U.S. Population and Increase Deaths from Heart Disease and The Coronary Artery Risk Development in Young Adults (CARDIA) Study:

Impact of Coronary Calcium on Young Adults

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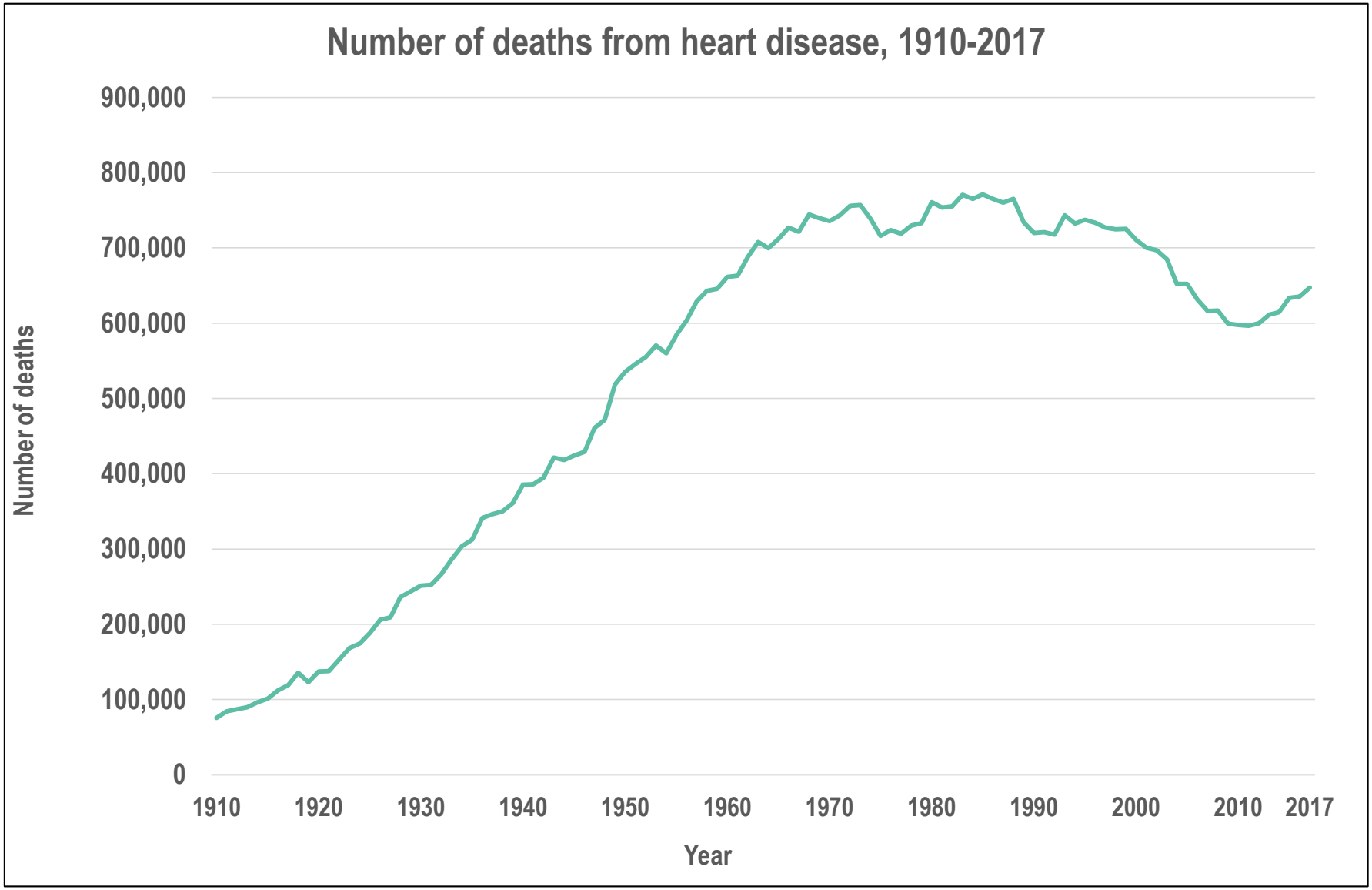
DIVISION OF RESEARCH



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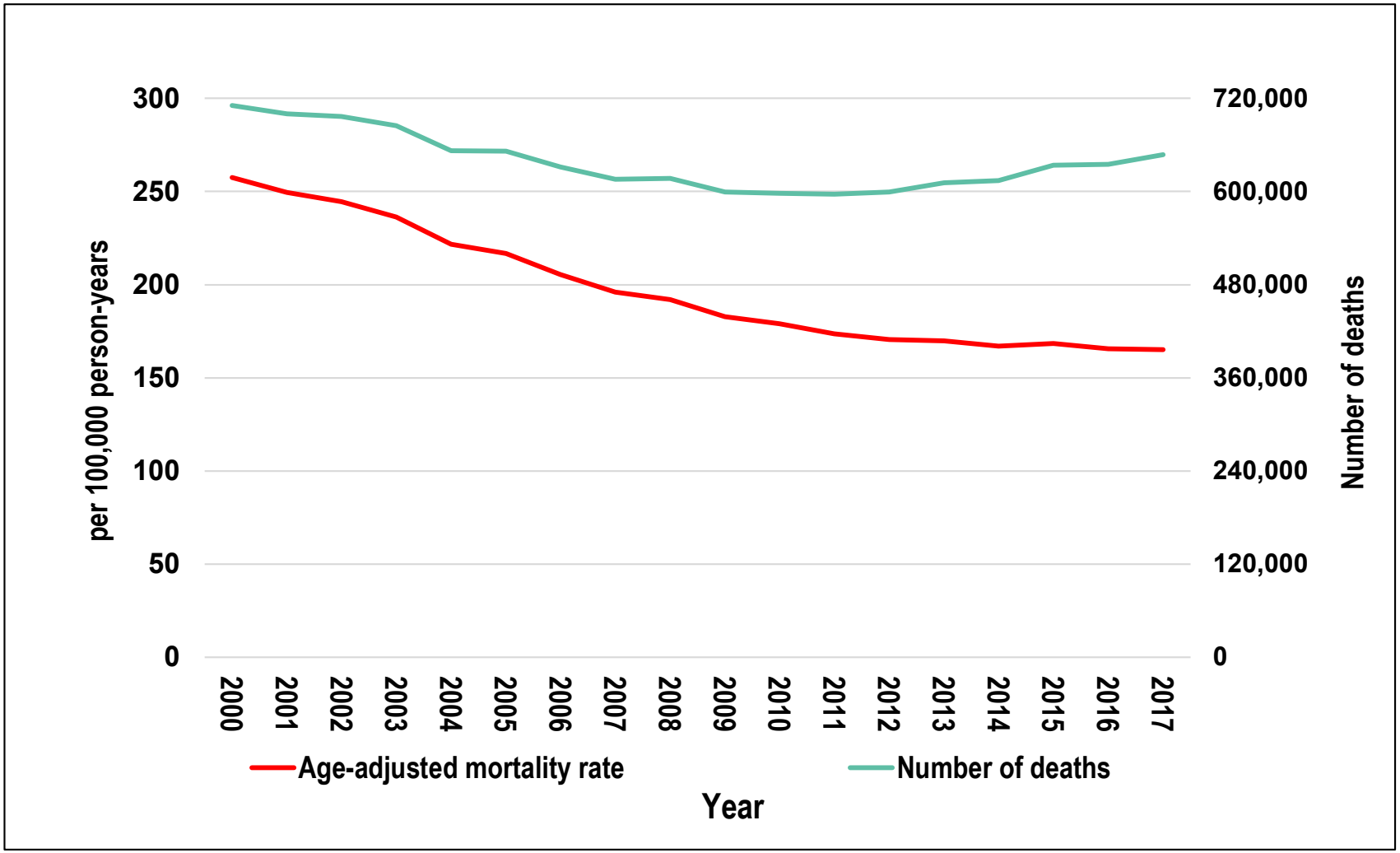
Age-adjusted mortality rate and total number of heart disease deaths, United States, 2000-2017



Sidney S, et al. JAMA Cardiol. doi:10.1001/jamacardio.2019.4187.

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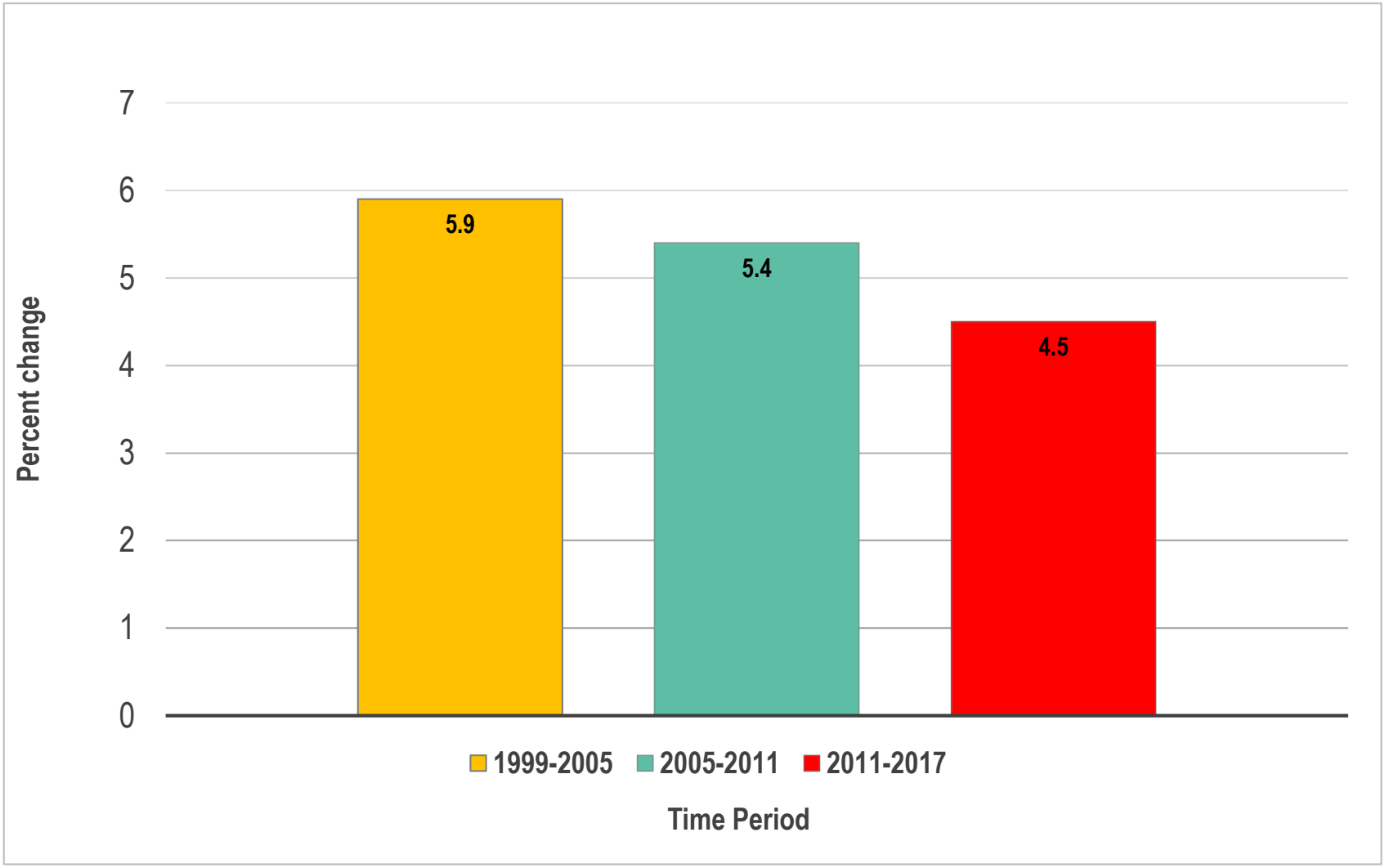
Total population growth rate (%), United States, 1999-2017



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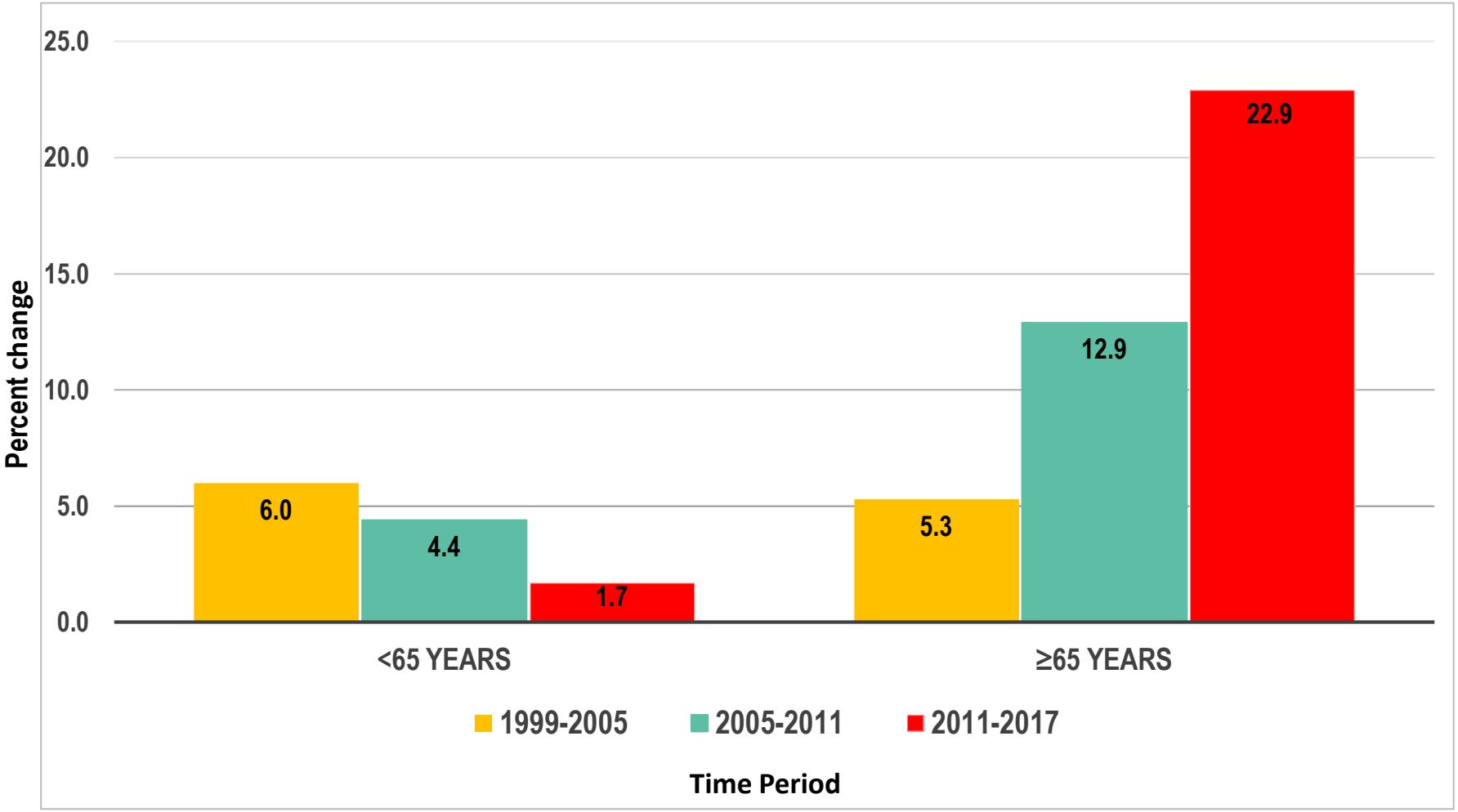
Ages 65 year and older:

80% of heart disease deaths

More than **90%** of heart failure deaths

Total population growth rate (%), United States by age groups, 1999-2017



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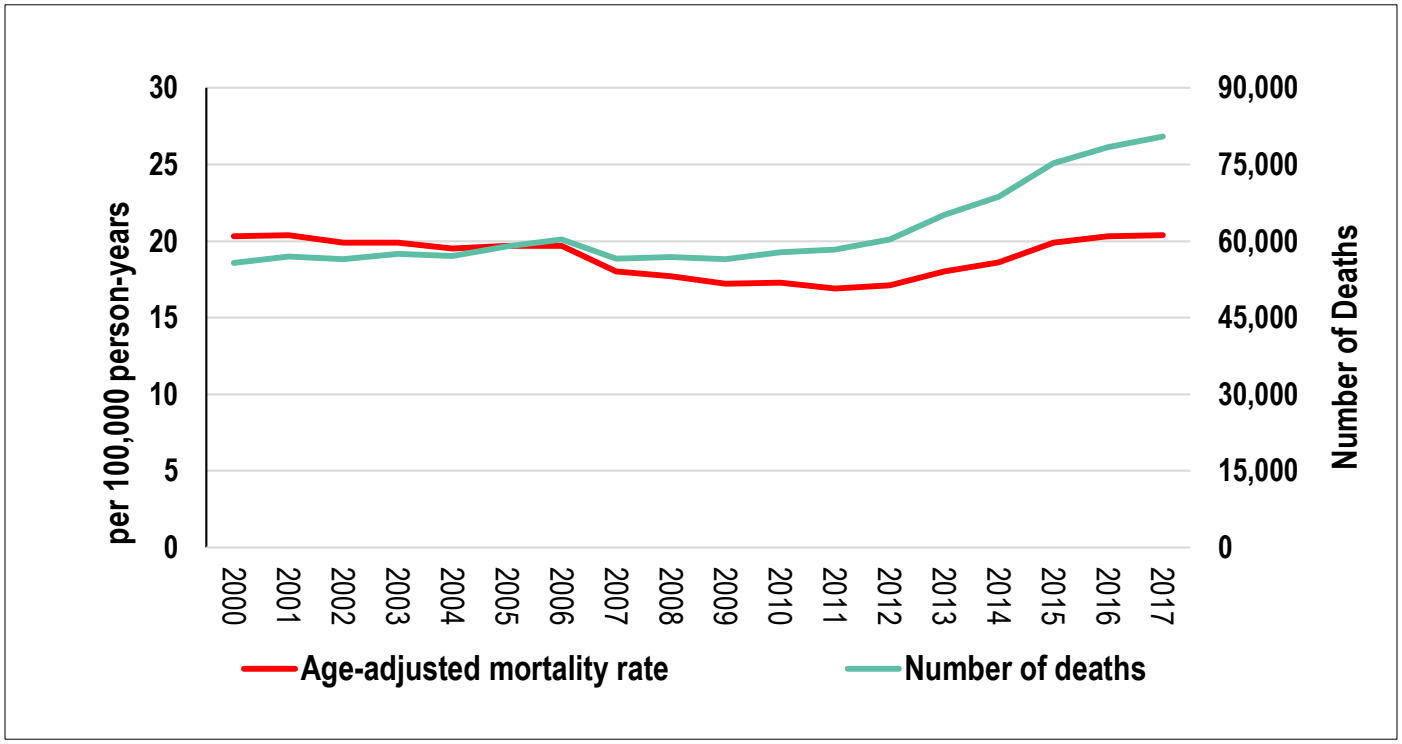
Age-adjusted mortality rate and total number of heart failure deaths, United States, 2000-2017



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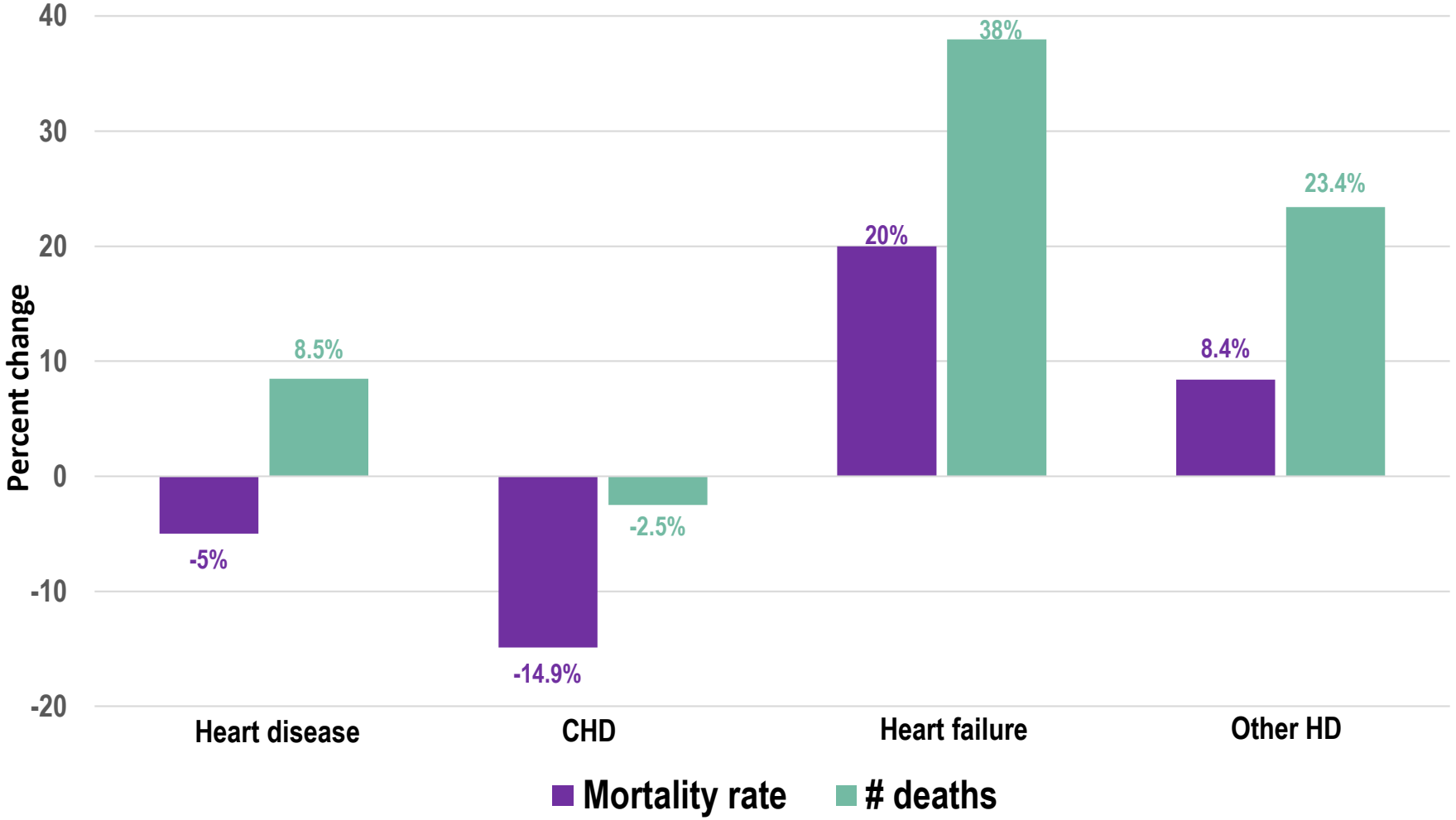
Percent change of age-adjusted mortality rate and number of deaths, 2011-2017



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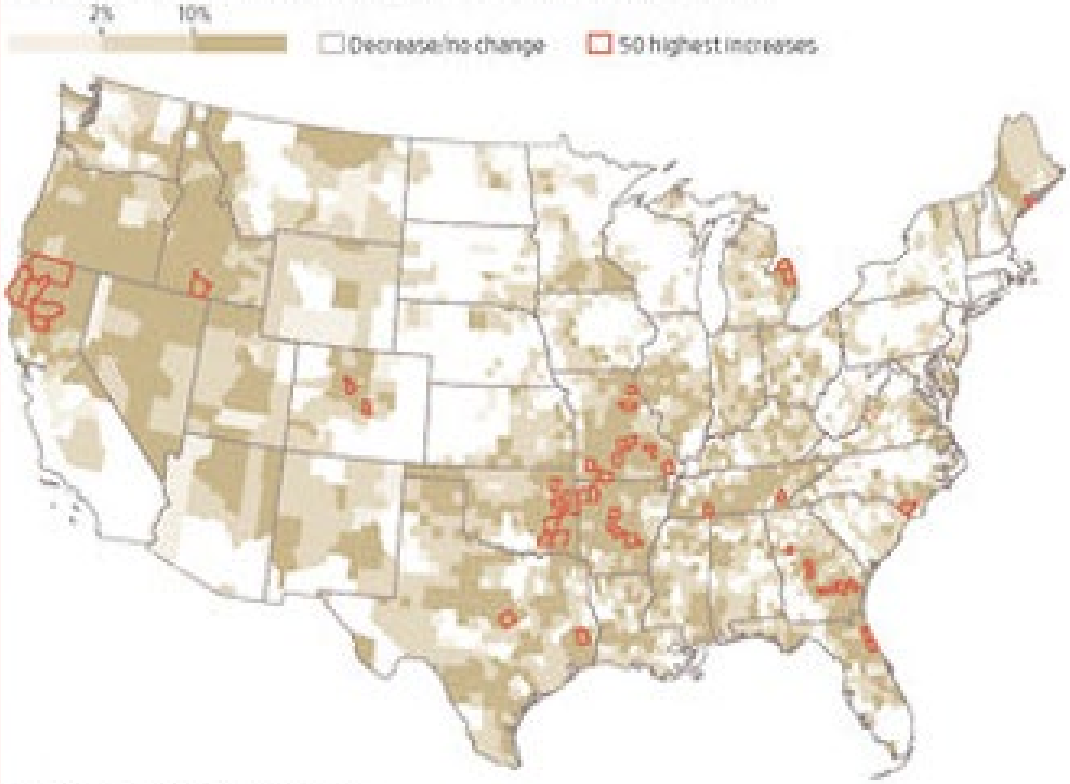
Where Death Rates Are Rising

After a half-century of improvements, middle-aged people are now more likely to die of cardiovascular disease than they were in 2011. Heart disease death rates for people aged 55-64 are especially increasing in the South, where they are already high, and in rural and smaller metro areas.

Percentage increase in heart disease death rates ages 55-64, 2010-15



Source: Centers for Disease Control and Prevention

Heart Disease Roars Back

Younger people and women are more often stricken; obesity and diabetes stall the decline

By Betsy McKay

One of America's greatest achievements over much of the past century has been a huge decline in death rates from heart disease and strokes. Anti-smoking campaigns, medications to control blood pressure and cholesterol, and surgical advances have extended millions of lives, fundamentally reshaping the U.S. population.

Now, progress has stalled. That's helping drive down life expectancy in the U.S. after decades in which each generation of Americans could expect to live longer than the one that came before.

The death rate for cardiovascular disease—which includes heart disease and strokes—has fallen just 4% since 2011 after dropping more than 70% over six decades, according to mortality statistics from the Centers for Disease Control and Prevention.

Particularly alarming is that the death rate is actually rising for middle-aged Americans.

The overall cardiovascular-disease death rate is an under-recognized contributor to the recent decline in U.S. life expectancy. While that has been driven mostly by deaths

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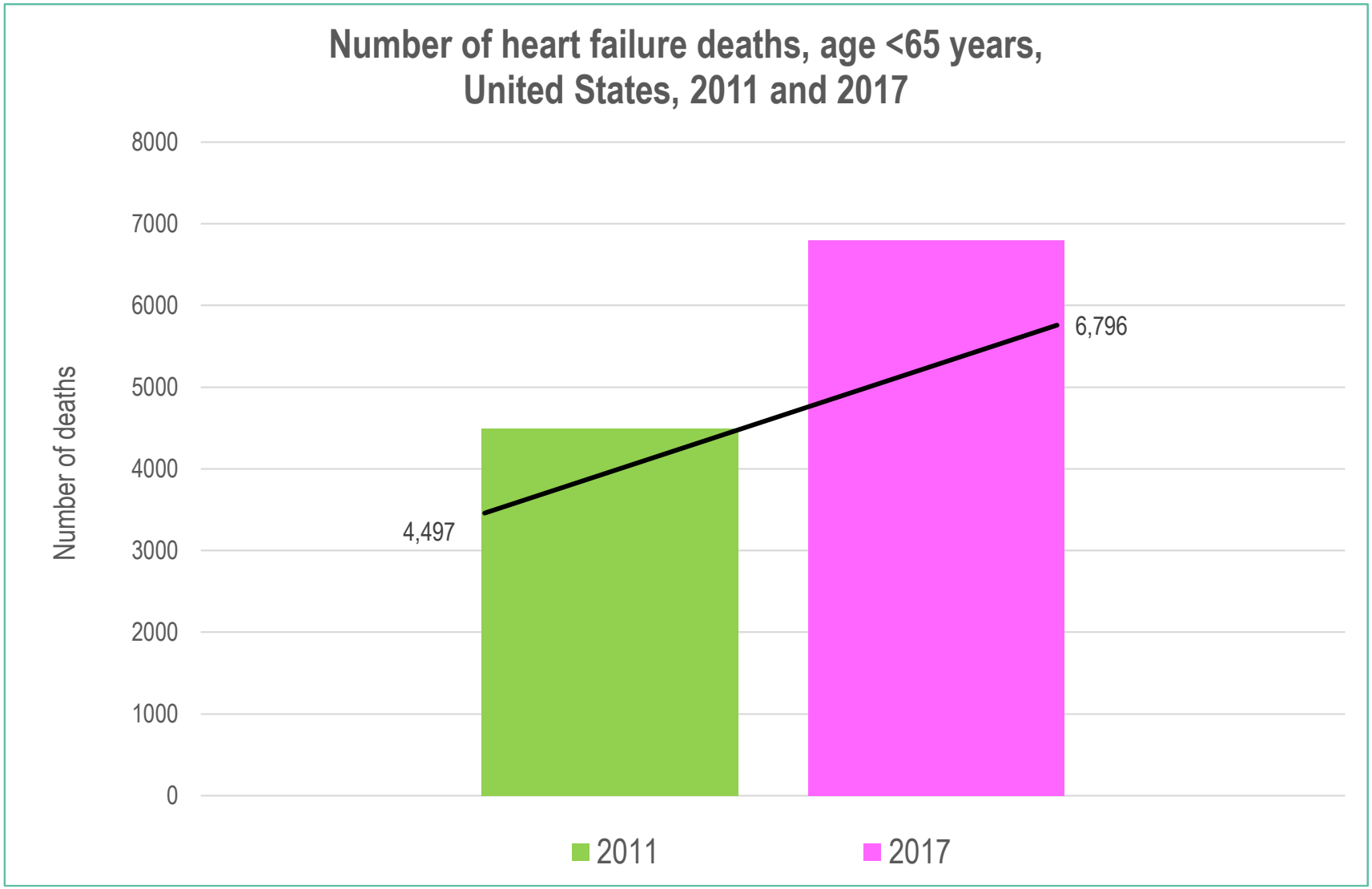

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Summary

A "silver tsunami" of population growth of the older population (≥65 years of age) is driving an increase in the number of heart disease deaths which are concentrated (80%) in this age group.

The growth in the number of heart failure deaths is particularly concerning and is driven by both the changing demographics and the increasing rate of HF mortality.

The ≥65 years of age population is projected to increased an additional 44% from 2017 to 2030 will exacerbate this growth and created challenges for the provision of the health care of this segment of the population.

CARDIA Study Design

Four Field Centers	
Birmingham	University of Alabama
Chicago	Northwestern University
Minneapolis	University of Minnesota
Oakland	Kaiser Permanente Northern California, Division of Research

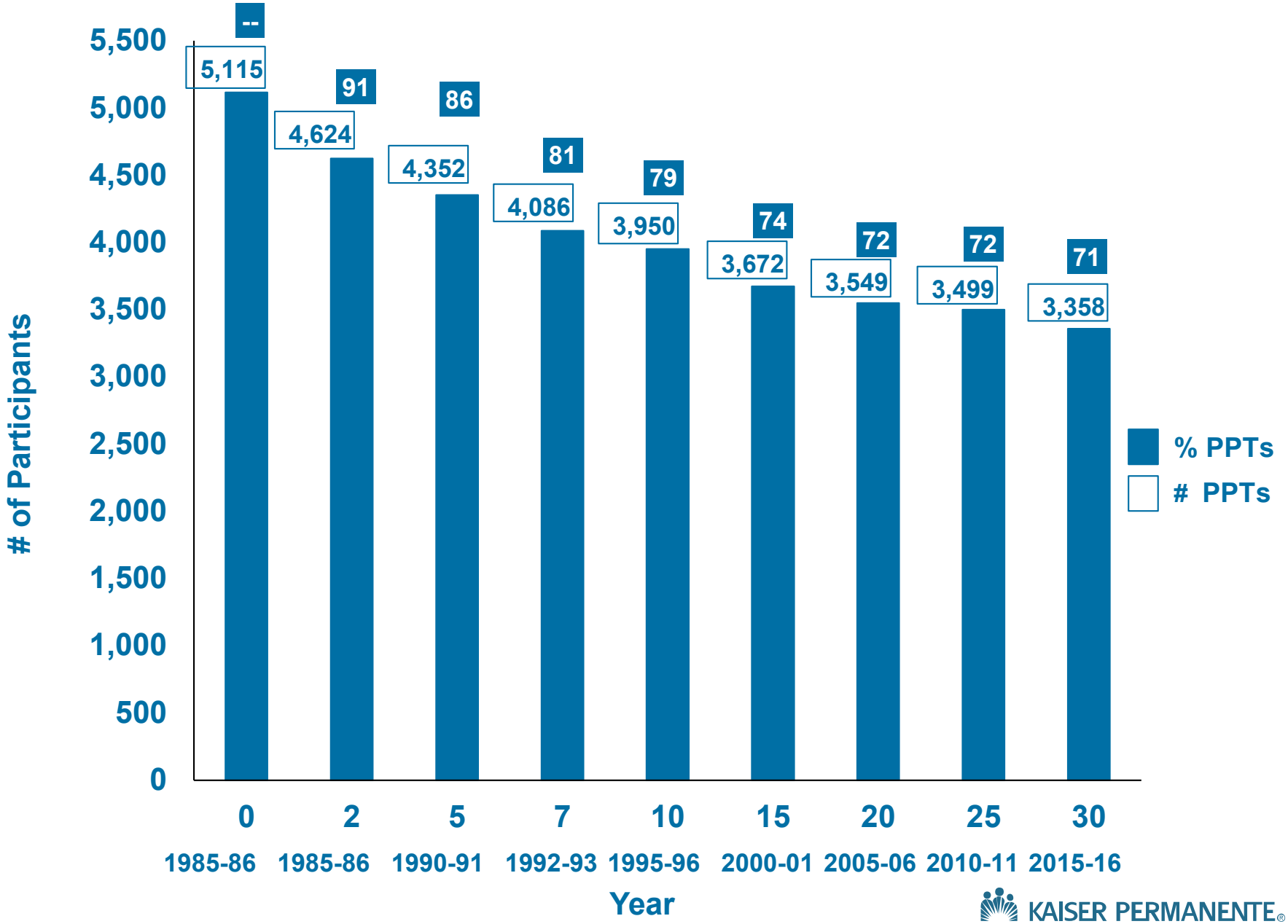
Multicenter cohort study of evolution of CVD risk beginning in young adulthood

Funded in December 1983 by National Heart Lung and Blood Institute

5,115 participants balanced in each center by:

- **Age (18-24, 25-30)**
- **Sex**
- **Race (AA/W)**
- **Education (≤HS, >HS)**

CARDIA Examination Status since 1985



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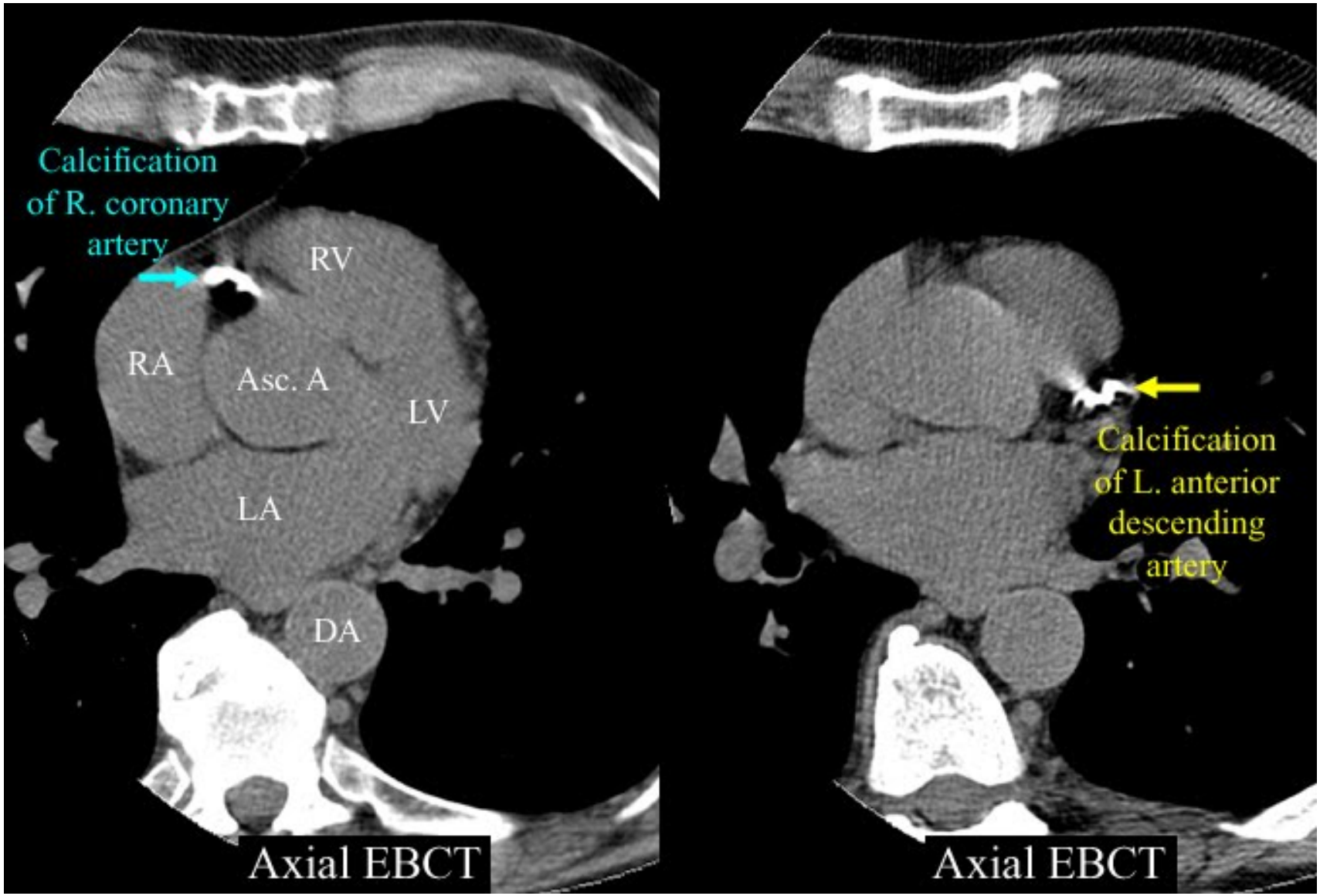
475 deaths (9.3% of cohort) reported; 411 adjudicated (as of 9/3/2019)

	Black	White	Total
Cancer	42	34	76
Cardiovascular disease	47	26	72
AIDS	27	23	49
Unintentional injury	18	14	32
Homicide	31	0	31
Unknown	14	7	21
Suicide	2	16	18
Liver disease	6	8	14
Kidney disease	10	3	13
Sepsis	8	2	10

CARDIA Morbidity

438 Non-fatal cardiovascular disease endpoints
96 strokes
97 myocardial infarctions
80 heart failure
65 atrial fibrillation/atrial flutter
44 coronary revascularization

Coronary Artery Calcification



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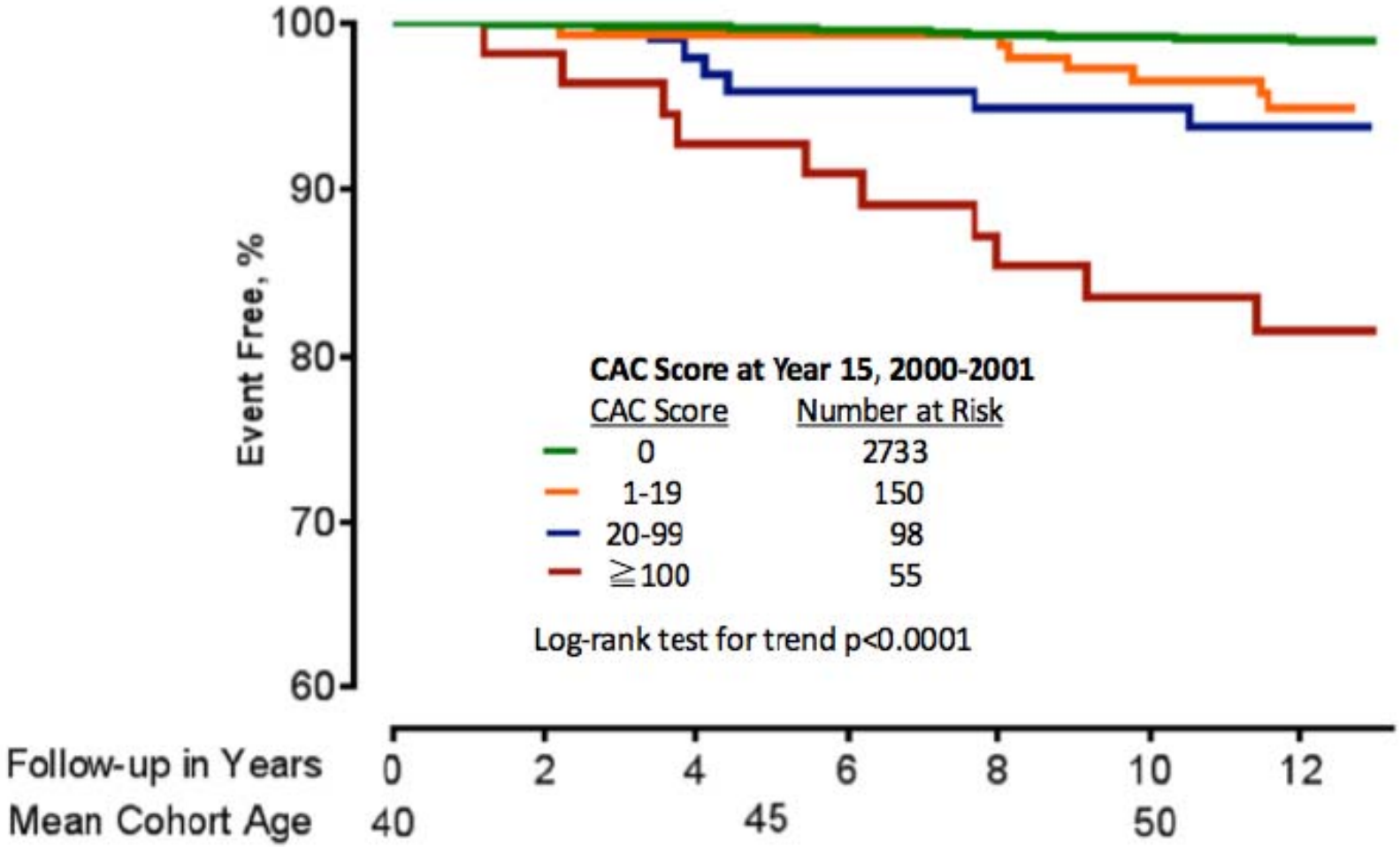
Association of Coronary artery calcification with incident CHD and Death

- Year 15 : 3,043 participants, mean age 40.3 years, with assessment for CAC.
- Prevalence of CAC: 309 individuals (10.2%) with geometric mean Agatson score 21.6.
- Follow-up from Y15 for up to 12.5 years with 57 incident CHD events and 108 incident CVD events.

Ref: Carr JC et al. Association of Coronary Artery Calcium in Adults Aged 32 to 46 Years With Incident Coronary Heart Disease and. Death *JAMA Cardiol*. 2017;2(4):391-399.

eFigure. Cumulative Event-Free Survival for Incident Coronary Heart Disease, Unadjusted Among Participants 32 to 46 Years by CAC Score Categories



Ref: Carr et al. JAMA Cardiol. Published online February 8, 2017.

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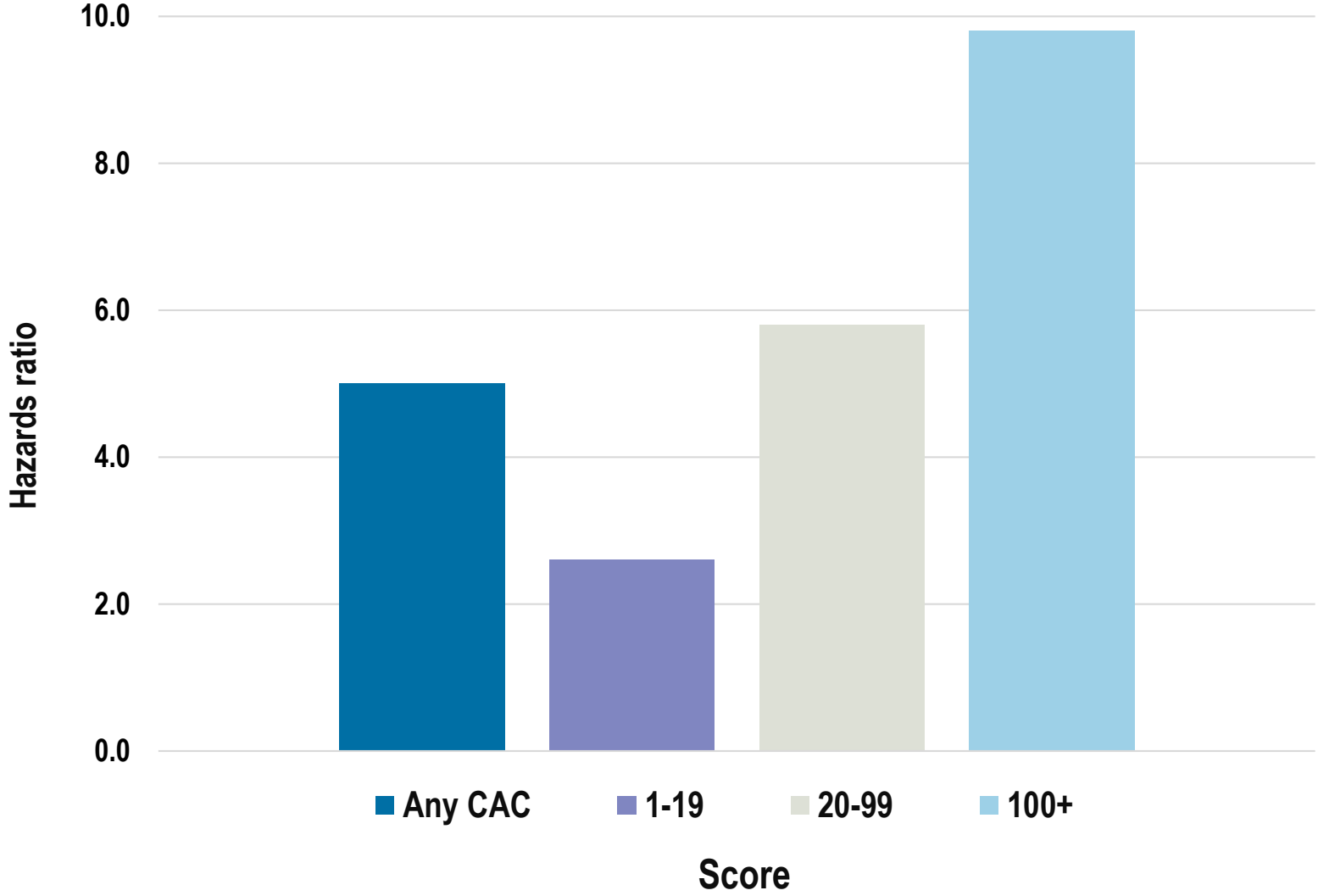
Incident CHD events by CAC score (odds ratios relative to no CAC)



Ref: Carr JC et al. *JAMA Cardiol*. 2017;2(4):391-399.

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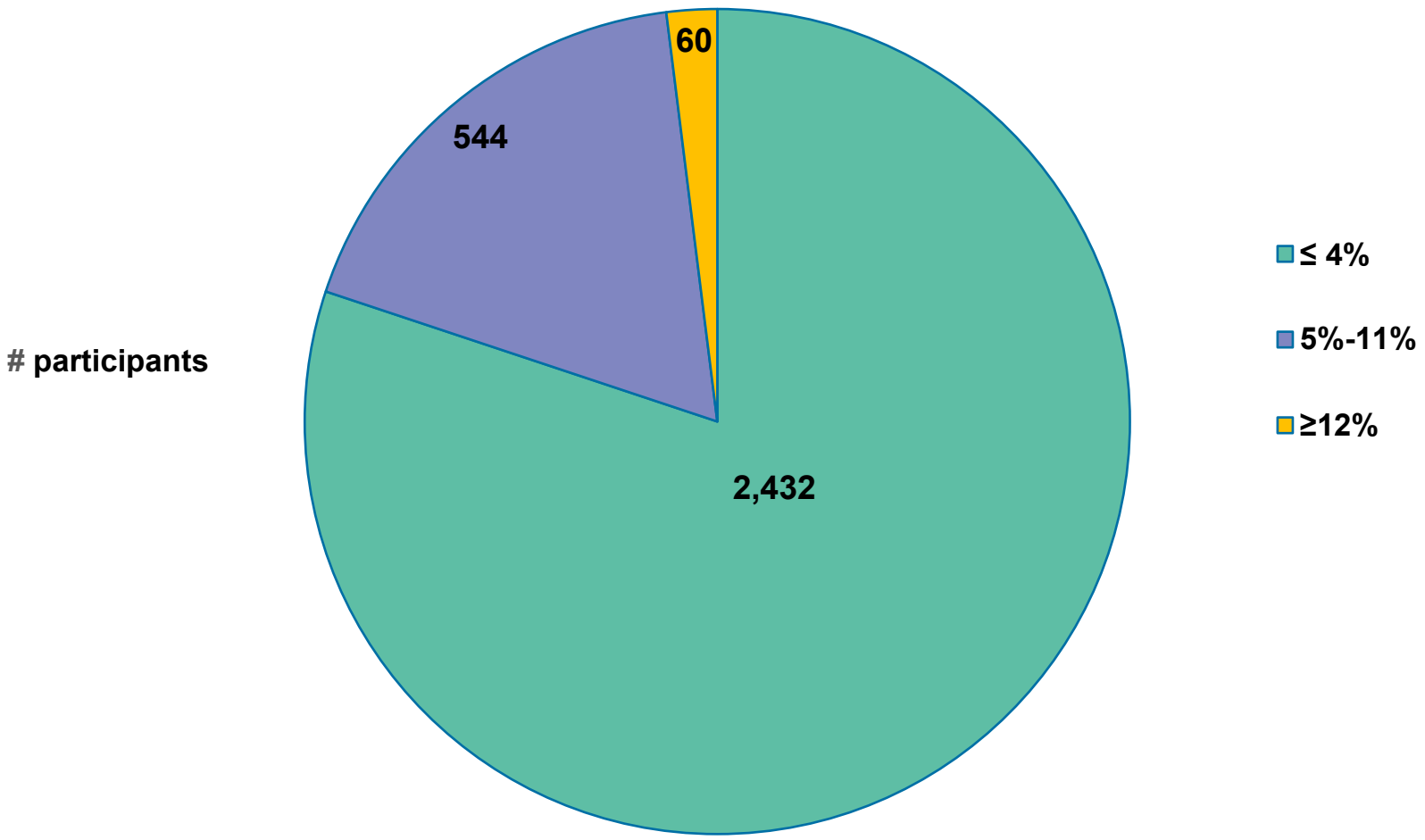
Table 3. Use of Risk Factors Measured in Early Adult Life to Identify the Population Most at Risk for Developing CAC and Incidence of Coronary Heart Disease[a]

CAC Screening Strategy in Middle Age	No. (%)	CHD Incidence, No. (%)	CAC Prevalence, No. (%)	Cohort CAC Found by CAC Screening Strategy, No. (%)	No. Enrolled to Find 1 Case of CAC
Entire eligible cohort	3330 (100)	67 (2.0)	964 (28.9)	964/964 (100.0)	3.5
Predicted low CAC risk	1665 (50.0)	3 (0.2)	219 (13.2)	219/964 (22.7)	7.7
Predicted high CAC risk	1665 (50.0)	64 (3.8)	745 (44.7)	745/964 (77.3)	2.2

Ref: Carr JC et al. *JAMA Cardiol*. 2017;2(4):391-399

CHD 10-year risk



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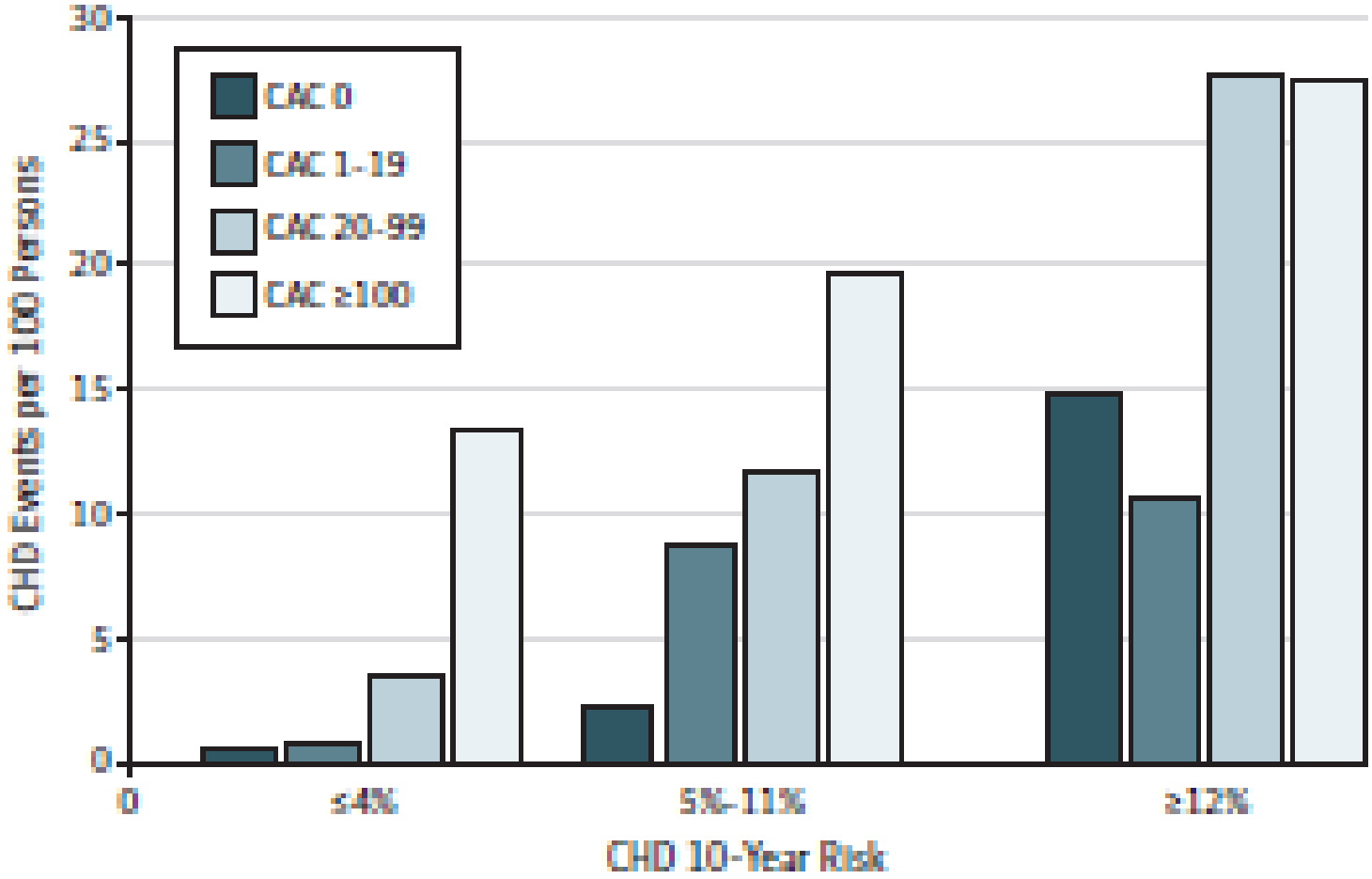
Incidence Density of Coronary Heart Disease (CHD) Events per 100 Persons



Ref: Carr JC et al. *JAMA Cardiol*. 2017;2(4):391-399.

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CENTRAL ILLUSTRATION **Proposed Decision-Making Approach to Selective Use of Coronary Artery Calcium Measurement for Risk Prediction**

Using 10-year ASCVD risk estimate plus coronary artery calcium (CAC) score to guide statin therapy				
Patient's 10-year atherosclerotic cardiovascular disease (ASCVD) risk estimate:	<5%	5-7.5%	>7.5-20%	>20%
Consulting ASCVD risk estimate alone	Statin not recommended	Consider for statin	Recommend statin	Recommend statin
Consulting ASCVD risk estimate + CAC				
If CAC score =0	Statin not recommended	Statin not recommended	Statin not recommended	Recommend statin
If CAC score >0	Statin not recommended	Consider for statin	Recommend statin	Recommend statin
Does CAC score modify treatment plan?	✗ CAC not effective for this population	✓ CAC can reclassify risk up or down	✓ CAC can reclassify risk up or down	✗ CAC not effective for this population

Greenland, P. et al. J Am Coll Cardiol. 2018;72(4):434–47.

The figure shows a modified approach to the guideline-based decision making by incorporating a consideration of coronary artery calcium (CAC) testing to reclassify a patient's risk up or down where it would make a clinically important change in the clinical decision. Adapted with permission from Nair et al. (90).

Ref: Greenland et al. JACC VOL. 72, NO. 4, 2018 JULY 24, 2018:434– 47

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CAC Expert Panel Algorithm

For Individuals Age 40-75, LDL 70-189, and Without Clinical ASCVD[1]

Step 1

Calculate 10 yr Risk Using ACC/AHA ASCVD Risk Calculator[2]

- 10 yr Risk <5% → Follow ACC/AHA guidelines for low risk
- 10 yr Risk 5% to <7.5%[3] → >50% of CAD events occur in the <7.5% Risk Group
- 10 yr Risk ≥7.5% → Follow ACC/AHA guidelines for ASCVD Statin Benefit Groups

Step 2

Family history of ASCVD

Coronary Artery Calcium (CAC) Score[4]

Step 3 Updated Risk Classification

CAC = 0	CAC = 1-299 & <75th %	CAC ≥300 or ≥75th %
Lifestyle Management Reassess risk at 4-6 years	Lifestyle Management Consider pharmacologic lipid Rx	Lifestyle Management Add pharmacologic lipid Rx

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Association of Coronary artery calcification with incident CHD and Death

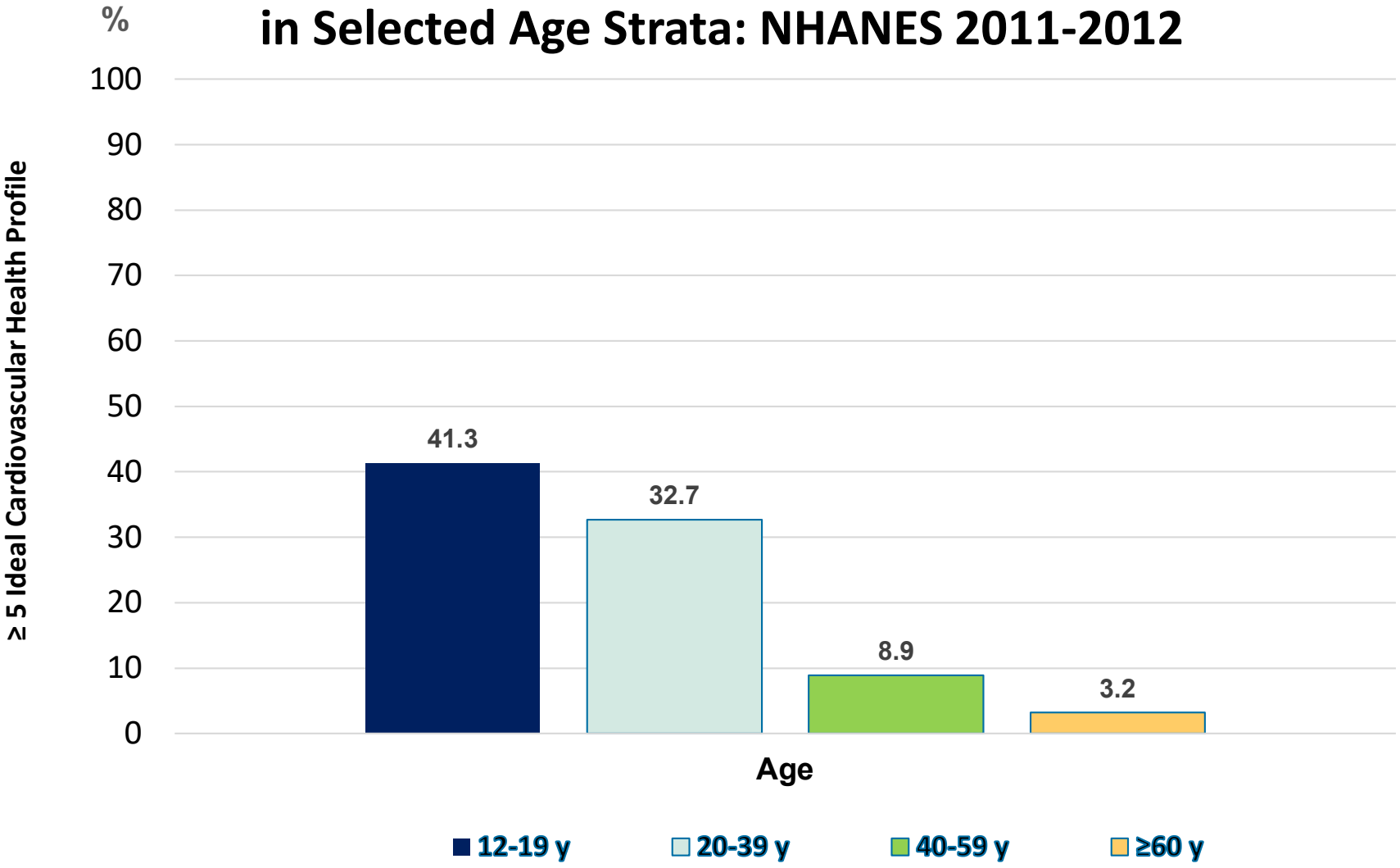
Bottom line:

- CAC measured at age 32 – 46 years is predictive of increased CHD over 12.5 years.
- It may be possible to develop an effective strategy for the using of CAC screening utilizing appropriate risk stratification.

Components of Cardiovascular Health (Life's Simple 7)

- Healthy diet
- Physical activity
- Maintain ideal body weight
- No smoking
- Normal blood pressure
- Normal blood cholesterol
- Normal fasting blood glucose

2011-2012 Prevalence of Ideal Cardiovascular Health and its Components in the US Population in Selected Age Strata: NHANES 2011-2012



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CARDIA

Coronary Artery Risk Development In Young Adults

NHLBI REPOSITORY DATA SETS AVAILABLE TO SCIENTIFIC COMMUNITY

- **Description of data on Public CARDIA website:**
  http://www.cardia.dopm.uab.edu
- **Procedures on how to request data:**
  https://biolincc.nhlbi.nih.gov/home/
- **For Information or Questions on how to request data:**
  biolincc@imsweb.com
- **For Other Information or Questions, send an email to:**
  CARDIAdataquestions@dopm.uab.edu