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ORIGINAL RESEARCH

Association of Life's Essential 8 and Simple 7 Scores With Mortality

Comparison With Pooled Cohort Equation

Naman S. Shetty, MD,[a] Mokshad Gaonkar, MS,[b] Nirav Patel, MD, MSPH,[a] Peng Li, PhD,[c] Garima Arora, MRCP, MD,[a] Pankaj Arora, MD[a,d]

ABSTRACT

BACKGROUND In 2022, the Life's Simple 7 (LS7) score was replaced with the Life's Essential 8 (LE8) score as a tool to measure cardiovascular health. The risk prediction values of LE8 and LS7 scores for mortality have not been compared. Additionally, the risk prediction value of these scores has not been compared with the pooled cohort equations (PCE) in individuals aged 40 to 79 years.

OBJECTIVES This study compared the risk prediction value of the: 1) LE8 and LS7 scores in the overall population; and 2) LE8 score, LS7 score, and PCE in the 40- to 79-year-old age group for all-cause and cardiovascular mortality in a nationally representative US population.

METHODS The LS7 and LE8 scores and the PCE were calculated in the National Health and Nutrition Examination Survey cycles 2007 to 2018. All-cause and cardiovascular mortality were identified by linking the participants to the National Death Index. The C-statistics of the respective weighted Cox models were used to compare the risk prediction value of the standardized scores.

RESULTS Among 21,721 individuals included, the C-statistics for all-cause mortality were 0.823 (95% CI: 0.803-0.843) and 0.819 (95% CI: 0.799-0.838) in the LE8 and LS7 score-based models, respectively. The C-statistics for cardiovascular mortality were 0.887 (95% CI: 0.857-0.905) for the LE8 score-based model and 0.883 (95% CI: 0.861-0.905) for the LS7 score-based model. Among 12,943 individuals aged 40 to 79 years, the C-statistics for the outcome of all-cause mortality were 0.756 (95% CI: 0.732-0.779), 0.674 (95% CI: 0.646-0.701), and 0.681 (95% CI: 0.656-0.706) for the PCE, LS7 score, and LE8 score-based models, respectively.

CONCLUSIONS The LS7 and LE8 scores had similar risk prediction values for all-cause and cardiovascular mortality. Among 40- to 79-year-old individuals, the PCE had better risk discrimination in the LE8 and LS7 scores in predicting all-cause mortality. (JACC Adv 2024;3:100945) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

From the [a]Division of Cardiovascular Disease, University of Alabama at Birmingham, Birmingham, Alabama, USA; [b]Department of Biostatistics, University of Alabama at Birmingham, Birmingham, Alabama, USA; [c]School of Nursing, University of Alabama at Birmingham, Birmingham, Alabama, USA; and the [d]Section of Cardiology, Birmingham Veterans Affairs Medical Center, Birmingham, Alabama, USA.

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ABBREVIATIONS AND ACRONYMS

ASCVD = atherosclerotic cardiovascular disease

AHA = American Heart Association

CVD = cardiovascular disease

CVH = cardiovascular health

LE8 Score = Life's Essential 8 Score

LS7 Score = Life's Simple 7 Score

NHANES = National Health and Nutrition Examination Survey

PCE = pooled cohort equations

Cardiovascular disease (CVD) affects nearly 10% of U.S. adults and is the leading cause of death in the United States.[1] The development of CVD is preceded by exposure to traditional cardiovascular risk factors encompassing physical inactivity, poor diet, smoking, obesity, hypertension, diabetes, and hyperlipidemia.[2] Recognizing these risk factors, the American Heart Association (AHA) introduced the Life's Simple 7 (LS7) score as a metric that combined the abovementioned 7 risk factors to provide a composite score of cardiovascular health (CVH) ranging from 0 to 14.[3] Though the LS7 score was formulated as a tool to measure and track changes in CVH, several prior studies have shown that the LS7 score has value for risk prediction of cardiovascular mortality and all-cause mortality.[4-6] In addition to the traditional cardiovascular risk factors, sleep has been shown to be associated with the risk of CVD and mortality.[7-9] Recognizing the importance of sleep, the AHA introduced the Life's Essential 8 (LE8) score, a new CVH metric that includes sleep as a component.[10] Apart from including sleep, the LE8 score improves over the LS7 score by improving the sensitivity of measurement through quantification of CVH on a scale of 0 to 100 and accounting for medication use.[10] Similar to the LS7 score, the LE8 score has been shown to be valuable in predicting the risk of developing CVD and mortality.[11-15].

Clinically, the pooled cohort equations (PCE) is considered the gold-standard tool for predicting the 10-year CVD risk in individuals between 40 and 79 years.[16] Apart from including traditional cardiovascular risk factors (eg, smoking status, systolic blood pressure, antihypertensive treatment, total cholesterol, high-density lipoprotein cholesterol, and diabetes status), the PCE also incorporates age, sex, and race into its risk prediction algorithm.[16] The PCE also integrates weights for each of the risk factors included in the equation based on their contribution to the development of CVD.[16] Given the well-recognized risk prediction value and widespread clinical use of the PCE, a comparison of the risk prediction value of the LS7 and LE8 scores with the PCE for mortality is warranted. Considering that the PCE is a calibrated tool developed for risk prediction, this study hypothesizes that the PCE will have a better risk prediction value for mortality compared with the LE8 and LS7 scores among individuals between 40 and 79 years.

This study utilized the National Health and Nutrition Examination Survey (NHANES) to compare the association of the 1) LS7 and LE8 scores with the risk of all-cause and cardiovascular mortality in adults and 2) PCE, LS7 score, and LE8 score with the risk of all-cause and cardiovascular mortality in the 40- to 79-year-old age group.

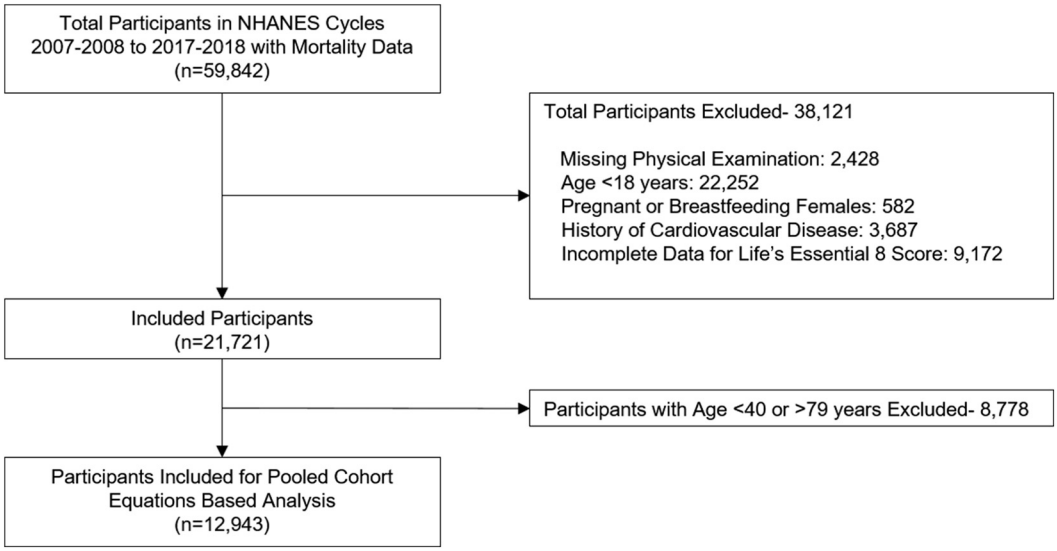
METHODS

DATA SOURCE. This study combined six NHANES cycles between 2007 and 2018. The NHANES is a biennial nationwide survey that assesses population-level health and nutrition in the United States.[17-20] To estimate the population-level status of health and nutrition, NHANES recruits a nationally representative population of individuals using a multistage probability-based sampling design.[17-20] Each participant undergoes a home interview and a physical examination. During the home interview, data on demographics, medical conditions, physical activity, sleep, smoking, and medication use were collected.[17-20] Consenting participants were invited to a mobile examination center for a physical examination.[17-20] During the physical examination visit, blood samples were collected for laboratory testing, anthropometric measurements, and vital sign measurements were collected.[17-20] All participants provided informed consent before the home interview and physical examination visits.[17-20] The University of Alabama at Birmingham Institutional Review Board provided ethical oversight for the current study.

STUDY POPULATION. This study included individuals aged ≥18 years from the NHANES cycles 2007 to 2018. Additionally, pregnant or breastfeeding females, participants with prevalent CVD, participants who did not undergo a physical examination, and participants with missing data for the calculation of the LE8 or LS7 scores were excluded.

STUDY EXPOSURE. The LS7 and LE8 scores were calculated in the overall cohort. The LS7 score is composed of 3 health behaviors (physical activity, diet, and smoking) and 4 health factors (blood sugar, blood lipids, body mass index, and blood pressure). Each component of the LS7 score is graded on a scale of 0 (poor), 1 (intermediate), and 2 (ideal). The LS7 score is calculated by adding the scores of the 7 components, making the LS7 score range from 0 to 14. The LE8 score comprises 4 health behaviors (physical activity, diet, smoking, and sleep) and 4 health factors (blood sugar, blood lipids, body mass index, and blood pressure). Each component of the LE8 score has at least 5 levels and is graded on a scale of 0 to 100. The LE8 score is the average of the 8 components and ranges from 0 to 100. The scoring schemes of the LE8

FIGURE 1 Study Population Flowchart



and LS7 scores have been described in Supplemental Tables 1 and 2.

In a subset of the population aged 40 to 79 years, the 10-year risk of atherosclerotic CVD was estimated using the PCE.

The average of three seated blood pressure measurements after 5 minutes of rest was used. The body mass index was calculated by dividing the weight in kilograms by the square of the height measured in meters. Blood glucose (using a hexokinase-based assay), glycated hemoglobin (using high-performance liquid chromatography), and lipids (enzymatic assay) were measured from the blood samples obtained at the examination visit. Data on sleep duration, physical activity (intensity, duration, and frequency), and smoking were collected using standardized questionnaires. Two nonconsecutive 24-hour dietary recalls were used to calculate the diet scores using the framework of the Dietary Approach to Stop Hypertension.[21]

STUDY COVARIATES. Self-reported age, race and ethnicity (non-Hispanic White, non-Hispanic Black, Mexican American, other Hispanic, and others), and sex (male and female) were used in this study. Additional covariates considered in this study include insurance status (yes or no), education status (12 years of education or less, some college, and college degree or higher), number of health care visits per year (0, 1-3, and ≥4), and poverty income ratio (<1.30, 1.30-3.50, and ≥3.50).

STUDY OUTCOMES. The outcomes of interest in the current study were all-cause mortality and cardiovascular mortality. Mortality data for the NHANES participants was obtained from the NHANES Linked Mortality File. The NHANES Linked Mortality File was used to link participants with mortality data from the National Death Index through December 31, 2019. Cardiovascular mortality was identified using the International Classification of Diseases-10 codes (I00-I78). Participants who died from a cause other than CVD were censored at the time of death. Participants who were not linked to a death record were considered to be alive throughout the study period. For the PCE-based analysis, the follow-up was censored at 10 years.

STATISTICAL ANALYSIS. All analyses were conducted on SAS version 9.4. As outlined in the analytical guidelines by the National Center for Health Statistics, SURVEY procedures in SAS were used to account for the complex multistage sampling design of the NHANES.[18] The sample weights for the physical examination subsample were used for all analyses. The LS7 score, LE8 score, and PCE were standardized (mean = 0, SD = 1) to allow comparability of the association of the scores with the outcomes. The risk of all-cause and cardiovascular mortality per SD

TABLE 1 Baseline Characteristics of the Study Populations in the National Health and Nutrition Examination Survey 2007-2018

	≥18 Years Old Cohort[a] (n = 21,721)	40-79 Years Old Cohort[b] (n = 12,943)
Age, y[c]	45.4 (31.9-58.1)	54.1 (46.7-62.3)
Sex[c]		
Male	47.7 (47.0-48.5)	46.1 (45.0-47.1)
Female	52.3 (51.5-53.0)	53.9 (52.9-55.0)
Race[c]		
Non-Hispanic White	68.2 (65.4-71.0)	73.1 (70.4-75.8)
Non-Hispanic Black	10.3 (8.9-11.7)	9.6 (8.3-11.0)
Other	21.5 (19.4-23.7)	17.2 (15.3-19.2)
Education level[c]		
High school or less	36.1 (34.2-38.0)	36.1 (34.0-38.3)
More than high school	63.9 (62.0-65.8)	63.9 (61.7-66.0)
Insurance status[c]		
Insured	82.8 (81.6-84.0)	87.5 (86.3-88.6)
Uninsured	17.2 (16.0-18.4)	12.5 (11.4-13.7)
Family poverty income ratio[c]		
≥1.30	74.5 (73.1-76.0)	79.0 (77.4-80.5)
<1.30	25.5 (24.0-26.9)	21.0 (19.5-22.6)
Number of health care visits[c]		
0	16.2 (15.5-17.0)	12.6 (11.8-13.4)
1-3	49.8 (48.8-50.8)	48.4 (47.0-49.8)
>3	33.9 (32.9-34.9)	38.9 (37.6-40.3)
Life's Simple 7 Score[d]	7.8 (6.2-9.4)	7.3 (5.7-8.7)
Life's Essential 8 Score[d]	66.4 (55.2-77.6)	63.1 (52.8-74.0)
Components of Life's Essential 8 Score[d]		
Physical activity score	50.9 (0.0-93.2)	35.7 (0.0-92.3)
Blood pressure score	72.9 (37.2-88.5)	58.6 (28.8-84.1)
Cholesterol score	53.6 (31.7-85.5)	47.6 (26.7-77.4)
Diabetes mellitus score	69.0 (51.7-84.5)	62.8 (46.7-81.4)
BMI score	45.7 (21.3-75.0)	42.0 (20.3-70.5)
Smoking score	81.9 (50.5-90.9)	81.0 (57.0-90.5)
Sleep score	91.4 (56.3-95.7)	91.4 (56.5-95.7)
Diet score	30.1 (8.1-57.3)	31.6 (8.3-59.1)

Values are [a]Weighted sample size is 156,937,384. [b]Weighted sample size is 93,714,536. [c]Values are % (95% CI). [d]Values are median (IQR).
BMI = body mass index.

increase in the LE8 and LS7 scores and per SD decrease in the PCE were calculated using the SURVEYPHREG procedure. The Cox models were adjusted for sex, age, race, income, insurance status, education level, and number of health care visits/year.[17,19] To avoid overfitting, the analysis comparing the LE8 score, LS7 score, and PCE was not adjusted for age, sex, and race, as these variables are included in the PCE algorithm. The C-statistics of the respective Cox models were used to compare the risk prediction value of the scores. Harrell's C-statistics were used to account for censoring of data. The cohort was split into a development (70% of the dataset) and validation (30% of the dataset) dataset to assess calibration curves, observed/expected ratios, and decision curve analysis using unweighted models (Supplemental Figures 1 to 4, Supplemental Tables 3 to 5).

RESULTS

COMPARISON OF THE LE8 AND LS7 SCORES. There were 59,842 individuals in the NHANES cycles between 2007 and 2018. Of the 59,842 individuals, 38,121 were excluded (22,252 individuals <18 years of age, 582 pregnant or breastfeeding females, 3,687 with prevalent CVD, and 9,172 had missing data for the components of the LE8 and LS7 scores) (Figure 1). Therefore, the current study included 21,721 adults, who represented ~156.9 million individuals in the U.S. population. Among the individuals included, the median age was 45.4 (IQR: 31.9-58.1) years, 52.3% (95% CI: 51.5%-53.0%) were females, and 68.2% (95% CI: 65.4%-71.0%) were non-Hispanic White individuals. The median LE8 and LS7 scores were 66.4 (IQR: 55.2-85.5) and 7.8 (IQR: 6.2-9.4), respectively, in the cohort included (Table 1).

Over a median follow-up of 6.5 (IQR: 3.6-9.7) years, the event rate of all-cause mortality was 4.7% (4.3%-5.2%). The risk of all-cause mortality was 0.72 (95% CI: 0.65-0.79) and 0.78 (95% CI: 0.71-0.85) per SD increase in the LE8 and LS7 scores, respectively (Table 2).

The event rate of cardiovascular mortality was 0.9% (0.8%-1.0%). The hazard ratio for cardiovascular mortality was 0.59 (95% CI: 0.49-0.70) and 0.64 (95% CI: 0.53-0.77) per SD increase in the LE8 and LS7 scores, respectively (Table 2).

For all-cause mortality, the C-statistics for the models with the LE8 score were 0.823 (95% CI: 0.803-0.843) and the LS7 score were 0.819 (95% CI: 0.799-0.838). The C-statistics of the all-cause mortality models with the LE8 score and the LS7 score were similar [ΔC-statistics$_{LE8\text{-}LS7}$: 0.004 (95% CI: −0.024 to 0.032)] (Table 2).

The C-statistics for cardiovascular mortality were 0.887 (95% CI: 0.857-0.905) for the LE8 score-based model and 0.883 (95% CI: 0.861-0.905) for the LS7 score-based model. The C-statistics for the outcome of cardiovascular mortality were similar in the LE8 score- and LS7 score-based models [ΔC-statistics$_{LE8\text{-}LS7}$: 0.004 (95% CI: −0.026 to 0.034)] (Table 2).

COMPARISON OF THE LS7 SCORE, LE8 SCORE, AND THE PCE. Among the 21,721 individuals included in the analysis comparing the LS7 and LE8 scores, 8,778 individuals below the age of 40 years and above 79 years were excluded. There were 12,943 individuals representing ~93.7 million U.S. individuals, for whom the PCE could be calculated. Among the 12,943 individuals, the median age was 54.1 (IQR: 46.7-62.3) years, 53.9% (IQR: 52.9%-55.0%) were females, and 73.1% (70.4%-75.8%) were non-Hispanic

TABLE 2 Associations of the Life's Simple 7 Score, Life's Essential 8 Score, and 10-Year Atherosclerotic Cardiovascular Disease Risk With All-Cause Mortality and Cardiovascular Mortality

	Unadjusted Model				Adjusted Model			
	Hazard Ratio (95% CI)	Ratio of Hazard Ratio (95% CI)	C-Statistics (95% CI)	Δ C-Statistics (95% CI)	Hazard Ratio (95% CI)	Ratio of Hazard Ratio (95% CI)	C-Statistics (95% CI)	Δ C-Statistics (95% CI)
Overall population (n = 21,721)[a]								
All-cause mortality								
Standardized Life's Simple 7 Score	0.56 (0.52-0.60)	Ref.	0.657 (0.635-0.678)	Ref.	0.78 (0.71-0.85)	Ref.	0.819 (0.799-0.838)	Ref.
Standardized Life's Essential 8 Score	0.56 (0.52-0.61)	1.00 (0.90-1.11)	0.663 (0.641-0.684)	0.006 (−0.024 to 0.036)	0.72 (0.65-0.79)	1.08 (0.95-1.24)	0.823 (0.803-0.843)	0.004 (−0.024 to 0.032)
Cardiovascular mortality								
Standardized Life's Simple 7 Score	0.47 (0.40-0.54)	Ref.	0.716 (0.677-0.755)	Ref.	0.64 (0.53-0.77)	Ref.	0.883 (0.861-0.905)	Ref.
Standardized Life's Essential 8 Score	0.47 (0.41-0.54)	1.00 (0.82-1.23)	0.719 (0.675-0.762)	0.003 (−0.057 to 0.064)	0.59 (0.49-0.70)	1.08 (0.84-1.40)	0.887 (0.857-0.905)	0.004 (−0.026 to 0.034)
40-79 years old (n = 12,943)[b]								
All-cause mortality								
Standardized ASCVD risk	0.55 (0.52-0.59)	Ref.	0.741 (0.717-0.764)	Ref.	0.58 (0.55-0.61)	Ref.	0.756 (0.732-0.779)	Ref.
Standardized Life Simple 7 Score	0.64 (0.58-0.71)	0.86 (0.76-0.97)	0.621 (0.591-0.648)	−0.120 (−0.156 to −0.084)	0.69 (0.63-0.77)	0.84 (0.75-0.94)	0.674 (0.646-0.701)	−0.082 (−0.045 to −0.118)
Standardized Life Essential 8 Score	0.62 (0.56-0.68)	0.89 (0.79-1.00)	0.638 (0.610-0.665)	−0.103 (−0.139 to −0.066)	0.67 (0.61-0.75)	0.87 (0.77-0.97)	0.681 (0.656-0.706)	−0.075 (−0.109 to −0.040)
Cardiovascular mortality								
Standardized ASCVD risk	0.52 (0.47-0.57)	Ref.	0.787 (0.745-0.831)	Ref.	0.54 (0.49-0.60)	Ref.	0.802 (0.761-0.843)	Ref.
Standardized Life Simple 7 Score	0.53 (0.43-0.65)	0.98 (0.83-1.16)	0.678 (0.619-0.736)	−0.110 (−0.183 to −0.037)	0.57 (0.46-0.71)	0.95 (0.75-1.20)	0.715 (0.658-0.772)	−0.087 (−0.167 to −0.007)
Standardized Life Essential 8 Score	0.49 (0.41-0.59)	1.06 (0.86-1.30)	0.711 (0.650-0.770)	−0.077 (−0.152 to −0.002)	0.52 (0.43-0.64)	1.04 (0.83-1.30)	0.735 (0.670-0.799)	−0.067 (−0.144 to 0.009)

[a]The risk of all-cause and cardiovascular mortality per SD increase in the LE8 and LS7 scores was calculated using Cox models adjusted for sex, age, race, income, insurance status, education level, and number of health care visits/year. [b]The risk of all-cause and cardiovascular mortality per SD increase in the LE8 and LS7 scores and pooled cohort equations was calculated using Cox models adjusted for income, insurance status, education level, and number of health care visits/year.

ASCVD = atherosclerotic cardiovascular disease.

White. The median LE8 score, LS7 score, and 10-year ASCVD risk were 63.1 (IQR: 52.8-74.0), 7.3 (IQR: 5.7-8.7), and 4.9% (IQR: 1.9%-10.9%), respectively (Table 1).

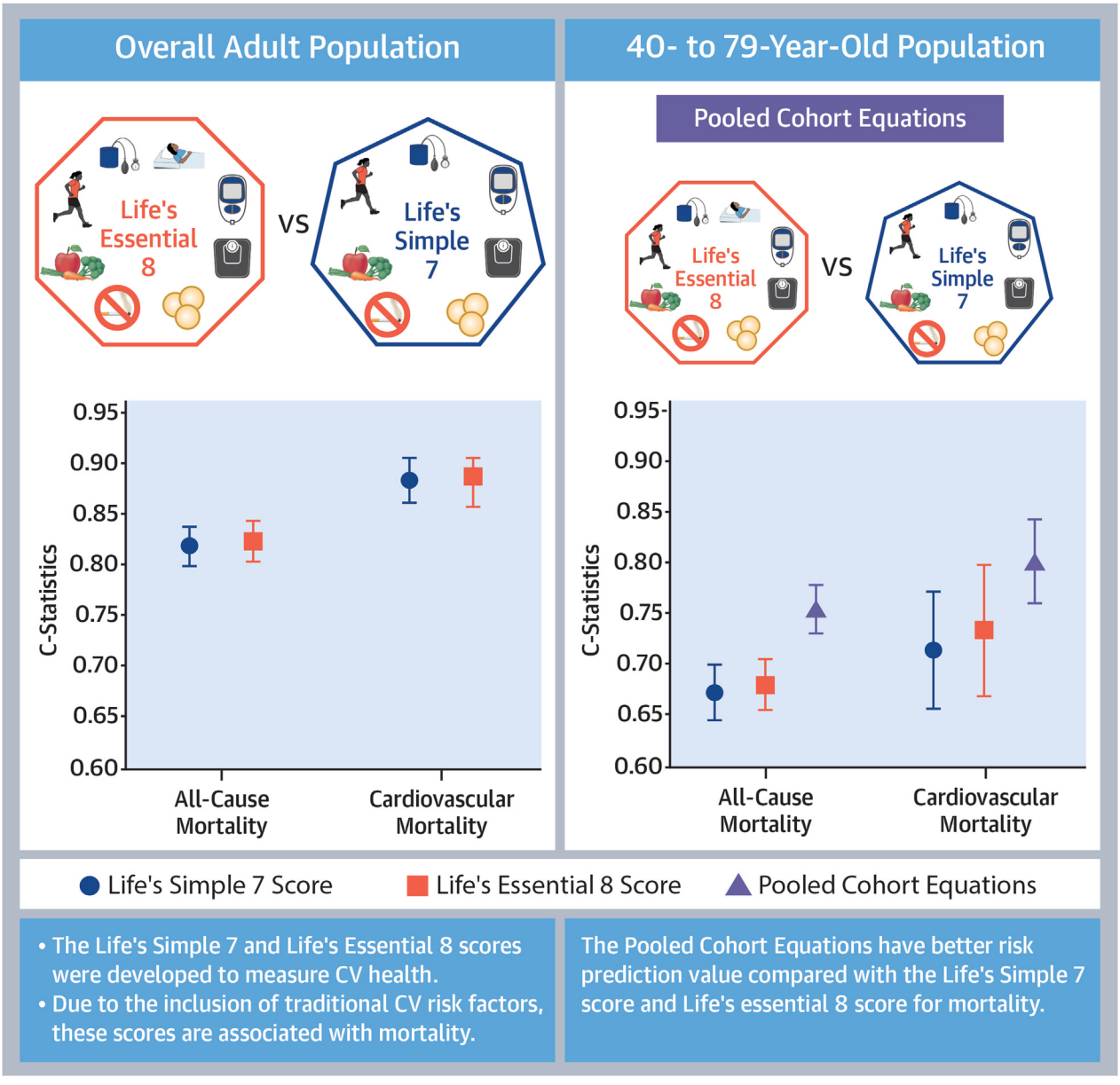
Over a median follow-up of 6.5 (IQR: 3.6-9.7) years, the event rate for all-cause mortality was 5.0% (IQR: 4.5%-5.5%). The risk of all-cause mortality was 0.67 (95% CI: 0.61-0.75) per SD increase of the LE8 score, 0.69 (95% CI: 0.63-0.77) per SD increase of the LS7 score, and 0.58 (95% CI: 0.55-0.61) per SD decrease in the 10-year ASCVD risk (Table 2).

The event rate for cardiovascular mortality was 0.9% (IQR: 0.7%-1.1%). The hazard ratio for cardiovascular mortality was 0.52 (95% CI: 0.43-0.64) per SD increase in the LE8 score, 0.57 (95% CI: 0.46-0.71) per SD increase in the LS7 score, and 0.54 (95% CI: 0.49-0.60) per SD decrease in the 10-year ASCVD risk (Table 2).

The C-statistics for the outcome of all-cause mortality were 0.756 (95% CI: 0.732-0.779), 0.674 (95% CI: 0.646-0.701), and 0.681 (95% CI: 0.656-0.706) for the PCE, LS7 score, and LE8 score-based models, respectively. The C-statistics for the Cox models predicting the risk of all-cause mortality was higher for the PCE-based model compared with LE8 score-based model [$\Delta C\text{-statistics}_{LE8\text{-}PCE}$: −0.075 (95% CI: −0.109 to −0.040) and the LS7 score-based model [$\Delta C\text{-statistics}_{LS7\text{-}PCE}$: −0.082 (95%CI: −0.045 to −0.118) (Table 2).

The C-statistics for the outcome of cardiovascular mortality were 0.802 (95% CI: 0.761-0.843) for the PCE-based model, 0.715 (95% CI: 0.658-0.772) for the LS7 score-based model, and 0.735 (95% CI: 0.670-0.799) for the LE8 score-based model. For the models predicting the risk of cardiovascular mortality, replacing the PCE with the LS7 score ($\Delta C\text{-statistics}_{LS7\text{-}PCE}$: −0.087 [95% CI: −0.167 to −0.007]) but not the LE8 score ($\Delta C\text{-statistics}_{LE8\text{-}PCE}$: −0.067 [95% CI: −0.144-0.009]) was associated with a decrease in the C-statistics (Table 2).

CENTRAL ILLUSTRATION **Comparison of the Risk Prediction Value of the Life's Simple 7 Score, Life's Essential 8 Score, and Pooled Cohort Equations for Mortality.**



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DISCUSSION

This population-level analysis of >20,000 individuals representing ~157 million U.S. adults found that the LS7 and the LE8 scores were associated with the risk of all-cause and cardiovascular mortality. Notably, the LE8 score and LS7 score have similar values in predicting the risk of all-cause and cardiovascular mortality. Among individuals aged between 40 to 79 years, the risk discrimination value of the PCE was higher than that of the LS7 and LE8 scores for all-cause and cardiovascular mortality based on the C-statistics. To summarize, this nationwide population-level analysis showed that the mortality risk prediction value for the LS7 and LE8 scores were similar in the overall population, but the PCE was a

potentially better risk tool for mortality compared with the LS7 and LE8 scores among individuals between 40 and 79 years (**Central Illustration**).

The comparable risk prediction values of the LS7 and LE8 scores may have several explanations. The components of the LS7 and LE8 scores are identical with the exception of sleep.[10] Sleep duration has been shown to predict the risk of CVD and mortality in several large studies.[9,22-24] Though the mechanism through which sleep increases the risk of CVD and mortality is not completely understood, sleep disturbances have been shown to be associated with dysregulation of other components of CVH.[10] Shorter durations of sleep have been associated with hypertension, diabetes, and obesity.[10,25-28] Reduced sleep leads to an increase in ghrelin levels (hunger-promoting hormone) and a decline in leptin levels (satiety-promoting hormone).[28] Furthermore, the lower leptin levels may also reduce energy expenditure, which promotes obesity.[29] Sleep deprivation has also been associated with activation of the sympathetic system.[27,30] This may impair glucose regulation and increase the risk of hypertension.[27,30] Therefore, traditional cardiovascular risk factors such as hypertension, diabetes, and obesity may be intermediaries between sleep and the risk of mortality. It could be postulated that the risk of mortality attributed to sleep may be captured by the increased risk of hypertension, diabetes, and obesity. This may explain the lack of difference in the risk prediction value of the LE8 and LS7 scores for mortality. The better risk prediction value of the PCE may be contributed by including age in the risk prediction algorithm and assigning specific weights to each component used in the tool. Furthermore, the PCE also has unique algorithms based on race and sex, which may further improve the risk prediction value by accounting for the differential risk of each component across the subgroups of sex and race.

Prior literature has focused on comparing the risk prediction values of the LE8 and LS7 scores for CVD events. The addition of sleep metrics to the LS7 score has been shown to improve risk prediction for incident CVD in the participants of the Multi-Ethnic Study of Atherosclerosis Sleep study.[31] However, a direct comparison of the risk prediction value of the LE8 and LS7 scores for incident CVD showed that both scores had comparable value among participants in the REGARDS study.[32] Apart from the use of the LE8 score, the discordant results between these two studies may be attributed to the differences in the measurement of sleep across the cohorts. The Multi-Ethnic Study of Atherosclerosis-based study utilized objectively measured sleep using polysomnography and actigraphy and included multiple aspects of sleep (duration, efficiency, insomnia, and daytime sleepiness).[31] The REGARDS-based study had a major limitation of using self-reported sleep that was collected about 3 years after the other variables used to compute the LE8 score were obtained.[32] Notably, both of these studies were limited to older individuals. The current study attempts to overcome the limitations of the previous studies by leveraging the NHANES data. Utilization of the NHANES data provided robust data collected using standardized techniques obtained at a single timepoint. Furthermore, the NHANES includes data from a nationally representative population including adults across the age range. While the prior studies focused on the risk prediction value for incident CVD, the current study is the first to compare the risk prediction value of the LS7 and LE8 scores for mortality. Lastly, this study also compares the risk prediction value of the LS7 and LE8 scores with PCE, a clinically validated cardiovascular risk prediction tool.

The results of this study may guide the clinical utility of the CVH measurement tools. The LE8 and LS7 scores were developed with a focus on improving CVH at an individual and population level.[10] The tools were formulated to encourage primordial prevention measures to prevent the development of risk factors for CVD.[10] The AHA envisioned that these efforts would lead to a reduction in CVD and CVD-associated mortality. By virtue of including the traditional cardiovascular risk factors in the computation of the scores, the LE8 and LS7 scores have been shown to be associated with CVD.[4-6,11-15] However, these tools were not primarily intended to be used as risk prediction tools. Cardiovascular risk prediction tools such as the PCE have been extensively validated for their risk prediction abilities.[16,33] Guidelines recommend the use of these tools in the clinical setting to guide the initiation of statin and antihypertensive therapy.[2,34] The current study highlights that the PCE is a superior mortality risk prediction tool in comparison with the LE8 and LS7 scores. While numerous studies have presented associations of the LE8 and LS7 scores with mortality, cautious interpretation of these results should be recommended.[4-6,11-15] Future research should redirect efforts away from assessing the risk prediction value of these tools and toward using these scores to characterize and track CVH as intended.

STUDY LIMITATIONS

First is the cross-sectional nature of the study, which prevents causal inferences from being drawn. Second,

this study excluded individuals with missing data. This may increase the variance in estimates due to the variability in the weight assigned to individuals. Third, residual confounding due to unmeasured confounders may influence the associations noted in the study. Fourth, several components such as sleep, physical activity, and smoking, were self-reported which may be prone to measurement errors. While techniques such as actigraphy may be more accurate in measuring sleep and physical activity, the guidelines recommend the utilization of self-reported data in these categories to compute the LE8 and LS7 scores.

CONCLUSIONS

The LS7 and LE8 scores were associated with all-cause and cardiovascular mortality and had similar risk prediction values. Compared with the LE8 and LS7 scores, the PCE may have a better risk discrimination value for all-cause and cardiovascular mortality among 40- to 79-year-old individuals. Future investigations should focus on refining the risk prediction value of the PCE and restricting the utilization of the LE8 and LS7 scores for the characterization of CVH.

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ADDRESS FOR CORRESPONDENCE: Dr Pankaj Arora, Division of Cardiovascular Disease, 1670 University Boulevard, Volker Hall B140, The University of Alabama at Birmingham, Birmingham, Alabama 35294-0019, USA. E-mail: parora@uabmc.edu.

PERSPECTIVES

COMPETENCY IN MEDICAL KNOWLEDGE: The LS7 and LE8 scores were designed as tools for assessing and monitoring CVH behaviors and risk factors at both individual and population levels. Unsurprisingly, both of these scores, which aggregate various CVH behaviors and risk factors, have been linked to mortality risk.However, compared to the LS7 and LE8 scores, the PCE, a validated risk prediction tool, offers greater accuracy in predicting mortality risk.

TRANSLATIONAL OUTLOOK: Given the superior predictive value of validated tools like the PCE, further exploration of mortality risk prediction using the LS7 and LE8 scores may be unnecessary. Instead, efforts should be redirected toward the original purpose of the LS7 and LE8 scores, ie, characterizing CVH.

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KEY WORDS Life's Essential 8 score, Life's Simple 7 score, risk reclassification, mortality

APPENDIX For supplemental tables and figures, please see the online version of this paper.