a significant amount of fat (40–50% as cocoa butter) (53), but the fat content of chocolate candy is influenced not only by the percentage of cacao solids but by addition of other ingredients, e.g. milk or cream (54).

The higher SFA intake may also be of concern from a standpoint of changes in serum lipid levels or other biomarkers of cardiovascular disease; however, recent evidence has questioned the role of SFA as a risk factor in heart disease (55). Children are less likely than adults to have lipid derangements; however, with the increasing levels of overweight and obesity in children, lipid levels

**Table 4.** Covariate-adjusted mean anthropometric measures in children 2–18 years of age by consumption of candy type

| Measure                                    | Total candy              |                              |         | Chocolate candy          |                              |         | Sugar candy              |                              |         |
|--|--------------------------|------------------------------|---------|--------------------------|------------------------------|---------|--------------------------|------------------------------|---------|
|  | Consumers<br>(n = 3,458) | Non-consumers<br>(n = 7,724) | p-value | Consumers<br>(n = 1,444) | Non-consumers<br>(n = 9,737) | p-value | Consumers<br>(n = 2,339) | Non-consumers<br>(n = 8,842) | p-value |
|  | Mean ± SE                | Mean ± SE                    |         | Mean ± SE                | Mean ± SE                    |         | Mean ± SE                | Mean ± SE                    |         |
| Weight (kg) <sup>a</sup>                   | 42.1 ± 0.32              | 43.5 ± 0.27                  | 0.0001  | 41.9 ± 0.46              | 43.3 ± 0.27                  | 0.0147  | 41.9 ± 0.39              | 43.4 ± 0.25                  | 0.0004  |
| Height (cm) <sup>a</sup>                   | 141.0 ± 0.16             | 140.8 ± 0.18                 | 0.4863  | 140.1 ± 0.29             | 141.0 ± 0.17                 | 0.0295  | 141.2 ± 0.22             | 140.8 ± 0.16                 | 0.0537  |
| BMI (kg/m <sup>2</sup> ) <sup>a</sup>      | 19.5 ± 0.12              | 20.1 ± 0.10                  | <0.0001 | 19.6 ± 0.16              | 20.0 ± 0.10                  | 0.0537  | 19.5 ± 0.13              | 20.1 ± 0.10                  | <0.0001 |
| WC (cm) <sup>a</sup>                       | 67.7 ± 0.35              | 68.9 ± 0.28                  | 0.0001  | 67.8 ± 0.42              | 68.6 ± 0.29                  | 0.0448  | 67.6 ± 0.38              | 68.8 ± 0.27                  | 0.0004  |
| Triceps SF (mm) <sup>a</sup>               | 13.6 ± 0.25              | 14.0 ± 0.13                  | 0.0334  | 14.0 ± 0.27              | 13.8 ± 0.15                  | 0.4405  | 13.5 ± 0.28              | 14.0 ± 0.14                  | 0.0356  |
| Percentile for weight-for-age <sup>b</sup> | 59.1 ± 0.71              | 63.5 ± 0.77                  | <0.0001 | 59.8 ± 1.3               | 62.5 ± 0.79                  | 0.0792  | 61.5 ± 1.7               | 63.6 ± 0.89                  | 0.2582  |
| z-score for weight-for-age <sup>b</sup>    | 0.35 ± 0.03              | 0.51 ± 0.03                  | <0.0001 | 0.38 ± 0.04              | 0.47 ± 0.03                  | 0.1071  | 0.43 ± 0.06              | 0.51 ± 0.04                  | 0.2645  |
| Percentile BMI-for-age <sup>b</sup>        | 57.8 ± 0.92              | 62.7 ± 0.76                  | <0.0001 | 58.9 ± 1.3               | 61.6 ± 0.79                  | 0.0352  | 58.7 ± 1.3               | 62.8 ± 0.99                  | 0.0167  |
| z-score for BMI-for-age <sup>b</sup>       | 0.28 ± 0.03              | 0.47 ± 0.03                  | <0.0001 | 0.31 ± 0.05              | 0.43 ± 0.03                  | 0.0522  | 0.31 ± 0.05              | 0.48 ± 0.03                  | 0.0164  |

Source: NHANES 1999–2004, 2–18 years of age, excluding pregnant/lactating females <http://www.cdc.gov/nchs/nhanes.htm>.

Abbreviations: SE, Standard Error; kg, kilogram; cm, centimeter; m, meter; BMI, body mass index; WC, waist circumference; SF, skinfold.

<sup>a</sup>Adjusted for gender, ethnicity, age, and energy.

<sup>b</sup>Adjusted for gender, ethnicity, and energy.

Table 5. Odds ratios for Healthy Eating Index and overweight/obesity by consumption of all types of candy

|                         | Total candy-gum   |                   |         | Chocolate candy   |                   |         | Sugar candy       |                   |         |
|-------------------------|-------------------|-------------------|---------|-------------------|-------------------|---------|-------------------|-------------------|---------|
|                         | Consumers         | Non-consumers     | p-value | Consumers         | Non-consumers     | p-value | Consumers         | Non-consumers     | p-value |
|                         | (n = 3,458)       | (n = 7,724)       |         | (n = 1,444)       | (n = 9,737)       |         | (n = 2,339)       | (n = 8,842)       |         |
| Measure <sup>a</sup>    | OR (95% CI)       | OR (95% CI)       |         | OR (95% CI)       | OR (95% CI)       |         | OR (95% CI)       | OR (95% CI)       |         |
| HEI                     | 0.87 (0.71, 1.08) | 1.00 (1.00, 1.00) | 0.1979  | 0.94 (0.71, 1.23) | 1.00 (1.00, 1.00) | 0.6377  | 0.86 (0.70, 1.06) | 1.00 (1.00, 1.00) | 0.1456  |
| Overweight <sup>b</sup> | 0.78 (0.68, 0.90) | 1.00 (1.00, 1.00) | <0.0001 | 0.83 (0.66, 1.03) | 1.00 (1.00, 1.00) | 0.0876  | 0.79 (0.69, 0.91) | 1.00 (1.00, 1.00) | 0.0015  |
| Obese <sup>c</sup>      | 0.74 (0.66, 0.82) | 1.00 (1.00, 1.00) | <0.0001 | 0.85 (0.62, 1.17) | 1.00 (1.00, 1.00) | 0.3166  | 0.80 (0.66, 0.95) | 1.00 (1.00, 1.00) | 0.0150  |

Source: NHANES 1999–2004, 2–18 years of age, excluding pregnant/lactating females <http://www.cdc.gov/nchs/nhanes.htm>.

Abbreviations: OR, odds ratio, CI, confidence interval; HEI, Healthy Eating Index.

<sup>a</sup>Adjusted for gender, ethnicity, age, and energy.

<sup>b</sup>Overweight = ≥85th percentile < 95th percentile.

<sup>c</sup>Obese = ≥95th percentile.

and other cardiovascular risk factors have become of concern in pediatric populations (56). Palmitic and stearic acids constitute the main types of SFA (57) in cocoa butter. Stearic acid is unique among saturated fats in that it is not associated with the low density lipoprotein cholesterol raising potential of other SFA (58, 59). Diet can influence lipid levels in children (60), so it would not have been surprising to find that consumption of chocolate candy modified lipid levels in children. However, unlike studies with adults that have shown that chocolate consumption may improve lipid profiles (61–63), no differences were seen in any lipid markers. These findings may have resulted from the relatively small sample size for chocolate consumers or the type of chocolate consumed, since dark chocolate with a high cacao content or cocoa is associated with the greatest improvement in lipids (64, 65).

Limitations

NHANES is a cross-sectional study; thus, cause and effect associations cannot be drawn. Twenty-four hour dietary recalls have several inherent limitations. They may not reflect usual intake and they depend on memory. Parents/guardians reported or assisted with the 24-hour recalls of children 2–11 years of age; whereas parents often report accurately what children eat at home, (66) but may not know what their children eat outside the home (67) that could result in reporting errors (68). In children and adolescents, a greater degree of under-reporting has been shown as relative adiposity increased (69, 70), which may have accounted for the results. To help obviate this potential problem, implausible energy intakes were deleted from the data set (41). Finally, chocolate candies were combined into a single group; thus, potential effects of dark chocolate could not be assessed.

Conclusions

This study showed that approximately one-third of children and adolescents consumed candy the day of the recall and that candy consumption was associated with higher intakes of energy and added sugars; chocolate candy consumption was also associated with higher total and SFA intake. Total, chocolate, and sugar candy consumption was not associated with weight/adiposity variables and candy consumers were less likely to be overweight or obese than non-candy consumers. Only chocolate candy consumers had a lower diet quality than non-consumers, but all individuals had poor diet quality regardless of whether they consumed candy. Current levels of candy consumption were not associated with adverse health parameters in children or adolescents.



**Table 6.** Adjusted mean physiologic measures for total candy-gum, chocolate candy, and sugar candy consumers 2–18 years

| Measure                          | n     | Total candy-gum |               |         | Chocolate candy |               |         | Sugar candy  |               |         |
|----------------------------------|-------|-----------------|---------------|---------|-----------------|---------------|---------|--------------|---------------|---------|
|                                  |       | Consumers       | Non-consumers | p-value | Consumers       | Non-consumers | p-value | Consumers    | Non-consumers | p-value |
| SBP, mmHg <sup>a</sup>           | 7,581 | 105.8 ± 0.40    | 106.3 ± 0.32  | 0.2759  | 105.3 ± 0.53    | 106.3 ± 0.29  | 0.0827  | 105.9 ± 0.47 | 106.2 ± 0.31  | 0.5250  |
| DBP, mmHg <sup>a</sup>           | 7,581 | 59.7 ± 0.48     | 59.3 ± 0.32   | 0.4349  | 60.1 ± 0.58     | 59.3 ± 0.29   | 0.1292  | 59.8 ± 0.53  | 59.4 ± 0.31   | 0.3299  |
| HDL-C, mg/dL <sup>b</sup>        | 2,835 | 54.9 ± 0.82     | 53.0 ± 0.73   | 0.0707  | 54.6 ± 1.4      | 53.4 ± 0.63   | 0.4487  | 55.2 ± 0.84  | 53.2 ± 0.70   | 0.0797  |
| LDL-C, mg/dL <sup>b</sup>        | 3,826 | 92.4 ± 1.0      | 93.3 ± 0.71   | 0.3924  | 93.7 ± 1.5      | 92.8 ± 0.70   | 0.5692  | 92.5 ± 1.3   | 93.1 ± 0.65   | 0.6295  |
| TG, mg/dL <sup>a</sup>           | 3,840 | 87.2 ± 2.0      | 91.3 ± 2.1    | 0.1174  | 86.2 ± 2.9      | 90.6 ± 1.9    | 0.2165  | 88.1 ± 2.3   | 90.4 ± 1.8    | 0.3286  |
| Serum folate, ng/mL <sup>c</sup> | 9,140 | 16.4 ± 0.23     | 16.1 ± 0.20   | 0.1395  | 16.4 ± 0.31     | 16.1 ± 0.19   | 0.3578  | 16.3 ± 0.26  | 16.1 ± 0.20   | 0.4172  |
| Folate, RBC, ng/mL <sup>c</sup>  | 9,233 | 267.9 ± 2.6     | 268.2 ± 2.4   | 0.8994  | 267.1 ± 4.4     | 268.3 ± 2.0   | 0.7808  | 266.7 ± 2.2  | 268.5 ± 2.4   | 0.4881  |
| Homocysteine, µg/mL <sup>c</sup> | 5,835 | 5.2 ± 0.05      | 5.3 ± 0.05    | 0.4283  | 5.2 ± 0.08      | 5.3 ± 0.04    | 0.7684  | 5.2 ± 0.07   | 5.3 ± 0.04    | 0.3110  |
| CRP, mg/dL <sup>d</sup>          | 9,226 | 0.15 ± 0.02     | 0.14 ± 0.01   | 0.6099  | 0.20 ± 0.04     | 0.14 ± 0.01   | 0.1492  | 0.12 ± 0.01  | 0.15 ± 0.01   | 0.0085  |

Source: NHANES 1999–2004, ages 2–18 years of age, excluding pregnant/lactating females <http://www.cdc.gov/nchs/nhanes.htm>.

Abbreviations: Kg, kilograms; cm, centimeters; BMI, Body Mass Index; m, meters; WC, waist circumference; SF, skinfold; mm, millimeter; SBP, systolic blood pressure; Hg, mercury; DBP, diastolic blood pressure; HDL-C, high density lipoprotein-cholesterol; mg, milligram; dL, deciliter; LDL-C, low density lipoprotein-cholesterol; TG, triglycerides; RBC, red blood cell; ng, nanogram; mL, milliliter; µg, microgram; CRP, C-reactive protein.

<sup>a</sup>Adjusted for gender, ethnicity, age, BMI, and energy.

<sup>b</sup>Adjusted for gender, ethnicity, age, BMI, energy, and saturated fatty acids and cholesterol intake.

<sup>c</sup>Adjusted for gender, ethnicity, age, BMI, energy, folate, and vitamins B6 and B12.

<sup>d</sup>Adjusted for gender, ethnicity, age, and energy.

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