Usefulness of the American Heart Association's Life Simple 7 to Predict the Risk of Atrial Fibrillation (From the REasons for Geographic And Racial Differences in Stroke [REGARDS] Study)

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Abstract

The American Heart Association has identified metrics of ideal cardiovascular (CV) health known as Life's Simple 7 (LS7). We determined the prospective relationship between the LS7 and incident AF in a biracial cohort. The Reasons for Geographic and Racial Differences in Stroke (REGARDS) study enrolled non-Hispanic black and white adults 45 years or older. This analysis included 9,576 REGARDS participants (mean age 63 ± 8.4 years; 57% women; 30% black) who were free of AF at baseline and completed a follow-up exam 9.4 years later. An overall LS7 score was calculated at baseline as the sum of the LS7 component scores and classified as inadequate (0–4), average (5–9), or optimal (10–14) CV health. The primary outcome was incident AF, identified at follow-up by either electrocardiogram or a self-reported medical history of a physician diagnosis. A total of 725 incident AF cases were detected. Compared to the inadequate category (n=534), participants in the optimal category (n=1953) had a 32% lower odds of developing AF (odds ratio (OR) 0.68; 95% confidence interval (CI) 0.47, 0.99) in a logistic regression model adjusted for demographic characteristics, alcohol use, left ventricular hypertrophy, coronary heart disease, and stroke. A 1-point higher LS7 score was associated with a 5% lower odds of incident AF (OR=0.95; 95% CI 0.91, 0.99). In conclusion, better CV health, as defined by the LS7 score, is associated with a reduction in development of AF.

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Keywords

Atrial fibrillation; Epidemiology; Risk factors; Life's Simple 7

Atrial fibrillation (AF) is the most commonly presenting cardiac arrhythmia in clinical practice, affecting over 2 million people in the United States, with a prevalence that is expected to more than double by 2050.[1] In 2010, the American Heart Association identified metrics of ideal cardiovascular (CV) health known as Life's Simple 7 (LS7) to target for the primary prevention of cardiovascular disease (CVD).[2] Attainment of ideal CV health is associated with a reduced incidence of CVD and stroke.[3-6] While AF and CVD share common risk factors and poor control of some LS7 components have been associated with a higher risk of AF, the association of the combination of all LS7 metrics with incident AF has not been evaluated.[7-14] Elucidating a relationship of LS7 with AF may provide information regarding the potential impact of achieving AHA's strategic goals on AF prevention. Therefore, the purpose of this study was to examine the association between LS7 and incident AF in the REasons for Geographic And Ethnic Differences in Stroke (REGARDS) study.

Methods

Details of REGARDS have been published previously.[15] Briefly, this is a prospective cohort study designed to identify causes of regional and racial disparities in stroke mortality. The study over sampled blacks and residents of the stroke belt (North Carolina, South Carolina, Georgia, Alabama, Mississippi, Tennessee, Arkansas, and Louisiana). Between January 2003 and October 2007, a total of 30,239 participants were recruited from a commercially available list of residents using postal mailings and telephone interviews. Socio-demographic information and medical histories were obtained by a computer-assisted telephone interview. An in-home examination was performed 3-4 weeks after the telephone interview. Trained staff collected medication information, blood and urine samples, blood pressure readings, and a resting electrocardiogram (ECG). A Block 98 food frequency questionnaire (FFQ) was left with the participants for self-administration and mailed to the study coordinating center.[16]

Approximately 10 years after the baseline assessment, participants completed a follow-up examination similar to the baseline visit. As of 2017, 16,674 (52%) participants were still being followed, 7,184 (24%) participants were dead, and 7,148 (24%) participants had withdrawn. Although nearly one-quarter of participants withdrew, annual study retention rate was high (97%) and compares favorably to other longitudinal cohort studies. Study fatigue was cited as the most common reason for withdrawal. The Institutional Review Board at the collaborating centers approved the REGARDS study protocol and all participants provided informed consent.

LS7 components, as defined by the AHA, include cigarette smoking, body-mass index (BMI), blood pressure, cholesterol, blood glucose, physical activity and diet.[2] Definitions for healthy diet and physical activity components were modified based on data available in REGARDS.[4] Participants were asked "How many times per week do you engage in intense

physical activity, enough to work up a sweat?" Ideal physical activity was defined as a frequency of 4 or more times per week, intermediate as 1-3 times per week, and poor as none. Responses to the Block FFQ were used for the 'healthy diet score' that is based on how many components of the 5 diet goals are met. Each LS7 component was given a point score of 0, 1 or 2 to represent poor, intermediate, or ideal health, respectively. An overall LS7 score ranging from 0 to 14 was calculated as the sum of the LS7 component scores. This score was classified as inadequate (0–4), average (5–9), or optimal (10–14) CV health.

AF was identified at baseline and a subsequent follow-up visit by (1) scheduled ECG and (2) self-reported history of a physician diagnosis during the computer-assisted telephone interview surveys. The ECGs were read and coded at a central reading center (EPICARE, Wake Forest School of Medicine, Winston-Salem, NC) by readers who were blind to other REGARDS data. Self-reported AF was defined as an affirmative response to the following question: "Has a physician or a health professional ever told you that you had atrial fibrillation?" This question has been shown to be a reliable predictor of incident stroke events as AF detected by ECG.[17]

Participant characteristics at baseline were used as covariates. Age, sex, race, income, education, alcohol use, and smoking status were self-reported. Alcohol use was classified by the number of drinks per week reported by study participants using the following criteria: none, moderate (1 to 2 drinks/day for men and 1 drink/day for women), and heavy (>2 drinks/day for men and >1 drink/day for women). Using baseline ECG data, left ventricular hypertrophy (LVH) was defined by the Sokolow-Lyon Criteria.[18] Coronary heart disease (CHD) was self-reported history of myocardial infarction, coronary artery bypass grafting, coronary angioplasty or stenting, or if evidence of prior myocardial infarction was present on the baseline ECG. Prior stroke was ascertained by participant's self-report.

Statistical Analysis

Individuals with missing baseline measures of any of the LS7 components, baseline AF (ECG or self-report) or missing AF follow-up data were excluded from the primary analyses. Baseline characteristics were compared across LS7 health categories and according to development of AF. Categorical variables were reported as frequency and percentage while continuous variables were reported as mean ± standard deviation. Statistical significance for categorical variables was tested using the chi-square method and the analysis of variance procedure for continuous variables.

Logistic regression was used to compute odds ratios (OR) and 95% confidence intervals (CI) for incident AF across overall LS7 score categories (optimal or average versus inadequate), per 1 ideal higher component score, and per 1-unit higher overall LS7 score. ORs for incident AF for each individual LS7 component (referent category=poor) were also computed. Multivariable models were constructed as follows: Model 1 adjusted for age, sex, race, education, income, and geographic region; Model 2 adjusted for Model 1 covariates with the addition of LVH, alcohol use, history of CHD, and prior stroke. We evaluated for effect modification by sex and race, using stratification and by using interaction terms. Because diet information was missing for a large number of excluded participants who completed a follow-up visit (n=3008), we performed a sensitivity analysis including these

participants assuming they had a poor diet (score=0). Statistical significance for all comparisons including interactions was defined as p <0.05. SAS Version 9.4 (Cary, NC) was used for all analyses.

Results

15,517 REGARDS participants completed both a baseline and follow-up examination. Comparison of baseline characteristics for these participants stratified by inclusion into the current analysis is shown in Supplemental Table 1. A total of 9,576 participants had data on all LS7 measures and no previous AF and were included. Mean age was 63 years, 30% were black, and 57% female. The mean LS7 score at baseline was 7.8 ± 2.0 (black: 7.1 ± 1.9; white: 8.1 ± 2.0). 725 (7.6%) participants developed AF over a median follow-up of 9.4 years. Compared to participants who did not develop AF, those who did were older, less likely to smoke, and more likely to be male, be white, have a higher SBP, have a lower total cholesterol, consume alcohol, be more physically active, have CHD, and have had a stroke (Table 1). Socio-demographic and clinical characteristics across baseline LS7 categories are compared in Table 2. Younger age, female sex, black race, less education, low income, less alcohol consumption, LVH on ECG, CHD, and stroke were all associated with poorer CV health.

Table 3 shows the risk of incident AF by LS7 category. After adjustment for age, sex, race, income, and geographic region participants in the optimal category had a lower risk of developing AF compared to the inadequate category. A 1-point higher LS7 score was also associated with a lower risk of incident AF. Associations were attenuated with adjustment for alcohol use, LVH, CHD, and prior stroke but remained significant. Although associations per 1-point improvement were not statistically significant among blacks (Supplemental Table 2), the risk did not significantly differ between blacks and whites (*p*-value for interaction=0.51). Associations also did not differ by gender (*p*-value for interaction=0.49). Results were similar when participants with missing diet scores were included and assumed to have a poor diet (Supplemental Table 3).

Table 4 shows the risk of incident AF according to the individual LS7 components, expressed as poor, intermediate, or ideal, evaluated in separate models. Compared to participants in the poor category of their respective components, those with ideal blood pressure or either intermediate or ideal BMI were at a significantly lower risk of incident AF. No participants had ideal CV health for all 7 metrics and only 129 (1.4%) participants had ideal health for 6 components. A 1 component higher number of ideal health metrics was associated with a 7% lower risk of incident AF in adjusted analysis (OR=0.93; 95% CI 0.87, 0.99).

Discussion

In this prospective biracial cohort study, better CV health, as defined by the LS7 score, was associated with a lower risk of incident AF. Individuals with optimal CV health had an over 30% lower risk of developing AF compared to those with inadequate health. A 1-point improvement in the LS7 score was associated with a 5% lower risk of AF.

Prior studies have already reported that the presence of a combination of the risk factors included in the LS7 can help to predict the risk of developing AF.[19-21] The CHARGE-AF consortium, for example, derived and validated a risk model to predict the development of AF based off of age, race, height, weight, systolic and diastolic blood pressure, current smoking, use of antihypertensive medication, diabetes, and history of myocardial infarction and heart failure.[20] By demonstrating an association between the LS7 score and AF development, our findings build upon previous literature and suggest that improvements in these risk factors may help to reduce the incidence of AF. Additionally, the LS7 is an easily interpretable and widely available tool that can be easily applied at the patient-level to encourage improvements in these risk factors.

The LS7 was designed to improve the overall CV health of all Americans by targeting 7 modifiable CV risk factors in an effort to reduce incident CVD.[2] However, achievement of ideal CV health is difficult.[3,22] While we report that optimal CV health is associated with a reduced incidence of AF, our findings suggest that even small improvements in the population distribution of LS7 components may have a dramatic impact on reducing the overall AF disease burden.

Only blood pressure and BMI were associated with risk of incident AF in individual component analysis. Similar findings have been reported for both blood pressure and BMI in other populations that also included non-Hispanic whites.[23-26] Diabetes has also been consistently associated with an increased AF risk in multiple prospective studies whereas the relationships for the other LS7 components not associated with incident AF in our study have either had mixed results or were not associated with risk of AF.[7,8-11,13,14,21,22,27,28] It is unclear as to why blood glucose showed no association in our study, although, ideal blood glucose was associated with a lower risk of AF in Model 1 before additional adjustment. In MESA, a cohort comprised of mainly non-Hispanic whites, there was also no significant association noted for diabetes and incident AF.[26]

Though individually these components may not all be strongly related to AF risk, it is possible that the components are interrelated and that improvements in a single component could result in a reduction of AF by influencing improvements in other components. In a study of ARIC participants ideal physical activity levels modified the AF risk associated with obesity in men much more then its overall protective effect in the entire cohort.[13] In the Look AHEAD trial, however, neither intensive lifestyle intervention nor improved physical fitness were associated with a reduced risk of incident AF amongst overweight or obese individuals with type 2 diabetes.[29] Considering that only blood pressure and BMI were associated with incident AF in this study, formal study as to whether improvements in LS7 factors, particularly those that were not significant, actually reduce AF incidence is needed.

Our study has some limitations. The majority of AF cases were by self-report at a single follow-up visit and participants may not have accurately recalled events that occurred years earlier. More sensitive detection methods such as hospitalization diagnosis were not available. This likely led to underascertainment of AF events, especially those that were asymptomatic, and may have played a role into nonsignificant associations for individuals LS7 components such as blood glucose or smoking. This method of AF detection treated

incident AF as a binary variable and did not allow use of longitudinal time to event analyses. Nearly 30% of participants who completed a follow-up visit were excluded due to missing covariate data, the most common being dietary information, and this may have biased associations. In a sensitivity analysis accounting for missing diet information, however, associations remained similar. Prior health factors and behaviors were assessed only at baseline and we cannot assess the impact of changes in LS7 score on AF incidence. Finally, baseline heart failure was not known and adjustment for this condition may have modified reported associations.

In conclusion, in this large population-based sample of US adults, a healthier CVD risk factor profile, as defined by the LS7 score, was associated with a substantially reduced risk of AF.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Table 1

Baseline characteristics of REGARDS participants according to presence or absence of incident atrial fibrillation[*]

Characteristic	Atrial Fibrillation		
	Yes (n=725)	No (n=8851)	p-value[†]
Age (Years)	67 ± 8	63 + 8	<0.001
Men	407 (56%)	3,668 (41%)	<0.001
Black	124 (17%)	2,774 (31%)	<0.001
Education 12 years	203 (28%)	2,585 (29%)	0.49
Annual Income			
$20,000	563 (78%)	6,920 (78%)	
< $20,000	79 (11%)	983 (11%)	
Refused	83 (11%)	948 (11%)	0.82
Body mass index (kg/m2)	29 ± 6	29 ± 6	0.15
Systolic blood pressure (mmHg)	127 ± 15	125 ± 15	<0.001
Diastolic blood pressure (mmHg)	76 ± 9	76 ± 9	0.07
Total cholesterol (mg/dL)	188 ± 38	194 ± 39	<0.001
Glucose (mg/dL)	100 ± 22	98 ± 25	0.16
Smoker			
Never or Former >1 year	656 (90%)	7,710 (87%)	
Former <1 year	12 (2%)	135 (2%)	
Current	57 (8%)	1,006 (11%)	0.01
Physical activity (times/week)			
None	195 (27%)	2,548 (29%)	
1 to 3	270 (37%)	3,557 (40%)	
4	260 (36%)	2,746 (31%)	0.03
Healthy diet score			
Poor	578 (80%)	6,948 (79%)	
Intermediate	147 (20%)	1,902 (21%)	
Ideal	0 (0%)	1 (<1%)	0.52[‡]
Alcohol consumption			
None	365 (50%)	5,053 (57%)	
Moderate	324 (45%)	3,387 (38%)	
Heavy	36 (5%)	411 (5%)	<0.01
Left ventricular hypertrophy[§]	57 (8%)	650 (7%)	0.61
Coronary heart disease	166 (23%)	950 (11%)	<0.001
Stroke	37 (5%)	253 (3%)	<0.001

[*]Continuous variables are expressed as mean (SD). Categorical variables are N (percent).

[†]Comparisons were made between cases and non-cases

[‡]Fisher's exact used to make statistical comparison.

[§]Left ventricular hypertrophy was defined according to Sokolow-Lyon Criteria on ECG

Table 2

Baseline characteristics of REGARDS participants according to Life's Simple 7 health category[*]

Variable	Life's Simple 7			p-value[†]
	0-4 (n=534)	5-9 (n=7089)	10-14 (n=1953)	
Age (Years)	61 ± 7	63 ± 8	63 ± 9	<0.001
Men	189 (35%)	3,040 (43%)	846 (43%)	0.003
Black	263 (49%)	2,339 (33%)	296 (15%)	<0.001
Education 12 years	205 (38%)	2,229 (31%)	354 (18%)	<0.001
Annual Income				
$20,000	363 (68%)	5,532 (78%)	1,588 (81%)	
< $20,000	113 (21%)	843 (12%)	106 (6%)	
Refused	58 (11%)	714 (10%)	259 (13%)	<0.001
Alcohol consumption				<0.001
None	333 (62%)	4127 (58%)	958 (49%)	
Moderate	177 (33%)	2633 (37%)	901 (46%)	
Heavy	24 (5%)	329 (5%)	94 (5%)	
Left ventricular hypertrophy[‡]	63 (12%)	577 (8%)	67 (3%)	<0.001
Coronary heart disease	96 (18%)	847 (12%)	173 (9%)	<0.001
Stroke	30 (6%)	232 (3%)	28 (1%)	<0.001

[*] Continuous variables are expressed as mean (SD). Categorical variables are N (percent).

[†] Statistical significance for categorical variables tested using the chi-square method and for continuous variables the analysis of variance procedure was used.

[‡] Left ventricular hypertrophy was defined according to Sokolow-Lyon Criteria on ECG

Table 3

Associations between overall Life's Simple 7 score and incident atrial fibrillation among REGARDS participants[*]

	n AF/N at risk	Model 1[†] OR (95% CI)	Model 2[‡] OR (95% CI)
LS7 Health Categories			
Inadequate (0 to 4 points)	42/534	1 (Referent)	1 (Referent)
Average (5 to 9 points)	544/7,089	0.73 (0.52, 1.02)	0.78 (0.55, 1.09)
Optimal (10 to 14 points)	139/1,953	0.62 (0.43, 0.90)	0.68 (0.47, 0.99)
LS7 score per unit increase	725/9,576	0.94 (0.90, 0.97)	0.95 (0.91, 0.99)

LS7=Life's Simple 7, AF=atrial fibrillation, OR=odds ratio, CI=confidence interval

[*] Results of multivariable logistic regression models

[†] Model 1 adjusted for age, sex, race, education, income, and geographic region

[‡] Model 2 adjusted for Model 1 + left ventricular hypertrophy, alcohol use, coronary heart disease, and stroke

Table 4

Associations between individual Life's Simple 7 components and incident atrial fibrillation among REGARDS participants[*]

Component	n AF/N at risk	Model 1[†] OR (95% CI)	Model 2[‡] OR (95% CI)
Total cholesterol			
Poor	71/1,103	1 (Referent)	1 (Referent)
Intermediate	399/5,148	0.97 (0.74, 1.27)	0.92 (0.70, 1.20)
Ideal	255/3,325	1.02 (0.77, 1.36)	1.04 (0.78, 1.37)
Blood pressure			
Poor	148/1,704	1 (Referent)	1 (Referent)
Intermediate	464/5,768	0.94 (0.77, 1.15)	0.94 (0.77, 1.15)
Ideal	113/2,104	0.68 (0.52, 0.89)	0.70 (0.54, 0.92)
Blood glucose			
Poor	64/755	1 (Referent)	1 (Referent)
Intermediate	209/2,412	0.90 (0.67, 1.21)	0.93 (0.69, 1.26)
Ideal	452/6,409	0.73 (0.55, 0.97)	0.79 (0.59, 1.04)
Physical activity			
Poor	195/2,743	1 (Referent)	1 (Referent)
Intermediate	270/3,827	0.98 (0.81, 1.20)	0.99 (0.82, 1.21)
Ideal	260/3,006	1.06 (0.87, 1.29)	1.07 (0.87, 1.30)
Healthy diet score			
Poor	578/7,526	1 (Referent)	1 (Referent)
Intermediate	147/2,049	0.92 (0.76, 1.12)	0.93 (0.77, 1.13)
Ideal	0/1	-	-
Smoker			
Poor	57/1,063	1 (Referent)	1 (Referent)
Intermediate	12/147	1.25 (0.65, 2.43)	1.33 (0.69, 2.58)
Ideal	656/8,366	1.13 (0.85, 1.51)	1.17 (0.88, 1.56)
Body mass index			
Poor	272/3,445	1 (Referent)	1 (Referent)
Intermediate	295/3,699	0.75 (0.63, 0.90)	0.76 (0.64, 0.91)
Ideal	158/2,432	0.59 (0.47, 0.72)	0.60 (0.49, 0.74)

AF=atrial fibrillation, OR=odds ratio, CI=confidence interval

[*] Results of multivariable logistic regression models

[†] Model 1 adjusted for age, sex, race, education, income, and geographic region

[‡] Model 2 adjusted for Model 1 + left ventricular hypertrophy, alcohol use, coronary heart disease, and stroke