1.a. Full Title: Ideal Cardiovascular Health Behaviors and Progression of Intima Media Thickness

b. Abbreviated Title (Length 26 characters): CVD Behaviors—IMT

2. Writing Group:
   Writing group members: Christina Shay, Tamar Polonsky, Norinna Allen, Stephanie Chiuve, Mercedes Carnethon, Aaron Folsom, Jennifer Nettleton, Vijay Nambi, Lloyd Chambless

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

First author: Christina Shay, PhD
Address: 680 N. Lakeshore Drive #1400 Chicago, IL 60626 Phone: 412-605-9782 Fax: 312-958-9588 E-mail: c-shay@northwestern.edu

ARIC author to be contacted if there are questions about the manuscript and the first author does not respond or cannot be located (this must be an ARIC investigator).
   Name: Mercedes Carnethon

1. Timeline: Draft by winter 2010

2. Rationale:

The American Heart Association’s Strategic Impact Goals for 2020 and Beyond (Lloyd-Jones DM, et al. Circulation 2010; 121:586-613) introduces a new concept, ideal cardiovascular health, which is defined by the simultaneous presence of both ideal CV health behaviors and factors. The specific behaviors outlined in the goals include abstinence from smoking within the last year, body mass index < 25 kg/m², recommended levels of physical activity, and diet recommended for the reduction of CVD risk. Despite the extensive evidence promoting adherence to these behaviors for prevention and reduction of CVD, whether these behaviors, as defined, are associated with the progression of intima media thickness has not been examined.
5. Main Hypothesis/Study Questions:

Are CVD health behaviors at ARIC baseline, both individually and combined, associated with progression of carotid intima media thickness?

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).

Design:

Exposure: ideal (a), intermediate (b), and poor (c) CVD health behaviors at ARIC baseline, by the following AHA definitions:

A. Physical Activity (hours/week)
   a. $\geq 150$ min/week moderate intensity or $\geq 75$ min/week vigorous intensity or $\geq 150$ min/week moderate + vigorous intensity (reference)
   b. 1-149 min/week moderate intensity or 1-74 min/week vigorous intensity or 1-149 min/week moderate + vigorous intensity
   c. 0 hours

B. Body Mass Index
   a. BMI $<24.9$ kg/m$^2$
   b. BMI 25.0-29.0 kg/m$^2$
   c. BMI $\geq 30.0$ kg/m$^2$

C. Smoking
   a. Never a smoker or Former $>12$ mo.
   b. Former smoker ($\leq 12$ mo)
   c. Current smoker

D. Diet (AHA Definition):
   a. Adherence to 4-5 (a), 2-3 (b), or 0-1 (c) of the following dietary intake guidelines:
      i. Fruits and Vegetables $\geq 4.5$ cups/day
      ii. Fish $\geq 2$ servings/week
      iii. Whole Grain (1 oz serving or 1.1 g/10 g carbohydrates) $\geq 3$ servings/day
      iv. Sodium $\leq 1500$ mg/day
      v. Sugar Sweetened Beverages ($< 450$ kcal or 36 oz/week)
   b. Modified to fit ARIC
      i. Fruits and vegetables: $\geq 4.5$ servings per day (as estimated from FFQ—includes fruits in Q9-Q14 & vegetables in Q15-Q25 + Q56- excluding Q21 and Q24 (peas/lima beans and lentils/beans, respectively)
      ii. Fish: $\geq$ two servings per week (preferably oily fish) (as estimated from FFQ—includes Q34, Q35, Q36)
iii. Fiber-rich whole grains: ≥three servings per day (as estimated from FFQ—including Q48 (if whole grain), Q49 and Q51)
iv. Sodium: <1500 mg per day
v. Sugar-sweetened beverages: ≤4 glasses (assuming ~10-oz glass) per week. (as estimated from FFQ—including Q64 & Q65)

Outcomes: Annualized rate of IMT progression determined from all available IMT measurements in participants with ≥2 available measures. Baseline IMT will be considered earliest available measure and progression will be calculated as an annual rate. The mean value of IMT will be examined and measures in specific anatomic regions (internal carotid, common carotid and bulb) will be examined as separate outcomes.

Analysis:
1. Participants with <2 IMT measures or missing baseline behavior data will be excluded as appropriate for individual analyses.
2. Annualized progression of mean change per IMT will be defined as the difference between the earliest available measure and final measurement divided by the time (years) between earliest and final measure.
3. Various sites for IMT measurement will be explored as separate outcome variables, specifically internal carotid, common carotid, and bulb regions.
4. The dependent IMT measures will be transformed to make measurement errors uncorrelated with that of baseline IMT.
5. Mixed modeling procedures will be used to estimate IMT progression according to levels of individual CVD behavior adjusting for baseline IMT, measurement error, and other baseline CVD risk factors, including age, sex, race, education, systolic blood pressure, antihypertensive medication use, total cholesterol, HDL cholesterol, diabetes, and cholesterol medication use. In these models, participant exclusion based on missing behavior data will be specific to the behavior being examined.
6. Additional models will be fit to examine the association of having 0, 1, 2, 3, or 4 ideal CV health behaviors with progression of IMT. For these models, only participants with valid baseline measures of all 4 CVD behaviors will be included.
7. Presence of plaque will also be explored as a dichotomous variable and modeled similarly to progression of IMT.
8. Likely few people will be classified as having ideal CVD health behaviors, limiting precision. As possible, outcome variables according to individual and combined behaviors will be examined by race and sex.

7.a. Will the data be used for non-CVD analysis in this manuscript? [ ] Yes [ ] x [ ] No

b. If Yes, is the author aware that the file ICTDER03 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
8.a. Will the DNA data be used in this manuscript? _____ Yes __x__ No

8.b. If yes, is the author aware that either DNA data distributed by the Coordinating Center must be used, or the file ICTDER03 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
_____x____ Yes ________ No

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)?

There are no current overlapping manuscripts. Manuscripts examining optimal CVD risk have been prepared but either they do not use the AHA definition or they focus on different outcomes.


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.cscu.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.