Vegetable Variety Is a Key to Improved Diet Quality in Low-Income Women in California

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ABSTRACT

Primary prevention education interventions, including those sponsored by the US Department of Agriculture for low-income families, encourage and support increases in vegetable intake. Promoting vegetable variety as a focal point for behavior change may be a useful strategy to increase vegetable consumption. A simple vegetable variety evaluation tool might be useful to replace the time-intensive 24-hour dietary recall. The purpose of our study was to determine whether vegetable variety is associated with vegetable consumption and diet quality among US Department of Agriculture program participants. Variety of vegetable intake and measures of total vegetable intake, diet quality, and diet cost were evaluated. Low-income, female participants (N=112) aged 20 to 55 years with body mass index 17.7 to 68.5 who were the primary food purchasers/preparers for their households were recruited from four California counties representing rural, urban, and suburban areas. Energy density and Healthy Eating Index-2005 were used to assess diet quality. Vegetable variety was based on number of different vegetables consumed per week using a food frequency questionnaire, and three groups were identified as: low variety, ≤5 different vegetables per week; moderate variety, 6 to 9 vegetables per week; and high variety, ≥10 vegetables per week. Compared with the low-variety group, participants in the high-variety group ate a greater quantity of vegetables per day (P<0.001); their diets had a higher Healthy Eating Index score (P<0.001) and lower energy density (P<0.001); and costs of their daily diet and vegetable use were higher (P<0.001). Thus, greater vegetable variety was related to better overall diet quality, a larger quantity of vegetables consumed, and increased diet cost.
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PLACING EMPHASIS ON INCREASING VEGETABLE variety instead of the abstract concept "diet quality" may be an important educational strategy to use with US Department of Agriculture (USDA) nutrition program participants in low-income communities; increasing vegetable variety may serve as a surrogate for an increase in diet quality via an increase in total vegetable intake. Assessing diet quality using the Healthy Eating Index (HEI) requires analysis from 24-hour diet recalls, a time-intensive procedure when self-administered in a group setting with low-literate USDA program participants. Recently, Meengs and colleagues[1] reported that in a laboratory setting, increasing vegetable variety offered at a single meal increased the quantity of vegetables consumed at that meal. Whether promoting vegetable variety at one meal or for longer periods translates into a sustained increased vegetable consumption overall, particularly with low-income clients, warrants investigation and is the purpose of our study.

Incorporation of vegetables into the daily diet may contribute favorably to overall diet quality by increasing nutrient density while lowering energy density.[2-5] The Dietary Guidelines for Americans 2010[2] recommends that adult women consume 2 to 3 cups of vegetables daily and choose vegetables weekly from dark green vegetables, orange and red vegetables, dry beans and peas, starchy vegetables, and other vegetables.

Surveys have demonstrated that low-income adults are at higher risk of not consuming recommended quantities of vegetables.[6-8] We assessed vegetable intake in a sample of low-income women to determine whether vegetable variety was related to energy density or the HEI-2005[9] scores as measures of diet quality. We hypothesized that greater vegetable variety would be associated with improved diet quality. Our ultimate goal was to explore the use of vegetable variety as an education strategy and as a pictorial evaluation measure of diet quality with low-literate USDA program participants.

METHODS

Participants

Low-income women were recruited from four California counties: San Joaquin, Solano, Calaveras, and Tulare. Participants were aged 18 to 55 years, able to read and speak English, not pregnant or lactating, and the primary food purchasers and preparers for their households. Maximum household income was 185% of the poverty threshold. Recruitment sites were health clinics and social service agencies served by USDA food assistance and education programs. The Institutional Review Board of the University of California-Davis approved procedures, and participants provided written consent.

Altogether 121 participants were enrolled, and 112 completed all procedures and questionnaires, including a food frequency questionnaire (FFQ), three 24-hour dietary recalls, demographic profile, food shopping questionnaire, and the food attitude/behavior questionnaire. This report is based on data from the 112 participants.

Dietary Assessment

Participants recorded their usual consumption over the past 3 months for food items included on the Fred Hutchinson Cancer Research Center FFQ. The FFQ is linked to the Nutrition Coordinating Center, University of Minnesota's nutrient database, and nutrient analysis software (version: G-SEL) was developed by the Fred Hutchinson Cancer Research Center.[10-12] FFQs were used to determine vegetable variety, quantity, and cost. Cost estimates were based on a newly validated method (see below).[13]

Three 24-hour dietary recalls were obtained on 3 nonconsecutive days, including 1 weekend day. One-on-one interviews with participants were conducted by trained staff following the steps of recall described in the USDA five-pass method.[14,15] Recall data were entered into the Nutrition Education Evaluation and Reporting System 5-program (NEERS5),[16] which is linked to a NEERS5 database maintained by the USDA Nutrient Data Laboratory. NEERS5 contains foods commonly eaten by various cultural groups in California and is used by the Expanded Food and Nutrition Education Program to evaluate state programs. Thus, it is well suited for evaluating diets of low-income populations. Recall data were used to calculate two diet quality measures.

Dietary Quality Measures

Energy density was calculated using all foods consumed but no beverages, as described previously.[3,17] Results are expressed as food energy in kilocalories per 100-g edible food product.

The HEI-2005[9] represents how well diet intake aligns with the Dietary Guidelines for Americans 2005, and is based on scores for 12 components (total fruits; whole fruits; total vegetables; dark green and orange vegetables and legumes; total grains; whole grains; milk; meat and beans; oils; saturated fat; sodium; and energy from solid fats, alcohol, and added sugars). A sum of subscores for these components yields a total score that can reach a maximum of 100.

Vegetable Variety Using FFQ

Use of 21 different vegetable categories consumed during a 1-week period was calculated for each participant using responses to FFQ vegetable categories: broccoli, cooked greens (spinach/mustard greens/collards), carrots, red peppers/chilies, tomatoes, winter squash (acorn/butternut/pumpkin), yams/sweet potatoes, refried beans, other beans (baked/lima/chili without meat), green peas, corn, fried potatoes, other potatoes, green salad (lettuce/spinach), green peppers/chilies, cauliflower/cabbage/Brussels sprouts, green beans, summer squash/zucchini, onions/leeks, garlic, and avocado/guacamole. Participants were ranked according to the number of different vegetable categories they ate weekly and divided into three groups: low variety (LV) (n=38) ate ≤5 different vegetable categories, moderate variety (MV) (n=41) ate from 6 to 9 different vegetable categories, and high variety (HV) (n=33) ate from ≥10 different vegetable categories at least once per week.

Food Attitude Questionnaire

A questionnaire about factors guiding food choices included these questions: "The foods I eat are nutritious" and "It is important to me that the foods I eat…1) taste good, 2) fill me up, 3) are affordable, 4) are healthy, 5) take little time to prepare, 6) keep well, and 7) are nutritious." Responses were recorded on a 5-point Likert scale of "strongly agree," "somewhat agree," "neither agree nor disagree," "somewhat disagree," or "strongly disagree."

Diet Cost Assessment Using FFQ

Daily diet costs and vegetable costs were estimated by attaching a food price vector to the nutrient database of the FFQ, as described and validated by Townsend and colleagues.[3,13]

Physical Characteristics of the Participants

Height was measured to the nearest 0.1 cm using a stadiometer, weight was measured to the nearest 0.1 kg using a calibrated scale, and body mass index was calculated.

Statistical Analysis

One-way analysis of variance was used to determine if there were differences among the vegetable variety groups for physical characteristics, sum quantity of vegetables eaten per day, HEI scores, dietary energy density, and diet cost. If a significant effect ($P<0.05$) of group was found, Tukey's test (equal variances) or Tamhane's test (unequal variances) was used to compare group means. Intake of individual vegetable categories was not normally distributed so the Kruskal-Wallis test was used to evaluate variety group effects. Cross-tabular distributions of frequencies were tested with the χ^2 test to determine whether differences among the vegetable variety groups existed with regard to attitudes toward foods and diet. All analyses were conducted with SAS software (version 9.2, 2002-2008, SAS Institute, Inc).

RESULTS AND DISCUSSION

Participants

Mean±standard deviation age of all participants was 35.4±9.7 years, and participants in the LV group were younger than those in the HV group ($P<0.01$) (Table 1). Overall, the racial/ethnic background was diverse: Hispanic (34%), non-Hispanic white (38%), non-Hispanic black (10%), Asian or Pacific Islander (10%), and American Indian/Alaskan Native (9%). The racial-ethnic distribution differed among vegetable variety groups, but there were no other demographic differences among the groups (Table 1).

Vegetable Consumption

Daily vegetable consumption (cups per day) differed among variety groups ($P<0.001$) and was highest in the HV group, 3.0±0.2, followed by MV group, 2.0±0.1, and lowest in LV