Life's Simple 7 in relation to supraventricular and ventricular arrhythmias on extended ambulatory cardiac monitoring: The Multi-Ethnic Study of Atherosclerosis

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Abstract

Life's Simple 7 in relation to supraventricular and ventricular arrhythmias on extended ambulatory cardiac monitoring: The Multi-Ethnic Study of Atherosclerosis

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Background: The Life's Simple 7 (LS7) metric consists of seven health behaviors and measures that are known risk factors for cardiovascular disease. Relatively little is known about the association of LS7 score with cardiac arrhythmias.

Methods: In the setting of the Multi-Ethnic Study of Atherosclerosis (MESA), we studied LS7 score, assessed at the 2010-2102 study visit, in relation to cardiac arrhythmias assessed by Zio Patch ambulatory electrocardiographic monitoring in 2016-2018. In participants free of clinically recognized cardiovascular disease and AF, we examined the association of total LS7 score with atrial fibrillation, supraventricular arrhythmias, and ventricular arrhythmias using logistic regression and linear regression.

Results: Among 1329 participants in the analysis, the mean (SD) age was 67(8) years and 48% were men. More favorable total LS7 score was associated with fewer PVCs per hour (ratio of geometric means for the upper quartile vs. the lower quartile 0.52 [0.34-0.81]). After adjustment

for sociodemographic characteristics, the association was attenuated (0.66 [0.43, 1.01]). Among the LS7 components, only body mass index (BMI) was associated with ventricular ectopy. In an adjusted model, compared with participants with poor body mass index (BMI), those with intermediate BMI had a 30% fewer PVCs/hour (ratio of geometric means 0.70 [0.50- 0.96]). We did not detect associations of total LS7 score with atrial arrhythmias.

Conclusion: In this longitudinal study of individuals free of clinically-recognized cardiovascular disease, there was little evidence of association of total LS7 score with cardiac arrhythmias. However, there was a suggestion that more favorable LS7 score was associated with fewer PVCs and specifically, that more favorable BMI was associated with fewer PVCs.

Introduction

Arrhythmias are abnormalities in the rate and/or rhythm of the heartbeat and are classified as supraventricular or ventricular based upon the location of the cardiac tissues responsible for their occurrence. Atrial fibrillation (AF) is the most common chronic arrhythmia among older adults[1] and is associated with substantially elevated risks of stroke, more rapid cognitive decline, dementia, and heart failure. Supraventricular ectopy includes premature atrial contractions (PACs) and runs of supraventricular tachycardia (SVT), and ventricular ectopy includes premature ventricular contractions (PVCs) and nonsustained runs of ventricular tachycardia (NSVT). Supraventricular ectopy is common[2,3] especially among older individuals,[2] and high levels have been associated with increased risks of AF, stroke, and death.[4] Ventricular ectopy is also common, particularly among older individuals,[5] and has been associated with an increased risk of heart failure and death.[6]

The Life's Simple 7 metric (LS7) was introduced by the American Heart Association (AHA) in 2010,[7] consisting of seven health behaviors and measures (smoking, body mass index (BMI), physical activity, diet, blood glucose, total cholesterol, and blood pressure)[8] which are known risk factors for cardiovascular disease. Research has shown that optimal LS7 status is associated with lower risk of clinically-detected AF[9] and specifically that poor physical activity, elevated BMI, and elevated blood glucose are associated with higher risk of AF.[10] A previous study reported an association of less favorable LS7 score with more frequent PACs,[11] but little is known about association between the LS7 metrics and subclinical AF or other types of cardiac arrhythmia such as runs of SVT, PVCs, and runs of NSVT. If LS7 is shown to be associated with subclinical ectopy and arrhythmia, this information could provide additional support for

achieving the AHA 2020 strategic goals and improve estimates of the impact of achieving this goal.[12]

Electrocardiographic (ECG) patch monitors can conduct ambulatory cardiac monitoring noninvasively and with longer durations than conventional Holter monitors. In addition to identifying subclinical AF, the monitors also provide information about frequency of PACs, PVCs, runs of SVT and runs of NSVT.[3] In the Multi-Ethnic Study of Atherosclerosis (MESA), we conducted a large-scale analysis of Life's Simple 7 score in relation to arrhythmia burden during ambulatory cardiac monitoring among participants without a prior diagnosis of AF, myocardial infarction (MI), heart failure, or stroke.

Methods

Study Sample

MESA is designed to study early cardiovascular disease and its progression; the study design has been described previously.[13] MESA includes 6814 men and women who self-identified as Black, Chinese-American, White, or Hispanic, recruited from six field centers (Baltimore, MD; Chicago, IL; Forsyth County, NC; Los Angeles, CA; New York City, NY; and St Paul, MN). All participants were 45-84 years of age and were free of clinically-recognized cardiovascular disease at cohort entry. A baseline examination was conducted in 2000-2002 and five follow-up examinations have been conducted, including Exam 5 in 2010-2012 and Exam 6 in 2016-2018.

Participant characteristics and Life's Simple 7 score

Participants self-reported their age, sex, race/ethnicity, and years of education at the baseline exam. LS7 components measured at Exam 5 were used for this analysis. According to AHA criteria, smoking status was categorized as never, former or current. Body mass index (BMI) was calculated as measured weight (kilograms) divided by squared height (meters). For physical activity, total minutes spent on intentional moderate and vigorous exercise were assessed by self-report using the MESA Typical Week Physical Activity Survey, adapted from the Cross-Cultural Activity Participation Study.[14] For diet, MESA participants filled out a modified-Block 120-item food frequency questionnaire (FFQ) that asked about average consumption of specific food items over the previous year.[15] Blood glucose and total cholesterol were measured from fasting blood samples. Blood pressure was measured from 3 readings taken after participants had rested for 5 minutes, and the average of the last 2 measurements was used for analysis. In addition, at Exam 5 participants reported their total family income, health insurance status, and use of hypertension, lipid-lowering, and diabetes medication.

Cardiovascular Events During Follow-Up

Since baseline, participants have been contacted by telephone every 9 to 12 months to identify new hospitalizations and medical diagnoses during follow-up. Medical records were obtained; stroke, MI, and heart failure were adjudicated by the MESA Morbidity and Mortality Committee. Clinically recognized atrial fibrillation or atrial flutter (hereafter AF) were considered together and were identified by an International Classification of Diseases code (Ninth Revision: 427.31 or 427.32; Tenth Revision: I48) in any position assigned at hospital discharge; by 12-lead ECG at Exam 5; or, for those enrolled in fee-for-service Medicare, by an inpatient, outpatient, or

physician claim with an AF diagnosis code in any position. Cardiovascular events were ascertained through the date of Exam 5.

Ambulatory ECG monitoring

At Exam 5, a subset of MESA participants (n=1557) enrolled in an ancillary study involving ambulatory ECG monitoring, as previously described.[3] The monitoring device used in this study was the Zio Patch XT (iRhythm Technologies, Inc, San Francisco, CA), a Food and Drug Administration–approved single-channel ECG patch monitor capable of recording up to 14 days of cardiac rhythm.[16] Study staff applied the monitoring device and asked the participant to wear it for 14 days and to return it by mail to the manufacturer for interpretation. A subset of 577 participants (37%) had 2 monitoring periods of up to 14 days each, with a median interval of 23 days between monitoring periods. Certified technicians at iRhythm processed and analyzed the ECG data. Reported arrhythmias were verified by the Epidemiological Cardiology Reading Center at Wake Forest University School of Medicine, Winston-Salem, NC.

Atrial fibrillation was defined as an irregularly irregular rhythm with absent P waves lasting at least 30 seconds. The supraventricular arrhythmias of interest were the average count of PACs/hour and the average number of runs per day (24 hours) of SVT, with a run of SVT defined as ≥4 consecutive PACs. Average PACs/hour and average runs of SVT/day could not be calculated for participants in continuous AF throughout the monitoring period. The ventricular arrhythmias of interest were the average count of PVCs/hour and the average number of runs per day of NSVT, with a run defined as ≥4 consecutive PVCs. For participants who wore 2 monitoring devices, the monitored time from both devices was included in quantifying the

arrhythmias.[17] Monitoring duration was defined as the total time during which the ECG tracing was adequate to determine rhythm.

Statistical Analysis

This analysis included all MESA participants with risk factor data available at Exam 5 who had cardiac monitoring at Exam 6. We excluded participants who developed clinically-recognized AF, MI, heart failure or stroke before Exam 5.

Characteristics of participants at Exam 5 were reported stratified by race/ethnicity. Each of the LS7 components at Exam 5 was categorized as ideal, intermediate, or poor and scored (ideal = 2 points, intermediate =1, and poor = 0 points) as previously described (Table S1).[7] Total LS7 scores were calculated by summing the component scores and were categorized into lowest quartile (0-7 points), middle two quartiles (8-10 points), and upper quartile (11-14 points).[7] Participants taking medications at Exam 5 to achieve ideal levels for cholesterol, blood pressure, or blood glucose were classified as intermediate for that health factor.

Four of the outcome variables were highly right-skewed and were log-transformed for regression analysis (PACs per hour, PVCs per hour, runs of SVT per day, and runs of NSVT per day). About 18% of participants had no runs of SVT. To avoid losing the information from these participants when using the log transformation, we added the value of 1 to the number of runs of SVT for each participant, calculated the average number of runs of SVT per day, and then did the log transform. In a secondary analysis, to compare results with a previous study[11], percent

PACs (the percentage of all beats that were isolated supraventricular ectopic beats) was classified into three categories: minimal (<0.1%), occasional (≥0.1–5%) and frequent (>5%).

Logistic regression was used to estimate the odds ratios (OR) and 95% confidence intervals (CI) for the association of LS7 score with presence of any AF and with presence of any NSVT on the monitor. We used linear regression with robust standard errors to examine the association of LS7 score with average PACs/hour, average PVCs/hour, average runs of SVT/day, and among those with any NSVT, average runs of NSVT/day. We also examined the association of specific LS7 components with PVCs/hour. Associations from the linear regression analyses are expressed as the ratio of geometric means, which provides the average percentage difference in, for example, PVCs/hour, per increment of LS7 score. For the secondary analysis of categories of percent PACs, multinominal logistic regression was used to compare our result to a previous study[11]. Linear regression models were adjusted for age, sex, race/ethnicity, education, family income, and health insurance. Logistic regression models were additionally adjusted for monitoring duration. All statistical analyses were conducted using Stata 15.1. A two-sided p-value < 0.05 indicated statistical significance.

Results

Among 4716 participants who attended Exam 5, 1458 completed ECG monitoring an average (SD) of 6.3 (0.5) years later and had data on all components of the LS7 score and other characteristics (Figure 1). We excluded 103 participants who developed clinically-recognized cardiovascular disease before Exam 5, 6 who had no follow-up for AF before Exam 5, and 20

whose monitoring time was less than 24 hours, leaving 1329 participants in the analysis. The characteristics of participants included and not included in the analysis are described in Table S2.

Characteristics of participants included in the analysis are presented overall and by race/ethnicity in Table 1. The mean (SD) age was 67 (8) years, 48% of participants were men, 40% were White, 14% Chinese-American, 25% Black and 21% Hispanic. Hypertension medication was used by 47% of participants at Exam 5 and 34% used lipid-lowering medication. Few (6%) were current smokers. The mean (SD) BMI was 28.3 (5.4) kg/m^2. The median (interquartile range) time of total moderate and vigorous physical activity per week was 270 (75-600) minutes. The proportion of participants who achieved ideal levels for cholesterol, blood pressure, or blood glucose while using medications was 29% for cholesterol, 21% for blood pressure, and 3% for fasting glucose. Few participants were classified as having ideal levels of BMI (29%) or diet (0%).

Table 2 shows the number and proportion of participants in whom AF or NSVT were detected and the median (IQR) for: PACs per hour, runs of SVT per day, PVCs per hour and among those with any NSVT, runs of NSVT per day. Among 1329 participants, AF was present in 5%, NSVT in 26% and the median (IQR) PVCs per hour was 1.3 (0.2-9.0). Among 1305 participants not in continuous AF, the median (IQR) PACs per hour was 4.0 (1.4-18.9) and median (IQR) runs of SVT per day was 0.5 (0.2-1.3). Among 351 participants with NSVT, the median (IQR) runs of NSVT per day was 0.08 (0.07-0.15). The proportion of participants with minimal PACs was 40%, for occasional PACs, 57%, and for frequent PACs, 4%.

Total LS7, modeled as either a categorical variable or as a continuous variable, was not associated with the presence of AF or with the presence of NSVT detected by the monitor in multivariable logistic regression analyses (Table 3). In multivariable linear regression analyses with total LS7 modeled as a categorical variable, no associations were observed with PACs/hour, with runs of SVT per day, or with runs of NSVT per day, in either unadjusted models or in models adjusted for sociodemographic characteristics (Table 4, Figure 2). An association of more favorable total LS7 score with fewer PVCs per hour was observed in the unadjusted analysis (ratio of geometric means for upper quartile vs. lower quartile 0.52; 95% confidence interval (CI) 0.34, 0.81, p-value=0.004; Table 4); this association was attenuated after adjustment for sociodemographic characteristics. Similarly, with LS7 score modeled as a continuous variable, each 1-point increase in score was associated with 9% fewer PVCs/hour in the unadjusted model (ratio of geometric means 0.91; 95% CI: 0.84, 0.97, p-value= 0.006; Table 4 and Figure 2), but the association was attenuated in the adjusted model (ratio of geometric means 0.94; 95%CI: 0.87, 1.01, p-value= 0.096). In the secondary analysis of total LS7 modeled as continuous variable with percent PACs categorized as minimal, occasional, or frequent, we did not observe any significant associations (Table S3).

Because there was a suggestion of association of total LS7 score with PVCs/hour, additional analyses were conducted to assess the associations of individual LS7 components with PVCs/hour. After adjusting for potential confounders, compared with those with poor BMI, participants with intermediate BMI had a 30% fewer PVCs/hour (ratio of geometric means, 0.70, 95% CI 0.50, 0.96, p=0.029 Table 5). The point estimate was similar for those with ideal BMI

compared with poor BMI (ratio of geometric means, 0.73, 95% CI 0.50, 1.08, p=0.113). No other individual LS7 components were associated with the frequency of PVCs.

Discussion

In the MESA cohort of older individuals free of a history of clinically-recognized AF, MI, heart failure, and stroke, there was little evidence of association of more favorable total LS7 score with fewer arrhythmias as detected by ambulatory ECG monitoring an average of 6.3 years later. In unadjusted analyses, more favorable LS7 score was indeed associated with fewer PVCs/hour, but these differences were no longer statistically significant after adjusting for sociodemographic characteristics. In analyses of individual LS7 components, more favorable BMI appeared to be associated with fewer PVCs/hour.

We are not aware of other studies that have examined LS7 score in relation to PVC frequency. Because we examined several arrhythmias, and for PVC frequency we examined all LS7 components, significant findings may have arisen by chance. Association of LS7 score with ventricular ectopy needs further study in other settings.

Past studies reporting an association of more favorable LS7 score with lower AF risk examined clinically-detected AF as an outcome rather than monitor-detected AF,[9] or examined monitor-detected AF but included in the analysis individuals with a clinical history of AF.[10] The present analysis focused on participants with no history of clinically-detected AF, MI, heart failure or stroke to examine whether more favorable LS7 was associated with subclinical arrhythmias. We found that associations with subclinical arrhythmias were null. In an analysis of data from the

Atherosclerosis Risk in Communities (ARIC) study that excluded participants with prior clinically-recognized AF, total LS7 score from 21 years earlier was associated with lower odds of frequent PACs versus minimal PACs.[11] In our analysis in MESA, with a shorter interval from LS7 score to ECG monitoring, point estimates were in the same direction as in ARIC but associations did not reach statistical significance. Participants in the ARIC analyses of LS7 in relation to arrhythmias were older at the time of monitoring than MESA participants and had more ectopy; these differences may have limited the ability to detect associations in MESA.

Several limitations of our study should be taken into consideration. First, intentional moderate and vigorous exercise were assessed by self-report rather than by objective measurement. The proportion of participants reporting physical activity in the ideal category was 67%, which may have been overestimated. Second, health behaviors were collected a mean of 6.3 years before the ECG monitoring. Our analysis did not take into account that participants' health behaviors may have changed over time, which may have resulted in exposure measurement error. It is possible that health behaviors in early and mid-life are more relevant than health behaviors at older ages. Finally, we used uniform BMI categories across race/ethnic groups, but conventional BMI categories may not be appropriate for people with Asian ancestry.[18]

Conclusion

In this longitudinal study of individuals free of clinically-recognized cardiovascular disease and AF, there was little evidence that LS7 score was associated with subclinical atrial and ventricular arrhythmias from extended cardiac monitoring.

Table 1. Characteristics at Exam 5 (2010-2012) of MESA participants with cardiac rhythm monitoring

	Overall N=1,329	White N=536	Chinese-American N=190	Black N=327	Hispanic N=276
Age(years), %					
45-64	46	48	50	42	46
65-74	32	31	31	33	33
>=75	22	21	19	24	22
Male, %	48	49	52	40	53
Total Family Income per year, %					
<$11999	6	2	11	5	12
$12000-$24999	15	8	22	14	27
$25000-$39999	17	12	14	24	22
$40000-$99999	39	44	34	41	29
$100,000 or more	22	34	19	16	9
Educational attainment, %					
High school graduate or less	28	12	31	26	58
Attended college /technical school	25	22	13	35	26
College graduate or higher	48	65	57	40	16
No health insurance, %	9	2	17	6	18
Hypertension medication, %	47	40	45	58	47
Lipid-lowering medication, %	34	36	31	31	35
Diabetes, %	16	8	12	19	19
Cholesterol treated to goal, %	29	32	26	25	30
Blood Pressure treated to goal, %	21	21	18	22	20
Fasting Glucose treated to goal, %	3	1	1	6	3
Current smoking status, %					
Never	54	48	81	46	57
Former	40	46	16	44	38
Current	6	6	3	10	5
BMI, mean (SD), kg/m2	28.3 (5.4)	27.7 (5.0)	24.2 (3.1)	30.2 (5.3)	30.1 (5.5)
Low density lipoprotein cholesterol level, mean (SD), mg/dl	109 (31)	109 (31)	111 (33)	111 (32)	106 (30)
Moderate and vigorous physical activity total (min/week), median (IQR)	270 (75-600)	300 (105-600)	300 (105-660)	270 (60-630)	218 (0-578)
Life's Simple 7 Score, %					
Lower quartile	25	19	10	35	36
Middle 2 quartiles	55	57	58	54	53
Upper quartile	19	24	32	10	13
Smoking, %					
Poor	6	6	3	10	5
Intermediate	1	1	1	1	1
Ideal	93	93	96	89	94
BMI, %					
Poor	33	29	4	48	43
Intermediate	39	38	34	38	43
Ideal	29	33	62	14	14
Physical Activity, %					
Poor	19	15	16	20	28
Intermediate	14	15	13	15	13
Ideal	67	71	72	65	59
Diet, %					
Poor	55	59	27	58	64
Intermediate	44	41	71	42	36

Ideal	0	0	2	0	0
Total cholesterol, %					
Poor	7	7	9	9	6
Intermediate	57	61	56	52	55
Ideal	36	32	34	39	39
Blood Pressure, %					
Poor	17	12	18	24	16
Intermediate	51	49	48	59	49
Ideal	32	39	34	17	35
Fasting plasma glucose, %					
Poor	8	5	8	10	11
Intermediate	30	24	38	28	37
Ideal	63	72	54	63	52

Table 2. Prevalence and frequency of arrhythmias in MESA participants overall and by categories of total Life's Simple 7 score

		Total Life's Simple 7 score		
	Overall	**Lower quartile (0-7)**	**Middle 2 quartiles (8-10)**	**Upper quartile (11-14)**
	N=1,329	**N=336**	**N=734**	**N=259**
AF present, N (%)	70(5)	14(4)	43(6)	13(5)
NSVT present, N (%)	351(26)	95(28)	191(26)	65(25)
PVCs per hour, median (IQR)	1.3 (0.2-9)	1.8 (0.2-8.9)	1.2 (0.2-10.0)	0.7 (0.1-6.7)
	N=1,305*	**N=161**	**N=889**	**N=255**
PACs per hour, median (IQR)	4.0 (1.4-18.9)	4.3 (1.5-19.3)	4.0 (1.3-18.3)	3.8 (1.4-18.9)
Runs of SVT per day, median (IQR)	0.5 (0.2-1.3)	0 .4(0.2-1.1)	0.4 (0.2-1.3)	0.5 (0.2-1.4)
	N=351**	**N=95**	**N=191**	**N=65**
Runs of NSVT per day, median (IQR)	0.08 (0.07-0.15)	0.09(0.07-0.21)	0.07 (0.07-0.14)	0.07(0.07-0.15)

*Sample size of 1305 excludes 24 participants in continuous atrial fibrillation
**Sample size of 351 is limited to participants who had any runs of NSVT during the monitoring period

Table 3. Association of total Life's Simple 7 score with the presence of arrhythmias from logistic regression (Odds Ratios (95% Confidence interval))

	Total Ls7 score in 3 categories			Total LS7 score as a continuous variable
	Lower quartile n=336	Middle 2 quartiles n=734	Upper quartile n=259	Per 1-point increment in LS7
Presence of AF	Reference	1.43 (0.77, 2.65)	1.21 (0.56, 2.63)	1.07 (0.94, 1.21)
		1.32 (0.70, 2.50)	*1.16 (0.51, 2.62)*	*1.06 (0.92, 1.21)*
Presence of NSVT	Reference	0.89 (0.69, 1.19)	0.85 (0.59, 1.23)	0.97 (0.91, 1.03)
		0.94 (0.69, 1.27)	*0.96 (0.64, 1.43)*	*0.98 (0.92, 1.05)*

*Results in regular font are unadjusted

** Results *in Italic font are adjusted for age, race, sex, health insurance, income, education, and monitoring duration*

Table 4. Association of total Life's Simple 7 score with arrhythmia frequency from linear regression (Ratio of geometric means (95% Confidence interval))

	Total LS7 score in 3 categories			Total LS7 score as continuous variable
	Lower quartile (0-7)	**Middle 2 quartiles (8-10)**	**Upper quartile (11-14)**	Per 1-point increment in LS7
PACs per hour	Reference	0.87 (0.69,1.11)	0.97(0.65, 1.78)	0.96 (0.91, 1.01)
		0.89 (0.71, 1.11)	*1.02 (0.77, 1.36)*	*0.99 (0.94, 1.04)*
Runs of SVT per day	Reference	1.03 (0.85, 1.24)	1.21 (0.96, 1.52)	1.02 (0.98,1.06)
		1.03 (0.86, 1.24)	*1.26 (1.00, 1.60)*	*1.03 (0.99,1.07)*
PVCs per hour	Reference	0.78 (0.56, 1.10)	0.52 (0.34, 0.81)	0.91 (0.84, 0.97)
		0.81 (0.58, 1.12)	*0.66 (0.43, 1.01)*	*0.94 (0.87, 1.01)*
Runs of NSVT per day	Reference	0.82 (0.65,1.03)	0.90(0.65, 1.22)	0.96 (0.92, 1.01)
		0.92 (0.73, 1.15)	*1.06 (0.76, 1.50)*	*0.99 (0.94, 1.05)*

*Results in regular font are unadjusted

** *Results in Italic font are adjusted for age, race, sex, health insurance, income, education*

Table 5. Association between LS7 individual components and PVCs/hour* from multivariable linear regression

	Ratio of Geometric Means	95% Confidence interval	p-value
Smoking			
Poor (n=85)	ref	ref	ref
Intermediate(n=12)	1.45	(0.29, 7.29)	0.650
Ideal (n=1237)	0.66	(0.38, 1.14)	0.135
BMI			
Poor (n=440)	ref	ref	ref
Intermediate(n=514)	0.70	(0.50, 0.96)	0.029
Ideal(n=380)	0.73	(0.50, 1.08)	0.113
Physical activity			
Poor (n=253)	ref	ref	ref
Intermediate (n=188)	1.14	(0.71, 1.85)	0.585
Ideal (n=893)	1.00	(0.70, 1.43)	0.993
Diet			
Poor (n=738)	ref	ref	ref
Intermediate (n=592)	0.97	(0.73, 1.29)	0.846
Ideal (n=4)	0.33	(0.03, 3.83)	0.372
Blood glucose			
Poor (n=103)	ref	ref	ref
Intermediate(n=396)	1.45	(0.85, 2.47)	0.174
Ideal (n=835)	0.95	(0.57, 1.58)	0.831
Total cholesterol			
Poor (n=98)	ref	ref	ref
Intermediate(n=759)	0.67	(0.37, 1.19)	0.173
Ideal(n=477)	0.95	(0.53, 1.73)	0.878
Blood pressure			
Poor (n=225)	ref	ref	ref
Intermediate (n=682)	1.11	(0.76, 1.65)	0.575
Ideal (n=427)	0.88	(0.57, 1.37)	0.572

*adjusted for age, race, sex, health insurance, income, education

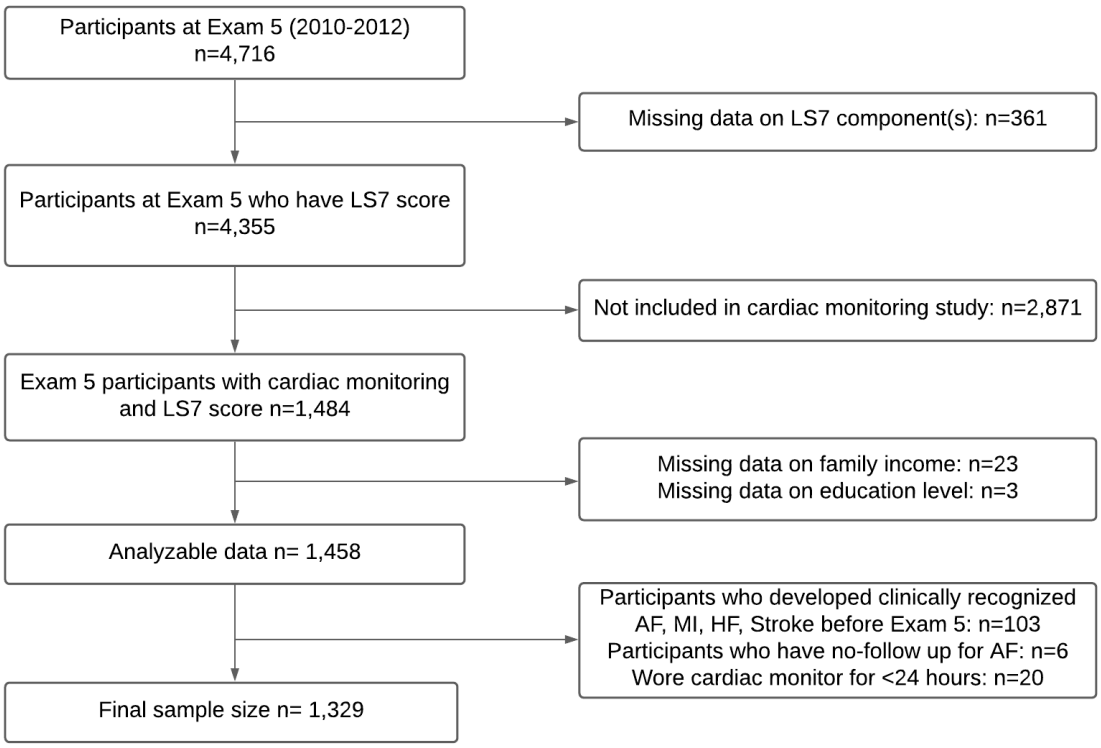

Figure 1. Study participation and inclusion in analysis.

Figure 2. Adjusted percentage difference in ratio of geometric means for PACs/ hour, runs of SVT, PVCs/hours, PVCs/hour and runs of NSVT associated with 1-point increment in Life's Simple 7 Score from linear regression

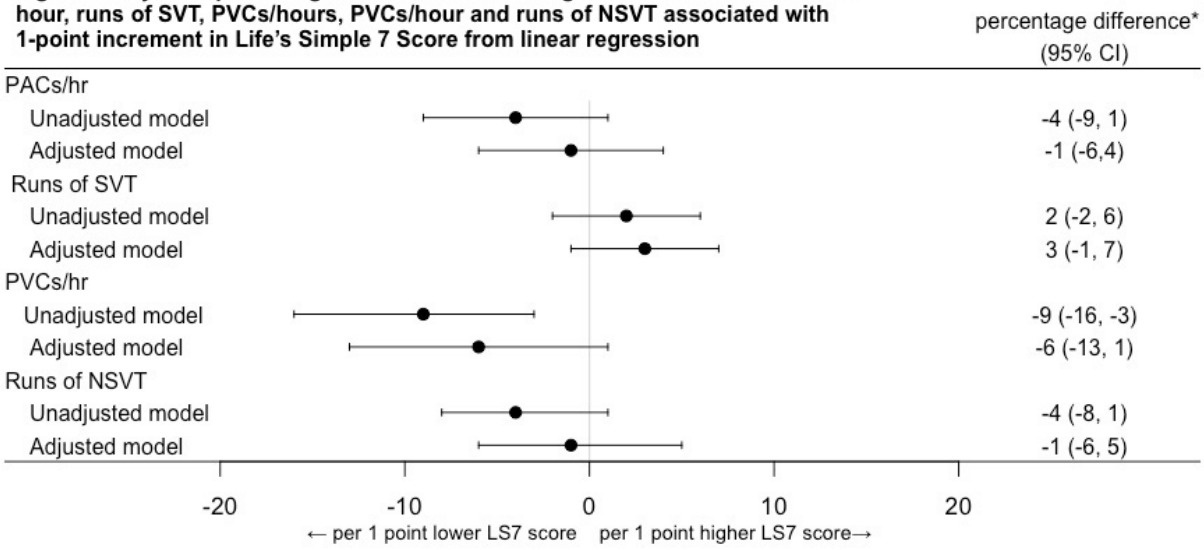

Table S1. American Heart Association (AHA) Definitions of Poor, Intermediate, and Ideal Cardiovascular Health (CVH) for each component

Metric	Poor (0 point)	Intermediate (1 point)	Ideal (2 points)
Smoking	Current smoker	Former ≤ 12 months	Never or quit ≥ 12 months
BMI	≥ 30 kg/m^2	25-29.9 kg/m^2	<25 kg/m^2
Physical Activity	None	1–149 min/week moderate intensity or 1–74 min/week vigorous intensity or 1-149 min/week moderate/vigorous	150 min/week moderate intensity or 75 min/week vigorous intensity or 150 min/week
Healthy diet score*	0-1 Components	2-3 Components	4-5 Components
Blood glucose	≥ 126 mg/dL	100-125 mg/dL or treated to 100 mg/dL	< 100 mg/dL
Blood pressure	SBP ≥ 140 or DPB ≥ 90 mm HG	SBP 120-139 or DBP 80-89 mm Hg or treated to <120/<80 mm Hg	<120/<80 mm Hg
Total cholesterol	≥240 mg/dL	200-239 mg/dL or treated to <200 mg/dL	<200 mg/dL

* Fruits and vegetables: ≥ 4.5 cups per day; Fish (preferably oily fish): ≥ two 3.5 oz servings per week; Sodium: < 1500 mg per day; Sugar-sweetened beverages: ≤ 450 kcal (36 oz) per week; Fiber-rich Whole grains: ≥ three 1-oz equivalent servings per day

Table S2. Characteristics of participants who attended Exam 5 (2010-2012), overall and for participants included and not included in the analysis

	Total N=4,716	**Participants included in analysis** N=1,329	**Participants not included in analysis** N=3,387
Age(years), %			
45-64	35	46	29
65-74	31	32	31
75-84	27	20	30
>=85	7	2	10
Male, %	47	48	46
Race, %			
White, Caucasian	41	40	41
Chinese-American	11	14	10
Black	27	25	27
Hispanic	21	21	21
Total Family Income, %			
<$11999	9	6	10
$12000-$24999	17	15	18
$25000-$39999	18	17	18
$40000-$99999	34	39	32
$100,000 or more	17	22	15
Missing	5	0	6
Education level, %			
High school graduate or lower	32	28	33
Attended college /technical school	24	25	23
College graduate or higher	44	48	43
Missing	0	0	0
No Health insurance, %	8	9	7
Hypertension medication, %	55	47	59
Lipid medication, %	39	34	41
Diabetes, %	16	14	17
Current smoking status, %			
Never	52	54	51
Former	39	40	39
Current	7	6	7
Missing	2	0	3
BMI (kg/m^2)	28.5 (5.7)	28.3 (5.4)	28.5 (5.8)
Low density lipoprotein cholesterol level (mg/dl)	105 (33)	109 (31)	104 (33)
Moderate and vigorous physical activity total (min/week), Median (IQR)	225 (30-540)	270 (75-600)	210 (0-525)

Table S3. Association of total Life's Simple 7 score as a continuous variable with PAC frequency categorized as Minimal, Occasional, or Frequent (Odds Ratios (95% Confidence Interval))

	Total LS7 score as continuous variable Per 1-point increment in LS7
Occasional PACs (≥0.1-5%) vs Minimal PACs (0.1%)	1.00 (0.94, 1.05)
	1.00 (0.94, 1.07)
Frequent PACs (>5%) vs. Minimal PACs (<0.1%)	0.91 (0.79, 1.05)
	0.93 (0.79, 1.09)

*Results in regular font are unadjusted

** Results *in Italic font are adjusted for age, race, sex, health insurance, income, education, and monitoring duration*

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