Consumption of Dried Fruits Is Associated with Greater Intakes of Underconsumed Nutrients, Higher Total Energy Intakes, and Better Diet Quality in US Adults: A Cross-Sectional Analysis of the National Health and Nutrition Examination Survey, 2007-2016

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ABSTRACT

Background Dried fruits are shelf-stable alternatives to fresh fruit that avert common barriers to consuming fruit. Consumption of dried fruits may facilitate greater fruit consumption and contribute to better diet quality and nutrient intakes.

Objective Our aims were to assess differences in diet quality and cardiometabolic health between dried fruit consumers and nonconsumers, and evaluate differences in nutrient intakes on days when dried fruits were consumed vs not consumed.

Design This is a cross-sectional analysis of data from the National Health and Nutrition Examination Survey 2007-2016.

Participants/setting Mean dried fruit intakes were estimated in adults 20 years and older (n = 25,590) who completed a dietary recall. Dried fruit consumers (one-quarter cup-equivalent/day or more) were defined in respondents with 2 complete dietary recalls (n = 22,311). Within-person differences in nutrient intakes were assessed in respondents who consumed dried fruit on 1 of 2 dietary recalls (n = 1,233).

Main outcome measures Cardiometabolic risk factors, diet quality scored using the Healthy Eating Index 2015, and nutrient intakes were assessed.

Statistical analyses Diet quality and cardiometabolic health were compared in consumers vs nonconsumers using multivariate linear regression, adjusted for demographic and lifestyle factors. Within-person differences in nutrient intakes on days when dried fruits were consumed vs not were assessed using multivariate linear regression.

Results Mean ± standard error dried fruit intake was 0.04 ± 0.001 cup-equivalents and represented 3.7% of total fruit consumed. Consumers (7.2% of adults) had higher quality diets than nonconsumers (mean ± standard error Healthy Eating Index 2015 score = 60.6 ± 0.5 vs 52.6 ± 0.3; $P < 0.001$) and lower mean body mass index, waist circumference, and systolic blood pressure ($P < 0.01$). Total carbohydrate, dietary fiber, potassium, and polyunsaturated fat intakes were greater on days when dried fruits were consumed vs not consumed ($P < 0.001$). Total calorie intakes were also greater (208-215 kcal; $P \leq 0.002$) when dried fruits were consumed.

Conclusions Dried fruit consumption is associated with higher diet quality and greater intakes of underconsumed nutrients. However, dried fruits do not appear to displace other calorie sources on days when consumed.

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POOR DIET QUALITY IS RESPONSIBLE FOR NEARLY one-half (48%) of deaths from cardiovascular disease in the United States.[1] Suboptimal fruit intake, in particular, is a leading contributor to diet-related disease and disability in the United States and worldwide.[1] Fruits are sources of underconsumed nutrients, such as dietary fiber and potassium,[2,3] as well as bioactives (eg, phenolic compounds, and carotenoids) that may have cardioprotective benefits.[4-6] Prospective observational evidence consistently shows inverse associations between fruit consumption and risk of hypertension, coronary heart disease, stroke, and type 2 diabetes.[7-13] However, 76% of women and

86% of men in the United States do not meet fruit intake recommendations.[14] To formulate strategies to increase fruit consumption, a greater understanding of current consumption patterns is required.

Reported barriers to consuming fruits, particularly fresh fruits, include limited availability or accessibility, poor quality, rapid spoilage, and cost.[15-17] Minimally processed forms of fruit, including frozen, canned, and dried fruits, offer several advantages over fresh fruits.[18] They are resilient to fluctuations in seasonal availability, are relatively consistent in quality, and can be stored for later consumption. Many are also less expensive per serving than their fresh counterparts.[19] By averting several common barriers to consumption, these forms of fruit may help increase intakes. Indeed, consumers of frozen,[20] canned,[21,22] and dried[23] fruits have been shown to achieve greater total fruit intakes than nonconsumers.

The 2015-2020 Dietary Guidelines for Americans (DGA) recommend 2 to 2.5 cup-equivalents of fruit on a 2,000-kcal diet.[2] Each cup of fresh, canned, or frozen fruit counts as 1 cup-equivalent. One hundred percent fruit juice is also counted cup for cup-equivalent but should comprise no more than one-half of total fruit intake due to its low fiber content and potential for overconsumption. Each one-half cup of dried fruit equals 1 cup-equivalent. No upper limit is specified for dried fruit consumption but guidelines caution that, like juice, excess consumption may contribute extra calories.[2]

Although juice intakes in the United States are well characterized,[24-26] less is known about how dried fruits are consumed and contribute to Americans' dietary intakes. It is plausible that dried fruits may be overconsumed and contribute excess calories because they are an energy-dense form of fruit. Conversely, they could potentially displace less healthful foods in the diet, thereby reducing consumption of overconsumed nutrients and improving intakes of recommended nutrients.[27] Previous studies reported favorable differences in nutrient intakes, albeit higher energy intakes, in consumers vs nonconsumers of dried fruits.[23,28] However, in these analyses, overall diet quality differed between consumers and nonconsumers, so the role of dried fruits was difficult to distinguish from differences in the dietary pattern as a whole. Instead, the present study assesses within-person differences in dietary intakes when dried fruits are consumed, compared with nonconsumption days, using a statistical approach published by Kant and Graubard[29] that compares each individual to oneself. As individual-level factors remain constant, differences in food group and nutrient intakes are interpreted in relation to the dried fruit "exposure."

The objectives of this study are to characterize and compare diet quality and cardiometabolic health in US adult dried fruit consumers and nonconsumers, and to evaluate differences in nutrient intakes on days when dried fruits were consumed vs not consumed.

RESEARCH SNAPSHOT

Research Question: Is dried fruit consumption associated with better diet quality and nutrient intakes in US adults?

Key Findings: A cross-sectional analysis of adult participants in the National Health and Nutrition Examination Survey 2007-2016 showed that dried fruit consumers had higher-quality diets, assessed by the Healthy Eating Index 2015, than nonconsumers (61 vs 53 of 100; $P < 0.001$). Intakes of polyunsaturated fats, total carbohydrates, dietary fiber, and potassium were greater on days when dried fruits were consumed vs not consumed ($P < 0.001$). Total energy intakes were also greater (208-215 kcal; $P \leq 0.002$) on consumption days, suggesting that dried fruits do not completely displace other calorie sources.

METHODS

Data were collected as part of the National Health and Nutrition Examination Survey (NHANES), which uses a complex, multistage, probability design to survey demographic, health, and dietary intake information in a nationally representative sample of noninstitutionalized US residents in 2-year cycles.[30] The NHANES protocol has been approved by the Research Ethics Review Board of the National Center for Health Statistics and all participants provided written informed consent. The present study was determined to be exempt from review by The Pennsylvania State University Institutional Review Board (STUDY00013711).

Analytic Sample

In the present analyses, data from 5 cycles (2007-2008, 2009-2010, 2011-2012, 2013-2014, and 2015-2016) were combined. The analytic sample was restricted to adults 20 years or older and excluded pregnant (n = 317) and lactating (n = 168) women. For the dietary intake interview component of NHANES, What We Eat in America, trained staff collect up to two 24-hour recalls from all participants using the US Department of Agriculture's Automated Multiple-Pass Method. The first recall is collected in person by a trained interviewer, and the second is obtained by telephone 3 to 10 days later. Approximately 83% to 89% (per cycle) of participants who provided the first recall also completed the second one. To maximize sample size, dried fruit intakes and sources were quantified in eligible participants who provided at least 1 (day 1) 24-hour recall that was deemed to be complete and reliable by the National Center for Health Statistics (n = 25,590). To achieve better separation of consumers vs nonconsumers, consumption status was defined based on two 24-hour recalls. Thus, analyses comparing consumers and nonconsumers are restricted to individuals who provided 2 reliable and complete dietary recalls (n = 22,311).

Estimation of Dried Fruit Intakes and Definition of Consumers

Foods containing dried fruit were identified in cycle-specific releases of the Food and Nutrient Database for Dietary Studies,[31-35] which contain nutritional information and recipes for foods and beverages reported by NHANES consumers. Ingredients in each recipe are identified by standard reference codes. Items containing dried fruits were queried using standard reference codes for dried fruits. Dried banana chips, which are typically fried and nutritionally distinct from other dried fruits, were not included. The Food and Nutrient Database for Dietary Studies data sets do not completely disaggregate some manufactured items, such as ready-to-eat cereals, into single food ingredients. Therefore, a manual search of all fruit-containing items identified any remaining foods containing dried fruits that were not initially identified by standard reference code.

The amount of dried fruit in each item was quantified using cycle-specific releases of the Food Patterns Equivalence Database.[36] The Food Patterns Equivalence Database converts each reported food and beverage into units of US Department of Agriculture's Food Patterns components for assessing alignment with dietary guidelines. Fruit intakes are quantified in cup-equivalents. Total fruit cup-equivalents for items containing exclusively dried fruits were directly equated to cup-equivalents of dried fruits. Proportional contributions from mixed sources of fruit (eg, juice or raw, along with dried) were determined using the Food and Nutrient Database for Dietary Studies recipe files.

Dried fruit consumers were defined as individuals reporting dried fruit intakes totaling one-quarter cup-equivalent (approximately one-eighth measured cup, or approximately 19 g, of most dried fruits) or more on either or both of two 24-hour recalls. This cut point is approximately half of the reference amount customarily consumed for dried fruits (40 g) defined by the US Food and Drug Administration[37] and was selected so that consumers of smaller but nutritionally meaningful amounts of dried fruits would be identified, while excluding consumers of negligible amounts, for instance, from a single raisin bagel.

Assessment of Diet Quality

Diet quality was assessed using the Healthy Eating Index 2015 (HEI-2015), which measures dietary alignment with the 2015-2020 DGA.[38] Thirteen individual dietary components are scored out of 5 to 10 points. Nine components assess adequacy of intakes for recommended foods and nutrients (total fruits, whole fruits, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, and fatty acids). The remaining 4 moderation components (ie, refined grains, sodium, added sugars, and saturated fats) award points for consuming less than recommended maximums. The maximum score, 100, indicates complete alignment with recommendations. The present analysis calculated diet quality for each person, individually, based on mean dietary intakes from two 24-hour recalls using the simple HEI scoring algorithm method.[39]

Assessment of Cardiometabolic Risk Factors

Physical examination and laboratory data were collected at the Mobile Examination Center visit according to standard NHANES protocols.[40] Assessments included body mass index (BMI); waist circumference; seated resting blood pressure; fasting plasma glucose; fasting serum insulin; glycated hemoglobin; and serum lipids, including total cholesterol, high-density lipoprotein cholesterol, fasting low-density lipoprotein cholesterol, and fasting triglycerides. All adult NHANES participants are eligible for the physical examination and most laboratory assessments. However, only individuals attending a morning examination were eligible for assessment of fasting glucose, insulin, low-density lipoprotein cholesterol, and triglycerides. Data are missing for various other reasons, detailed further in documentation for each data set.[40]

Assessment of Nutrient and Food Group Intakes

Nutrient intake totals for each 24-hour recall were calculated by the US Department of Agriculture's Food Surveys Research Group. Nutrients contributed by supplements were not included. To limit the number of statistical comparisons, a subset of nutrients was selected *a priori* for the within-person comparisons on the basis of relevance to cardiometabolic health and content in dried fruits. All energy-yielding macronutrients were included along with potassium, an underconsumed nutrient of public health concern identified by the 2015-2020 DGA[2] that is provided by many dried fruits, and also sodium, a nutrient target for reduction in US diets.[41] Energy intake from fat and protein were calculated using Atwater factors 9 and 4 kcal/g, respectively,[42] and expressed as a percentage of total calorie intake. The percentage of energy from carbohydrates was calculated as the remaining nonalcohol calories. Added sugar and food group intakes were obtained from Food Patterns Equivalence Database.

Statistical Analysis

Survey procedures in *SAS*, version 9.4 (SAS Institute)[43] incorporating appropriate survey weights, strata, and primary sampling units were used for all statistical analyses to account for the complex survey design of NHANES. Mean intakes of fruits (total, juice, and dried) were assessed for the first (day 1) 24-hour recall using day 1 dietary weights. One 24-hour recall is regarded as sufficient to estimate mean intakes of a group.[44] Total dried fruit intakes along with intakes from specific food sources and eating occasions were quantified. Plain dried fruit was defined as dried fruits consumed alone or in mixtures with other dried fruits. The What We Eat in America food categories were used to categorize foods containing dried fruits as follows: cereals (hot, cold, and cereal bars), breads (yeast-risen bread, quick breads, English muffins, bagels), sweets (cookies, cakes, pies, puddings, candy), nuts/seeds (mixtures of dried fruits with nuts/seeds), and other (savory dishes, soups, sauces) (Table 1). Eating occasions were categorized by participants' self-reported labels and their Spanish equivalents: breakfast (breakfast, *desayuno*, and *almuerzo*); lunch (lunch, *comida*, and brunch); dinner (dinner, supper, and *cena*); and snack (snack, extended consumption, *botana*, *bocadillo*, *entre comida*, *merienda*, *tentempié*, drink, *bebida*). No dried fruit reports were categorized as "other" or "don't know."

Comparisons of consumers and nonconsumers were restricted to participants who completed both dietary recalls. Therefore, day 2 dietary weights, which adjust for additional nonresponse for the second dietary recall, were used in accordance with the least common denominator approach advised in the NHANES analytical guidelines.[45] Fasting laboratory variables were analyzed using fasting subsample weights. Categorical demographic and lifestyle characteristics of consumers and nonconsumers were compared using the Rao-Scott χ^2 test, a design-adjusted version of the Pearson χ^2 test recommended by the National Center for Health Statistics.[46] Least square means and 99% CIs for HEI-2015 scores (total and components) and cardiometabolic risk factors in dried fruit consumers and nonconsumers were determined

Table 1. Categorization of dried fruit food sources, according to WWEIA[a] food categories

Food	WWEIA code	WWEIA category
Cereals	4004	Pasta, noodles, cooked grains
	4602	Ready-to-eat cereal, higher sugar (>21.2 g/100 g)
	4604	Ready-to-eat cereal, lower sugar (≤21.2 g/100 g)
	9002	Baby food: cereals
	4802	Oatmeal
	5402	Cereal bars
	5404	Nutrition bars
Breads	4202	Yeast breads
	4206	Bagels and English muffins
Sweets	5202	Crackers, excludes saltines
	5502	Cakes and pies
	5504	Cookies and brownies
	5506	Doughnuts, sweet rolls, pastries
	5804	Pudding
	5702	Candy containing chocolate
	5704	Candy not containing chocolate
Nuts/seeds	2804	Nuts and seeds
Other	3002	Meat mixed dishes
	3004	Poultry mixed dishes
	3202	Rice mixed dishes
	3204	Pasta mixed dishes, excludes macaroni and cheese
	3208	Turnovers and other grain-based items
	3506	Other Mexican mixed dishes
	3802	Soups
	6018	Other fruits and fruit salads
	6422	Vegetable mixed dishes
	8402	Tomato-based condiments
	8406	Mustard and other condiments
	8412	Dips, gravies, sauces
	8806	Jams, syrups, toppings

[a]WWEA = What We Eat in America.

using multivariate linear regression. Estimates adjusted for age, sex, race/ethnicity, education, family poverty to income ratio, current smoking status, and self-reported physical activity. Physical activity level was categorized as sedentary (no reported work or leisure physical activity), low (below minimum recommendations), moderate (meeting recommended weekly targets of 150 to 300 minutes of moderate-intensity or 75 to 150 minutes of vigorous activity), or high (exceeding recommendations). Another model additionally adjusted for BMI was included for analyses of cardiometabolic risk variables, with the exception of BMI and waist circumference. A simplified model adjusted only for age and sex is also presented for all variables.

Within-person differences in nutrient and food group intakes on days when dried fruits were consumed vs not were assessed using linear regression as described by Kant and Graubard.[29] The analytic sample was restricted to individuals reporting dried fruit consumption (one-quarter cup-equivalent or more) on either of two 24-hour recalls, but not both (n = 1,233). Differences in intakes, calculated by subtracting total intakes on the nonconsumption day from totals on the consumption day, were defined as dependent variables in the regression model. Least square means were calculated for differences in nutrient intakes, adjusting for differences in the mode by which recalls were administered (in-person interview vs by phone) and the

Table 2. Mean fruit intakes and demographic and lifestyle characteristics of nonpregnant, nonlactating adults 20 years and older (n = 25,590) by tertile of total fruit consumption on day 1 dietary recall in National Health and Nutrition Examination Survey 2007-2016

Variable	Tertile 1 (n = 8,297)[a]	Tertile 2 (n = 8,562)	Tertile 3 (n = 8,731)
	←——— *mean±SE* [b]	———→	
Total fruit (cup-equivalents)	NR[c]	0.48 ± 0.01	2.40 ± 0.02
Dried fruit	NR	0.04 ± 0.002	0.07 ± 0.003
Juice	NR	0.12 ± 0.004	0.71 ± 0.02
Other[d]	NR	0.32	1.62
	←——— *%*[e] *(99% CI)*	———→	
Sex, female	46.9 (44.9-48.8)	54.6 (52.7-56.4)	51.4 (49.7-53.0)
Race/ethnicity			
Non-Hispanic White	67.0 (62.1-71.9)	69.2 (64.8-73.5)	65.5 (61.4-69.6)
Non-Hispanic Black	12.4 (9.6-15.2)	10.7 (8.5-12.8)	10.8 (8.8-12.7)
Mexican American	8.6 (6.2-11.1)	7.8 (5.6-9.9)	9.2 (6.7-11.7)
Other Hispanic	5.4 (3.8-6.9)	5.0 (3.6-6.5)	6.4 (4.8-8.0)
Other	6.6 (5.4-7.9)	7.4 (5.8-8.9)	8.2 (6.6-9.8)
Age			
20-39 y	42.1 (39.7-44.5)	31.4 (28.9-34.0)	33.6 (30.8-36.3)
40-59 y	39.3 (37.0-41.6)	38.4 (36.3-40.6)	36.6 (34.3-38.9)
≥60 y	18.6 (16.9-20.3)	30.2 (27.7-32.6)	29.9 (27.8-31.9)
Poverty to income ratio			
<1.3	28.7 (25.7-31.7)	19.6 (17.3-21.9)	20.4 (17.9-23.0)
1.3-1.85	11.8 (10.1-13.6)	10.9 (9.9-12.0)	10.8 (9.2-12.4)
>1.85	59.4 (55.9-63.0)	69.5 (66.6-72.3)	68.8 (65.4-72.1)
Education			
Less than high school	20.8 (18.3-23.3)	15.1 (13.2-17.0)	14.4 (12.5-16.2)
High school	26.4 (24.0-28.7)	22.0 (19.9-24.1)	18.7 (16.9-20.6)
Some college	34.0 (32.0-36.0)	31.4 (29.1-33.8)	30.6 (28.3-32.9)
4-y degree or more	18.9 (16.1-21.6)	31.4 (28.2-34.7)	36.3 (33.1-39.4)
Physical activity			
Sedentary	24.4 (22.3-26.5)	24.0 (22.0-26.0)	19.2 (17.3-21.0)
Low	13.4 (11.9-14.9)	15.0 (13.4-16.6)	13.7 (12.2-15.1)
Moderate	12.0 (10.5-13.5)	15.5 (13.7-17.2)	15.1 (13.6-16.5)
High	50.2 (47.6-52.9)	45.5 (43.2-47.8)	52.1 (49.6-54.5)
Current smoker	32.3 (30.0-34.6)	17.2 (15.9-18.6)	12.5 (10.9-14.2)
Taking glucose-lowering medication	8.4 (7.3-9.5)	9.3 (8.0-10.6)	8.4 (7.3-9.5)
Taking lipid-lowering medication	13.9 (12.3-15.5)	19.3 (17.4-21.3)	16.7 (15.1-18.4)
Taking blood pressure-lowering medication	22.1 (20.0-24.1)	26.1 (24.0-28.2)	23.3 (21.2-25.4)

[a]Number per tertile are unweighted.
[b]SE = standard error.
[c]NR = number too small to report.
[d]Other refers to all nondried and nonjuice fruits, including fresh, frozen, and canned.
[e]Percentages were adjusted for survey weights.

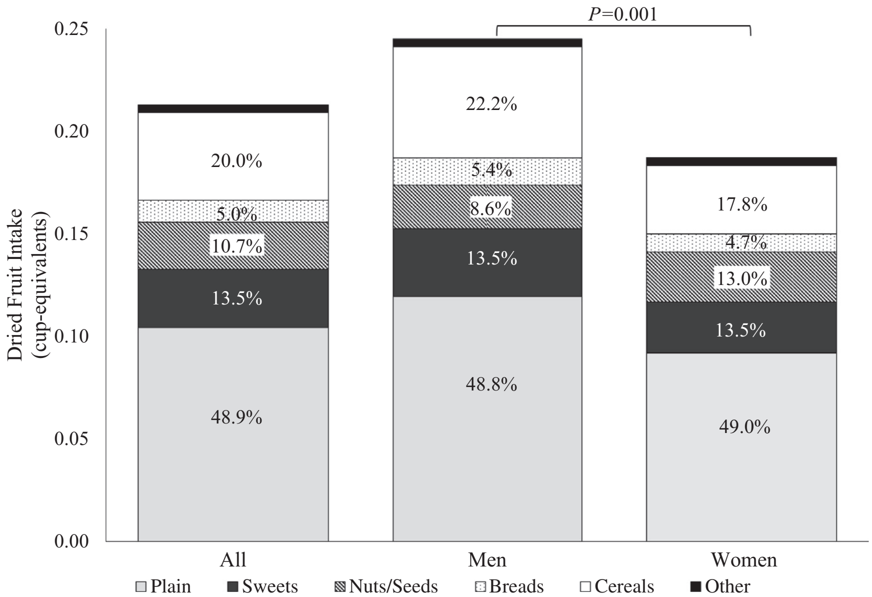

Figure. Food sources of reported dried fruit intakes among nonpregnant, nonlactating adults 20 years or older consuming any dried fruit on day 1 dietary recall (n = 3,823) in National Health and Nutrition Examination Survey 2007-2016. "Other" accounted for ≤2% in both men and women. *P* for *t* test comparing mean intakes in men and women.

days on which recalls were obtained (weekend days Friday through Sun vs weekdays Monday through Thursday). Day 2 dietary weights were used for these analyses. For all analyses, significance was defined at 2-tailed $P < 0.01$. Data are presented as means ± standard errors or 99% CIs, unless otherwise specified.

RESULTS

Mean dried fruit intake in US adults was 0.04 ± 0.001 cup-equivalents/day, representing 3.7% of total daily fruit intakes. Mean dried fruit intakes were greater across increasing tertiles of total fruit intake but comprised a small proportion of consumed fruits (Table 2). Juice and other forms of fruit, including fresh as well as canned and frozen, were the main sources contributing to greater fruit intakes in tertile 2 (26% juice, 67% other) and tertile 3 (30% juice, 67% other).

Among individuals who reported consuming any dried fruit (>0) on the day 1 dietary recall (n = 3,823; 16.7% of adults), mean ± standard error intake was 0.21 ± 0.01 cup-equivalents/day (Figure). Approximately even proportions of dried fruits were consumed plain (0.10 ± 0.01 cup-equivalents/day) or as ingredients in other foods (0.11 ± 0.004 cup-equivalents/day), with the greatest proportion consumed as ingredients in cereals (39.2%), followed by sweets (26.4%), nuts (21.0%), breads (9.9%), and other sources (3.5%). Most dried fruits were consumed at breakfast (38.2%) or as snacks (37.7%). Mean intakes were greater in men than women (mean difference ± standard error = 0.06 ± 0.02 cup-equivalents; $P = 0.001$).

Sociodemographic and Lifestyle Characteristics and Dietary Quality of Dried Fruit Consumers vs Nonconsumers

Approximately 7.2% of adults (n = 1,438; 51.1% female) consumed at least one-quarter cup-equivalent of dried fruit on either or both of two 24-hour recalls. Compared to nonconsumers, a greater proportion of consumers were non-Hispanic White and fewer were non-Hispanic Black, Mexican American, or other Hispanic (Table 3). Fewer consumers were 20 to 39 years of age and more were 60 years or older, and consumers had higher family incomes relative to the poverty guideline and attained higher levels of education. Fewer smoked and a greater proportion met physical activity recommendations. Self-reported blood pressure- and lipid-lowering medication use did not significantly differ, and statistically fewer consumers than nonconsumers reported use of medications for glycemic control ($P < 0.01$).

Mean total diet quality was significantly higher in consumers compared with nonconsumers (mean difference = 8.1 units, 99% CI 6.7-9.4 units; $P < 0.001$), after adjusting for demographic and lifestyle factors (Table 4). Consumers had higher scores for all HEI-2015 components except for total vegetables ($P = 0.49$), total dairy ($P = 0.08$), total protein ($P = 0.70$), and added sugars ($P = 0.64$).

Cardiometabolic Risk Factors in Dried Fruit Consumers vs Nonconsumers

Dried fruit consumers had a lower mean BMI (−0.8, 99% CI −1.4 to −0.2; $P = 0.002$) and waist circumference (−2.6 cm, 99% CI −4.2 to −0.9 cm; $P < 0.001$) than nonconsumers, after adjusting for demographic and lifestyle factors (Table 5). Consumers also had lower mean systolic blood pressure (SBP, −1.8 mm Hg, 99% CI −3.2 to −0.4 mm Hg; $P = 0.001$), fasting insulin (−1.7 μU/mL [to convert to pmol/L, multiply by 6.945], 99% CI −3.0 to −0.5; $P < 0.001$), and glycated hemoglobin (−0.07%, 99% CI −0.13% to −0.01%; $P = 0.002$). After additionally adjusting for BMI, the difference in SBP remained significant (−1.6 mm Hg, 99% CI −3.0 to −0.1 mm Hg; $P = 0.005$), and other differences were attenuated to nonsignificance ($P \geq 0.01$). The difference in SBP also remained significant after further adjustment for self-

Table 3. Demographic and lifestyle characteristics of nonpregnant, nonlactating adults 20 years and older (n = 22,311) reporting consumption of one-quarter cup-equivalent or more dried fruit on at least one of two 24-hour recalls, compared with nonconsumers, in National Health and Nutrition Examination Survey 2007-2016

Characteristics	Consumers (n = 1,438)	Nonconsumers (n = 20,873)	P[a] value
	←——%[b] (99% CI)——→		
Sex, female	51.1 (46.1-56.1)	51.4 (50.1-52.6)	0.91
Race/ethnicity			<0.001
Non-Hispanic White	76.1 (71.6-80.7)	66.8 (62.6-71.1)	
Non-Hispanic Black	8.8 (6.3-11.2)	11.4 (9.1-13.7)	
Mexican American	4.7 (2.8-6.6)	8.9 (6.6-11.1)	
Other Hispanic	3.6 (2.4-4.8)	5.6 (4.0-7.2)	
Other	6.8 (4.0-9.6)	7.3 (6.1-8.6)	
Age			
20-39 y	27.8 (22.9-32.8)	36.2 (33.9-38.4)	<0.001
40-59 y	40.0 (34.9-45.1)	38.0 (36.3-39.6)	
≥60 y	32.2 (26.6-37.7)	25.9 (24.3-27.4)	
Poverty to income ratio			<0.001
<1.3	12.8 (9.3-16.3)	22.9 (20.5-25.4)	
1.3-1.85	8.1 (5.1-11.0)	11.5 (10.4-12.7)	
>1.85	79.1 (74.5-83.8)	65.5 (62.4-68.6)	
Education			<0.001
Less than high school	8.1 (5.6-10.8)	16.7 (14.7-18.7)	
High school	15.4 (11.8-19.0)	22.6 (21.0-24.2)	
Some college	30.4 (26.4-34.4)	31.9 (30.1-33.6)	
4-y degree or more	46.0 (40.6-51.5)	28.8 (26.1-31.6)	
Physical activity			<0.001
Sedentary	16.4 (12.4-20.3)	22.7 (21.0-24.4)	
Low	16.0 (11.4-20.5)	14.4 (13.5-15.4)	
Moderate	19.3 (14.7-24.0)	14.4 (13.3-15.5)	
High	48.3 (42.4-54.3)	48.5 (46.7-50.4)	
Current smoker	9.8 (7.1-12.4)	20.4 (18.9-21.8)	<0.001
Taking glucose-lowering medication	6.5 (4.5-8.5)	8.8 (8.0-9.5)	<0.01
Taking lipid-lowering medication	19.3 (15.3-23.4)	16.6 (15.3-17.8)	0.07
Taking blood pressure-lowering medication	21.4 (17.2-25.5)	23.9 (22.4-25.5)	0.11

[a]P value for Rao-Scott χ^2 test comparing consumers and nonconsumers.
[b]Percentages were adjusted for survey weights.

reported use of blood pressure−lowering medications (−1.4 mm Hg, 99% CI −2.9 to 0 mm Hg; $P = 0.009$).

Within-Person Differences in Nutrient and Food Group Intakes on Days When Dried Fruit Is Consumed vs Not Consumed

Total fruit intakes were 0.50 and 0.54 cup-equivalents greater in men and women, respectively (both $P < 0.001$), on days when dried fruit was consumed (Table 6), contributing to total fruit intakes of 1.85 (men) and 1.74 cup-equivalents (women). This was almost entirely attributable to the dried fruit itself, as mean dried fruit intakes were 0.55 (men) and 0.51 cup-equivalents (women) on the consumption days. Total calories, polyunsaturated fat, total carbohydrates, dietary fiber, and potassium intakes were greater on days when dried fruit was consumed, for both men and women. Men consumed a greater percentage of calories from carbohydrates, and both men and women consumed smaller percentages of calories from protein, on dried fruit consumption days. Added sugar intake was greater only in men, and total fat and monounsaturated fat intakes were greater only in women. Saturated fat, protein, and

Table 4. Total HEI-2015[a] and component scores for nonpregnant, nonlactating adults 20 years and older (n = 22,311) reporting consumption of one-quarter cup-equivalent or more dried fruit on at least one of two 24-hour recalls, compared with nonconsumers, in National Health and Nutrition Examination Survey 2007-2016

HEI-2015 Component and Model[b]	Consumers (n = 1,438)	Nonconsumers (n = 20,873)	*P*[c] value
	←——— *LSM*[d] *(99% CI)* ———→		
Total HEI-2015 score (maximum 100)			
Model 1	63.5 (62.1-64.8)	53.7 (53.1-54.4)	<0.001
Model 2	60.6 (59.3-62.0)	52.6 (51.9-53.3)	<0.001
Total vegetables (maximum 5)			
Model 1	3.5 (3.3-3.7)	3.3 (3.3-3.4)	0.006
Model 2	3.3 (3.1-3.4)	3.2 (3.2-3.3)	0.49
Greens and beans (maximum 5)			
Model 1	2.4 (2.2-2.7)	2.0 (1.9-2.1)	<0.001
Model 2	2.4 (2.2-2.7)	2.1 (2.0-2.2)	0.002
Total fruit (maximum 5)			
Model 1	3.5 (3.3-3.7)	2.4 (2.3-2.4)	<0.001
Model 2	3.3 (3.1-3.5)	2.3 (2.2-2.4)	<0.001
Whole fruit (maximum 5)			
Model 1	4.0 (3.8-4.1)	2.5 (2.4-2.6)	<0.001
Model 2	3.6 (3.4-3.8)	2.3 (2.2-2.4)	<0.001
Whole grains (maximum 10)			
Model 1	4.5 (4.2-4.8)	2.8 (2.7-2.9)	<0.001
Model 2	3.9 (3.5-4.2)	2.4 (2.3-2.6)	<0.001
Total dairy (maximum 10)			
Model 1	5.7 (5.4-6.1)	5.4 (5.3-5.5)	0.004
Model 2	5.0 (4.6-5.4)	4.8 (4.6-4.9)	0.08
Total protein (maximum 5)			
Model 1	4.5 (4.4-4.6)	4.5 (4.5-4.5)	0.76
Model 2	4.5 (4.4-4.6)	4.5 (4.5-4.6)	0.70
Seafood and plant protein (maximum 5)			
Model 1	3.7 (3.5-4.0)	2.9 (2.8-3.0)	<0.001
Model 2	3.5 (3.3-3.8)	2.8 (2.7-3.0)	<0.001
Fatty acids[e] (maximum 10)			
Model 1	5.6 (5.3-5.9)	4.9 (4.8-5.1)	<0.001
Model 2	5.7 (5.3-6.0)	5.1 (4.9-5.3)	<0.001
Sodium (maximum 10)			
Model 1	4.9 (4.6-5.2)	3.9 (3.8-4.0)	<0.001
Model 2	5.2 (4.9-5.6)	4.1 (4.0-4.3)	<0.001
Refined grains (maximum 10)			
Model 1	7.3 (7.0-7.6)	6.3 (6.1-6.4)	<0.001
Model 2	6.7 (6.3-7.1)	5.8 (5.7-6.0)	<0.001
Saturated fat (maximum 10)			
Model 1	6.5 (6.1-6.9)	6.0 (5.9-6.1)	<0.001
Model 2	7.0 (6.6-7.4)	6.5 (6.3-6.6)	<0.001

(*continued on next page*)

Table 4. Total HEI-2015[a] and component scores for nonpregnant, nonlactating adults 20 years and older (n = 22,311) reporting consumption of one-quarter cup-equivalent or more dried fruit on at least one of two 24-hour recalls, compared with nonconsumers, in National Health and Nutrition Examination Survey 2007-2016 (*continued*)

HEI-2015 Component and Model[b]	Consumers (n = 1,438)	Nonconsumers (n = 20,873)	P^c value
Added sugars (maximum 10)			
Model 1	7.3 (7.0-7.5)	6.8 (6.7-7.0)	<0.001
Model 2	6.6 (6.3-6.9)	6.5 (6.4-6.7)	0.64

[a]HEI-2015 = Healthy Eating Index 2015.
[b]Model 1 covariates include age and sex. Model 2 covariates include age, sex, race/ethnicity, education, family poverty-income ratio, smoking, and self-reported physical activity level.
[c]*P* value for t-test comparing consumers and non-consumers, with regression adjustment for covariates.
[d]LSM = least square mean.
[e]Scored based on the ratio of summed mono- and polyunsaturated fats to saturated fats.

sodium intakes were not significantly different whether dried fruit was consumed or not. Both men and women consumed more whole grains and nuts and seeds on days when dried fruit was consumed. Intakes of total vegetables, refined grains, total dairy, and cheese did not differ between days.

After adjusting for within-person differences in total energy intake, the aforementioned differences remained significant. In addition, women had significantly greater intakes of saturated fat (3.4 g, 99% CI 1.5-5.2 g; $P < 0.001$), added sugar (1.8 tsp-equivalents, 99% CI 0.3-3.4 tsp-equivalents; $P = 0.002$) and protein (5.9 g, 99% CI 2.0-9.9 g; $P < 0.001$) on days when dried fruit was consumed vs not, and men had greater intakes of total fat (6.1 g, 99% CI 1.7-10.5 g; $P < 0.001$).

DISCUSSION

This study is the first to examine, in a large nationally representative sample, how nutrient intakes differ within individuals on days when dried fruits are consumed vs not. Importantly, this approach keeps demographic, health, and diet quality differences that distinguish consumers from nonconsumers constant. The within-person analysis showed consumption of dried fruits was associated with higher intakes of several underconsumed nutrients, although total energy intake was greater on days when dried fruits were consumed. The between-individual analyses showed dried fruit consumers, on average, had lower BMI, waist circumference, and SBP than nonconsumers, and had higher-quality diets with better intakes of several components, which could explain the previously reported differences in nutrient intakes between consumers and nonconsumers.[23] Together these analyses suggest dried fruits, when consumed, increase total fruit intake and contribute to higher diet quality and nutrient intake; however, the increase in energy intake on consumption days underscores the importance of ensuring energy balance if dried fruits are chosen to meet fruit intake recommendations.

Dried fruit consumption contributed minimally to adults' total fruit intakes (3.7%), although slightly more than previously reported for adults and children combined (2.6%).[47] Absolute intakes of dried fruit were highest in adults with the greatest total fruit consumption but represented a small proportion of total fruit consumed, relative to juice and other nondried (eg, fresh, frozen, and canned) fruits. Although dried fruits are not currently substantial contributors to fruit intakes, the within-person analysis indicated that dried fruits add to total fruit intake rather than displace other fruit forms. Thus, increasing dried fruit consumption might help Americans achieve greater fruit intakes.

Among individuals that consumed any dried fruits, total intakes were low. The mean intake (0.21 cup-equivalents) equates to just 10% of the recommended 2 cup-equivalent fruit intake target for a 2,000-calorie diet on the Healthy US-Style Eating Pattern.[2] Breakfast and snacks were the primary occasions for dried fruit consumption, which is consistent with observed patterns for total fruit consumption.[48] Approximately half of dried fruits were consumed as ingredients in other foods, including prepackaged cereals and baked goods. Further evaluation of the nutritional contributions of these foods—which often contain added sugars and sodium—is warranted before recommending them as strategies to increase fruit intakes.

Dried fruit consumers had lower mean BMI, waist circumference, and SBP, supporting findings reported previously by Keast and colleagues[23] in an earlier analysis of NHANES data (1999-2004). Consumers also had lower fasting insulin and glycated hemoglobin, consistent with better cardiometabolic health. Differences in BMI appeared to explain the favorable associations with glycemic health but not SBP. The difference in SBP between dried fruit consumers vs nonconsumers in the BMI-adjusted model (−1.6 mm Hg; $P = 0.005$) was similar in magnitude to that reported by Keast and colleagues (−1.5 mm Hg; $P < 0.05$), in spite of defining consumers at different cut points (one-quarter vs one-eighth cup-equivalent). However, these results should be interpreted cautiously because dried fruit consumers differed from nonconsumers in a number of behavioral and sociodemographic characteristics and residual confounding could explain these observations.

Previous studies that compared consumers and nonconsumers of mixed dried fruits[23] and raisins[28] reported that consumers' nutrient intakes compared favorably against nonconsumers, with greater intakes of underconsumed nutrients including dietary fiber and potassium and lower intakes of overconsumed nutrients including saturated fat and sodium. However, the contributions of dried fruits to these nutrient differences are difficult to distinguish from other components in the diet that varied between individuals. The present study confirmed prior observations that the overall dietary patterns of consumers and nonconsumers differ substantially.[23,28] Consumers selected overall healthier diets, with a mean HEI-2015 score exceeding the national mean of 57.7.[49] Thus, differences in their nutrient intakes are reflective of differences in the entire dietary pattern.

Table 5. Cardiometabolic health of nonpregnant, nonlactating adults 20 years and older reporting consumption of one-quarter cup-equivalent or more of dried fruit on at least one of two 24-hour recalls compared with nonconsumers in National Health and Nutrition Examination Survey 2007-2016[a]

Cardiometabolic risk factor and model[b]	Consumers n	Consumers LSM[c] (99% CI)	Nonconsumers n	Nonconsumers LSM (99% CI)	Difference (consumers minus nonconsumers) Estimate (99% CI)	P[d] value
BMI[e]						
Model 1	1,424	28.0 (27.3 to 28.6)	20,649	29.2 (28.9 to 29.4)	−1.2 (−1.8 to −0.6)	<0.001
Model 2	1,314	28.4 (27.6 to 29.1)	18,925	29.2 (28.8 to 29.5)	−0.8 (−1.4 to −0.2)	0.002
Waist circumference (cm)						
Model 1	1,385	96.6 (94.9 to 98.3)	20,120	100.1 (99.5 to 100.7)	−3.5 (−5.1 to −1.8)	<0.001
Model 2	1,283	97.1 (95.2 to 99.0)	18,456	99.7 (98.8 to 100.6)	−2.6 (−4.2 to −0.9)	<0.001
Systolic blood pressure (mm Hg)						
Model 1	1,413	120.7 (119.2 to 122.3)	20,361	123.3 (122.7 to 123.9)	−2.6 (−3.7 to −1.4)	<0.001
Model 2	1,307	122.4 (120.8 to 124.0)	18,679	124.3 (123.4 to 125.1)	−1.8 (−3.2 to −0.4)	0.001
Model 3	1,294	122.7 (121.0 to 124.3)	18,504	124.3 (123.4 to 125.2)	−1.6 (−3.0 to −0.1)	0.005
Diastolic blood pressure (mm Hg)						
Model 1	1,408	70.1 (68.9 to 71.4)	20,297	70.7 (70.2 to 71.3)	−0.6 (−1.7 to 0.5)	0.16
Model 2	1,303	69.6 (68.1 to 71.0)	18,622	70.5 (69.8 to 71.3)	−1.0 (−2.2 to 0.2)	0.03
Model 3	1,290	69.8 (68.3 to 71.3)	18,450	70.6 (69.9 to 71.3)	−0.8 (−2.0 to 0.4)	0.08
Total cholesterol (mg/dL)[f]						
Model 1	1,381	194.3 (190.0 to 198.7)	19,909	195.6 (194.2 to 197.1)	−1.3 (−5.6 to 3.0)	0.43
Model 2	1,275	194.2 (188.9 to 199.5)	18,270	196.4 (194.0 to 198.7)	−2.2 (−6.8 to 2.4)	0.20
Model 3	1,262	194.3 (189.0 to 199.6)	18,098	196.4 (194.1 to 198.8)	−2.1 (−6.7 to 2.5)	0.23
HDL-C[fg] (mg/dL)						
Model 1	1,381	54.8 (52.4 to 57.2)	19,909	53.0 (52.5 to 53.6)	1.8 (−0.5 to 4.0)	0.04
Model 2	1,275	51.4 (49.1 to 53.8)	18,270	51.0 (50.2 to 51.9)	0.4 (−1.9 to 2.7)	0.63
Model 3	1,262	50.7 (48.5 to 52.9)	18,098	50.9 (50.2 to 51.7)	−0.2 (−2.3 to 1.9)	0.79
LDL-C[fh] (mg/dL)						
Model 1	680	114.3 (110.0 to 118.7)	9,406	114.8 (113.5 to 116.1)	−0.5 (−5.0 to 4.1)	0.78
Model 2	637	115.9 (111.1 to 120.7)	8,604	116.4 (114.0 to 118.7)	−0.5 (−4.9 to 3.9)	0.76
Model 3	633	116.3 (111.4 to 121.1)	8,524	116.5 (114.1 to 118.9)	−0.2 (−4.6 to 4.2)	0.89
Triglycerides (mg/dL)[i]						
Model 1	691	119.9 (108.6 to 131.3)	9,565	126.9 (123.3 to 130.6)	−7.0 (−19.1 to 5.1)	0.13
Model 2	647	133.4 (119.3 to 147.6)	8,747	135.4 (128.4 to 142.4)	−2.0 (−14.3 to 10.4)	0.68
Model 3	643	136.5 (122.8 to 150.5)	8,665	136.3 (129.5 to 143.0)	0.2 (−11.5 to 12.0)	0.96
Fasting glucose (mg/dL)[j]						
Model 1	702	103.9 (100.8 to 107.0)	9,745	107.2 (106.0 to 108.4)	−3.4 (−6.7 to 0)	0.009
Model 2	657	107.2 (104.0 to 110.3)	8,911	109.4 (107.7 to 111.1)	−2.3 (−5.3 to 0.8)	0.05
Model 3	652	108.1 (104.8 to 111.5)	8,827	109.7 (108.1 to 111.3)	−1.6 (−4.6 to 1.5)	0.19
Fasting insulin (μU/mL)[k]						
Model 1	686	10.8 (9.8 to 11.8)	9,536	13.2 (12.6 to 13.8)	−2.4 (−3.7 to −1.2)	<0.001
Model 2	641	12.1 (10.8 to 13.4)	8,729	13.9 (12.9 to 14.9)	−1.7 (−3.0 to −0.5)	<0.001
Model 3	636	13.3 (12.2 to 14.4)	8,645	14.2 (13.3 to 15.1)	−0.9 (−1.9 to 0)	0.01

(*continued on next page*)

Table 5. Cardiometabolic health of nonpregnant, nonlactating adults 20 years and older reporting consumption of one-quarter cup-equivalent or more of dried fruit on at least one of two 24-hour recalls compared with nonconsumers in National Health and Nutrition Examination Survey 2007-2016[a] (*continued*)

Cardiometabolic risk factor and model[b]	Consumers		Nonconsumers		Difference (consumers minus nonconsumers)	P[d] value
	n	LSM[c] (99% CI)	n	LSM (99% CI)	Estimate (99% CI)	
HbA1c[l] (%)						
Model 1	1,388	5.54 (5.48 to 5.60)	20,105	5.68 (5.65 to 5.71)	−0.14 (−0.20 to −0.08)	<0.001
Model 2	1,282	5.76 (5.70 to 5.83)	18,449	5.83 (5.79 to 5.88)	−0.07 (−0.13 to −0.01)	0.002
Model 3	1,269	5.79 (5.72 to 5.86)	18,275	5.84 (5.80 to 5.88)	−0.05 (−0.11 to 0.01)	0.05

[a]Day 2 dietary weights used for BMI, waist circumference, systolic blood pressure, diastolic blood pressure, total cholesterol, HDL-C, and HbA1c; fasting subsample weights used for LDL-C, triglycerides, glucose, and insulin.
[b]Model 1 covariates include age and sex. Model 2 covariates include age, sex, race/ethnicity, education, family poverty to income ratio, smoking, and self-reported physical activity level. Model 3 adjusted for Model 2 covariates and additionally for BMI.
[c]LSM = least square mean.
[d]P value for t test comparing consumers and nonconsumers, with regression adjustment for covariates.
[e]BMI = body mass index; calculated as kg/m^2.
[f]To convert mg/dL cholesterol to mmol/L, multiply by 0.0259.
[g]HDL-C, high-density lipoprotein cholesterol.
[h]LDL-C, low-density lipoprotein cholesterol.
[i]To convert mg/dL triglycerides to mmol/L, multiply by 0.0113.
[j]To convert mg/dL glucose to mmol/L, multiply by 0.0555.
[k]To convert μU/mL insulin to pmol/L, multiply by 6.945.
[l]HbA1c = hemoglobin A1c (glycated hemoglobin).

To better understand the nutritional contributions of dried fruits, within-person differences in nutrient intakes when dried fruits are consumed vs not were assessed. As the 2 dietary recalls for each person were obtained within a 2-week span, person-level effects (eg, demographic characteristics, food preferences, and health consciousness) were assumed to remain constant, and recall differences related to day of consumption and mode of recall report were adjusted for in the regression model. Dried fruits appear to be added to the diet without substantially displacing other foods, as total energy intakes were approximately 200 kcal greater on consumption days. A previous clinical trial reported incomplete caloric substitution by participants instructed to consume 120 g/day (1.6 cup-equivalents) of dried figs, in spite of instruction to replace calories from sweets and desserts.[50] Like juice, energy-dense dried fruits may be less satiating than fresh fruits.[51] Compensatory changes in intake of other foods may not completely offset the extra calorie intakes from energy-dense foods in free-living individuals.[52,53] The observed mean intake of dried fruit on consumption days (approximately 0.5 cup-equivalent) provides only 90 to 115 kcal.[27] The additional calories are presumed to come from concurrent increases in other foods, which also explain the greater intakes of nutrients not typically found in dried fruits (total and polyunsaturated fats) on days when dried fruits were consumed.

It is notable that dried fruit consumers had lower mean BMI and waist circumference than nonconsumers, given the finding of higher caloric intake on a day when dried fruit was consumed vs a nonconsumption day in the within-person analysis. This suggests that higher calorie intakes on consumption days may not translate into long-term positive energy balance, which may be, at least partly, attributable to infrequent consumption of dried fruits. In addition, dried fruit consumers were demographically different from nonconsumers and exhibited more health-promoting behaviors. Thus, this finding should be interpreted with caution, as it may not be generalizable to most US adults in whom consumption of more energy-dense diets is associated with greater energy intakes, higher BMI,[53,54] and cardiometabolic disease risk.[55,56]

Intakes of underconsumed nutrients, potassium and dietary fiber, were greater on days when dried fruit was consumed. However, intakes of sodium and saturated fat were not significantly different. For men, but not women, intakes of added sugars were also greater on dried fruit consumption days, and intakes of polyunsaturated fat intakes were greater for both men and women. Some dried fruits are sweetened and thereby contribute dietary added sugars, but dried fruits are fat free. These nutrients likely came from accompanying food sources such as the cereals, nut and seed mixtures, and sweets in which dried fruits are commonly consumed. This is supported by the observation that intakes of whole grains, and nuts and seeds, were greater on days when dried fruits are consumed.

Strengths of this study include use of data from a large, nationally representative sample of US adults. Several data cycles were aggregated to increase the number of dried fruit consumers for analysis. Thorough identification of dried fruit sources was achieved through careful review of the cycle-specific releases of the dietary database. This permitted quantification of total and specific food sources of dried fruits, which have not been reported previously. Future studies can apply this method to assess dried fruit consumption in other

Table 6. Within-person differences in nutrient and food group intakes for day of reported dried fruit consumption (¼ cup-equivalent or more) vs nonconsumption (less than one-quarter cup-equivalent) among nonpregnant, nonlactating adults 20 years and older reporting consumption of dried fruit on one of two 24-hour recalls (n = 1,233) in National Health and Nutrition Examination Survey 2007-2016

	Men (n = 593)		Women (n = 640)	
Variable	**n**	**%[a]**	**n**	**%[a]**
Mode by which dried fruit consumption was reported				
In person	300	56	303	49
By phone	293	44	337	51
Day on which dried fruit consumption was reported				
Weekday[b]	358	62	376	60
Weekend[c]	235	38	264	40
	LSM[d] (99% CI)	***P* value[e]**	**LSM (99% CI)**	***P* value**
Calories (kcal)	208 (41 to 374)	0.002	215 (99 to 330)	<0.001
Total fat (g)	3.2 (−5.9 to 12.3)	0.36	9.8 (2.9 to 16.6)	<0.001
Calories from fat (% kcal)	−1.3 (−2.9 to 0.2)	0.03	0.4 (−0.9 to 1.8)	0.41
Saturated fat (g)	−1.2 (−5.4 to 2.9)	0.43	2.5 (−0.2 to 5.2)	0.02
Polyunsaturated fat (g)	3.0 (0.7 to 5.2)	<0.001	3.0 (1.0 to 5.1)	<0.001
Monounsaturated fat (g)	1.0 (−2.5 to 4.6)	0.44	3.4 (0.9 to 6.0)	<0.001
Total carbohydrates (g)	53 (29 to 77)	<0.001	34 (20 to 48)	<0.001
Calories from carbohydrate (% kcal)	3.0 (0.9 to 5.1)	<0.001	0.6 (−0.9 to 2.1)	0.26
Dietary fiber (g)	6.3 (4.1 to 8.6)	<0.001	4.2 (2.5 to 5.9)	<0.001
Added sugars (tsp-equivalents)	3.5 (0.5 to 6.5)	0.003	1.3 (−0.2 to 2.9)	0.02
Protein (g)	2.7 (−4.0 to 9.4)	0.29	4.2 (−1.5 to 9.8)	0.06
Calories from protein (% kcal)	−0.9 (−1.8 to −0.1)	0.006	−0.9 (−1.7 to −0.1)	0.005
Potassium (mg)	461 (205 to 717)	<0.001	344 (174 to 514)	<0.001
Sodium (mg)	1 (−397 to 398)	1.0	−52 (−311 to 206)	0.59
Total fruit (cup-equivalents)	0.50 (0.24 to 0.75)	<0.001	0.54 (0.27 to 0.82)	<0.001
Dried fruit (cup-equivalents)	0.52 (0.45 to 0.59)	<0.001	0.49 (0.44 to 0.54)	<0.001
Total vegetables (cup-equivalents)	0.04 (−0.29 to 0.38)	0.73	−0.08 (−0.30 to 0.13)	0.31
Refined grains (ounce-equivalents)	0.17 (−0.75 to 1.09)	0.62	−0.16 (−0.75 to 0.44)	0.48
Whole grains (ounce-equivalents)	0.46 (0.11 to 0.81)	0.001	0.24 (0.01 to 0.47)	0.008
Nuts/seeds (ounce-equivalents)	0.98 (0.38 to 1.59)	<0.001	0.87 (0.42 to 1.32)	<0.001
Total dairy (cup-equivalents)	0.07 (−0.38 to 0.53)	0.67	0.34 (−0.09 to 0.77)	0.04
Total cheese (cup-equivalents)	−0.20 (−0.44 to 0.05)	0.04	0.26 (−0.11 to 0.63)	0.07

[a]Percentages were adjusted for survey weights.
[b]Monday through Thursday.
[c]Friday through Sunday.
[d]LSM = least square mean differences in intakes (calculated as intake on day when dried fruit was consumed minus intake on day when dried fruit was not consumed), adjusting for differences in mode of interview and days (weekend vs weekday) on which recalls were obtained.
[e]*P* for *t* test of difference from 0.

age groups, such as children and adolescents, or extend the method to identify other foods sources of interest. Although most NHANES analyses define consumers of specific foods or beverages based on a single dietary recall, consumption status was defined using 2 recalls, achieving better separation between consumers and nonconsumers. Finally, a previously published within-person approach[29] was applied to observe dietary changes that accompany dried fruit consumption in free-living adults. Although clinical trials impose restrictions in the dietary context of consumption, this observational crossover approach allowed us to observe how adults voluntarily incorporate dried fruits into their diets.

Data from NHANES are cross-sectional and, therefore, the direction and temporality of associations between diet and health are not known. Limitations of self-reported dietary intakes assessed by 24-hour recalls include measurement error resulting from participants' difficulty remembering and estimating quantities of consumed foods and beverages, as well as potential biases related to weight status or social desirability.[57] As individual-level factors remained constant in within-person comparisons of dietary intakes, reporting errors resulting from these biases were assumed to cancel out. Although a single recall per person is regarded as sufficient to estimate population mean dietary intakes, substantial within-person variability in intakes prohibits accurate estimation of the distribution of usual intakes.[58] However, the purpose of this study was to describe average intakes and not to compare population intakes to a reference standard, so this is not perceived to be a critical limitation. Dried fruits are not consumed by everyone on every day; thus, defining consumption status based on two 24-hour recalls may misclassify some infrequent consumers as nonconsumers. Misclassification is expected to attenuate true differences between consumers and nonconsumers in dietary intakes and cardiometabolic risk factors, under the assumption that misclassification is nondifferentiable by these outcomes. Within-person comparisons of nutrient and food group intakes were interpreted in relation to dried fruit consumption. However, unidentified accompanying dietary shifts could have contributed to the observed differences. Finally, these analyses of dried fruit intake aggregated all dried fruits, which individually vary in nutrient and bioactive composition. This approach is consistent with the 2015-2020 DGA, which do not recommend any individual fruit types over others but rather provide guidance regarding how different fruit forms, including dried, can contribute to total fruit intake.

CONCLUSIONS

Although dried fruits are not currently substantial contributors to US adults' fruit intakes, encouraging consumption could increase intakes of important underconsumed nutrients, namely, fiber and potassium. However, the associated greater intakes of total energy and added sugars suggest that unstructured advice to consume more dried fruits could have unintended dietary consequences. Guidance to select varieties without added sugar and replace other calorie sources may help to support maintenance of energy balance when dried fruits are added to the diet.

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All authors contributed to the study design. V. K. Sullivan performed statistical analyses. V. K. Sullivan and K. S. Petersen wrote the first draft with contributions from P. M. Kris-Etherton. All authors reviewed and commented on subsequent drafts of the manuscript.

THE ART OF DIETETICS

The many benefits of chili peppers: delicious, unique taste; high in antioxidants; easy to grow. Grow your own to use fresh and freeze or dry the extras. Chiles belong to the Capsicum annum family along with other nightshades (Solanacea) such as tomatoes. Their antioxidant properties make them better than supplements or medicine. Use food as medicine and eat food first.

Photo taken by Digna I. Cassens, MHA, RDN, CLT.

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