RESEARCH
Original Research

Nutrient Intake, Diet Quality, and Weight/Adiposity Parameters in Breakfast Patterns Compared with No Breakfast in Adults: National Health and Nutrition Examination Survey 2001-2008

Carol E. O'Neil, PhD, MPH, LDN, RD; Theresa A. Nicklas, DrPH; Victor L. Fulgoni III, PhD

ARTICLE INFORMATION

Article history:
Accepted 19 August 2014

Keywords:
Breakfast
Breakfast patterns
Adults
Nutrient intake
National Health and Nutrition Examination Survey (NHANES)

http://dx.doi.org/10.1016/j.jand.2014.08.021

A portion of this work was presented previously at the 2012 Food and Nutrition Conference and Expo in Philadelphia, PA.

ABSTRACT

Background The effect of different breakfast consumption patterns on nutrient intake, diet quality, and weight/adiposity status is unknown.

Objective To compare nutrient intake, diet quality, and weight/adiposity measures of consumers assigned to different breakfast patterns with breakfast skippers.

Design and participants These associations were assessed in adults 19+ years (N=18,988) participating in the 2001-2008 National Health and Nutrition Examination Survey. Intake was determined from 1-day 24-hour dietary recall. Diet quality was quantified using the Healthy Eating Index-2005. Body mass index (calculated as kg/m^2) and waist circumferences were determined. Twelve patterns (including No Breakfast [approximately 19% of population]), explaining 58% of the variance in energy from the breakfast meal, were examined. Covariate adjusted general linear models were used to compare nutrient intakes, Healthy Eating Index-2005 scores, and body mass index/waist circumference of consumers of different patterns with breakfast skippers. The *P* value was Bonferroni corrected (<0.05/12 breakfast patterns <0.0042).

Results Consumers of the Grain/100% Fruit Juice and Presweetened Ready-to-Eat Cereal (RTEC)/Lower-Fat Milk patterns had lower daily intakes of nutrients to limit (added sugars, saturated fatty acids, solid fats, cholesterol, and sodium) than breakfast skippers. Consumers of the Grain/100% Fruit Juice; Presweetened RTEC/Lower-Fat Milk; and RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice patterns had higher daily intakes of all shortfall nutrients examined (dietary fiber; vitamins A, D, and C; calcium, potassium, folate, iron, and magnesium) than breakfast skippers. Consumers of the Grain/100% Fruit Juice; Grain; Presweetened RTEC/Lower-Fat Milk; RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice; Cooked Cereal; Lower-Fat Milk/Whole Fruit; and Whole Fruit patterns had higher Healthy Eating Index-2005 scores than breakfast skippers. Consumers of the Grain/100% Fruit Juice; Presweetened RTEC/Lower-Fat Milk; RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice; and Cooked Cereal patterns had lower body mass indexes and waist circumferences than breakfast skippers.

Conclusions Results suggest dietary and weight advantages of consuming breakfast, especially ones that include grains, cereals, lower-fat milk, and whole fruit/100% fruit juice, in contrast to the potential adverse effects of skipping breakfast.
J Acad Nutr Diet. 2014;114:S27-S43.

Statement of Potential Conflict of Interest and Funding/Support: See page S43.

To take the Continuing Professional Education quiz for this article, log in to www.eatright.org, click the "myAcademy" link under your name at the top of the homepage, select "Journal Quiz" from the menu on your myAcademy page, click "Journal Article Quiz" on the next page, and then click the "Additional Journal CPE Articles" button to view a list of available quizzes, from which you may select the quiz for this article.

TRADITIONALLY, BREAKFAST HAS BEEN CONSIDERED the most important meal of the day. Studies in adults have shown that consuming breakfast improves daily nutrient intake,[1-6] food group selection,[4,5,7,8] dietary adequacy,[2,9] and diet quality.[1,8,10,11] In general, breakfast consumption has also been associated with positive measures of body mass index (BMI),[7,10-13] other adiposity parameters,[7,10,12] and cardiovascular risk factors[8,13-18]; however, the literature is inconsistent.[19]

Adult breakfast consumers have been shown to have higher intakes of many nutrients, especially micronutrients,[1,2,4] than

breakfast skippers. A study by Nicklas and colleagues[2] showed that young adults participating in the Bogalusa Heart Study that consumed breakfast had lower total daily intakes of energy, protein, and saturated fatty acids (SFA) when compared with breakfast skippers. These results were confirmed and extended in a study using data from the National Health and Nutrition Examination Survey (NHANES) 1999-2002 comparing nutrient intake of young adults consuming ready-to-eat cereal (RTEC) breakfasts, "other breakfasts," or no breakfast. Those consuming RTEC or "other breakfasts" had higher intakes of dietary fiber, vitamins A and B-12, thiamin, riboflavin, folate, calcium, phosphorus, magnesium, and potassium than breakfast skippers.[1] In addition, those consuming RTEC breakfasts had higher intakes of vitamins C and B-6, niacin, iron, and zinc than breakfast skippers. Although that study listed some of the foods found in the "other breakfasts," no attempt was made to link specific breakfast foods or breakfast meal patterns with dietary intake. Higher intakes of micronutrients may have been the result of the nearly universal vitamin and mineral fortification of RTEC.

Consumption of a breakfast meal has also been associated with improved weight/adiposity measures in adults. Song and colleagues[12] showed that breakfast consumption was associated with a lower prevalence of overweight and obesity, but that the type of breakfast mattered and that there were sex differences. When RTEC and other breakfast consumers were compared with breakfast skippers, RTEC consumers weighed less than other breakfast consumers or breakfast skippers.[1] Data from the Coronary Artery Risk Development in Young Adults study showed that hazard ratios in those consuming breakfast daily breakfast were lower for obesity and abdominal obesity.[13]

Despite these health benefits, the breakfast meal is frequently skipped. Breakfast skipping in adults is age-dependent. Data from the most recent *What We Eat in America*[20] tables have shown that 28% of males and 22% of females 20 to 29 years of age skipped breakfast, and the prevalence of skipping breakfast declined with age, until by 70+ years only 5% of males and 4% of females did not consume a breakfast meal.

The purposes of this study were to identify breakfast patterns consumed by a nationally representative sample of adults and to determine association of the breakfast patterns to the total daily nutrient intake and diet quality of consumers of these patterns vs breakfast skippers (No Breakfast pattern). Weight and adiposity measures were also compared from those consuming different breakfast patterns with breakfast skippers.

METHODS

NHANES

NHANES is a continuous surveillance program designed to collect nationally representative information on the nutrition and health status of the civilian, noninstitutionalized US population. Conducted by the National Center for Health Statistics, data are collected using a complex, stratified, multistage probability cluster sampling design. Survey data are collected via an in-home interview for demographic and basic health information, and a comprehensive health examination is conducted in a mobile examination center. Detailed descriptions of the sample design, interview procedures, and physical examinations conducted are available online.[21] These descriptions include the response rates of the survey release cycles, which vary by cycle, sex, and age.[22]

Study Participants

Data from adults (N=18,988) 19+ years old participating in the 2001-2002, 2003-2004, 2005-2006, and 2007-2008 NHANES were combined to increase sample size.[23] Analyses included only individuals with reliable dietary records; females who were pregnant or lactating were excluded from analyses. NHANES has stringent protocols and procedures that ensure confidentiality and protect individual participants from identification using federal laws.[24] This was a secondary data analysis that lacked personal identifiers; therefore, this study did not require institutional review.[25]

DEMOGRAPHICS AND DIETARY INFORMATION

Demographic information was obtained by interview.[26] Intake data were obtained from *What We Eat in America* which used in-person 24-hour dietary recall interviews administered using an automated multiple-pass method.[27,28] A single 24-hour dietary recall was collected from each participant in 2001-2002; however, beginning in 2003-2004, two days of intake were collected. To ensure consistency, only the data from the in-person interview (first recall or Day 1) were used for this study. Detailed descriptions of the dietary interview methods are available.[29]

BREAKFAST, FOOD GROUPINGS, AND NUTRIENT ANALYSIS

Breakfast meals were self-reported and included consumption of any food/beverage other than water, at the meal reported by the study population as breakfast/brunch (*desayuno/almuerzo* in Spanish). The US Department of Agriculture (USDA) Food and Nutrient Database for Dietary Studies[30] (FNDDS) food groups were combined into 20 breakfast food groupings (Table 1). All food codes fit into only one of the food groups. Food group equivalent intakes were determined using MyPyramid Equivalents Database, versions 1.0[31] and 2.0[32]; when necessary, intakes for 2005-2008 NHANES were hand matched to similar foods because there were no MyPyramid Equivalents Databases released during that time. There is no consistent definition of a presweetened RTEC; however, for the purposes of this study, an RTEC was classified as a presweetened RTEC if the reference amount customarily consumed contained ≥6 g sugar.[33] The Food and Drug Administration definition for 100% fruit juice was used.[34] Added sugars were defined, using the USDA definition,[35] as any caloric sweeteners eaten separately or used as ingredients in processed or prepared foods. Lower-fat milk was defined as all fluid milk other than whole milk.

Energy and nutrient intakes were calculated using the FNDDS (versions 1.0–4.0)[30] for NHANES 2001-2002, 2003-2004, 2005-2006, and 2007-2008, respectively. The vitamin D content of foods was determined from the Vitamin D Addendum to USDA FNDDS 3.0[36]; this database was also used to hand match similar foods to determine vitamin D content of foods in previous FNDDS releases. The nutrients studied reflect the nutrients to limit, nutrients of public health

Table 1. Breakfast food groupings from the US Department of Agriculture Food and Nutrient Database for Dietary Studies used to determine breakfast patterns

Group no.	Group name	Food codes
1	Milk, whole	11000000, 11100000, 11111000, 11111100, 11111150, 11114000, 11114100, 11114350, 11116000, 11120000, 11121100, 11122000, 11210050, 11211050, 11220000
2	Milk, low-fat	111X or 112X not whole milk
3	Yogurt	114X
4	Milk products	12X or 13X
5	Cheeses	14X
6	Meat, poultry, fish	2X
7	Eggs	3X
8	Vegetables and legumes not potatoes	4X or 7X not potatoes (71X)
9	Potatoes	71X
10	Grain, not cereal	5X not RTEC[a] or presweetened RTEC
11	Cooked cereal	food_code in (56200300, 56200350) or (food_code $\geq$ 56202960 and food_code $\leq$ 56203620) or (food_code $\geq$ 56206970 and food_code $\leq$ 56207080) or (food_code $\geq$ 56207190 and food_code $<$57300000)
12	RTEC (not presweetened)	571X-574X g/RACC[b] added sugar $<$6
13	Presweetened RTEC	571X-574X g/RACC added sugar $\geq$6
14	Whole fruit	6X not 612X, 641X, 642X, 672X
15	Fruit juice	612X, 641X, 642X, 672X
16	Fats, oils, salad dressings	8X
17	Sugars and sweets	91X
18	Coffee and tea	921X, 922X, 923X
19	Soft drinks and fruit drinks	924X, 925X
20	Other drinks	926X-942X

[a]RTEC=ready-to-eat cereal.
[b]RACC=reference amount customarily consumed.

concern, and nutrients underconsumed, as defined by the 2010 Dietary Guidelines for Americans.[37] Estimates of nutrient intake were limited to foods and did not include dietary supplements.

HEI-2005

Diet quality was determined by the HEI-2005 score,[38] which in turn was determined using the downloadable SAS code from the Center for Nutrition Policy and Promotion website.[39]

Anthropometric Measures

Height, weight, and waist circumference (WC) were obtained according to NHANES protocols.[40] Body mass index (BMI) was calculated as body weight (kg) divided by height (m) squared.[41]

Statistical Analyses

Breakfast patterns were identified using SAS 9.2 (2009, SAS Institute) PROC CLUSTER.[42] For each participant, the percent of energy at the breakfast meal from each of the food groupings was determined. The patterns identified by the cluster analysis were then identified by percent energy within each food grouping consumed at breakfast at the centroid of each cluster. Initially, 4, 8, 12, and 16 clusters were evaluated; however, for subsequent analyses, the 12 pattern output (including No Breakfast) was used since this set of breakfast patterns allowed delineation of type of RTEC and the use of lower-fat milk and explained moderately more variance in energy from the breakfast meal (12 breakfast patterns accounted for approximately 58% of the variance in energy from the breakfast meal, as compared to the analyses with 8 patterns which accounted for only 45%). Based on their dietary intake, participants were placed into one breakfast pattern and dietary day 1 weights were used for all analyses.[23]

Least-square means±standard error were calculated using PROC REGRESS of SUDAAN (version 10.0, 2008, RTI International) for dietary intake and diet quality (HEI-2005) was determined for participants placed into each breakfast pattern. After confirming a significant overall *F*-test for

Table 2. The percent of breakfast energy from food groups at the centroid of the pattern, the name and assigned number of the

				Percent of Breakfast Energy at Centroid of Pattern						
Pattern	Pattern name	% Population	Sample (n)	Milk, whole	Milk, lower-fat	Yogurt	Milk products	Cheeses	MPF[c]	Eggs
1	Grain/FJ[f]	24.49	4,714	4	5	3	1	3	5	5
2	No Breakfast	18.75	3,789							
3	Grain	12.17	2,238	1	0	0	2	2	0	0
4	PSRTEC/LFM[g]	10.09	1,725	5	18	1	1	0	0	0
5	Eggs/Grain/MPF	6.73	1,436	0	1	0	2	1	6	53
6	RTEC/LFM/Whole Fruit/FJ	6.02	1,109	5	23	0	1	0	0	0
7	Coffee/C&S[h]/ Sweets	4.98	810	1	0	0	39	0	1	1
8	Cooked Cereal	4.81	1,044	1	6	1	1	0	0	1
9	MPF/Grain/Eggs	4.47	1,002	1	2	0	1	2	54	8
10	LFM/Whole Fruit	3.04	430	0	75	0	1	0	1	0
11	Coffees/Teas	2.42	361	1	1	0	4	0	0	1
12	Whole Fruit	2.03	330	0	1	0	3	0	0	0
All		100.00	18,988	3	9	1	4	1	5	7

[a]Twelve breakfast patterns accounted for approximately 58% of the variance in energy from the breakfast meal.
[b]Source: Adults 19+ years of age participating in National Health and Nutrition Examination Survey, 2001-2008, excludes pregnant/lactating females.
[c]MPF=Meat, Poultry, Fish.
[d]RTEC=Ready-to-Eat Cereal.
[e]PSRTEC=Presweetened Ready-to-Eat Cereal.
[f]FJ=100% Fruit Juice.
[g]LFM=Lower-Fat Milk.
[h]C&S=Cream and Sugar.

breakfast patterns (entered as categorical variables [patterns 1-12]), differences for variables of interest were determined via *t*-test compared with the No Breakfast pattern. Covariates were age, sex, race/ethnicity, poverty income ratio grouped into three categories (<1.25, 1.25 to 3.49, and >3.49), physical activity level (sedentary, moderate, and vigorous), smoking status (yes/no), alcohol intake (g/day), and energy intake (kcal) for macro- and micronutrients (but not for energy intake itself). The HEI-2005 was not adjusted for energy intake because it is already adjusted.[38] Covariate-adjusted logistic regression was used to determine whether the breakfast patterns had a lower odds ratio of being overweight or obese. For the comparison of the least square means, a probability of $P<0.05$ was considered significant; however, a Bonferroni correction for multiple comparisons (0.05/12) was applied, so the effective P value was <0.0042. For the logistic regression, Bonferroni corrected 95th percent confidence intervals were used to detect differences.

RESULTS

Breakfast Patterns

The 12 breakfast patterns identified were 1. Grain/100% Fruit Juice (n=4,714; 24.49% consumed this pattern); 2. No Breakfast (n=3,789; 18.75%) (ie, breakfast skippers); 3. Grain (n=2,238, 12.17%); 4. Presweetened RTEC/Lower-Fat Milk (n=1,725, 10.09%); 5. Eggs/Grain/Meat, Poultry, Fish (n=1,436, 6.73%); 6. RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice (n=1,109, 6.02%); 7. Coffee/Cream and Sugar/Sweets (n=810, 4.98%); 8. Cooked Cereal (n=1,044, 4.81%); 9. Meat, Poultry, Fish/Grain/Eggs (n=1,002, n=4.47%); 10. Lower-Fat Milk/ Whole Fruit (n=430, 3.04%); 11. Coffees/Teas (n=361, 2.42%); and 12. Whole Fruit (n=330, 2.03%) (Table 2). Tables 3, 4, and 5 show population demographics, the 10 most commonly consumed foods for breakfast in each pattern, and the 10 foods consumed at breakfast with the highest energy contribution in each pattern, respectively.

Energy and Nutrients to Limit

The percent of energy contributed by the breakfast meal varied widely among the breakfast patterns, with Coffees/ Teas contributing the lowest percent with 4%, and Meat, Poultry, Fish/Grain/Eggs contributing the most with 26% (Table 6). For added sugars, those consuming the Whole Fruit breakfast pattern had the lowest intake and those consuming the Presweetened RTEC/Lower-Fat Milk had the highest intake. Those consuming the Whole Fruit breakfast pattern had the lowest intake of SFA at the breakfast meal, whereas those consuming the Meat, Poultry, Fish/Grain/Eggs pattern

12 breakfast patterns,[a] along with the number and percent of the population consuming those breakfast patterns[b]

Percent of Breakfast Energy at Centroid of Pattern												
Vegetables and legumes	Potatoes	Grain not cereal	Cooked cereal	RTEC[d]	PSRTEC[e]	Whole fruit	100% fruit juice	Fats & oils	Sugars and sweets	Coffee and tea	Soft/ fruit drinks	Other drinks
6	4	30	0	0	0	3	10	4	6	2	7	1
1	0	82	0	0	0	1	2	2	3	2	1	0
0	0	3	0	1	55	5	5	0	2	1	1	0
2	1	17	1	0	0	2	2	3	3	1	3	0
1	0	4	0	47	0	7	6	1	3	1	0	0
0	0	4	0	0	0	0	0	0	41	11	1	0
2	0	8	57	0	0	7	5	2	5	1	1	0
2	1	17	0	0	0	1	1	2	2	1	4	0
2	0	4	1	1	0	7	0	0	4	3	0	0
0	0	0	0	0	0	3	0	0	1	90	0	0
1	0	3	0	0	0	81	7	0	2	2	0	0
3	1	25	4	4	7	5	5	2	6	5	3	0

had the highest intake. Sodium intake at the breakfast meal for those consuming the Meat, Poultry, Fish/Grain/Eggs pattern was highest, and those consuming the Whole Fruit pattern had the lowest sodium consumption.

Mean daily energy intake by those assigned to four breakfast patterns—Coffee/Cream and Sugar/Sweets; Lower-Fat Milk/Whole Fruit; Coffees/Teas; and Whole Fruit—was not different from that of breakfast skippers. Those placed into other patterns showed a higher daily energy intake than breakfast skippers (Table 6). Consumers placed into all breakfast patterns except Coffee/Cream and Sugar/Sweets had lower mean intakes of added sugars than breakfast skippers. Those placed into the Meat, Poultry, Fish/Grain/Eggs; Eggs/Grain/Meat, Poultry, Fish; and Coffee/Cream and Sugar/Sweets patterns had higher daily intakes of SFA than breakfast skippers, whereas those in three other breakfast patterns: Cooked Cereal, Presweetened RTEC/Lower-Fat Milk, and RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice had lower daily intakes of SFA than breakfast skippers. On average, mean daily intake of sodium of those placed into all breakfast patterns exceeded the recommendations for sodium intake. Those placed into the Meat, Poultry, Fish/Grain/Eggs pattern had mean daily sodium intakes higher than breakfast skippers; whereas, consumers placed into the Presweetened RTEC/Lower-Fat Milk and Cooked Cereal patterns had lower mean sodium intakes than breakfast skippers.

Nutrients of Public Health Concern and Those Nutrients Potentially Underconsumed by Some Groups

Those in the Coffees/Teas pattern had a mean intake of dietary fiber at breakfast that did not differ from breakfast skippers; those in the Coffee/Cream and Sugar/Sweets and Coffees/Teas patterns had a mean intake of vitamin C at breakfast that did not differ from breakfast skippers. Those in all other patterns and for all other nutrients examined (dietary fiber; vitamins A, D, and C; calcium; potassium; folate; iron; and magnesium) had higher intakes at breakfast than breakfast skippers (Table 7).

When mean total daily intake of dietary fiber was considered, those placed into six breakfast patterns (Grain/100% Fruit Juice; Presweetened RTEC/Lower-Fat Milk; RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice; Cooked Cereal; Lower-Fat Milk/Whole Fruit; and Whole Fruit) had higher mean daily intakes than breakfast skippers (Table 7). Those in the Meat, Poultry, Fish/Grain/Eggs breakfast pattern had the lowest mean total intake of dietary fiber (although not lower than

Table 3. Demographics by breakfast pattern—from adults participating in the 2001-2008 National Health and Nutrition Examination Survey[a]

	Pattern											
Variable	Grain/FJ[b]	No Breakfast	Grain	PSRTEC[c]/ LFM[d]	Eggs/Grain/ MPF[e]	RTEC[f]/ LFM/Whole Fruit/FJ	Coffee/ C&S[g]/ Sweets	Cooked Cereal	MPF/Grain/ Eggs	LFM/ Whole Fruit	Coffees/ Teas	Whole Fruit
n	4,714	3,789	2,238	1,725	1,436	1,109	810	1,044	1,002	430	361	330
	←———————————————————————————*least-square means ± standard error*———————————————————————————→											
Male (%)	49.3±0.9	52.9±0.9	47.7±1.4	50.0±1.4	53.2±1.5	46.5±1.7	44.5±2.3	39.3±1.7	54.4±1.8	43.1± 3.1	53.4±3.2	38.7±3.8
Female (%)	50.7±0.9	47.1±0.9	52.3±1.4	50.0±1.4	46.8±1.5	53.5±1.7	55.5±2.3	60.7±1.7	45.6±1.8	57.0±3.1	46.6±3.2	61.3±3.8
NHW[h] (%)	71.1±1.9	63.4±2.4	72.3±1.9	83.0±1.4	69.5±2.6	84.6±1.7	71.4±2.6	77.3±2.2	59.6±2.3	74.6±2.9	86.5±1.9	78.2±2.4
NHB[i] (%)	11.4±1.1	16.7±1.5	6.9±0.7	7.8±1.0	14.6±1.6	5.2±0.7	11.5±1.3	9.6±1.3	21.8±2.1	4.4±0.9	3.4±0.8	9.7±1.4
MA[j] (%)	11.8±1.1	15.0±1.9	14.5±1.1	6.6±0.8	12.5±1.8	8.2±1.2	11.7±1.6	8.0±1.1	13.7±1.8	13.2±2.2	6.0±1.5	6.2±1.1
Other (%)	5.6±0.6	4.9±0.6	6.3±1.0	2.6±0.6	3.4±0.8	2.0±0.6	5.5±1.2	5.2±1.1	4.9±1.1	7.8±2.1	4.1±1.3	6.0±2.2
PIR[k]	3.1±0.04	2.6±0.1	3.2±0.1	3.3±0.1	3.0±0.1	3.2±0.1	3.1±0.1	3.1±0.1	2.6±0.1	3.3±0.1	3.4±0.1	3.2±0.2
Sedentary (%)	31.8±1.1	32.5±1.1	30.7±1.5	25.6±1.6	31.9±1.9	28.7±1.7	31.4±2.3	29.4±1.8	36.0±2.2	21.3±2.6	32.5±3.7	28.3±3.6
Moderate (%)	31.3±1.2	31.0±1.2	34.8±1.7	31.9±1.5	30.8±1.5	39.6±2.1	35.3±2.6	37.9±2.0	32.9±2.3	30.6±3.5	27.6±3.5	29.3±3.7
Vigorous (%)	36.9±1.2	36.5±1.3	34.5±1.6	42.5±2.0	37.3±2.0	31.7±2.1	33.3±2.0	32.7±2.2	31.1±2.3	48.0±3.2	39.9±3.6	42.4±4.7
Alcohol No (%)	73.5±1.2	73.4±1.3	76.4±1.2	72.2±1.6	71.7±2.0	78.1±2.0	66.3±2.6	82.5±2.0	69.1±2.2	70.7±3.4	62.56±3.6	74.0±2.9
Alcohol Yes (%)	26.5±1.2	26.7±1.3	23.6±1.2	27.8±1.6	28.3±2.0	21.9±2.0	33.8±2.6	17.5±2.0	30.9±2.2	29.3±3.4	37.4±3.6	26.0±2.9
Smoking No (%)	79.0±1.0	63.0±1.5	76.7±1.7	82.7±1.4	76.3±1.7	86.8±1.5	57.8±2.6	90.7±1.4	68.8±2.2	78.7±2.6	62.4±4.0	84.0±3.0
Smoking Yes (%)	21.0±1.0	37.0±1.5	23.3±1.7	17.3±1.4	23.7±1.7	13.2±1.5	42.2±2.2	9.3±1.4	31.2±2.2	21.3± 2.6	37.6±4.0	16.0±3.0

[a]Data source: Adults 19+ years of age participating in National Health and Nutrition Examination Survey 2001-2008.
[b]FJ=100% Fruit Juice.
[c]PSRTEC=Presweetened Ready-to-Eat Cereal.
[d]LFM=Lower-Fat Milk.
[e]MPF=Meat, Poultry, Fish.
[f]RTEC=Ready-to-Eat Cereal.
[g]C&S=Cream and Sugar.
[h]NHW=non-Hispanic white.
[i]NHB=non-Hispanic black.
[j]MA=Mexican American.
[k]PIR=poverty income ratio.

Table 4. The 10 most commonly consumed foods in each breakfast pattern consumed at breakfast by adults 19+ years of age participating in the National Health and Nutrition Examination Survey 2001-2008

Pattern	Pattern name	10 Most commonly consumed foods in pattern (n=consumers)[a]
1	Grain/FJ[b]	Coffee, made from ground, regular (n=1,191); sugar, white (n=919); orange juice, canned, bottled, or in a carton (n=486); egg, whole fried (n=460); whole milk (n=456); 2% milk (n=418); bacon not specified (n=390); white toast (n=365); banana (n=333); butter, salted (n=284)
2	No Breakfast	
3	Grain	Coffee, made from ground, regular (n=695); sugar, white (n=445); coffee, made from powdered instant, regular (n=192); whole milk (n=191); cream substitute, powdered (n=156); bagel (n=118); orange juice, canned, bottled, or in a carton (n=98); cream, half and half (n=92); doughnut, cake (n=84); cheese, cream (n=83)
4	PSRTEC[c]/LFM[d]	2% milk (n=624); whole milk (n=373); coffee, made from ground, regular (n=363); nonfat milk (n=341); banana (n=293); sugar, white (n=227); 1% milk (n=214); Honey Nut Cheerios[e] (n=168); orange juice, canned, bottled, or in a carton (n=147); Frosted Mini-Wheats[f] (n=121)
5	Eggs/Grain/MPF[g]	Coffee, made from ground, regular (n=435); egg, fried (n=360); sugar, white (n=298); egg omelet or scrambled egg, fat added in cooking (n=232); bacon not specified (n=216); white toast (n=173); egg omelet or scrambled egg, with cheese (n=142); salted butter (n=105); cream substitute, powdered (n=105); egg omelet or scrambled egg, not specified as to fat added in cooking (n=96)
6	RTEC[h]/LFM/Whole Fruit/FJ	2% milk (n=393); Cheerios[e] (n=286); coffee, made from ground, regular (n=283); white sugar (n=261); nonfat milk (n=245); banana (n=237); whole milk (n=204); Corn Flakes[f] (n=182); 1% milk (n=165); orange juice, canned, bottled, or in a carton (n=109)
7	Coffee/C&S[i]/Sweets	Coffee, made from ground, regular (n=515); white sugar (n=464); cream substitute, powdered (n=207); cream, half and half (n=99); coffee, made from powered instant, regular (n=91); cream substitute, liquid (n=85); sugar substitute, saccharin-based, dry powder and tablets (n=41); cream substitute, flavored liquid (n=40); sucralose-based sweetener, sugar substitute (n=38); sugar substitute, aspartame-based, dry powder (n=36)
8	Cooked Cereal	Oatmeal, cooked, instant, fat not added in cooking (n=365); coffee, made from ground, regular (n=292); oatmeal, cooked, regular, fat not added in cooking (n=285); white sugar (n=233); oatmeal, cooked, quick, fat not added in cooking (n=195); 2% milk (n=162); banana (n=158); orange juice, canned, bottled, or in a carton (n=104); nonfat milk (n=94); raisins (n=81)
9	MPF/Grain/Eggs	Coffee, made from ground, regular (n=208); white sugar (n=150); egg, whole fried (n=137); bacon not specified (n=130); not specified pork sausage (n=103); white bread (n=85); white toast (n=62); cream substitute, powdered (n=60); soft drink, cola-type (n=59); 2% milk (n=56)
10	LFM/Whole Fruit	2% milk (n=145); coffee, made from ground, regular (n=81); white sugar (n=51); nonfat milk (n=45); meal supplement or replacement, commercially prepared, ready-to-drink (n=43); banana (n=42); 1% milk (n=37); fruit smoothie drink, made with fruit or fruit juice and dairy products (n=21); milk, soy, ready-to drink (n=20); meal replacement, protein type, milk-based, powdered, not reconstituted (n=20)

(*continued on next page*)

Table 4. The 10 most commonly consumed foods in each breakfast pattern consumed at breakfast by adults 19+ years of age participating in the National Health and Nutrition Examination Survey 2001-2008 *(continued)*

Pattern	Pattern name	10 Most commonly consumed foods in pattern (n=consumers)[a]
11	Coffees/Teas	Coffee, made from ground, regular (n=203); coffee, made from powdered instant, regular (n=38); coffee, made from powdered instant mix, with whitener and sugar, instant (n=16); cream substitute, powdered (n=15); white sugar (n=13); cappuccino (n=13); coffee, latte (n=11); coffee, mocha (n=10); sugar substitute, aspartame-based, dry powder (n=10); banana (n=10)
12	Whole Fruit	Banana (n=188); coffee, made from ground, regular (n=77); apple (n=58); orange (n=30); white sugar (n=28); not specified grapes (n=19); grapefruit (n=15); coffee, made from powdered instant, regular (n=14); cantaloupe (n=13); tea, leaf, unsweetened (n=13)

[a]All milk refers to cow's fluid milk; all eggs are chicken eggs; bacon is pork bacon.
[b]FJ=100% Fruit Juice.
[c]PSRTEC=Presweetened Ready-to-Eat Cereal.
[d]LFM=Lower-Fat Milk.
[e]General Mills, Inc.
[f]Kellogg's.
[g]MPF=Meat, Poultry, Fish.
[h]RTEC=Ready-to-Eat Cereal.
[i]C&S=Cream and Sugar.

breakfast skippers). Those placed into five breakfast patterns had higher mean total daily vitamin D intakes than breakfast skippers. Those placed into the Lower-Fat Milk/Whole Fruit breakfast pattern had the highest intake of vitamin D, and those in the Grain breakfast pattern had the lowest. Mean daily consumption of calcium by those placed into five breakfast consumption patterns (Grain/100% Fruit Juice; Presweetened RTEC/Lower-Fat Milk; RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice; Cooked Cereal; and Lower-Fat Milk/Whole Fruit) had higher mean total daily intakes of calcium than breakfast skippers. On average, only those in the Grain/100% Fruit Juice; Presweetened RTEC/Lower-Fat Milk; RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice; Cooked Cereal; and Lower-Fat Milk/Whole Fruit patterns met the daily value for calcium. On average, those placed in any of the breakfast patterns had mean total daily intakes that did not meet the daily value for potassium. However, those placed into seven breakfast patterns (Grain/100% Fruit Juice; Presweetened RTEC/Lower-Fat Milk; RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice; Cooked Cereal; Lower-Fat Milk/Whole Fruit; Coffees/Teas; and Whole Fruit) had higher mean total daily intakes of potassium than breakfast skippers. Table 7 also shows the mean daily and mean breakfast-meal-only intakes, by those in the 12 breakfast patterns, of vitamins A and C, folate, iron, and magnesium.

HEI-2005

Overall, the HEI-2005 scores were low, and consumers placed in half of the breakfast patterns (including breakfast skippers) showed a total daily score of <50 (Figure). Those placed into seven breakfast patterns: (Grain/100% Fruit Juice; Grain; Presweetened RTEC/Lower-Fat Milk; RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice; Cooked Cereal; Lower-Fat Milk/Whole Fruit; and Whole Fruit) had higher mean HEI-2005 scores than breakfast skippers. No other differences were seen.

Weight and Adiposity Measures

When compared with breakfast skippers, breakfast consumers placed into the Grain/100% Fruit Juice; Presweetened RTEC/Lower-Fat Milk; RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice; and Cooked Cereal patterns had lower mean BMI and WC measurements (Table 8). Consumers placed into the same patterns had a lower prevalence of overweight/obesity, obesity, and elevated WC when compared with breakfast skippers. Consumers placed into the Grain/100% Fruit Juice, Presweetened RTEC/Lower-Fat Milk, RTEC/Lower-Fat Milk, and Cooked Cereal patterns were also less likely to be overweight/obese, obese, or have an elevated WC than breakfast skippers. Finally, those placed into the Whole Fruit pattern were less likely to be overweight/obese than breakfast skippers (Table 9).

DISCUSSION

This study showed that nearly 20% of the adult population skipped breakfast; in addition, 11 specific breakfast patterns consumed by adults were identified. Mean daily nutrient consumption and diet quality among the participants assigned to the different patterns varied, and not all patterns differed significantly from breakfast skippers. Only consumers of breakfast meals characterized by cereal or grain intake, ironically except the actual "Grain" pattern itself, which included primarily sweetened grains, such as

Table 5. The 10 foods in each breakfast pattern consumed at breakfast by adults 19+ years of age participating in the National Health and Nutrition Examination Survey 2001-2008 that contributed the most energy

Pattern	Pattern name	10 Foods contributing the most weighted energy[a]
1	Grain/FJ[b]	Whole milk; egg, whole fried; orange juice, canned, bottled, or in a carton; pancakes, plain; 2% milk; white potato, hash brown, not specified as to from fresh, frozen, or dry mix; white toast; white potatoes; white sugar; tortilla, flour (wheat)
2	No Breakfast	
3	Grain	Bagel; doughnut, raised or yeast; muffin, fruit or nuts; roll, sweet, cinnamon bun, frosted; doughnut, cake type; whole milk; roll, sweet, sugar topping, Mexican (*pan dulce*); breakfast tart; roll, sweet, no topping, Mexican (*pan dulce*); white sugar
4	PSRTEC[c]/LFM[d]	2% milk; whole milk; Honey Nut Cheerios[e]; Frosted Mini-Wheats[f]; banana; Raisin Bran[f]; Frosted Flakes[f]; nonfat milk; raisin bran not further specified; 1% milk
5	Eggs/Grain/MPF[g]	Egg, whole fried; egg omelet or scrambled egg, fat added in cooking; egg omelet or scrambled egg, with cheese; egg omelet or scrambled egg, not specified as to fat added in cooking; white toast; tortilla, flour (wheat); not specified bacon; egg omelet or scrambled egg, with ham or bacon and cheese; egg, cheese, and ham on English muffin; egg, cheese, and sausage on English muffin
6	RTEC[h]/LFM/Whole Fruit/FJ	2% milk; Cheerios[e]; whole milk; Corn Flakes[f]; banana; nonfat milk; Special K[f]; 1% milk; shredded wheat; orange juice, canned, bottled, or in a carton
7	Coffee/C&S[i]/Sweets	White sugar; cream substitute, powdered; cream, half and half; cream substitute, liquid; cream substitute, flavored, liquid; coffee, made from ground, regular; pudding, rice; milk gravy, quick gravy; ice cream, regular, flavors other than chocolate; white toast
8	Cooked Cereal	Oatmeal, cooked, instant, fat not added in cooking; oatmeal, cooked, regular, fat not added in cooking; oatmeal, cooked, quick, fat not added in cooking; banana; 2% milk; orange juice, canned, bottled, or in a carton; white sugar; oatmeal, cooked, instant, fat added in cooking; oatmeal, cooked, regular, fat added in cooking; white toast
9	MPF/Grain/Eggs	Sausage on biscuit; pork sausage, fresh, bulk, patty or link, cooked; not specified bacon; egg, whole fried; white bread; soft drink, cola-type; pork sausage, brown and serve, cooked; egg omelet or scrambled egg, fat added in cooking; white toast; biscuit, baking powder or buttermilk type, commercially baked
10	LFM/Whole Fruit	2% milk; meal supplement or replacement, commercially prepared, ready-to-drink; fruit smoothie drink, made with fruit or fruit juice and dairy products; 1% milk; nonfat milk; banana; cocoa and sugar mixture, whole milk added; cocoa, sugar, and dry milk mixture, water added; meal replacement, protein type, milk-based, powdered, not reconstituted; milk fruit drink
11	Coffees/Teas	Coffee, mocha; coffee, made from ground, regular; coffee, made from powdered instant mix, with whitener and sugar; cappuccino; coffee, latte; tea, leaf, presweetened with sugar; coffee beverage, Frappuccino[j], regular; banana; tea, not specified as to type, presweetened, not specified as to sweetener; tea, not specified as to type, presweetened with sugar
12	Whole Fruit	Banana; apple; orange; avocado; orange juice, with calcium added, canned, bottled or in a carton; not specified grapes; cantaloupe; pear; orange juice, canned, bottled or in a carton; cream, half and half

[a]Weighted energy is the population weighted energy contribution of each food in each pattern vs the number of individuals in the analytic sample consuming the food. All milk refers to cow's fluid milk; all eggs are chicken eggs; bacon is pork bacon.
[b]FJ=100% Fruit Juice.
[c]PSRTEC=Presweetened Ready-to-Eat Cereal.
[d]LFM=Lower-Fat Milk.
[e]General Mills, Inc.
[f]Kellogg's.
[g]MPF=Meat, Poultry, Fish.
[h]RTEC=Ready-to-Eat Cereal.
[i]C&S=Cream and Sugar.
[j]Starbucks Corporation.

Table 6. Consumption of energy and nutrients to limit by breakfast pattern in adults participating in the 2001-2008 National Health and Nutrition Examination Survey

No.	Pattern name	Energy (kcal)	Added sugar (tsp)	SFA[a] (g)	Solid fat (g)	Cholesterol (mg)	Sodium (mg)
		←——————————least square mean±standard error——————————→					
	Breakfast consumption only[b]						
1	Grain/FJ[c]	487±7	4.02±0.10	5.8±0.1	11.1±0.3	104±4	703±16
2	No Breakfast						
3	Grain	391±9	3.8±0.1	4.6±0.2	11.1±0.4	38±2	531±15
4	PSRTEC[d]/LFM[e]	436±8	5.1±0.1	3.2±0.1	4.6±0.2	20±2	442±11
5	Eggs/Grain/MPF[f]	515±8	2.7±0.2	9.0±0.2	17.1±0.3	417±10	993±16
6	RTEC[g]/LFM/Whole Fruit/FJ	362±9	1.9±0.1	2.9±0.2	4.2±0.2	21±2	441±13
7	Coffee/C&S[h]/Sweets	159±13	3.6±0.2	2.9±0.2	5.2±0.5	23±4	136±16
8	Cooked Cereal	429±10	3.5±0.2	3.3±0.2	4.9±0.3	29±4	456±13
9	MPF/Grain/Eggs	596±17	2.6±0.2	10.3±0.3	20.0±0.7	188±9	1,369±39
10	LFM/Whole Fruit	308±15	4.1±0.3	3.7±0.2	5.9±0.4	27±2	337±17
11	Coffees/Teas	73±11	1.6±0.3	1.4±0.2	2.4±0.3	13±3	87±11
12	Whole Fruit	173±8	0.8±0.1	0.9±0.2	1.3±0.3	8±3	69±16
	Total daily consumption[b]						
1	Grain/FJ	2,314±20[i]	18.9±0.4[i]	27.1±0.2	46.2±0.4	302±4[i]	3,478±30
2	No Breakfast	1,948±25	22.9±0.6	27.8±0.3	48.0±0.6	260±5	3,498±31
3	Grain	2,239±27[i]	19.5±0.4[i]	26.8±0.3	48.2±0.7	245±4	3,495±40
4	PSRTEC/LFM	2,313±38[i]	20.6±0.5[i]	25.1±0.3[i]	41.3±0.6[i]	219±1[i]	3,310±29[i]
5	Eggs/Grain/MPF	2,264±36[i]	18.6±0.8[i]	30.7±0.4[i]	53.1±0.9[i]	608±11[i]	3,633±37
6	RTEC/LFM/Whole Fruit/FJ	2,224±39[i]	16.8±0.6[i]	25.5±0.5[i]	41.7±0.9[i]	231±5[i]	3,517±44
7	Coffee/C&S/Sweets	2,068±42	21.4±0.7	29.8±0.6	50.5±1.1	274±9	3,407±60
8	Cooked Cereal	2,227±32[i]	17.4±0.6[i]	24.4±0.3[i]	40.2±0.8[i]	231±7[i]	3,285±49[i]
9	MPF/Grain/Eggs	2,303±38[i]	16.4±0.6[i]	31.7±0.4[i]	56.1±1.0[i]	380±10[i]	3,967±68[i]
10	LFM/Whole Fruit	2,082±46	19.3±0.8[i]	26.5±0.4	43.5±1.1[i]	266±10	3,401±79
11	Coffees/Teas	1,901±54	18.1±0.9[i]	29.3±0.6	49.3±1.4	283±12	3,713±104
12	Whole Fruit	2,142±82	17.0±1.0[i]	26.2±1.0	43.1±1.9	220±11[i]	3,282±102

[a]SFA=saturated fatty acids.
[b]Covariates: Age, sex, race/ethnicity, poverty income ratio grouped into three categories (<1.25, 1.25 to 3.49, and >3.49), current smoking status (yes/no), physical activity level (sedentary, moderate and vigorous), alcohol intake (g/d), energy intake for nutrient related variables.
[c]FJ=100% Fruit Juice.
[d]PSRTEC=Presweetened Ready-to-Eat Cereal.
[e]LFM=Lower-Fat Milk.
[f]MPF=Meat, Poultry, Fish.
[g]RTEC=Ready-to-Eat Cereal.
[h]C&S=Cream and Sugar.
[i]Statistically different from No Breakfast; with the Bonferroni correction effective $P<0.0042$; comparison for total daily consumption only; energy and all nutrients consumed at the breakfast meal only were statistically different from No Breakfast $P<0.0042$.

doughnuts, cinnamon buns, and muffins, had lower weight/adiposity parameters than breakfast skippers.

The effect of breakfast skipping and breakfast consumption by adults on nutrient intake, diet quality, and weight/adiposity status has not been as well studied as it has in children, and results from existing studies are inconsistent,[7,10,11,12,43,44] making them difficult to interpret. In part, this is the result of the lack of consistent definitions for "breakfast," "breakfast consumer," and "breakfast skipper,"[45] and in part to the failure of many studies to characterize the breakfast meal, implying that breakfast meals are homogeneous.

Only those assigned to 8 of the 11 breakfast consumption patterns had higher mean daily energy intake than breakfast skippers. There have been conflicting results from previous

Table 7. Consumption of nutrients of public health concern and nutrients of potential concern to some groups by breakfast pattern by adults participating in the 2001-2008 National Health and Nutrition Examination Survey

		Nutrients of Public Health Concern[a]				Nutrients of Potential Concern for Some Groups[a]				
No.	Pattern name	Dietary fiber (g)	Vitamin D[b] (μg)	Calcium (mg)	Potassium (mg)	Vitamin A (RAE[c] μg)	Vitamin C (mg)	Folate DFE[d] (μg)	Iron (mg)	Magnesium (mg)
		least square mean±standard error								
	Breakfast consumption only[e]									
1	Grain/FJ[f]	3.1±0.1	1.5±0.04	254.9±5.2	700.9±10.7	159.8±4.8	35.9±1.3	112.8±2.0	3.3±0.1	64.8±1.0
2	No Breakfast									
3	Grain	2.6±0.1	0.4±0.02	126.6±5.5	341.9±10.2	80.4±2.6	10.9±0.8	115.0±2.6	3.0±0.1	39.1±1.1
4	PSRTEC[g]/LFM[h]	5.6±0.1	3.9±0.1	374.4±9.1	778.4±14.01	365.4±9.1	29.8±1.4	493.9±14.6	11.6±0.3	96.7±1.8
5	Eggs/Grain/MPF[i]	2.1±0.1	2.1±0.1	232.3±6.4	606.5±14.5	244.2±8.0	16.7±1.3	116.2±7.1	3.9±0.1	55.4±1.7
6	RTEC[j]/LFM/Whole Fruit/FJ	5.1±0.2	3.6±0.1	400.9±11.0	744.4±17.7	337.5±10.0	41.1±2.2	520.9±18.1	12.0±0.4	82.7±1.9
7	Coffee/C&S[k]/ Sweets	0.6±0.1	0.3±0.1	58.5±5.7	355.1±11.6	40.5±5.6	4.7±1.2[j]	27.9±2.2	0.7±0.1	24.5±1.0
8	Cooked Cereal	5.8±0.2	1.2±0.1	290.1±14.0	676.5±20.7	306.8±16.8	25.8±1.8	163.5±7.6	6.0±0.2	100.8±2.5
9	MPF/Grain/Eggs	2.5±0.2	1.7±0.1	202.1±11.3	707.9±22.4	144.5±8.3	16.3±1.4	105.4±3.9	4.0±0.1	60.7±2.0
10	LFM/Whole Fruit	2.4±0.3	4.5±0.3	448.2±22.8	814.8±28.9	330.8±24.2	19.8±2.2	83.0±5.4	3.2±0.3	88.3±4.3
11	Coffees/Teas	0.5±0.1[l]	0.5±0.1	68.2±7.1	411.3±19.7	25.4±4.1	3.4±0.9[l]	25.5±2.8	0.4±0.1	36.2±3.3
12	Whole Fruit	4.0±0.2	0.2±0.04	50.0±7.3	598.7±28.6	46.2±10.2	34.9±3.8	45.4±4.4	0.9±0.1	41.2±2.2
	Total daily consumption[e]									
1	Grain/FJ	15.5±0.2[m]	4.4±0.1[m]	914.4±11.5[m]	2791.8±18.3[m]	598.4±12.5[m]	102.6±2.5[m]	486.3±6.2[m]	14.3±0.1[m]	290.7±2.3[m]
2	No Breakfast	14.4±0.3	3.6±0.2	831.5±16.3	2,500.7±29.0	485.8±13.6	71.3±2.7	448.8±6.0	13.4±0.1	263.9±2.8
3	Grain	15.3±0.2	3.0±0.1	776.5±11.1	2,453.4±24.5	535.2±33.3	73.4±2.0	500.9±8.1[m]	14.5±0.2[m]	264.6±2.4
4	PSRTEC/LFM	18.5±0.3[m]	6.7±0.2[m]	1,063.2±15.9[m]	2,906.9±28.0[m]	807.6±16.7[m]	97.6±3.1[m]	871.0±13.6[m]	22.7±0.3[m]	326.1±3.2[m]
5	Eggs/Grain/MPF	13.8±0.4	4.8±0.2[m]	887.5±19.0	2,597.6±34.3	686.7±31.4[m]	79.7±3.1	465.6±10.9	14.3±0.2[m]	274.1±5.2
6	RTEC/LFM/Whole Fruit/FJ	19.1±0.4[m]	6.6±0.2[m]	1,132.1±22.3[m]	2,997.7±45.1[m]	825.6±23.7[m]	110.4±3.5[m]	927.8±17.0[m]	23.7±0.4[m]	323.9±4.8[m]
7	Coffee/C&S/ Sweets	13.8±0.2	3.3±0.2	821.9±22.4	2,598.0±37.5	504.1±16.9	71.0±4.1	436.8±8.8	13.0±0.1	269.7±3.4

(*continued on next page*)

Table 7. Consumption of nutrients of public health concern and nutrients of potential concern to some groups by breakfast pattern by adults participating in the 2001-2008 National Health and Nutrition Examination Survey (*continued*)

		Nutrients of Public Health Concern[a]				Nutrients of Potential Concern for Some Groups[a]				
No.	Pattern name	Dietary fiber (g)	Vitamin D[b] (μg)	Calcium (mg)	Potassium (mg)	Vitamin A (RAE[c] μg)	Vitamin C (mg)	Folate DFE[d] (μg)	Iron (mg)	Magnesium (mg)
		←——————————————————————*least square mean±standard error*——————————————————————→								
	Total daily consumption[e]									
8	Cooked Cereal	20.4±0.5[m]	4.0±0.2	1,001.6±24.0[m]	2,932.1±37.8[m]	797.4±26.7[m]	101.0±4.2[m]	555.8±10.0[m]	17.7±0.3[m]	355.0±7.6[m]
9	MPF/Grain/Eggs	13.2±0.4	4.1±0.2	823.8±19.7	2625.1±47.3	510.1±13.4	76.9±5.6	429.0±10.5	14.1±0.3	265.9±4.6
10	LFM/Whole Fruit	16.7±0.6[m]	7.9±0.5[m]	1,238.3±43.3[m]	3,197.3±67.3[m]	878.8±69.4[m]	99.7±6.2[m]	475.4±13.1	15.5±0.4[m]	346.6±8.8[m]
11	Coffees/Teas	15.2± 0.6	4.1±0.3	856.1±26.1	2,823.0±74.2[m]	604.1±92.6	76.7±5.9	476.9±15.0	14.1±0.3	298.0±9.3
12	Whole Fruit	20.4± 0.7[m]	4.0±0.4	837.6±35.8	3094.4±60.2[m]	540.6±28.9	114.3±7.6[m]	514.4±26.4	13.9±0.3	316.2±8.2[m]

[a]Nutrients of public health concern and underconsumed nutrients were identified by the 2010 Dietary Guidelines for Americans.
[b]Vitamin D=D-2+D-3.
[c]RAE=retinol activity equivalent.
[d]DFE=dietary folate equivalent.
[e]Covariates: Age, sex, race/ethnicity, poverty income ratio grouped into three categories as (<1.25, 1.25 to 3.49, and >3.49), current smoking status (yes/no), physical activity level (sedentary, moderate and vigorous), alcohol intake (g/day), energy intake for nutrient related variables.
[f]FJ=100% Fruit Juice.
[g]PSRTEC=Presweetened Ready-to-Eat Cereal.
[h]LFM=Lower-Fat Milk.
[i]MPF=Meat, Poultry, Fish.
[j]RTEC=Ready-to-Eat Cereal.
[k]C&S=Cream and Sugar.
[l]Value is not different from No Breakfast, $P<0.0042$; for the breakfast meal only.
[m]Statistically different from No Breakfast; with the Bonferroni correction effective $P<0.0042$.

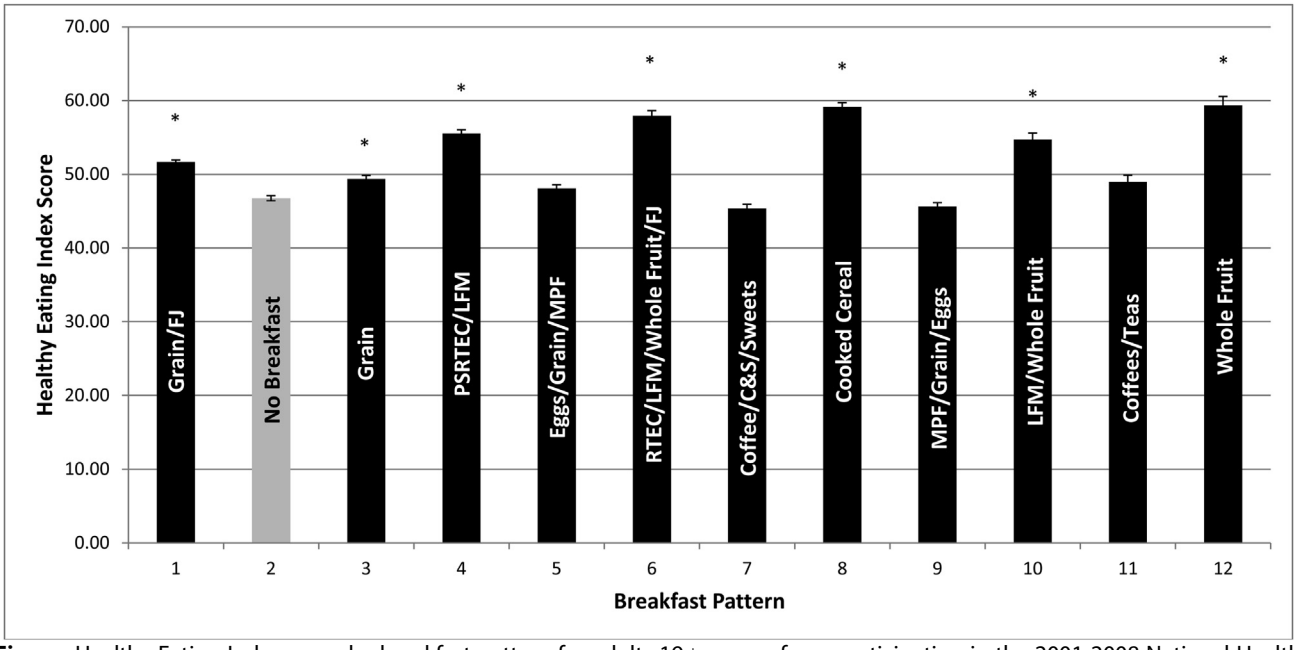

Figure. Healthy Eating Index score by breakfast pattern for adults 19+ years of age participating in the 2001-2008 National Health and Nutrition Examination Survey. Asterisk means that values are significantly different from No Breakfast (Pattern 2)—Bonferroni corrected $P<0.0042$. Covariates: Age, sex, race/ethnicity, poverty income ratio grouped into three categories (<1.25, 1.25 to 3.49, and >3.49), current smoking status (yes/no), and physical activity level (sedentary, moderate, and vigorous), alcohol intake (g/day). C&S=Cream and Sugar. FJ=100% Fruit Juice. PSRTEC=Presweetened Ready-to-Eat Cereal. LFM=Lower-Fat Milk. MPF=Meat, Poultry, Fish. RTEC=Ready-to-Eat Cereal.

epidemiologic studies in adults that have looked at daily energy intake in association with the breakfast meal.[2,7,9,10,44] Cho and colleagues[7] showed that daily energy intake was lowest in breakfast skippers and in fruit and vegetable consumers, suggesting that the type of breakfast consumed is an important contributor to total daily energy intake. Using NHANES 1999-2004 data, Kant and colleagues[10] showed that breakfast consumers had higher daily energy intake than breakfast skippers; this was also shown by Nicklas and colleagues[2] using data from young adults that participated in the Bogalusa Heart Study. In the study of Nicklas and colleagues,[2] the difference in energy intake between breakfast consumers and breakfast skippers was greater than the mean amount of energy consumed at breakfast, suggesting that breakfast consumers may have had different overall eating patterns throughout the day than breakfast skippers. Neither study[2,10] examined different types of breakfast meals.

Breakfast skippers had the highest daily percentage of energy from added sugars (18.8%), confirming results from an earlier NHANES study.[1] That consumers placed in all breakfast consumption patterns, except Coffee/Cream and Sugar/Sweets, had lower intakes of added sugars than breakfast skippers suggests that breakfast skippers may have overall unhealthy eating patterns, but additional studies are needed. Higher intakes of added sugars have been associated with higher proportions of individuals at risk for inadequate intakes of selected nutrients,[46] as was shown in our study. On average, none of the consumers, including those placed in the Grain, Presweetened RTEC, or Coffee/Cream and Sugar/Sweets patterns, had a mean daily intake of added sugars that exceeded the Institute of Medicine's threshold of 25% of total energy,[47] suggesting a moderate intake of foods with added sugars at the breakfast meal or that foods low in added sugars were consumed throughout the day.

Consumption of breakfast has been associated with better intake of dietary fiber and micronutrients, including several nutrients of public health concern for the general population (ie, dietary fiber, vitamin D, calcium, and potassium) and shortfall nutrients (eg, vitamins A and C, folate, iron, and magnesium), than seen in breakfast skippers.[1,2,6,7] Consumers placed into most breakfast patterns had higher intakes of at least some nutrients when compared with breakfast skippers; however, those in the Grain and Coffee/Cream and Sugar/Sweets patterns did not. Only the consumers of the Grains/100% Fruit Juice, Presweetened RTEC/Lower-Fat Milk, and RTEC/Lower-Fat Milk/Whole Fruit/100% Fruit Juice patterns had higher intakes of all the identified shortfall nutrients than breakfast skippers, confirming that use of the "other breakfast" category in other studies[1] failed to account for heterogeneity of the breakfast meal.

The positive nutrient contribution of breakfast depends on the quality of the breakfast meal or the type of foods consumed. There is no standard definition of a high-quality or nutrient-dense breakfast, despite the recommendation from the DGA to consume a "nutrient-dense" breakfast; the DGA provide no recommendations for consumption of specific nutrients or foods to be consumed at breakfast.[37] No recommendations for a "healthful" or "nutritious" breakfast are available for adults; however, a study of adolescents[48] used quantitative and qualitative aspects of breakfast foods, the frequency of breakfast consumption, and the energy contribution of the breakfast meal to designate a breakfast score for defining three groups—no breakfast, "low-quality" breakfast, and "good/excellent quality" breakfast. Those

Table 8. Weight/adiposity status by breakfast consumption pattern from adults participating in the 2001-2008 National Health and Nutrition Examination Survey[a]

No.	Breakfast pattern	Body mass index[b] (n=18,537)	WC[c] (cm) (n=18,234)	Overweight[d]	Overweight/ obese	Obese[d]	Elevated WC
		←—mean (LSM[e]±SE[f])—→		←—%±SE—→			
1	Grain/FJ[g]	28.1±0.2[h]	96.6±0.4[h]	34±0.01	65±0.01[h]	31±0.01[h]	50±0.01[h]
2	No Breakfast	28.9±0.2	98.4±0.3	34±0.01	69±0.01	36±0.01	55±0.01
3	Grain	28.6±0.2	97.6±0.5	34±0.01	69±0.01	35±0.01	52±0.01
4	PSRTEC[i]/LFM[j]	27.7±0.2[h]	95.9±0.5[h]	33±0.01	62±0.02[h]	29±0.02[h]	48±0.02[h]
5	Eggs/Grain/MPF[k]	28.9±0.3	98.6±0.6	35±0.02	71±0.02	36±0.02	55±0.02
6	RTEC[l]/LFM/Whole Fruit/FJ	27.8±0.3[h]	95.8±0.6[h]	35±0.02	63±0.01[h]	28±0.02[h]	48±0.02[h]
7	Coffee/C&S[m]/Sweets	28.3±0.3	97.1±0.7	37±0.02	69±0.02	32±0.03	52±0.03
8	Cooked Cereal	27.2±0.3[h]	94.4±0.6[h]	34±0.02	60±0.02[h]	26±0.02[h]	46±0.02[h]
9	MPF/Grain/Eggs	29.8±0.4	100.7±0.8	31±0.02	72±0.02	41±0.02	61±0.02
10	LFM/Whole Fruit	27.9±0.4	96.8±1.1	34±0.03	64±0.03	30±0.03	50±0.04
11	Coffees/Teas	28.0±0.3	96.4±0.7	31±0.03	62±0.03	30±0.03	49±0.03
12	Whole Fruit	27.3±0.5	95.2±1.3	29±0.04	56±0.04	27±0.04	47±0.04

[a]Data Source: Adults 19+ years of age participating in National Health and Nutrition Examination Survey 2001-2008. Breakfast patterns are compared with the No Breakfast group. Covariates: age, sex, race/ethnicity, poverty income ratio grouped into three categories (<1.25, 1.25 to 3.49, and >3.49), current smoking status (yes/no), physical activity level (sedentary, moderate, and vigorous), alcohol intake (g/day), energy intake for nutrient-related variables.
[b]Calculated as kg/m^2.
[c]WC=waist circumference.
[d]Overweight (body mass index 25.0 to 29.9) and obesity (body mass index ≥30.0) were defined using the National Institutes of Health definitions. An elevated waist circumference was defined as >102 cm for men and >88 cm for women.
[e]LSM=least squares mean.
[f]SE=standard error.
[g]FJ=100% Fruit Juice.
[h]Statistically different from No Breakfast; with the Bonferroni correction effective $P<0.0042$.
[i]PSRTEC=Presweetened Ready-to-Eat Cereal.
[j]LFM=Lower-Fat Milk.
[k]MPF=Meat, Poultry, Fish.
[l]RTEC=Ready-to-Eat Cereal.
[m]C&S=Cream and Sugar.

consuming "good/excellent quality" breakfasts had higher intakes of bread, fruit, vegetables, milk, and fruit juice and lower intakes of soft drinks than those consuming "low-quality breakfasts." In children, high-quality breakfasts have been defined as those including whole grain, fruit or fruit juice, and low-fat milk products or other sources of calcium.[49] Results from our study support that this definition of a high-quality breakfast would be a good recommendation for adults as well.

Good diet quality is fundamental to lowering chronic disease risk. Overall, diet quality in our population was poor and consumers of only seven breakfast patterns had a higher diet quality than breakfast skippers. Elderly[43] and young[11,44] adults who consumed breakfast always or frequently[8] had better diet quality than breakfast skippers. This study expanded the findings of the study of Deshmukh-Taskar and colleagues[44] by refining the term "other breakfasts" into specific patterns and by demonstrating that not all breakfasts were associated with an overall higher diet quality.

Habitual meal skipping is thought by many consumers to facilitate weight loss.[50] However, the DGA recommends consuming a nutrient-dense breakfast, in part, because it has been associated with weight loss and weight maintenance in adults.[37] Lower measures of weight/adiposity or maintaining weight after weight loss were shown in several studies[12,13,44,51]; however, other studies found this relationship in only one sex.[15,16,52] RTEC consumers have been shown to be the most likely to show an inverse relationship with weight/adiposity when compared with breakfast skippers.[12,44] The inverse relationship with weight/adiposity and consumption of presweetened RTEC shown in this study has been shown previously in children,[53-55] but not in adults. Grains, including cereals, and fruit juice were in the patterns generally associated with lower BMI and WC; each of these foods has been previously associated with lower weights among consumers.[1,12,13,52,56-58] Lower-fat milk was also consumed by those assigned to many of the patterns associated with lower weight parameters; however, the role of milk consumption and weight is unclear.[59]

Table 9. Odds ratios for overweight, obesity, and elevated waist circumference by breakfast pattern—from adults participating in the 2001-2008 National Health and Nutrition Examination Survey[a]

		Variable			
No.	Breakfast pattern	Overweight	Obese	Overweight/ obese	Elevated waist circumference
		←——————*odds ratio (Bonferroni corrected 95th percentile CI)*——————→			
1	Grain/FJ[b]	1.01 (0.83-1.23)	0.82 (0.67-0.99)[c]	0.82 (0.68-0.99)[c]	0.80 (0.65-0.98)[c]
3	Grain	1.03 (0.80-1.31)	0.95 (0.77-1.18)	0.97 (0.77-1.23)	0.89 (0.70-1.12)
4	PSRTEC[d]/LFM[e]	0.97 (0.77-1.24)	0.74 (0.55-0.98)[c]	0.72 (0.57-0.92)[c]	0.72 (0.55-0.93)[c]
5	Eggs/Grain/MPF[f]	1.04 (0.80-1.36)	1.02 (0.78-1.34)	1.09 (0.78-1.52)	1.01 (0.75-1.35)
6	RTEC[g]/LFM/Whole Fruit/FJ	1.03 (0.72-1.48)	0.72 (0.52-0.99)[c]	0.74 (0.58-0.95)[c]	0.74 (0.56-0.97)[c]
7	Coffee/C&S[h]/Sweets	1.16 (0.85-1.60)	0.85 (0.59-1.24)	0.99 (0.68-1.46)	0.89 (0.62-1.29)
8	Cooked Cereal	1.01 (0.73-1.39)	0.62 (0.46-0.83)[c]	0.63 (0.46-0.88)[c]	0.66 (0.49-0.88)[c]
9	MPF/Grain/Eggs	0.86 (0.62-1.19)	1.28 (0.94-1.74)	1.15 (0.79-1.67)	1.29 (0.93-1.80)
10	LFM/Whole Fruit	1.01 (0.64-1.60)	0.77 (0.49-1.21)	0.78 (0.49-1.24)	0.80 (0.49-1.31)
11	Coffees/Teas	0.90 (0.58-1.40)	0.78 (0.49-1.24)	0.70 (0.48-1.04)	0.76 (0.48-1.20)
12	Whole Fruit	0.79 (0.42-1.50)	0.68 (0.39-1.19)	0.56 (0.33-0.97)[c]	0.70 (0.41-1.19)

[a]Data source: Adults 19+ years of age participating in National Health and Nutrition Examination Survey 2001-2008. Covariates: age, sex, race/ethnicity, poverty income ratio grouped into three categories (<1.25, 1.25 to 3.49, and >3.49), current smoking status (yes/no), physical activity level (sedentary, moderate, and vigorous), alcohol intake (g/day). Pattern 2 (No Breakfast) is the reference group.
[b]FJ=100% Fruit Juice.
[c]Statistically different from No Breakfast.
[d]PSRTEC=Presweetened Ready-to-Eat Cereal.
[e]LFM=Lower-Fat Milk.
[f]MPF=Meat, Poultry, Fish.
[g]RTEC=Ready-to-Eat Cereal.
[h]C&S=Cream and Sugar.

Strengths and Limitations

The major strengths of this study include use of a large nationally representative sample, analysis of different types of breakfast meals, and the use of statistical techniques to adjust for potential confounding. However, the study was not without limitations. NHANES is a cross-sectional study and cause and effect cannot be established. Twenty-four-hour dietary recalls have inherent limitations, including failure to reflect usual intake. These recalls are also memory dependent, which can lead to under- or over-reporting; however, a single 24-hour recall is sufficient to report mean group intake.[60] Finally, breakfast and breakfast skipping were self-defined, which could lead to classification errors.

CONCLUSIONS

These data suggest that breakfast is an important meal and generally makes a positive contribution to nutrient intake and diet quality, but that care should be taken to select nutrient-dense foods, such as fortified cereals and other healthy grain foods low in fat and added sugars, as well as whole fruit/100% fruit juice and lower-fat milk. It is also important to integrate this type of nutrient-dense breakfast with an overall healthy eating plan. These results, as well as the inverse association with weight and adiposity measures shown in consumers placed in some patterns, need additional study. Additional study is also needed to determine how breakfast meals influence energy, nutrient, and food group intakes and the timing of meals/snacks throughout the day.

References

1. Deshmukh-Taskar PR, Radcliffe JD, Liu Y, Nicklas TA. Do breakfast skipping and breakfast type affect energy intake, nutrient intake, nutrient adequacy, and diet quality in young adults? NHANES 1999-2002. *J Am Coll Nutr*. 2010;29(4):407-418.
2. Nicklas TA, Myers L, Reger C, Beech B, Berenson GS. Impact of breakfast consumption on nutritional adequacy of the diets of young adults in Bogalusa, Louisiana: Ethnic and gender contrasts. *J Am Diet Assoc*. 1998;98(12):1432-1438.
3. Kerver JM, Yang EJ, Obayashi S, Bianchi L, Song WO. Meal and snack patterns are associated with dietary intake of energy and nutrients in US adults. *J Am Diet Assoc*. 2006;106(1):46-53.
4. Song WO, Chun OK, Kerver J, Cho S, Chung CE, Chung SJ. Ready-to-eat breakfast cereal consumption enhances milk and calcium intake in the US population. *J Am Diet Assoc*. 2006;106(11):1783-1789.
5. Peters BS, Verly E Jr, Marchioni DM, Fisberg M, Martini LA. The influence of breakfast and dairy products on dietary calcium and vitamin D intake in postpubertal adolescents and young adults. *J Hum Nutr Diet*. 2012;25(1):69-74.
6. Williams P. Breakfast and the diets of Australian adults: An analysis of data from the 1995 National Nutrition Survey. *Int J Food Sci Nutr*. 2005;56(1):65-79.
7. Cho S, Dietrich M, Brown CJ, Clark CA, Block G. The effect of breakfast type on total daily energy intake and body mass index: Results from the Third National Health and Nutrition Examination Survey (NHANES III). *J Am Coll Nutr*. 2003;22(4):296-302.
8. Min C, Noh H, Kang YS, et al. Skipping breakfast is associated with diet quality and metabolic syndrome risk factors of adults. *Nutr Res Pract*. 2011;5(5):455-463.

9. Morgan KJ, Zabik ME, Stampley GL. The role of breakfast in diet adequacy of the U.S. adult population. *J Am Coll Nutr*. 1986;5(6):551-563.
10. Kant AK, Andon MB, Angelopoulos TJ, Rippe JM. Association of breakfast energy density with diet quality and body mass index in American adults: National Health and Nutrition Examination Surveys, 1999-2004. *Am J Clin Nutr*. 2008;88(5):1396-1404.
11. Azadbakht L, Haghighatdoost F, Feizi A, Esmaillzadeh A. Breakfast eating pattern and its association with dietary quality indices and anthropometric measurements in young women in Isfahan. *Nutrition*. 2013;29(2):420-425.
12. Song WO, Chun OK, Obayashi S, Cho S, Chung CE. Is consumption of breakfast associated with body mass index in US adults? *J Am Diet Assoc*. 2005;105(9):1373-1382.
13. Odegaard AO, Jacobs DR Jr, Steffen LM, Van Horn L, Ludwig DS, Pereira MA. Breakfast frequency and development of metabolic risk. *Diabetes Care*. 2013;36(10):3100-3106.
14. Pereira MA, Erickson E, McKee P, et al. Breakfast frequency and quality may affect glycemia and appetite in adults and children. *J Nutr*. 2011;141(1):163-168.
15. Farshchi HR, Taylor MA, MacDonald IA. Beneficial metabolic effects of regular meal frequency on dietary thermogenesis, insulin sensitivity, and fasting lipid profiles in healthy obese women. *Am J Clin Nutr*. 2005;81(1):16-24.
16. Farshchi HR, Taylor MA, MacDonald IA. Deleterious effects of omitting breakfast on insulin sensitivity and fasting lipid profiles in healthy lean women. *Am J Clin Nutr*. 2005;81(2):388-396.
17. Jenkins DJ, Kendall CW, Vidgen E, et al. Effect of soy-based breakfast cereal on blood lipids and oxidized low-density lipoprotein. *Metabolism*. 2000;49(11):1496-1500.
18. Yamamoto R, Kawamura T, Wakai K, et al. Favorable life-style modification and attenuation of cardiovascular risk factors. *Jpn Circ J*. 1999;63(3):184-188.
19. Timlin MT, Pereira MA. Breakfast frequency and quality in the etiology of adult obesity and chronic diseases. *Nutr Rev*. 2007;65(6 Part 1):268-281.
20. US Department of Agriculture. *What We Eat in America* 2009-2010. http://www.ars.usda.gov/SP2UserFiles/Place/12355000/pdf/0910/Table_13_BRK_GEN_09.pdf. Accessed August 8, 2014.
21. Centers for Disease Control and Prevention, National Center for Health Statistics. The National Health and Nutrition Examination Survey (NHANES) questionnaires, datasets, and related documentation. http://www.cdc.gov/nchs/nhanes/nhanes_questionnaires.htm. Accessed August 8, 2014.
22. Centers for Disease Control and Prevention, National Center for Health Statistics. The National Health and Nutrition Examination Survey (NHANES). NHANES response rates and population totals. http://www.cdc.gov/nchs/nhanes/response_rates_CPS.htm. Accessed August 8, 2014.
23. Centers for Disease Control and Prevention, National Center for Health Statistics. The National Health and Nutrition Examination Survey (NHANES) analytic and reporting guidelines. http://www.cdc.gov/nchs/data/nhanes/nhanes_03_04/nhanes_analytic_guidelines_dec_2005.pdf. Accessed December 17, 2013.
24. National Center for Health Statistics, Centers for Disease Control and Prevention. Welcome NHANES participants: Is my information confidential? http://www.cdc.gov/nchs/nhanes/participant.htm. Accessed December 17, 2013.
25. US Department of Health and Human Services. Office of Extramural Research. http://grants.nih.gov/grants/policy/hs/hs_policies.htm. Accessed December 17, 2013.
26. National Health and Nutrition Examination Survey. 2003-2004 Data Documentation, Codebook, and Frequencies. Demographic Variables and Sample Weights (DEMO_C). Last revised, September, 2009. http://www.cdc.gov/nchs/nhanes/nhanes2003-2004/DEMO_C.htm. Accessed November 24, 2013.
27. Moshfegh AJ, Rhodes DG, Baer DJ, et al. The US Department of Agriculture Automated Multiple-Pass Method reduces bias in the collection of energy intakes. *Am J Clin Nutr*. 2008;88(2):324-332.
28. Blanton CA, Moshfegh AJ, Baer DJ, Kretsch MJ. The USDA Automated Multiple-Pass Method accurately estimates group total energy and nutrient intake. *J Nutr*. 2006;136(10):2594-2599.
29. NHANES Dietary Interview Component. http://wwwn.cdc.gov/nchs/nhanes/search/datapage.aspx?Component=Dietary&CycleBeginYear=2007. Accessed October 8, 2014.
30. US Department of Agriculture. Agricultural Research Service. Food and Nutrient Database for Dietary Studies. http://www.ars.usda.gov/services/docs.htm?docid=12089. Accessed December 5, 2013.
31. Friday JE, Bowman SA. MyPyramid Equivalents Database for USDA Survey Food Codes, 1994-2002, Version 1.0. http://www.ars.usda.gov/Services/docs.htm?docid=8498. Accessed December 15, 2013.
32. Bowman SA, Friday JE, Moshfegh A. MyPyramid Equivalents Database, 2.0 for USDA Survey Foods, 2003-2004. http://www.ars.usda.gov/Services/docs.htm?docid=8498. Accessed December 15, 2013.
33. US Department of Agriculture, Food and Nutrition Service. WIC food packages—Regulatory requirements for WIC-eligible foods. breakfast cereals. http://www.fns.usda.gov/sites/default/files/WICRegulations-7CFR246.pdf. Accessed December 17, 2013.
34. US Food and Drug Administration. Labeling & nutrition guidance documents & regulatory information. guidance for industry. http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/default.htm. Accessed December 15, 2013.
35. US Department of Agriculture. Choose MyPlate. What are added sugars? http://www.choosemyplate.gov/weight-management-calories/calories/added-sugars.html. Accessed August 8, 2014.
36. US Department of Agriculture, Agricultural Research Service. The USDA Food and Nutrient Database for Dietary Studies, 3.0—Documentation and User Guide, 2008. Vitamin D Addendum to USDA FNDDS 3.0. http://www.ars.usda.gov/Services/docs.htm?docid=18807. Accessed December 17, 2013.
37. US Department of Agriculture. 2010 Dietary Guidelines for Americans. http://www.cnpp.usda.gov/DGAs2010-PolicyDocument.htm. Accessed December 15, 2013.
38. Guenther PM, Reedy J, Krebs-Smith SM, Reeve BB, Basiotis PP. Development and evaluation of the Healthy Eating Index-2005: Technical report. Center for Nutrition Policy and Promotion, US Department of Agriculture. http://www.cnpp.usda.gov/HealthyEatingIndex.htm. Accessed December 15, 2013.
39. US Department of Agriculture, Center for Nutrition Policy and Promotion. HEI2005_NHANES0102.txt. http://www.cnpp.usda.gov/HealthyEatingIndex-2005report.htm. Accessed December 15, 2013.
40. National Center for Health Statistics. The NHANES Anthropometry Procedures Manual. Revised 2004. http://www.cdc.gov/nchs/data/nhanes/nhanes_03_04/BM.pdf. Accessed November 24, 2013.
41. National Institutes of Health. National Heart, Lung, and Blood Institute. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. http://www.nhlbi.nih.gov/guidelines/obesity/ob_gdlns.pdf. Accessed November 24, 2013.
42. SAS. PROC CLUSTER. http://support.sas.com/documentation/cdl/en/statug/63347/HTML/default/viewer.htm#cluster_toc.htm. Accessed August 7, 2014.
43. Ford DW, Hartman TJ, Still C, et al. Diet-related practices and BMI are associated with diet quality in older adults. *Public Health Nutr*. 2014;17(7):1565-1569.
44. Deshmukh-Taskar P, Nicklas TA, Radcliffe JD, O'Neil CE, Liu Y. The relationship of breakfast skipping and type of breakfast consumed with overweight/obesity, abdominal obesity, other cardiometabolic risk factors and the metabolic syndrome in young adults. The National Health and Nutrition Examination Survey (NHANES): 1999-2006. *Public Health Nutr*. 2013;16(11):2073-2082.
45. O'Neil CE, Byrd-Bredbenner C, Hayes D, Jana L, Klinger SE, Stephenson-Martin S. The role of breakfast in health: Definition and criteria for a quality breakfast. *J Acad Nutr Diet*. 2014;114(12 suppl 3):S8-S26.
46. Marriott BP, Olsho L, Hadden L, Connor P. Intake of added sugars and selected nutrients in the United States, National Health and Nutrition Examination Survey (NHANES) 2003-2006. *Crit Rev Food Sci Nutr*. 2010;50(3):228-258.
47. Institute of Medicine of the National Academies. *Panel on macronutrients. Dietary Reference Intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids*. Washington, DC: National Academy Press; 2002.

48. Monteagudo C, Palacin-Arce A, Bibiloni Mdel M, et al. Proposal for a Breakfast Quality Index (BQI) for children and adolescents. *Public Health Nutr*. 2013;16(4):639-644.

49. Giovannini M, Verduci E, Scaglioni S, Salvatici E. Breakfast: A good habit, not a repetitive custom. *J Int Med Res*. 2008;36(4):613-624.

50. McCrory MA. Meal skipping and variables related to energy balance in adults: A brief review, with emphasis on the breakfast meal. *Physiol Behav*. 2014;134:51-54.

51. van der Heijden AA, Hu FB, Rimm EB, van Dam RM. A prospective study of breakfast consumption and weight gain among US men. *Obesity (Silver Spring)*. 2007;15(10):2463-2469.

52. Albertson AM, Wold AC, Joshi N. Ready-to-eat cereal consumption patterns: The relationship to nutrient intake, whole grain intake, and body mass index in an older American population. *J Aging Res*. 2012;2012:631310.

53. O'Neil CE, Zanovec M, Nicklas TA, Cho SS. Pre-sweetened and non-pre-sweetened ready-to-eat cereals improve nutrient intake and diet quality without increasing body weight of children and adolescents: The National Health and Nutrition Examination Survey 1999-2002. *Am J Lifestyle Med*. 2012;6(1):60-71.

54. Albertson AM, Thompson DR, Franko DL, Holschuh NM. Weight indicators and nutrient intake in children and adolescents do not vary by sugar content in ready-to-eat cereal: Results from National Health and Nutrition Examination Survey 2001-2006. *Nutr Res*. 2011;31(3):229-236.

55. Miller KB, Liska DJ, Fulgoni VL. The association between body metrics and breakfast food choice in children. *Infant Child Adolesc Nutr*. 2013;5(1):43-50.

56. Bazzano LA, Song Y, Bubes V, Good CK, Manson JE, Liu S. Dietary intake of whole and refined grain breakfast cereals and weight gain in men. *Obes Res*. 2005;13(11):1952-1960.

57. O'Neil CE, Zanovec M, Cho SS, Nicklas TA. Whole grain and fiber consumption are associated with lower body weight measures in US adults: National Health and Nutrition Examination Survey 1999-2004. *Nutr Res*. 2010;30(12):815-822.

58. O'Neil CE, Nicklas TA, Rampersaud GC, Fulgoni VL 3rd. 100% orange juice consumption is associated with better diet quality, improved nutrient adequacy, decreased risk for obesity, and improved biomarkers of health in adults: National Health and Nutrition Examination Survey, 2003-2006. *Nutr J*. 2012;11:107.

59. Wang H, Troy LM, Rogers GT, et al. Longitudinal association between dairy consumption and changes of body weight and waist circumference: The Framingham Heart Study. *Int J Obes (Lond)*. 2014;38(2):299-305.

60. Thompson FE, Byers T. Dietary assessment resource manual. *J Nutr*. 1994;124(11 suppl):2245S-2317S.

AUTHOR INFORMATION

C. E. O'Neil is the Class of 1941 Alumni professor, School of Nutrition and Food Sciences, Louisiana State University Agricultural Center, Baton Rouge. T. A. Nicklas is a professor, US Department of Agriculture/Agricultural Research Service, Children's Nutrition Research Center, Department of Pediatrics, Baylor College of Medicine, Houston, TX. V. L. Fulgoni III is senior vice president, Nutrition Impact, LLC, Battle Creek, MI.

Address correspondence to: Carol E. O'Neil, PhD, MPH, LDN, RD, School of Nutrition and Food Sciences, 261 Knapp Hall, Louisiana State University Agricultural Center, Baton Rouge, LA 70803. E-mail: coneil1@lsu.edu

STATEMENT OF POTENTIAL CONFLICT OF INTEREST

C. E. O'Neil was a member of the Kellogg's Breakfast Council at the time this article was written, which had no input into the study design or interpretation of the data. T. A. Nicklas and V. L. Fulgoni III have no potential conflicts of interest to declare other than the funding declaration made elsewhere.

FUNDING/SUPPORT

Publication of this article was supported by an unrestricted educational grant from the Kellogg Company. This research project was supported by the US Department of Agriculture's Agricultural Research Service (USDA/ARS) through specific cooperative agreement 58-6250-6-003 (T. A. Nicklas). Partial support was received from the USDA Hatch Project LAB 93951 (C. E. O'Neil). Partial support was also received from the Kellogg's Corporate Citizenship Fund (T. A. Nicklas). The funding agencies had no input into the study design or interpretation of the data. This work is a publication of the USDA/ARS Children's Nutrition Research Center, Department of Pediatrics, Baylor College of Medicine, Houston, TX. The contents of this publication do not necessarily reflect the views or policies of the USDA, nor does mention of trade names, commercial products, or organizations imply endorsement from the US government.