CLINICAL RESEARCH STUDY

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# American Heart Association's Life's Simple 7: Avoiding Heart Failure and Preserving Cardiac Structure and Function

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## ABSTRACT

**BACKGROUND:** Many people may underappreciate the role of lifestyle in avoiding heart failure. We estimated whether greater adherence in middle age to American Heart Association's Life's Simple 7 guidelines—on smoking, body mass, physical activity, diet, cholesterol, blood pressure, and glucose—is associated with lower lifetime risk of heart failure and greater preservation of cardiac structure and function in old age.

**METHODS:** We studied the population-based Atherosclerosis Risk in Communities Study cohort of 13,462 adults ages 45-64 years in 1987-1989. From the 1987-1989 risk factor measurements, we created a Life's Simple 7 score (range 0-14, giving 2 points for ideal, 1 point for intermediate, and 0 points for poor components). We identified 2218 incident heart failure events using surveillance of hospital discharge and death codes through 2011. In addition, in 4855 participants free of clinical cardiovascular disease in 2011-2013, we performed echocardiography from which we quantified left ventricular hypertrophy and diastolic dysfunction.

**RESULTS:** One in four participants (25.5%) developed heart failure through age 85 years. Yet, this lifetime heart failure risk was 14.4% for those with a middle-age Life's Simple 7 score of 10-14 (optimal), 26.8% for a score of 5-9 (average), and 48.6% for a score of 0-4 (inadequate). Among those with no clinical cardiovascular event, the prevalence of left ventricular hypertrophy in late life was approximately 40% as common, and diastolic dysfunction was approximately 60% as common, among those with an optimal middle-age Life's Simple 7 score, compared with an inadequate score.

**CONCLUSIONS:** Greater achievement of American Heart Association's Life's Simple 7 in middle age is associated with a lower lifetime occurrence of heart failure and greater preservation of cardiac structure and function.

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Americans' lifetime risk of heart failure is substantial. Epidemiologists have estimated that lifetime risk of heart failure was 1 in 5 in the Framingham Heart Study,[1] 1 in 3 in the Rotterdam Study,[2] and 20%-45% among various sex-ethnic groups in the Cardiovascular Lifetime Risk Pooling Project.[3] Because heart failure risk is so high, primary prevention must be a public health priority.

For primary prevention of overall cardiovascular disease, the American Heart Association (AHA) recommends that Americans follow "Life's Simple 7." Life's Simple 7 describe ideal, intermediate, and poor levels of cardiovascular disease risk factors or behaviors, namely, smoking, body mass index, physical activity, diet, total cholesterol, blood pressure, and fasting serum glucose.[4] The Atherosclerosis Risk in Communities (ARIC) Study documented that the number of ideal Simple 7 factors achieved is associated strongly and inversely with later incidence of total cardiovascular disease,[5] heart failure,[6,7] and cancer.[8] Yet, no publication has, to our knowledge, specifically addressed the degree to which following Life's Simple 7 might lower lifetime heart failure risk or preserve cardiac structure and function to old age.

We therefore analyzed ARIC data, with longer follow-up than previously available, to examine whether greater adherence to Life's Simple 7 in middle age is associated with 1) reduced incidence rates and lifetime risk of heart failure, and 2) greater preservation of cardiac structure and function among elderly participants without a history of heart failure or myocardial infarction.

**CLINICAL SIGNIFICANCE**

- One in 4 middle-aged adults will develop heart failure if they survive to age 85 years.
- Enabling patients to reach middle age with few cardiovascular risk factors will greatly preserve their cardiac function and reduce their lifetime risk of heart failure.

## METHODS

### Study Population

The ARIC Study[9] enrolled 15,792 men and women ages 45 to 64 years in 1987-1989, in 4 US communities: Forsyth Co., NC, Jackson, MS (African Americans only), suburban Minneapolis, MN, and Washington Co., MD. The investigators followed the cohort for incident cardiovascular disease events and conducted 4 subsequent examinations, including an echocardiogram at Visit 5 in 2011-2013, approximately 25 years after baseline. The institutional review committees at each study center approved the methods, and staff obtained informed participant consent.

### Measurement of Life's Simple 7

We used the ARIC baseline visit, when participants were middle aged, as the point for assessment and classification of Life's Simple 7 characteristics. Measurements included a food frequency questionnaire, physical activity, body mass index, smoking, total cholesterol, seated blood pressure after a 5-minute rest, and fasting glucose.[9] We classified each factor according to AHA's Simple 7 categories of ideal, intermediate, or poor[4,5] (**Appendix, Supplementary Table**, available online). For example, the respective ideal, intermediate, and poor body mass categories are $< 25$, 25-29.99, and $\geq 30$ kg/m$^3$.

### Heart Failure and Myocardial Infarction Occurrence

We defined preexisting heart failure at baseline as the following: 1) an affirmative response to "Were any of the medications you took during the last 2 weeks for heart failure?" or 2) Stage 3 or "manifest heart failure," based on symptoms and signs, using Gothenburg criteria.[10,11] We defined preexisting coronary heart disease at baseline by self-reported prior physician diagnosis of myocardial infarction or coronary revascularization, or by prevalent myocardial infarction by 12-lead electrocardiogram (ECG).

To identify incident events through December 31, 2011, ARIC staff contacted participants annually, identified hospitalizations and deaths during the prior year, and surveyed discharge lists from local hospitals and death certificates from state vital statistics offices.[12] We defined incident heart failure as the first occurrence of either a hospitalization that included an International Classification of Diseases, 9th Revision (ICD-9) discharge code of 428 (428.0 to 428.9) among the primary or secondary diagnoses, or else a death certificate with an ICD-9 code of 428 or an ICD-10 code of I50 among the listed or underlying causes of death.[11] Incident myocardial infarction was defined by combinations of chest pain symptoms, ECG changes, and cardiac biomarkers.[12]

### Visit 5 Echocardiographic Data

Using the same model of equipment, trained echo technicians in the 4 ARIC sites obtained images in the parasternal long- and short-axis and apical 4-chamber views.[13] We measured, in triplicate from the 2-dimensional views, left ventricular dimensions, volumes, and wall thickness, and took Doppler measures of mitral inflow and mitral annular relaxation velocities following the recommendations of the American Society of Echocardiography.[14]

For this report, we focused on 3 echocardiographic measures obtained in 2011-2013—left ventricular hypertrophy, left ventricular systolic dysfunction, and left ventricular diastolic dysfunction—among participants at Visit 5 with no history of heart failure or myocardial infarction through 2011. ARIC determined left ventricular mass according to American Society of Echocardiography recommendations and indexed to height to the power of 2.7. We