

Citation:

Steffen LM, Kroenke CH, Yu X, Pereira MA, Slattery ML, Van Horn L, Gross MD, Jacobs DR Jr. Associations of plant food, dairy product, and meat intakes with 15-y incidence of elevated blood pressure in young black and white adults: the Coronary Artery Risk Development in Young Adults (CARDIA) Study. *Am J Clin Nutr.* 2005 Dec;82(6):1169-77.

PubMed ID: [16332648](#)

Study Design:

Prospective Cohort Study

Class:

B - [Click here](#) for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To evaluate associations of dietary intake with the 15-year incidence of elevated blood pressure, defined as incident systolic blood pressure >130 mmHg, diastolic blood pressure >85 mmHg, or use of antihypertensive medications.

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Inclusion Criteria:

- Participants in the Coronary Artery Risk Development in Young Adults (CARDIA) Study
- Aged 18 - 30 years at baseline

Exclusion Criteria:

- Participants reporting extreme caloric intakes at years 0 or 7 (<800 and >8000 kcal/day for men and <600 and >6000 kcal/day for women)
- Women who were lactating or pregnant at baseline or at 7 years
- Participants with elevated blood pressure or diabetes at baseline
- Participants with a nonfasting blood sample

Description of Study Protocol:

Recruitment

Participants of the Coronary Artery Risk Development in Young Adults (CARDIA), a multicenter, population-based, prospective study of cardiovascular disease risk factor evolution in black and white men and women. Recruitment methods not described in this article.

Design: Prospective cohort study

Blinding used (if applicable): not applicable

Intervention (if applicable): not applicable

Statistical Analysis

- Average food intake was computed within quintiles of each food group for plant foods and dairy and meat products by using linear regression, adjusted for age, sex, race, center, education and energy intake
- Proportional hazards regression was used to evaluate relations of dietary intake at years 0 and 7 with 15-year incidence of elevated blood pressure
- Hazard ratios were computed for quintiles 2 - 5 of the respective food groups with quintile 1 (lowest intake) as the referent group

Data Collection Summary:

Timing of Measurements

- 6 clinic exams at years 0, 2, 5, 7, 10 and 15
- Dietary intake measured at years 0 and 7
- Subjects followed for 15 years

Dependent Variables

- Blood pressure measured with sphygmomanometer
- Blood samples analyzed for antioxidant concentrations
- Body weight, height, BMI
- Waist circumference

Independent Variables

- Dietary intake of plant foods (fruit, vegetables, whole and refined grains, nuts and legumes), dairy products (milk, cheese, yogurt and dairy desserts) and meat (red and processed meat, poultry, fish and eggs)
- CARDIA diet history was interviewer-administered

Control Variables

- Age
- Sex
- Race
- Center
- Education
- Energy intake
- Cardiovascular disease risk factors
- Physical activity

- Smoking

Description of Actual Data Sample:

Initial N: 5,115 participants in original cohort

Attrition (final N): 4,304 participants: 883 black men, 1249 black women, 989 white men, 1183 white women

Age: aged 18 - 30 years at baseline

Ethnicity: as above

Other relevant demographics:

Anthropometrics

Location: United States

Summary of Results:

Key Findings

- Over 15 years, 23.2% of study participants experienced incident elevated blood pressure, of whom 591 (13.7%) had hypertension and 406 (9.4%) had high-normal blood pressure.
- Of those who developed elevated blood pressure during 15 years of follow-up, 64% were black men and women.
- Elevated blood pressure incidence varied from 12% in white women to 33% in black men
- Plant food intake (whole grains, refined grains, fruits, vegetables, nuts or legumes) was inversely related to elevated blood pressure after adjustment for potential confounding variables
- Compared with quintile 1, the relative hazards of elevated blood pressure for quintiles 2 through 5 of plant food intake were 0.83 (95% confidence interval: 0.68 - 1.01), 0.83 (95% confidence interval: 0.67 - 1.02), 0.82 (95% confidence interval: 0.65 - 1.03), and 0.64 (95% confidence interval: 0.53 - 0.90), respectively, P for trend = 0.01.
- Dairy intake was not related to elevated blood pressure (P for trend = 0.06) and positive dose-response relations for elevated blood pressure were observed across increasing quintiles of meat intake (P for trend = 0.004).
- In subgroup analyses, risk of elevated blood pressure was positively associated with red and processed meat intake, whereas it was inversely associated with intakes of whole grain, fruit, nuts and milk.
- Adjustment for intermediary factors in the causal pathway attenuated these relations.
- Hazard ratio for 15-yr EBP incidence between extreme quintiles was 0.77 (95% CI:0.55,1.07; p for trend=0.14) in the fully adjusted model.

CARDIA Participants	Systolic/Diastolic Blood Pressure (mmHg)	High-normal Blood Pressure n (%)	Hypertension n (%)	Elevated Blood Pressure n (%)
All (n = 4304)	111 ± 13/73 ± 11	406 (9.4%)	591 (13.7%)	997 (23.2%)

Black men (n = 883)	116 ± 14/75 ± 12	127 (14.4%)	162 (18.3%)	289 (32.7%)
White men (n = 989)	112 ± 11/74 ± 9	110 (11.1%)	104 (10.5%)	214 (21.6%)
Black women (n = 1249)	113 ± 15/74 ± 12	114 (9.1%)	240 (19.2%)	354 (28.3%)
White women (n = 1183)	105 ± 11/69 ± 9	55 (4.6%)	85 (7.2%)	140 (11.8%)

Author Conclusion:

Plant food consumption is inversely associated with and meat consumption is positively associated with the incidence of elevated blood pressure. This study suggests that greater plant food intakes and lower meat intakes may prevent the development of elevated blood pressure when consumed by free-living black and white men and women as part of a habitual diet.

Reviewer Comments:

Dietary intake assessed at years 0 and 7, 15 years of follow-up. Authors note the following limitations:

- *Relative homogeneity of the diet in some subgroups*
- *Limited range of intake of specific foods or narrowly defined food groups*
- *Issues with misclassification in self-reported dietary intakes*
- *Documentation of frequency compared with quantity*
- *Difficulty in categorizing recipes with multiple food groups and ingredients*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions

1.	Was the research question clearly stated?	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	Was the selection of study subjects/patients free from bias?	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	Were study groups comparable?	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	Was method of handling withdrawals described?	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes

4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	Was blinding used to prevent introduction of bias?	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were intervening factors described?	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	Were outcomes clearly defined and the measurements valid and reliable?	Yes

7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	Was the statistical analysis appropriate for the study design and type of outcome indicators?	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	Are conclusions supported by results with biases and limitations taken into consideration?	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	Is bias due to study's funding or sponsorship unlikely?	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes

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