Canned Vegetable and Fruit Consumption Is Associated with Changes in Nutrient Intake and Higher Diet Quality in Children and Adults: National Health and Nutrition Examination Survey 2001-2010

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ABSTRACT

Background Canned vegetables and fruit (CV+CF) are ubiquitous throughout the food supply. Yet information regarding their specific contribution to nutrient intake and health measures is lacking.

Objective The objective of this study was to examine the association of CV+CF with nutrient intake, diet quality, anthropometric indicators of overweight/obesity, and blood pressure in a nationally representative population.

Design and participants A secondary analysis of cross-sectional data from 17,344 children and 24,807 adults in the National Health and Nutrition Examination Survey 2001-2010 was conducted. A dataset was developed that distinguished CV+CF consumers from nonconsumers.

Main outcome measures Diet quality was calculated using the Healthy Eating Index 2010.

Statistical analyses Regression analysis determined differences between groups.

Results About 11% of the population consumed CV+CF on a given day. Compared with nonconsumers, child (n=2,066) and adult (n=2,746) CV+CF consumers ate more energy, and energy adjusted dietary fiber, total sugar, choline, and potassium, and less fat and saturated fat. Child consumers also ate more energy adjusted protein, vitamin A, calcium, and magnesium. Child and adult consumers and nonconsumers had comparable energy adjusted sodium and added sugar intakes. Compared with nonconsumers, the total Healthy Eating Index 2010 score was higher ($P<0.001$) in child (45.8±0.5 vs 43.3±0.3) and adult (49.0±0.4 vs 47.4±0.3) consumers. Covariate adjusted body weight, body mass index, waist circumference, and blood pressure were comparable in both of the child and adult groups.

Conclusions Results suggest CV+CF consumption was associated with higher intake of select nutrients, a higher-quality diet, and comparable adiposity measures and blood pressure.
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THE 2010 DIETARY GUIDELINES FOR AMERICANS (DGA)[1] recommend maintenance of caloric balance to achieve and sustain a healthy weight. The DGA also recommend increased consumption of nutrient-dense foods and beverages (such as vegetables, fruits, whole grains, low- or fat-free milk products, lean proteins, eggs, beans and peas, and nuts and seeds), while limiting consumption of foods that provide too much sodium, solid fats, and added sugars.[1] Consuming a healthful diet, in general, and consuming vegetables and fruits, in particular, helps to provide adequate dietary intake of nutrients of concern—vitamin D, calcium, potassium, and dietary fiber,[1] and nutrients identified by the Dietary Guidelines Advisory Committee as "tenuous for adult men and women"—vitamins A, C, E, and K, choline, and magnesium.[2] Consumption of vegetables and fruits is also associated with health benefits.[1] Longitudinal studies suggest that a greater intake of vegetables and/or fruits may protect against adiposity in children and adolescents.[3] In adults, there is a modest inverse association between vegetable and fruit intake and body weight,[4] and myocardial infarction and stroke.[5] Some vegetables and fruits may reduce the risk of breast, lung, colorectal, or prostate cancer.[1]

The recommended intake for vegetables and fruits depends on age, sex, and physical activity and ranges from 1 to 3 cups/day for vegetables and from 1 to 2 cups/day for fruits.[6] All

vegetables and fruits, including 100% vegetable and fruit juices, count toward intake. Vegetables and fruits may be canned, fresh, frozen, or dried/dehydrated; they may be consumed raw or cooked; and they may be whole, cut-up, mashed, or puréed.[6] Although the majority of vegetables and fruits consumed by Americans are fresh,[7] the Academy of Nutrition and Dietetics (the Academy) promotes the total diet approach to healthy eating,[8] a position supportive of the DGA. Noting that most Americans fail to meet DGA recommendations for vegetables and fruits,[9-12] the Academy encourages food and nutrition practitioners to recommend, along with fresh forms, inclusion of frozen, canned, and dried forms of vegetables and fruits, which have similar nutrient profiles,[13-15] but may offer consumers additional benefits with respect to cost, seasonality, storage, and transport.[8,13]

Studies have examined associations of whole vegetables and fruits,[16-18] individual vegetables and fruits,[19-22] dried fruits,[23] and 100% fruit juices[24,25] with nutrition-related or health outcomes. Little is known about the overall effect that consumption of canned vegetables and fruit (CV+CF) has on nutrient intake, dietary quality, and health measures. The purpose of this study was to determine, using National Health and Nutrition Examination Survey (NHANES) 2001-2010, the association of CV+CF with nutrient intake, diet quality, anthropometric indicators of overweight/obesity, and blood pressure.

METHODS

Study Population

This study involved analyses of cross-sectional data from US children aged 2 to 18 years (n=17,344) and adults aged ≥19 years (n=24,807) participating in the 2001-2002, 2003-2004, 2005-2006, 2007-2008, and 2009-2010 NHANES. The data from these five cycles were merged to increase sample size. The study population was limited to participants with complete, reliable 24-hour dietary recall data. Pregnant or lactating females were excluded. Details of NHANES study design, implementation, datasets, analytic considerations, and other documentation are available online.[26-30] As described therein, following administration of a series of questionnaires in a detailed in-home interview, participants visit a Mobile Examination Center where in-person health examinations and a dietary interview, commonly referred to as the What We Eat in America component of the NHANES was conducted. All participants or proxies provided written informed consent and the Research Ethics Review Board at the National Center for Health Statistics approved the survey protocol.[31]

Collection of Dietary Intake Data

Dietary intake data were obtained from multipass, in-person, 24-hour dietary recall interviews, conducted by experienced interviewers with the use of a computer-assisted dietary interview system.[32,33] For the years when two 24-hour recalls were publicly available, only the first day of the dietary recall data were used. Parents/guardians of children aged 2 to 5 years provided the dietary recalls, and assisted children aged 6 to 11 years. Children aged 12 to 18 years self-reported intake. Descriptions of interview methods are available in the NHANES Dietary Interviewer's Training Manual, which includes pictures of the computer-assisted dietary interview system screens, measurement guides, and charts used to collect dietary information.[34]

CV+CF Consumption and Nutrient Intake Data

The US Department of Agriculture (USDA) Food and Nutrient Database for Dietary Studies is updated for each 2-year cycle of What We Eat in America. The versions corresponding to NHANES 2001-2002, 2003-2004, 2005-2006, 2007-2008, and 2009-2010[35-39] were used to code, process, and analyze dietary data for nutrient content. Almost 7,000 foods from all food groups, including their source (eg, from fresh, frozen, or canned) and method of preparation (eg, cooked or raw or with added salt) were included. Each food is identified by a unique eight-digit code. The first digit identifies one of the nine major food groups. In this initial examination of intake of CV+CF, we focused on canned food products available in traditional metal cans. As such, canned vegetables were defined as all items, including tomatoes, beginning with the food code 7 that were listed as "cooked, from canned" (ie, beans, string, green, cooked, from canned); "canned" (ie, corn, yellow, canned); or "from canned" (ie, corn, yellow, from canned, cream style). Spaghetti sauce, tomato sauce, tomato paste, and black olives were included as canned vegetables. Canned fruits comprised all items beginning with the food code 6 that were listed as either "cooked or canned" (ie, peach, cooked or canned), or "canned or frozen" (ie, orange, mandarin, canned or frozen). The only fruit included as canned that was not listed as such was cranberries, which was listed as "NS (not further specified) as to raw, cooked, or canned" (in addition to being listed as "cooked or canned"). Exclusions to the CV+CF category included all fruit and vegetable juices (listed as canned, bottled, or in a carton or as juice); all soups (even if listed as canned); and all mixed dishes containing vegetables. Salsa, pickles, relish, all legumes, and applesauce were also excluded. Participants were classified as CV+CF consumers based on their reported consumption of at least one item classified as a canned vegetable or a canned fruit. We focused analyses on energy; macronutrients (ie, protein, total fat, saturated fat, monounsaturated fat, dietary fiber, total sugars, and added sugars); and nutrients mentioned in the DGA as overconsumed or possibly a concern for underconsumption for at least some population groups (eg, vitamin A, vitamin D, choline, folate, calcium, iron, sodium, and potassium). In addition, we calculated the sodium–potassium ratio.

The Healthy Eating Index (HEI)-2010

HEI-2010 was used to determine diet quality.[40-42] The HEI-2010 is an updated version that reflects the DGA and includes 12 components. Nine components assess dietary adequacy (Total Fruit, Whole Fruit, Total Vegetables, Greens and Beans, Whole Grains, Dairy, Total Protein Foods, Seafood and Plant Proteins, and Fatty Acids Ratio) and three assess dietary components that should be consumed in moderation (Refined Grains, Sodium, and Empty Calories [energy from solid fats, alcohol, and added sugars]). Higher intake for the adequacy components and lower intake for the moderation components indicate better compliance with the DGA and result in higher scores. The total score (which has a maximum value of 100) is a measure of overall diet quality in terms of dietary intake per 1,000 kcal.[43] The SAS code (version 9.2, 2010, SAS Institute, Inc) used to calculate