Nutrient Profiles of Vegetarian and Nonvegetarian Dietary Patterns

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ABSTRACT

Background Differences in nutrient profiles between vegetarian and nonvegetarian dietary patterns reflect nutritional differences that can contribute to the development of disease.

Objective Our aim was to compare nutrient intakes between dietary patterns characterized by consumption or exclusion of meat and dairy products.

Design We conducted a cross-sectional study of 71,751 subjects (mean age=59 years) from the Adventist Health Study 2. Data were collected between 2002 and 2007. Participants completed a 204-item validated semi-quantitative food frequency questionnaire. Dietary patterns compared were nonvegetarian, semi-vegetarian, pesco vegetarian, lacto-ovo vegetarian, and strict vegetarian. Analysis of covariance was used to analyze differences in nutrient intakes by dietary patterns and was adjusted for age, sex, and race. Body mass index and other relevant demographic data were reported and compared by dietary pattern using χ^2 tests and analysis of variance.

Results Many nutrient intakes varied significantly between dietary patterns. Nonvegetarians had the lowest intakes of plant proteins, fiber, beta carotene, and magnesium compared with those following vegetarian dietary patterns, and the highest intakes of saturated, *trans*, arachidonic, and docosahexaenoic fatty acids. The lower tails of some nutrient distributions in strict vegetarians suggested inadequate intakes by a portion of the subjects. Energy intake was similar among dietary patterns at close to 2,000 kcal/day, with the exception of semi-vegetarians, who had an intake of 1,707 kcal/day. Mean body mass index was highest in nonvegetarians (mean=28.7 [standard deviation=6.4]) and lowest in strict vegetarians (mean=24.0 [standard deviation=4.8]).

Conclusions Nutrient profiles varied markedly among dietary patterns that were defined by meat and dairy intakes. These differences are of interest in the etiology of obesity and chronic diseases.
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AWARENESS OF POSSIBLE DIFFERENCES IN NUTRIENT profiles is important when comparing dietary patterns and their associations with disease. Previous studies have shown that dietary patterns characterized by lower meat intake[1] are associated with lower risk of disorders, such as the metabolic syndrome,[2,3] diabetes,[3,4] cardiovascular disease,[5-7] and certain types of cancers.[8,9] Variations in nutrient content can account for these observed differences in health outcomes.

The Adventist Health Study 2 (AHS-2) provides a rich data resource to address these questions. With 45% of the 96,335 study subjects being vegetarian and approximately 8% strict vegetarians, it is presently one of the very few large cohort studies that include a high proportion of vegetarians. Associations between vegetarian dietary patterns and health outcomes can be addressed with adequate power.

This report describes the intakes of major nutrients, vitamins, and minerals in dietary patterns that are characterized by varying animal and plant food consumption. Relevant demographic and socioeconomic data, such as age, education, and marital status, as well as other lifestyle factors such as physical activity, alcohol consumption, and smoking, were included in this study as they may be of relevance when comparing dietary patterns. To show possible associations that differing dietary patterns might have with health-relevant outcomes, body mass index (BMI) was similarly reported and briefly discussed.

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METHODS

The analyses are based on cross-sectional data obtained between 2002 and 2007 from a 50-page self-administered questionnaire.[10] The number of subjects in the present analysis included 71,751 US and Canadian participants from the

AHS-2 cohort whose dietary data had been released for analysis.[10] The study was reviewed and approved by the Institutional Review Board of Loma Linda University, Loma Linda, CA, and informed consent was obtained from all participants.

Race and ethnicity were stratified into black (African American, West Indian/Caribbean, African, or other black) and white (white non-Hispanic, Hispanic, Middle Eastern, Asian, Native Hawaiian/other Pacific Islander, or American Indian) subjects. Education was stratified into the following categories: completed high school diploma or less; some college; and bachelors, masters, or higher university degrees.

Participants reported anthropometric data on height (without shoes in feet and inches) and weight (wearing light clothes in pounds), which had previously been demonstrated to have good validity.[11] BMI was calculated as weight (kg)/height (m^2). Alcohol intake and tobacco use were defined as never, past, or current consumption.

Assessment of Intake of Nutrients, Vitamins, and Minerals

The food frequency questionnaire (FFQ) includes >204 hard-coded foods and space for approximately 50 write-ins, all relating to the diet during the previous 1 year. It consists of two major sections. The first section includes fruits, vegetables, legumes, grains, nuts, oils, dairy, fish, eggs, meats, and beverages; the second consists of approximately 70 commercially prepared products, such as dietary supplements, dry cereals, and vegetarian protein products. Pictures of common foods or beverages typically served together were included with the questionnaire to assist participants in estimating portion sizes. The questionnaire was mailed to each subject, completed at home, and then returned to AHS-2. The FFQ has been validated against 24-hour recall data.[12,13] In this report, intakes from supplements are combined with dietary intakes to form total intakes.

FFQ data were entered using the Nutrition Data System for Research (version 4.06, Nutrition Coordinating Center). Nutrient composition of foods was based on the Nutrition Data System for Research 2008 database, which contains >20,000 foods that are annually updated while maintaining nutrient profiles true to the version used for data collection.[14]

Dietary Patterns

Dietary patterns were defined by level of animal food intake stratified in five categories.[15] Nonvegetarians were defined as those consuming some meat (red meat, poultry, at least once per month), and the total of meat and fish more than one time per week. Semi-vegetarians might consume dairy products and/or eggs, eat some meat (red meat and poultry) one or more times per month, and the total of fish and meat one or more times per month but less than once a week. Pesco vegetarians were subjects consuming fish one or more times per month but who consumed red meat and poultry less than one time per month. There were no restrictions on dairy or egg intake. Lacto-ovo vegetarians were those who reported consuming the total of meat, poultry, or fish less than once a month, also with no restrictions on eggs and or dairy products. Strict vegetarians were subjects who reported consuming each of the following not at all or less than one time per month: meat (red meat, poultry), fish, eggs, milk, and dairy products.

Nutrient intakes were standardized to 2,000 kcal by multiplying observed nutrient by the ratio 2,000/measured kcal. Total caloric intake was calculated by summing information from all dietary sources captured in the FFQ. Percentages of energy intake for major nutrients were reported.

Statistical Analysis

On average, 6% to 7% of dietary data were missing for any particular food item and were filled by guided multiple imputation.[16] Dietary patterns were then compared according to selected demographic variables. χ^2 tests (categorical variables) and analysis of variance (ANOVA) (continuous variables) were used for these comparisons. Percentiles (5th, 50th, and 95th) for nutrient intakes stratified by dietary pattern were reported.

Analysis of covariance with Sidak's adjustments for multiple comparisons was used to test nutrient and BMI differences between dietary patterns. Nutrient intakes were logarithmically transformed for statistical testing. Mean values are reported stratified by dietary pattern and adjusted for age, sex, or race. Mean intake values that differed by ≥20% between dietary patterns were marked.

Analyses were carried out using the statistical software packages IBM SPSS Statistics 20.0.0.1 (2012, SPSS Inc) and R 2.13.1: A Language and Environment for Statistical Computing (2011, R Foundation for Statistical Computing). Type I error rate was set at 0.05.

RESULTS

Basic demographic information is reported in Table 1. Significant differences by dietary pattern were seen for all variables. Across all dietary patterns, 30- to 55-year-olds comprised the largest group ($P<0.001$). The proportions of men among semi- or strict vegetarian were 3 percentage points higher than in nonvegetarians. The nonvegetarians and pesco vegetarian groups had relatively high proportions of black subjects (29.4% and 31.6%, respectively) compared with 24.3% overall.

Across dietary patterns, lacto-ovo vegetarians had the highest proportion of college graduates (60.1%). Lacto-ovo vegetarians had the lowest proportion of low household incomes and strict vegetarians had the highest (28.2% vs 38%). Lacto-ovo and strict vegetarians had the highest proportions of married subjects (78.1% and 76.2%). The proportion of those engaging in 45 minutes or more of vigorous physical activity was generally similar across dietary patterns, with the highest proportion in nonvegetarians (32.5%) and the lowest in lacto-ovo vegetarians (27.9%).

Nonvegetarians had the highest proportion of subjects who had used alcohol or tobacco at some point in their lives (41.7% and 26.2%, respectively) and the highest proportions of current users (11.8% and 2%, respectively).

Nonvegetarians had the highest BMI values (mean=28.7; standard deviation [SD]=6.4) and the highest proportion of obese subjects (33.3%) when compared with any other dietary pattern. Strict vegetarians had the lowest BMI (mean=24.0; SD=4.8) and the lowest proportion of obese subjects (9.4%). Analysis of covariance showed that after adjustments for age, sex, race, and physical activity, dietary