

ARIC Manuscript Proposal # 1208

PC Reviewed: _12/_19/06

Status: _A___

Priority: _2___

SC Reviewed:

Status:

Priority:

1.a. Full Title: Dietary intake is related to risk of developing elevated or high blood pressure in middle-aged adults: ARIC

b. Abbreviated Title (Length 26 characters): Diet and high blood pressure

2. Writing Group:

Writing group members: Lyn M. Steffen, Jennifer Nettleton, Aaron Folsom, Woody Chambless.

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

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3. Timeline:

Data analysis: 3 months for analysis (Steffen)

First draft of the paper: 6 months

Co-author review/revisions: 3-6 months

4. Rationale:

Diet plays an important role in the modulation of blood pressure in hypertensive or normotensive adults (1-13). The DASH feeding study (Dietary Approaches to Stop Hypertension) found that a combination diet rich in fruit, vegetables, and low-fat dairy products as well as reductions in saturated fat intake could substantially lower systolic and diastolic blood pressure levels in 459 moderately hypertensive white and black men and women (1,10). Numerous studies have shown that vegetarians have lower blood pressure than nonvegetarians (11), and that adding meat to a vegetarian diet increases

blood pressure (12). However, most US adults are not vegetarians. In a recent study of men aged 41-57 years, consumption of 14-42 servings of vegetables per month vs. < 14 servings/month was associated with a lower increase in blood pressure, while consumption of beef, veal, lamb, and poultry was positively related to blood pressure over 7 years of follow-up (13). Few studies have examined pattern of food intake of middle-aged adults and their risk of developing elevated or high blood pressure, especially among African American adults. Therefore, we will examine the associations of plant food (fruit, vegetables, whole and refined grains, nuts, and legumes), dairy (milk, cheese, yogurt, and ice cream), and meat (red and processed meat, poultry, fish, and eggs) consumption with incidence of elevated and high blood pressure in middle-aged African American and white adults. We hypothesize that plant and dairy foods will be inversely related to elevated and high blood pressure and meat consumption will be positively related to elevated and high blood pressure. Further, we hypothesize that diet patterns, such as the western diet pattern will be positively related and the Mediterranean diet pattern will be inversely related to incident elevated and high blood pressure.

References

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5. Main Hypothesis/Study Questions:

- a) Plant foods, including whole grains, fruit and vegetables) and low-fat dairy (lowfat milk and yogurt) products will be inversely associated with incident elevated (SBP $\geq$ 130 mmHg and/or DBP $\geq$ 85 mmHg (no med use)) and high (SBP $\geq$ 140 mmHg and/or DBP $\geq$ 90 mmHg or antihypertensive medication use) blood pressure, while red and processed meat will be adversely associated with incident elevated and high blood pressure among middle-aged black and white adults.
- b) Dietary patterns, such as a Western diet pattern, will be adversely associated, while the Mediterranean diet pattern will be inversely associated with elevated and high blood pressure.

6. Design and analysis (study design, inclusion/exclusion, outcome and other variables of interest with specific reference to the time of their collection, summary of data analysis, and any anticipated methodologic limitations or challenges if present).

Longitudinal analysis: Associations will be determined between baseline and visit 3 dietary intake and incident elevated blood pressure and with high blood pressure (visit 4); we will also explore the longitudinal associations of baseline, visit 3, and visit 5 dietary intake with incident elevated and high blood pressure measured at the last visit (ARIC MRI cohort).

Cross-sectional analysis: Using ARIC MRI data, associations will be determined between dietary intake and incident elevated and high blood pressure. Models will be weighted according to the ARIC MRI sampling scheme.

EXCLUSIONS:

- Inadequate dietary intake information or extreme energy intake
- Participants with elevated or high blood pressure at baseline
- Participants who are not white or African-American

EXPOSURES VARIABLES:

Food groups and subgroups will be created using baseline, year 6, and ARIC MRI food and frequency/serving size data as well as the following nutrient data: sodium, saturated fat, calcium, magnesium, potassium, and dietary fiber. Food groups include whole grain

foods, refined grain foods, fruit, nuts, vegetables, dairy, meat, coffee, etc. Subgroups of major food groups will be created: for example, dairy food subgroups include milk, yogurt, cheese and ice cream. Meat subgroups include red and processed meat, poultry, and fish. The average of baseline and year 6 food intakes will be used to increase precision, except in the case when elevated or high blood pressure occurs prior to year 6 diet data collection, then only baseline diet data will be used.

Diet patterns, such as the western diet pattern, will be created using principal components analysis. A Mediterranean pattern score will be created according to the method used by Dr. Chambless in a previous paper. A value of 0 or 1 was assigned to each of nine indicated components with the use of the sex-specific median as the cutoff.

- For beneficial components (vegetables, legumes, fruits and nuts, whole grain foods, and fish), persons whose consumption was below the median were assigned a value of 0, and persons whose consumption was at or above the median were assigned a value of 1.
- For components presumed to be detrimental (meat, poultry, and dairy products), persons whose consumption was below the median were assigned a value of 1, and persons whose consumption was at or above the median were assigned a value of 0.
- For ethanol, a value of 1 was assigned to men who consumed between 10 and 50 g per day and to women who consumed between 5 and 25 g per day.
- For fat intake we used the ratio of monounsaturated + polyunsaturated fats to saturated fats, above the median taken as a beneficial intake.

Our Mediterranean diet score is similar to that of Trichopoulou (14), except that we separated nuts and fruits, we replaced the cereal category by whole grains, we combined meat and poultry, and for fat we used the ratio of monounsaturated plus polyunsaturated fats to saturated fats (instead of the ratio of monounsaturated fats to saturated fats).

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OUTCOME VARIABLES:

- Elevated blood pressure (EBP) defined as systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 85 mmHg and no antihypertensive medication use.
- High blood pressure (HBP) defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg and antihypertensive medication use.

STATISTICAL ANALYSIS:

In longitudinal analysis, Cox proportional hazards regression analysis will evaluate the relation between dietary intake (food groups, food subgroups, and diet patterns) and incident elevated or high blood pressure over 9 years of followup. Because change in diet after the development of an endpoint (EBP or HBP) may confound the exposure-disease association (15), one should stop updating at the time interval during which an individual developed the endpoint of interest in the updated analysis (16). Therefore, we will evaluate the relation between diet and blood pressure where baseline dietary intake is

used in the models with visits 1 and 2 blood pressure; whereas the average of visits 1 and 3 dietary intake will be used with visits 3 and 4 blood pressure. However, if EBP or HBP was diagnosed at visit 3, then only visit 1 dietary intake will be used in the model. If EBP or HBP was diagnosed at visit 4, then the average of visits 1 and 3 diet will be used. We will also develop a model using dietary intake at visits 1, 3, and 5 predicting EBP and HBP at visit 5.

In cross-sectional analysis, logistic regression will evaluate the relations between food or diet pattern intake and prevalence of EBP or HBP in the ARIC MRI sample (using appropriate weights).

Limitations: An important limitation is the use of a food frequency questionnaire containing only 66-items (visit 1 and 3), thus restricting the number of food categories to characterize usual dietary intake which likely results in energy intake that is underestimated. Dietary intake may be misclassified by this questionnaire, contributing to measurement error in the point estimates that may potentially result in large biases either towards or away from the null (17). We will explore the effects of bias due to measurement error and will consider correction for that error (18,19).

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MODEL COVARIATES:

Model 1. Adjusted for age, gender, race, field center, education, energy intake;

Model 2. Adjusted for model 1 plus physical activity, alcohol intake, baseline smoking status, pack-years, vitamin supplement use, and simultaneous adjustment for other food groups (for food group models);

Model 3. Adjusted for model 2 plus potential explanatory nutrients (sodium, saturated fat, calcium, magnesium, potassium, and dietary fiber) and physiological measurements (baseline systolic blood pressure, antihypertensive medication use, body mass index, fasting insulin).

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.csc.unc.edu/ARIC/search.php>

☒ Yes ☐ (No overlap)

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 ☒ 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.csc.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.

I am aware of this policy.