ARIC Manuscript Proposal #1117

1.a. Full Title:
Different methods for deriving dietary patterns and their relation with risk of developing incident coronary heart disease: the ARIC study

b. Abbreviated Title (Length 26 characters):
Diet patterns and risk of CHD

2. Writing Group:
Writing group members: Jennifer A. Nettleton, Xia (Summer) Zhou, June Stevens

I, the first author, confirm that all the coauthors have given their approval for this manuscript proposal. ___LMS__ [please confirm with your initials electronically or in writing]
Authors approved this manuscript.

First author: Lyn M. Steffen, PhD, MPH, RD
Address: University of Minnesota School of Public Health, Division of Epidemiology and Community Health, 1300 South Second St, Suite 300; Minneapolis, MN 55454
Phone: 612-625-9307 Fax: 612-624-0315
E-mail: steffen@epi.umn.edu

Corresponding/senior author (if different from first author correspondence will be sent to both the first author & the corresponding author):
Address:
Phone: Fax:
E-mail:

3. Timeline: Literature review completed
Data analysis – 3 months
Writing the manuscript – 6 months
Coauthor review and revisions - 6 months

4. Rationale:
Most studies about diet and disease have explored the relation of a single nutrient or single food with morbidity or mortality. Because individuals consume combinations of foods, defined as an eating or diet pattern, the diet pattern may be a better predictor of good health or risk factor for disease than the single nutrient or food. Several approaches have been used to derive diet patterns for evaluating the effects of dietary intake on
health outcomes, including diet quality scores, diet index scores, factor analysis, and reduced rank regression. Diet quality scores, such as the USDA Healthy Eating Index (1), or diet index score (2) are based on published dietary guidelines or other prior knowledge that forms the index or score (a priori approach). Principal components analysis and reduced rank regression are statistical methods that utilize the data to derive the diet patterns (posteriori approach) (3-6).

Diet quality score. Healthy Eating Index (HEI), developed at the USDA, is a 10-component diet quality score, reflecting the US Dietary Guidelines for Americans, which measures quality of the diet (1). Criteria for a perfect score of 10 (each item = 1 point) includes: 6-11 servings of grains, 3-5 servings of vegetables, 2-4 servings of fruit, 2-3 servings of milk, 2-3 servings of meat, < 30% of energy from total fat, < 10% of energy from saturated fat, 300 mg or less of cholesterol, 2400 mg or less of sodium, and 8 or more different food items per day (variety score).

Results from two studies show HEI had weak to moderate associations with risk of cardiovascular disease (CVD) in men and women. In women, comparing the highest with lowest HEI quintile, the relative risk (RR) = 0.86 (95% C.I.: 0.72, 1.03; p=0.085) (7). In men, comparing the highest with lowest HEI quintile, the relative risk (RR) = 0.72 (95% C.I.: 0.60, 0.88; p <0.001) (8).

Diet index score. In a study of food intake and elevated blood pressure among young black and while adults, a food index was created to represent an eating pattern including the following food groups: whole grains, fruit, vegetables, nuts, dairy, and meat (2). An individual was assigned the sum of scores of 0-4 that corresponded to the quintile of intake for each of whole grain, fruit, vegetable, and nuts and dairy foods (Q1=0, Q2=1, Q3=2, Q4=3, and Q5=4) and reversed for meat intake. For example, a person who was in Q1 for meat intake and in Q5 for each of whole grain, fruit, vegetable, nut, and dairy was assigned a score of 4 for each food group, totaling 24. A food index was created to reflect an eating pattern, i.e., higher scores represent a ‘prudent diet pattern’ and lower scores represent a ‘western diet pattern’.

An inverse dose-response relation across increasing quintiles of the food index was observed with risk of developing elevated blood pressure, adjusting for baseline age, race, sex, education, center, energy intake, physical activity, alcohol intake, baseline smoking, saturated fat, sodium, and vitamin supplementation (2). Compared to quintile 1, the hazard ratios (95% CI) across Q2 – Q5 were 0.99 (0.82-1.20), 0.91 (0.75-1.11), 0.85 (0.68-1.06), and 0.59 (0.45-0.76); p for trend <0.001.

Principal components analysis (PCA). PCA was used to identify two dietary patterns that included in the model 32 food groups obtained from the ARIC food frequency questionnaire (4). In these analyses, the first two factors derived from PCA were the ‘Prudent diet pattern’ (consisting of high loading scores for fruit, vegetables, legumes, poultry and fish) and the ‘Western diet pattern’ (consisting of high loading scores for red and processed meats, eggs, fast/fried foods, refined grain, regular soda, snack foods and desserts). These PCA patterns were consistent with those found in other studies (3,5,9).

Over an average 11.9 years of follow-up, there was an increasing risk of death from all causes, CVD, CHD, and all cancers across increasing quintiles of intake of the
western pattern. For the prudent diet pattern: there was a decreasing risk of death from all causes, but not from specific causes, across increasing quintiles of intake of the prudent pattern. These data suggest that a diet including more animal foods and fewer plant foods is associated with an increased risk of death. In other studies, a diet pattern rich in plant foods, defined as a ‘prudent diet’, was related to lower risk of colon cancer (3), CVD (5,9) and CVD risk factors (10). Conversely, a diet rich in meat products, a ‘Western diet’, was related to higher risk of colon cancer (3) and CVD (4,5,9).

Reduced rank regression (RRR). RRR or maximum redundancy analysis uses data from the study of interest and a priori knowledge to develop statistical models. RRR has recently been used to create dietary patterns and, further, to determine their relation with disease (6,11). RRR uses a pre-specified set of response variables to derive dietary patterns. These variables are related to the outcome to interest; e.g., risk factors for the metabolic syndrome (response variables) are related to CVD (outcome of interest). Using the RRR method, dietary patterns have been identified that were related to CVD (11), type 2 diabetes (12), and all-cause mortality (13).

5. Main Hypothesis/Study Questions:
Dietary pattern analysis may be a valuable method for assessing the relation between dietary intakes and disease. However, it is not clear whether the four methods will yield similar results. We propose to evaluate the relation between each diet pattern score and risk of incident CHD in African American and Caucasian middle-aged adults. We will compare the risk estimates (95% C.I) of each diet pattern to the others for strength and direction of the association. We hypothesize that the RRR pattern will be most strongly related to risk of developing CVD and that the HEI will be minimally related, while PCA and the diet index score patterns will have intermediary risk estimates.

6. Data (variables, time window, source, inclusions/exclusions):
Participants with CVD, cancer, diabetes, and metabolic syndrome (defined according to the ATP3 guidelines) at baseline and missing or outlying energy intake will be excluded from the analyses. Follow-up time will be calculated as time from baseline to event, last follow up contact or through December 31, 2002, whichever occurs first.

Outcome variables: Incident CHD

Exposure variables: Derived diet scores for each study participant from 4 diet patterns, including the Healthy Eating Index, diet index score, principal components factor score, and RRR score. Risk factors for the metabolic syndrome will be used in developing the RRR score. All of the foods and associated frequency and portion size information will be used to develop the diet patterns.

Potential confounding factors: age, sex, race, center, energy intake, smoking status, pack-years, vitamin supplements (yes/no), physical activity, body mass index, waist circumference, triglycerides, HDL-cholesterol, glucose, and systolic blood pressure, and antihypertensive medication use.

Statistical methods:
Creation of the diet patterns. Diet patterns will be created as described above and using previously published methods (1-3, 6). Because the metabolic syndrome is a risk factor
for CHD (14), risk factors for the metabolic syndrome will be used in developing the RRR diet pattern.

**Descriptive statistics.** Risk factors for the metabolic syndrome, demographic, and lifestyle information will be described. The diet pattern scores will be categorized into quintiles and diet composition for quintiles of each diet pattern will be described.

**Cox proportional regression analysis.** In separate proportional hazards regression analyses, the relations of metabolic syndrome risk factors across quintiles of intake for each diet pattern score will be assessed, adjusting for age, sex, ethnicity, energy intake, education, smoking, alcohol intake, physical activity, body mass, and hormone replacement therapy. Additionally, the relations between quintiles of intake for each diet pattern score and risk of developing incident coronary heart disease will be assessed, adjusting for age, sex, ethnicity, center, energy intake, education, smoking, alcohol intake, physical activity, body mass index, and risk factors for the metabolic syndrome (except the RRR model, which will not be adjusted for the metabolic syndrome risk factors given that they were used to develop the score). Hazard ratio estimates from each diet score model will be compared to the others for direction and strength of the association. The similarities and differences of each diet pattern will also be discussed.

7.a. **Will the data be used for non-CVD analysis in this manuscript?**  
___ Yes  _____ No

b. **If Yes, is the author aware that the file ICTDER02 must be used to exclude persons with a value RES_OTH = “CVD Research” for non-DNA analysis, and for DNA analysis RES_DNA = “CVD Research” would be used?**  
___ Yes  _____ No

(This file ICTDER02 has been distributed to ARIC PIs, and contains the responses to consent updates related to stored sample use for research.)

8.a. **Will the DNA data be used in this manuscript?**  
___ Yes  _____ No

8.b. **If yes, is the author aware that either DNA data distributed by the Coordinating Center must be used, or the file ICTDER02 must be used to exclude those with value RES_DNA = “No use/storage DNA”?**  
___ Yes  _____ No

9. **The lead author of this manuscript proposal has reviewed the list of existing ARIC Study manuscript proposals and has found no overlap between this proposal and previously approved manuscript proposals either published or still in active status. ARIC Investigators have access to the publications lists under the Study Members Area of the web site at:**  
http://www.cscce.unc.edu/ARIC/search.php

___ Yes  _____ No

MS #750 (Steffen, etc) proposes to evaluate the relation of diet patterns with incident CHD and mortality. The current proposal is a little different, such that the risk estimates from each diet pattern will be compared for strength and direction of the relation. Additionally, the loading scores for foods within each diet pattern will be compared.
Aaron Folsom suggested that I submit another manuscript proposal since it is a little different than MS#750.

10. What are the most related manuscript proposals in ARIC (authors are encouraged to contact lead authors of these proposals for comments on the new proposal or collaboration)?

11. a. Is this manuscript proposal associated with any ARIC ancillary studies or use any ancillary study data?  
   _____ Yes  _X___ No

11.b. If yes, is the proposal  
   ___  A. primarily the result of an ancillary study (list number* __________)  
   ___  B. primarily based on ARIC data with ancillary data playing a minor role (usually control variables; list number(s)* __________  __________ __________)  

*ancillary studies are listed by number at http://www.cscc.unc.edu/aric/forms/

12. Manuscript preparation is expected to be completed in one to three years. If a manuscript is not submitted for ARIC review at the end of the 3-years from the date of the approval, the manuscript proposal will expire.

REFERENCES:


