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Candy consumption was not associated with body weight measures, risk factors for cardiovascular disease, or metabolic syndrome in US adults: NHANES 1999-2004

Carol E. O'Neil[a,*], Victor L. Fulgoni III[b], Theresa A. Nicklas[c]

[a]*School of Human Ecology, Louisiana State University Agricultural Center, Baton Rouge, LA 70803, USA*
[b]*Senior Vice President, Nutrition Impact, LLC, Battle Creek, MI 49014, USA*
[c]*USDA/ARS Children's Nutrition Research Center, Department of Pediatrics, Baylor College of Medicine, Houston, TX 77030, USA*

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Abstract

There is limited research examining the relationship of candy consumption by adults on diet and health. The purpose of this study was to determine total, chocolate, or sugar candy consumption and their effect on energy, saturated fatty acid and added sugar intake, weight, risk factors for cardiovascular disease, metabolic syndrome (MetS), and diet quality in adults 19 years and older (n = 15 023) participating in the 1999-2004 National Health and Nutrition Examination Survey. Twenty-four-hour dietary recalls were used to determine intake. Covariate-adjusted means ± SE and prevalence rates were determined for candy consumption groups. Odds ratios were used to determine the likelihood of cardiovascular risk factors and MetS. A total of 21.8%, 12.9%, and 10.9% of adults consumed total, chocolate, and sugar candy, respectively. Mean daily per capita intake of total, chocolate, and sugar candy was 9.0 ± 0.3, 5.7 ± 0.2, and 3.3 ± 0.2 g, respectively; intake in consumers was 38.3 ± 1.0, 39.9 ± 1.1, and 28.9 ± 1.3 g, respectively. Energy (9973 ± 92 vs 9027 ± 50 kJ; $P < .0001$), saturated fatty acid (27.9 ± 0.26 vs 26.9 ± 0.18 g; $P = .0058$), and added sugar (25.7 ± 0.42 vs 21.1 ± 0.41 g; $P < .0001$) intake were higher in candy consumers than nonconsumers. Body mass index (27.7 ± 0.15 vs 28.2 ± 0.12 kg/m^2; $P = .0092$), waist circumference (92.3 ± 0.34 vs 96.5 ± 0.29 cm; $P = .0051$), and C-reactive protein (0.40 ± 0.01 vs 0.43 ± 0.01 mg/dL; $P = .0487$) levels were lower in candy consumers than nonconsumers. Candy consumers had a 14% decreased risk of elevated diastolic blood pressure ($P = .0466$); chocolate consumers had a 19% decreased risk of lower high-density lipoprotein cholesterol ($P = .0364$) and a 15% reduced risk of MetS ($P = .0453$). Results suggest that the current level of candy consumption was not associated with health risks.

Keywords: Candy; Chocolate; Sugar Candy; Nutrient Intake; Diet Quality; Health Risk Factors; Metabolic Syndrome; Healthy Eating Index; Adults; NHANES

Abbreviations: AS, added sugars; BP, blood pressure; BMI, body mass index; CRP, C-reactive protein; HEI, Healthy Eating Index; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MetS, metabolic syndrome; MEC, Mobile Examination Centers; NHANES, National Health and Nutrition Examination Survey; SFA, saturated fatty acids; USDA, US Department of Agriculture; WC, waist circumference.

1. Introduction

The term *candy* comes from the Arabic *qandi* or a sugar confection. In the United States, it is a general term for delicacies that are sweet; although in other countries, the word has different connotations. The 2 major categories of

* Corresponding author. Tel.: +1 225 578 1631; fax: +1 225 578 4443.
E-mail address: coneil1@lsu.edu (C.E. O'Neil).

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candy in the United States are sugar candy and chocolate candy. Sugar candy consists of sugar in crystalline form or semisolid (amorphous) forms with other ingredients including flavors and colors; examples include peppermint, lollipops, licorice, and gum drops. Chocolate candy is a mixture of processed cacao, cocoa butter, and sugar and often contains other ingredients, including milk, fruit, nuts, and caramels. There are a variety of types of chocolate candy ranging from milk chocolate, semisweet or bittersweet chocolate, to unsweetened chocolate [1]. Types of chocolates include varying amounts of chocolate liquor, cocoa butter, sugar, and milk. Cocoa may also be used in the preparation of chocolate candies, for example, in chocolate truffles. White chocolate is made from cocoa butter, milk, and sugar but does not contain nonfat cocoa solids [2].

Candy is a source of added sugars (AS) and, for some candies, such as chocolate, a source of solid fat [3]. Recommended amounts of AS vary; for adults, the Institute of Medicine recommends that the population consume no more than 25% of energy from AS [4]; the World Health Organization recommends no more than 10% of energy come from AS [5]; and the American Heart Association recommends that for women and men, no more than 419 and 628 kJ, respectively, come from AS each day [6]. Several recent reviews have looked at the strength of the evidence on the association between intakes of AS or sweetened beverages on total energy intake [7], diet quality [8,9], and adverse health conditions, including dental caries [10,11], overweight and obesity [12], cardiovascular risk factors [13-16], and cancer [17,18]. The Institute of Medicine, based on the available data, concluded there was insufficient evidence to set an upper limit for AS [4].

Intake of candy in US adults is not well defined. In 2008, per capita domestic disappearance of candy and other confectionery products was 21.7 lb [19]. Data from the United States Department of Agriculture (USDA) Nationwide Food Consumption Survey 1987-1988 showed that 11% of the US population reported consuming chocolate candy on at least one of the 3 days of recorded food intake, but less than 1.0% consumed chocolate every day [20]. Bachman et al [21], using data from the National Health and Nutrition Examination Survey (NHANES) 2001-2002, showed that candy was the fifth highest contributor of AS to the diet with 6.2% of the total and the sixth highest contributor of oils with 4.6% of the total. Marriott et al [22], using NHANES 2003-2006 data, showed that across 8 categories of AS intake, nutrient intake was less with each 5% increase in AS intake above 5% to 10%; however, they did not specifically look at candy consumption. Nutrients at most risk for inadequacy based on the Estimated Average Requirements were vitamins E, A, C, and magnesium; these were identified as shortfall nutrients in adults by the 2005 Dietary Guidelines Advisory Committee [23].

A single study in the literature was found that examined the association of candy consumption by adults with diet and health [24]. That study showed candy consumers had a higher body mass index (BMI) and ate more red meat, vegetables, and green salads. That study did not differentiate between sugar and chocolate candy. Consumption of chocolate or cocoa has been shown to be associated with decreased cardiovascular risk factors [25-28] and lower all-cause mortality [29]. Little is known about the overall effect that candy consumption has on diet quality, cardiovascular risk factors, or metabolic syndrome (MetS) in adults. The purpose of this study was to determine the association of candy consumption with nutrient intake, diet quality, weight status, cardiovascular risk factors, and MetS in US adults.

2. Methods and materials

2.1. Study population

Data from adults 19 years and older (n = 15 023) participating in the NHANES 1999-2000, 2001-2002, and 2003-2004 were combined for these analyses. The data sets from these 3 release cycles were concatenated to increase sample size. Groups excluded from the analyses were women who were pregnant or lactating (n = 949) and those with 24-hour recall data that the Food Surveys Research group judged to be incomplete or unreliable (n = 785). Age, sex, race, ethnicity, and other demographics were collected on the participants during the interview in the Mobile Examination Centers (MEC). The NHANES has stringent protocols that ensure confidentiality to protect participants from identification [30]. Because these analyses used secondary data, which lacked personal identifiers, this study was exempted by the Louisiana State University Agricultural Center (Baton Rouge, La, USA) Institutional Review Board.

2.2. 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 [31,32]. For data collection years, 1999-2002, only a single 24-hour dietary recall was collected. Although 2 24-hour dietary recalls were collected in 2003-2004, 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 [33].

2.3. Candy consumption and nutrient intake data

Individual food codes in NHANES 1999-2000, 2001-2002, and 2003-2004 were used to determine intake of candy. Candy consumers were defined as those participants consuming any amounts of candy/confection except gum and were placed in 1 of 3 overlapping consumption groups: (*a*) any candy (including chocolate candy and sugar candy), (*b*) chocolate candy only, and (*c*) sugar candy only. To assess nutrient intake, the Food and Nutrient Database for Dietary Studies, versions 1 [34] and 2 [35], 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 [36]. The MyPyramid Equivalents Database for USDA Survey Food Codes, versions 1.0 [37] and 2.0 [38], was used in NHANES 1999-2002 and 2003-2004, respectively, to determine intake of food groups and AS.

2.4. The Healthy Eating Index (2005)

The Healthy Eating Index (HEI)–2005 was used to determine diet quality [39]. The HEI-2005 contains 12 food components that reflect the recommendations of the 2005 Dietary Guidelines for Americans. Dietary intake is expressed per 1000 kilocalories for all components except saturated fatty acids (SFA) and sodium, which are fixed recommendations. The maximum possible score was 100. The Statistical Analysis Software code used to calculate HEI-2005 scores was downloaded from the Center for Nutrition Policy and Promotion Web site [40].

2.5. Physiologic measures

Physiologic measures and collection of fasting blood samples were taken in the MEC. Height and weight were obtained according to NHANES protocols [41]. Briefly, standing height (in centimeters) was measured with a fixed stadiometer with a vertical backboard and a moveable headboard. Weight (measured in pounds and automatically converted to kilograms) was measured using a Toledo digital scale (Mettler-Toledo, Inc., Columbus, Ohio, USA) with participants wearing only underwear, a paper gown, and foam slippers; results are presented in kilograms. Body mass index was calculated as body weight (kilograms) divided by height (meters) squared [42]. Waist circumference (WC) [41] was measured at the midaxillary line of the body to the nearest 0.1 cm; results are presented in centimeters. Triceps skinfold measurements were taken at the midpoint of the right upper arm using calipers to the nearest 0.1 mm [41]; results are presented in millimeters. Blood pressure (BP) [43] was taken in a sitting position using the right arm; results are presented in millimeters of mercury.

All laboratory values were measured using NHANES protocols and procedures. Triglycerides [44] were measured enzymatically in subjects who had fasted between 8.5 and 24 hours. High-density lipoprotein cholesterol (HDL-C) levels were determined spectrometrically [45]. Low-density lipoprotein cholesterol (LDL-C) levels were calculated according to the Friedewald formula [46]: [LDL-C] = [total cholesterol] − [HDL-C] − [triglycerides/5]. Results of all lipid levels are presented in milligram per deciliter. Participants that were examined in the morning session only had fasting glucose levels determined using the enzyme hexokinase method [47], and C-reactive protein (CRP) levels were determined using latex-enhanced nephelometry [47]; both sets of values are presented in milligram per deciliter. Serum and red blood cell folate levels were determined using Bio-Rad Laboratories "Quantaphase II Folate/Vitamin B12" radioassay kits (Bio-Rad Laboratories, Diagnostics Group, Hercules, Calif, USA) [48], and results are presented in nanogram per deciliter. Homocysteine levels were determined using a fluorescence polarization immunoassay from Abbott Diagnostics (Abbott Park, Ill, USA) [49]; results are presented in microgram per milliliter. Self-reported exercise, used as a covariate in several of the analyses, was determined through questionnaire response [50].

Metabolic syndrome was defined using the National Heart Lung and Blood Institute Adult Treatment Panel III criteria [51], that is, having 3 or more of the following risk factors: abdominal obesity, WC >102 cm (men), >88 cm (women); hypertension, systolic BP ≥130 mm Hg or diastolic BP ≥85 mm Hg; low HDL-C, <40 mg/dL (men), <50 mg/dL (women); high triglycerides, ≥150 mg/dL; and high fasting glucose, ≥110 mg/dL.

2.6. Statistical analyses

Sample-weighted data were used, and all analyses were performed using SAS Release 9.2 (SAS Institute, Cary, NC) and SUDAAN Release 9.0.1 (Research Triangle Institute, Research Triangle Park, NC) to adjust the variance for the complex sample design. For the 6 years of 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 or assigning one third of the 2-year weight for 2003-2004 if the person was sampled in 2003-2004. The MEC-examined sample weight was used in analyses of intake, body measurements, BP, and laboratory data, but a fasted sample weight was used in analyses of LDL-C, triglycerides, plasma glucose, and MetS.

Analyses of health parameters were adjusted for sex, ethnicity, age, and other relevant covariates (see footnotes in tables for specifics). Covariates were used if they could affect the analyses. For example, the prevalence of hypertension varies by race [52]; thus, race was used as a covariate in analyses of BP.

Logistic regression, was used to determine if candy consumers had a lower odds ratio of having low HDL-C (<40 mg/dL in men and <50 mg/dL in women), elevated fasting triglycerides (≥150 mg/dL), elevated fasting blood glucose (≥110 mg/dL), increased waist size (>102 cm in men and >88 cm in women), and elevated BP. High levels of LDL-C (≥100 mg/dL) were also assessed. Data are presented as means ± SE, and $P < .05$ was deemed significant. For certain analyses, self-reported exercise levels were used as a covariate; when inclusion of exercise in regression models reduced the significance of the relationship of candy consumption with dependent variables of interest, the relationship was considered attenuated. To further evaluate the association of candy intake with food/nutrient intake and health, the methods of Huang et al [53] were used to determine implausible energy intakes, and certain analyses were rerun to assess impact of eliminating subjects with energy intakes too high or too low as related to expected energy requirements.

3. Results

3.1. Consumption

Candy consumers (n = 3091), defined as those consuming any amounts of candy, constituted 21.8% of the population (Table 1). Chocolate (n = 1831) and sugar (n = 1547) candy consumers constituted 12.9% and 10.9% of the population, respectively. There were significant differences in the percentages of consumers of total, chocolate, and sugar candy between sexes and among ethnicities, with women and non-Hispanic whites having the highest prevalence.

Mean per capita intake of total candy, chocolate only, and sugar candy only for individuals 19+ years was 9.0 ± 0.3, 5.7 ± 0.2. and 3.3 ± 0.2 g, respectively. Among consumers, the mean intake for total candy, chocolate only, and sugar candy only for individuals 19+ years was 38.3 ± 1.0, 39.9 ± 1.1, and 28.9 ± 1.3 g, respectively (data not shown). Mean per capita intake of total candy, chocolate only, and sugar candy only for individuals 19 to 50 years was 9.8 ± 0.4, 6.4 ± 0.3, and 3.5 ± 0.3 g, respectively. The mean intake of total candy, chocolate only, and sugar candy only by individuals 51 years and older was 7.3 ± 0.4, 4.6 ± 0.3, and 3.1 ± 0.2 g, respectively. Among consumers, the mean intake for total candy, chocolate only, and sugar candy only for individuals 19 to 50 years was 41.8 ± 1.5, 43.8 ± 1.3, and 30.3 ± 2.0 g, respectively, and for those 51 years and older was 32.0 ± 1.3, 33.0 ± 1.5, 26.6 ± 1.5 g, respectively.

3.2. Nutrient intake and HEI

Total energy intake (9973 ± 92 vs 9027 ± 50 kJ; P < .0001), SFA (27.9 ± 0.26 vs 26.9 ± 0.18 g; P = .0058), and AS (25.7 ± 0.42 vs 21.1 ± 0.41 g; P < .001) were significantly higher in candy consumers than nonconsumers (Table 2). Chocolate candy consumers had higher energy (10 061 ± 109 vs 9110 ± 50 kJ; P < .001), total fat (86.2 ± 0.83 vs 82.1 ± 0.42 g; P = .001), SFA (29.5 ± 0.34 vs 26.8 ± 0.17 g; P < .001), and AS (25.4 ± 0.59 vs 21.7 ± 0.38 g; P < .001) intakes than nonconsumers. Sugar candy consumers had higher energy (9935 ± 126 vs 9157 ± 46 kJ; P < .0001) and AS (26.7 ± 0.58 vs 21.6 ± 0.38 g; P < .0001) intakes and lower total fat (79.2 ± 0.80 vs 83.1 ± 0.40 g; P < .0001) and SFA (25.9 ± 0.34 vs 27.3 ± 0.16 g; P = .004) intakes than nonconsumers. Only in sugar candy consumers, HEI was significantly lower (49.4 ± 0.45 vs 50.3 ± 0.33; P = .0319) than nonconsumers, although change was less than 1 point (<2%), and both groups had "poor" quality diets.

3.3. Anthropometrics, BP, and laboratory values

Candy consumers, 19 years and older, had significantly lower weight (79.5 ± 0.44 vs 80.7 ± 0.31 kg; P = .0339), BMI (27.7 ± 0.15 vs 28.2 ± 0.12kg/m^2; P = .0092), WC (95.3 ± 0.34 vs 96.5 ± 0.29 cm; P = .0051) and CRP levels (0.40 ± 0.01 vs 0.43 ± 0.01 mg/dL; P = .0487) as compared with nonconsumers (Table 3). Relative to nonconsumers, chocolate candy consumers had significantly lower weight (78.8 ± 0.64 vs 80.7 ± 0.29 kg; P = .0096), WC (95.0 ± 0.48 vs 96.5 ± 0.27 cm), triglyceride levels (132.1 ± 3.4 vs 149.9 ± 3.2 mg/dL; P = .0002), and CRP levels (0.38 ± 0.02 vs 0.43 ± 0.01 mg/dL; P = .0174); chocolate candy consumers also had significantly higher HDL-C levels (55.0 ± 0.69 vs 53.4 ± 0.42 mg/dL; P = .0187) than nonconsumers. Adult consumers of sugar candy had significantly lower weight (79.1 ± 0.64 vs 80.6 ± 0.30 kg; P = .0449), BMI (27.6 ± 0.21 vs 28.1 ± 0.11 kg/m^2; P = .0290), and WC (94.8 ± 0.49 vs 96.4 ± 0.27 cm; P = .0065) than nonconsumers. Moderate (or vigorous) physical activity did not influence results in total and sugar candy but did attenuate association with body weight in chocolate candy consumers.

Table 4 shows the odds ratios of cardiovascular risk factors and MetS. Total candy consumption was associated

Table 1
Demographics of total, chocolate, and sugar candy consumers and nonconsumers 19 years and older (n = 15023): NHANES 1999-2004

Variable	Total candy			Chocolate candy			Sugar candy		
	Consumers (n = 3091) (21.8%)	Nonconsumers (n = 11101) (78.2%)	P	Consumers (n = 1831) (12.9%)	Nonconsumers (n = 12362) (87.1%)	P	Consumers (n = 1547) (10.9%)	Nonconsumers (n = 12646) (89.1%)	P
	Mean ± SE	Mean ± SE		Mean ± SE	Mean ± SE		Mean ± SE	Mean ± SE	
Sex			<.0001			.0029			<.0001
Male	41.7 ± 1.04	49.9 ± 0.52		43.7 ± 1.34	48.7 ± 0.49		38.2 ± 1.03	49.2 ± 0.47	
Female	58.3 ± 1.04	50.1 ± 0.52		56.3 ± 1.34	51.3 ± 0.49		61.8 ± 1.03	50.8 ± 0.47	
Ethnicity			.0001			<.0001			.0005
Non-Hispanic white	83.3 ± 1.61	78.8 ± 1.45		85.32 ± 1.76	78.89 ± 1.41		81.57 ± 1.64	79.62 ± 1.48	
Non-Hispanic black	10.4 ± 1.22	12.5 ± 1.14		8.48 ± 1.04	12.63 ± 1.15		12.27 ± 1.53	11.98 ± 1.11	
Mexican Hispanic	6.33 ± 1.07	8.71 ± 1.05		6.20 ± 1.29	8.48 ± 1.02		6.16 ± 0.96	8.4 ± 1.06	
Age (y)	45.6 ± 0.47	45.8 ± 0.28	.5928	45.8 ± 0.57	45.8 ± 0.29	.9749	45.7 ± 0.66	45.8 ± 0.28	.8419
% ≤ PIR 1.85	36.2 ± 1.09	38.8 ± 1.09	.0306	35.17 ± 1.26	38.68 ± 1.26	.0190	36.01 ± 1.63	38.46 ± 1.23	.1036

Data are presented as sample-weighted percentages ± SE for sex, ethnicity, and PIR. Age in years is presented as sample-weighted means ± SE using PROC DESCRIPT of SUDAAN.
http://www.cdc.gov/nchs/nhanes.htm.
PIR indicates poverty income ratio.

Table 2
Covariate-adjusted mean daily intake of energy, total and saturated fatty acids, AS, and healthy eating index by consumption of candy type in adults 19 years and older (n = 15023): NHANES 1999-2004

Nutrients [a]	Total candy			Chocolate candy			Sugar candy		
	Consumers (n = 3279)	Nonconsumers (n = 10914)	*P*	Consumers (n = 1831)	Nonconsumers (n = 12362)	*P*	Consumers (n = 1547)	Nonconsumers (n = 12646)	*P*
	Mean ± SE	Mean ± SE		Mean ± SE	Mean ± SE		Mean ± SE	Mean ± SE	
Food energy (kcal) [a]	2383 ± 22	2156 ± 12	<.0001	2403 ± 26	2176 ± 12	<.0001	2373 ± 30	2187 ± 11	<.0001
Food energy (kJ) [a]	9973 ± 92	9027 ± 50	<.0001	10061 ± 109	9110 ± 50	<.0001	9935 ± 126	9157 ± 46	<.0001
Total fat (g) [b]	83.2 ± 0.67	82.5 ± 0.42	.3828	86.2 ± 0.83	82.1 ± 0.42	.0001	79.2 ± 0.80	83.1 ± 0.40	<.0001
SFA (g) [b]	27.9 ± 0.26	26.9 ± 0.18	.0058	29.5 ± 0.34	26.8 ± 0.17	<.0001	25.9 ± 0.34	27.3 ± 0.16	.0004
AS [b]	25.7 ± 0.42	21.1 ± 0.41	<.0001	25.4 ± 0.59	21.7 ± 0.38	<.0001	26.7 ± 0.58	21.6 ± 0.38	<.0001
HEI [b]	49.9 ± 0.36	50.3 ± 0.34	.1650	50.0 ± 0.48	50.3 ± 0.32	.5707	49.4 ± 0.45	50.3 ± 0.33	.0319

SFA indicates saturated fatty acids; AS, added sugars; HEI, Healthy Eating Index.
Data are presented as sample weighted means ± SE using PROC DESCRIPT of SUDAAN. http://www.cdc.gov/nchs/nhanes.htm.
[a] Adjusted for sex, ethnicity, and age.
[b] Adjusted for sex, ethnicity, age, and food energy.

with a 14% decreased risk of elevated diastolic BP (*P* = .0466); chocolate only consumption was associated with a 19% decreased risk of lower HDL-C (*P* = .0364) and a 15% reduced risk of MetS (*P* = .0453). Sugar candy consumption was not associated with an increased risk of any risk factor examined.

4. Discussion

These data showed that the percentage of adults that reported consumption of candy was relatively low (~20%) and that the amounts of any candy consumed were low (9 g/d per capita and 38 g/d for consumers only). Per capita consumption figures are lower than the actual availability of candy and confectionery products in 2008; availability was 21.7 lb per person [19]. Per capita food availability data are used as a proxy for actual food intake or consumption because these data do not account for waste that accumulates in the distribution system and what is discarded in the home; these data typically overestimate actual consumption [54].

Intake data were obtained using 24-hour recalls; although the multiple-pass method used in NHANES provides more accurate data than other recall methods [33,34], over-reporting and underreporting may still occur. Individuals may selectively underreport foods generally known to be high in fats, carbohydrates, and sugars [55,56]. Social desirability may also influence the underreporting of foods

Table 3
Adjusted mean anthropometric and physiologic measures for total candy-gum, chocolate candy, and sugar candy consumers 19 years and older (n = 15023): NHANES 1999-2004

Measure	N	Total candy			Chocolate candy			Sugar candy		
		Consumers	Nonconsumers	*P*	Consumers	Nonconsumers	*P*	Consumers	Nonconsumers	*P*
Weight (kg) [a]	13049	79.5 ± 0.44	80.7 ± 0.31	.0339	78.8 ± 0.64	80.7 ± 0.29	.0096	79.1 ± 0.64	80.6 ± 0.30	.0449
Height (cm) [a]	13027	169.2 ± 0.15	169.1 ± 0.11	.5497	168.4 ± 0.30	169.2 ± 0.14	.0176	169.0 ± 0.21	169.1 ± 0.09	.7743
BMI (kg/m^2) [a]	12937	27.7 ± 0.15	28.2 ± 0.12	.0092	27.7 ± 0.21	28.1 ± 0.11	.0735	27.6 ± 0.21	28.1 ± 0.11	.0290
WC (cm) [a]	12822	95.3 ± 0.34	96.5 ± 0.29	.0051	95.0 ± 0.48	96.5 ± 0.27	.0067	94.8 ± 0.49	96.4 ± 0.27	.0065
Triceps SKF (mm) [a]	11931	18.9 ± 0.18	19.1 ± 0.13	.2487	19.4 ± 0.27	19.0 ± 0.14	.2342	19.0 ± 0.27	19.1 ± 0.11	.6313
SBP (mm Hg) [b]	12507	122.6 ± 0.42	123.2 ± 0.35	.1294	122.2 ± 0.55	123.2 ± 0.33	.0899	122.6 ± 0.50	123.1 ± 0.33	.2974
DBP (mm Hg) [b]	12507	72.0 ± 0.29	72.0 ± 0.25	.9588	72.0 ± 0.34	72.0 ± 0.25	.9615	71.6 ± 0.51	72.0 ± 0.23	.4128
HDL-C (mg/dL) [c]	4175	54.2 ± 0.76	53.5 ± 0.46	.2937	55.0 ± 0.69	53.4 ± 0.42	.0187	54.8 ± 1.2	53.5 ± 0.45	.2832
LDL-C (mg/dL) [c]	5482	120.2 ± 1.5	120.9 ± 0.87	.7018	118.6 ± 1.6	121.1 ± 0.77	.1360	122.7 ± 1.9	120.5 ± 0.82	.2967
TG (mg/dL) [b]	5641	144.4 ± 5.8	148.1 ± 3.0	.5452	132.1 ± 3.4	149.9 ± 3.2	.0002	156.9 ± 11.4	145.8 ± 2.7	.3443
Serum folate (ng/mL) [d]	12337	14.6 ± 0.24	14.6 ± 0.22	.9884	14.5 ± 0.33	14.6 ± 0.21	.6675	14.7 ± 0.32	14.6 ± 0.21	.5997
Folate, RBC (ng/mL) [d]	12414	300.4 ± 3.5	297.6 ± 3.1	.3781	295.9 ± 4.2	298.7 ± 3.1	.5209	307.7 ± 4.9	297.1 ± 3.0	.0247
Homocysteine (μg/mL) [d]	8157	8.8 ± 0.15	8.8 ± 0.08	.8855	8.9 ± 0.17	8.7 ± 0.08	.1746	8.6 ± 0.22	8.8 ± 0.08	.2918
CRP (mg/dL) [a]	12630	0.40 ± 0.01	0.43 ± 0.01	.0487	0.38 ± 0.02	0.43 ± 0.01	.0174	0.40 ± 0.02	0.42 ± 0.01	.2624

Data are presented as sample-weighted means ± SE using PROC REGRESS of SUDAAN.
SKF indicates skinfold thickness measurement; SBP, systolic BP; DBP, diastolic BP; TG, triglycerides; RBC, red blood cell.
[a] Adjusted for sex, ethnicity, age, and food energy.
[b] Adjusted for sex, ethnicity, age, body mass index, and food energy.
[c] Adjusted for sex, ethnicity, age, body mass index, food energy, and SFA and cholesterol intake.
[d] Adjusted for sex, ethnicity, age, body mass index, food energy, folate, and vitamins B6 and B12.

Table 4
The association of consumption of total candy-gum, chocolate candy, and sugar candy on the risks of MetS risk components, metabolic syndrome, and low LDL-C levels in adults 19 years and older (n = 15023): NHANES 1999-2004

Variable	Total candy			Chocolate candy			Sugar candy		
	Consumers	Nonconsumers	P	Consumers	Nonconsumers	P	Consumers	Nonconsumers	P
Elevated systolic BP risk [a]	0.96 (0.84, 1.10)	1.00	.5679	0.97 (0.81, 1.17)	1.00	.7629	0.93 (0.80, 1.09)	1.00	.3577
Elevated diastolic BP risk [b]	0.86 (0.74, 1.00)	1.00	.0466	0.85 (0.70, 1.02)	1.00	.0776	0.84 (0.69, 1.03)	1.00	.0900
Elevated BP risk [c]	0.96 (0.84, 1.08)	1.00	.4673	0.94 (0.79, 1.11)	1.00	.4544	0.95 (0.82, 1.09)	1.00	.4553
Lower HDL-C risk [d]	0.90 (0.77, 1.06)	1.00	.1999	0.81 (0.66, 0.99)	1.00	.0364	1.04 (0.84, 1.29)	1.00	.6857
Elevated TG risk [e]	0.94 (0.78, 1.13)	1.00	.4902	0.86 (0.71, 1.05)	1.00	.1267	1.05 (0.83, 1.31)	1.00	.6852
Elevated fasting glucose risk [f]	0.98 (0.75, 1.28)	1.00	.8761	0.97 (0.70, 1.33)	1.00	.8406	1.01 (0.73, 1.40)	1.00	.9350
Increased WC risk [g]	0.92 (0.81, 1.04)	1.00	.1858	0.93 (0.82, 1.06)	1.00	.2686	0.88 (0.73, 1.06)	1.00	.1682
Metabolic syndrome risk [h]	0.90 (0.78, 1.04)	1.00	.1533	0.85 (0.73, 1.00)	1.00	.0453	0.97 (0.80, 1.19)	1.00	.7962
Elevated LDL-C risk [i]	0.98 (0.81, 1.20)	1.00	.8622	1.01 (0.79, 1.29)	1.00	.9157	1.01 (0.81, 1.26)	1.00	.9517

Data are presented as sample-weighted odds ratio (95% confidence interval) with nonconsumers as the reference group using PROC RLOGIST of SUDAAN. All values were adjusted for sex, age, and ethnicity.
[a] Elevated systolic BP was defined as ≥130 mm Hg.
[b] Elevated diastolic BP was defined as ≥85 mm Hg.
[c] Elevated BP was defined as ≥130/85 mm Hg.
[d] Lower HDL-C was defined as <40 mg/dL for men and <50 mg/dL for women.
[e] Elevated fasting triglycerides were defined as ≥150 mg/dL.
[f] Elevated fasting glucose was defined as ≥110 mg/dL.
[g] Increased WC was defined as >102 cm for men and >88 cm for women.
[h] Meets 3 or more of MetS risk components.
[i] Elevated LDL-C was defined as ≥100 mg/dL.

[57]. Given possible reporting errors, individuals with implausible intakes [53] were excluded from the analyses; however, all reported associations of candy consumption with health parameters did not change.

Overall, evaluation of the 24-hour recall data demonstrated that candy consumers had significantly higher intakes of energy, SFA, and AS than nonconsumers. Chocolate consumers also had a higher intake of total fat than nonconsumers; sugar candy consumers had lower intakes of total fat and SFA than nonconsumers, suggesting that chocolate candy consumers were driving results of SFA levels. Cacao beans contain a significant amount of fat (40%-50% as cocoa butter) [3], although the fat content of chocolate candy is influenced by the percentage of cacao solids and addition of other ingredients, for example, milk or cream [58]. The increased SFA intake in total and chocolate candy consumers was not surprising because SFA are found in higher proportions than unsaturated fatty acids in cocoa butter. Palmitic and stearic acids constitute the main types of SFA [59] in cocoa butter. Stearic acid is unique among saturated fats in that it is not associated with the LDL-C-raising potential of other SFA [60,61].

Diet quality, measured by HEI, was not affected by total or chocolate candy consumption. Although HEI was lower in sugar candy consumers as compared with nonconsumers, the magnitude of the difference was quite small, suggesting that sugar candy did not replace healthy items in the diet.

Candy consumers had lower weight and WC than noncandy consumers; in addition, total and sugar candy consumers also had a lower mean BMI than noncandy consumers. A lower mean BMI was not seen in chocolate candy consumers. Although candy contributed modestly to energy intake and AS in the diet, there was no association of total candy intake to increased weight/BMI, suggesting that, over time, consumers were able to balance longer term energy intake.

From a cardiovascular health perspective, interest has focused on chocolate, especially dark chocolate and cocoa [25,28]. Dark chocolate can be a rich source of phytonutrients, including total polyphenols, epicatechin, catechin, total monomers, and flavan-3-ol oligomers and polymers (procyanidins) [62,63]. The amount of these compounds varies by chocolate type and preparation [62]; natural cocoas have the highest levels of total polyphenols and procyanidins followed by baking chocolates, dark chocolates and baking chips, and, finally, milk chocolate and syrups [63].

A recent meta-analysis of 8 short-term randomized controlled trials showed that consumption of cocoa products improved LDL-C levels [64]. Previous studies have suggested that consumption of chocolate, especially dark chocolate or cocoa, was associated with improved HDL-C levels [25,65]; although, these findings are not universal [64]. In our study, chocolate candy consumers had lower levels of 3 risk factors associated with cardiovascular disease than nonchocolate consumers, including higher HDL-C levels. Our study did not show a difference in LDL-C levels in any of the 3 candy consumption groups, including the chocolate consumers.

C-reactive protein is a marker of oxidative stress and may contribute to the decreased risk of cardiovascular disease seen in chocolate consumers [27,28]. In this study, total and chocolate candy consumers were shown to have lower CRP levels than nonconsumers. This relationship was not seen in sugar candy consumers suggesting results from total candy consumption were driven by chocolate candy consumption. A previous dietary intervention trial with dark chocolate was shown to reduce CRP levels in women only [25], and a second trial did not reduce CRP levels [65]. Results from a prior epidemiological study in Italy showed that all chocolate consumers had lower levels of CRP [26]. Further research is needed to discern the relationship of CRP with candy consumption, including, specifically, the impact of chocolate candy consumption.

Metabolic syndrome is characterized by dyslipidemia, hypertension, abdominal obesity, insulin resistance, and hyperglycemia and it is a major risk factor for cardiovascular disease and type 2 diabetes [66,67]. In the United States, the prevalence of MetS was 34.5% [68], indicating it is a major health problem. In this study, candy consumption was not associated with an increased risk of MetS, and chocolate consumption was associated with a lower risk of MetS compared with nonconsumers. Studies that have looked at chocolate/cocoa products have shown reduced risk factors for MetS among consumers [65,69,70].

This study was not without limitations. Twenty-four-hour dietary recalls may not reflect usual intake, they depend on memory, and subjects may underreport or overreport. Dietary intake reported on a single day may not relate to longer term intake and cannot capture subtle changes in intake that may occur to balance energy intake over time. The NHANES is a cross-sectional study, and causal inferences cannot be drawn from cross-sectional analyses. Candy groups were combined; thus, potential effects of a single type of candy, for example, dark chocolate, may have been ameliorated.

In conclusion, these cross-sectional data show an increase in energy, AS, and SFA associated with candy consumption but did not show an increase in weight/adiposity status, BP, cardiovascular risk factors, or risk of MetS. Candy consumers actually had a lower body weight and lower adiposity status than nonconsumers, even after adjusting for implausible intakes; CRP was also significantly reduced with consumption of candy. Consumption of chocolate candy was also associated with higher HDL-C and lower triglycerides. Candy consumers had a lower risk of elevated diastolic BP than nonconsumers, whereas chocolate consumers had a decreased risk of lower HDL-C and MetS. Total candy consumption was not associated with a lower HEI. Overall, current level of candy consumption was not associated with adverse health effects.

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