Supplementary Materials for "Evaluating the Life's Crucial 9 Score as a Predictor of All-Cause and Cardiovascular Mortality in a Diabetic and Pre-diabetic Population: Insights from NHANES 2005-2018"

1 Multiple Imputation of Missing Data

Supplementary Table SI details the number and percentage of missingness in covariates and individual LC9 components before imputation. Multiple imputation by chained equations (MICE) was used to handle the missing data, and the analysis was based on the mice package in R software. The MICE procedure generated 20 complete datasets (m = 20), with ten iterations (maxit = 10) performed for each imputation. Estimates across the imputed datasets were combined using Rubin's rules. A random seed of 2026 was set to ensure the reproducibility of the imputation process. The model also incorporated auxiliary variables without missing values to improve the plausibility of the imputed values. Meanwhile, different imputation methods were specified based on variable type: predictive mean matching for continuous variables and polytomous logistic regression for categorical variables. Finally, a visual assessment of the imputation quality was conducted using density plots. The distributions of the original observed data were compared with those of the 20 imputed datasets; substantial overlap indicated the reasonableness of the imputation results.

Supplementary Table SI Missingness in covariates and individual LC9 components prior to multiple imputation

Variable	Number of Missing Values	Missing Percentage
PIR	1917	9.6%
Alcohol consumption	2560	12.9%
Diabetes/prediabetes status	33	0.2%
anti.Diabetic	22	0.1%
anti.Hypertensive	22	0.1%
anti.Hyperlipidemic	22	0.1%

Variable	Number of Missing Values	Missing Percentage
HEI-2015 diet score	4797	24.1%
Physical activity score	4797	24.1%
Tobacco exposure score	4808	24.2%
Sleep health score	4844	24.4%
BMI score	4946	24.9%
Non-high-density lipoprotein cholesterol score	5158	26.0%
Blood glucose score	5908	29.7%
Blood pressure score	5088	25.6%
PHQ-9 score	4797	24.1%
Family history of diabetes	821	4.1%
Family history of CVD	941	4.7%

2 Comparison of baseline characteristics

Supplementary Table SII Comparison of selected characteristics and mortality status between included and excluded participants

Variables	Included analytic cohort	Excluded participants
Age (year)	54.3	53.4
Sex		
Female	0.486	0.492
Male	0.514	0.508
Race/ethnicity		
Mexican American	0.079	0.111
Non-Hispanic Black	0.114	0.154
Non-Hispanic White	0.691	0.553
Other Hispanic	0.0475	0.0702
Other Race - Including Multi-Racial	0.0686	0.1116
Marital status		
Divorced/separated/widowed	0.222	0.247
Married/living with a partner	0.668	0.610
Never married	0.110	0.143
PIR	3.05	2.63
Alcohol use		
former	0.171	0.162
heavy	0.164	0.179
mild	0.403	0.347
moderate	0.151	0.135
never	0.111	0.177
Education level		
≥College	0.583	0.497

Completed high school	0.250	0.252
< High school diploma	0.167	0.251
Family history of diabetes		
No	0.524	0.516
Yes	0.476	0.484
Family history of CVD		
No	0.844	0.851
Yes	0.156	0.149
Diabetes/prediabetes status		
Diabetes	0.271	0.368
Prediabetes	0.729	0.632
Antidiabetic medication		
No	0.811	0.803
Yes	0.189	0.197
Antihypertensive medication		
No	0.571	0.579
Yes	0.429	0.421
Antihyperlipidemic medication		
No	0.689	0.712
Yes	0.311	0.288
All-cause mortality		
Alive	0.890	0.869
Dead	0.110	0.131
CVD-related mortality		
Alive	0.9657	0.9627
Dead	0.0343	0.0373

Continuous variables are presented as weighted means and categorical variables as weighted proportions.

3 Comparison of the primary analysis and multiple imputation

Supplementary Table SIII Comparison of the primary analysis and multiple imputation for the association between LC9 score and mortality.

Outcome	Model	Primary analysis (HR, 95% CI)	MI (HR, 95% CI)
CVD mortality	Q4 vs Q1	0.449(0.365,0.552)	0.467(0.376,0.581)
All-cause mortality	Q4 vs Q1	0.434(0.317,0.594)	0.478(0.412,0.556)

Adjusted for age, sex, ethnicity, education, alcohol use, marital status, poverty income ratio (PIR), family history of diabetes, family history of cardiovascular disease (CVD), antidiabetic drugs, antihypertensive drugs, and antihyperlipidemic drugs.
Abbreviations: CI, confidence interval; HR, hazard ratio.

4 Results of Multiple Imputation Analysis

Supplementary Table SIV. Cox regression models for the associations of Life's Crucial 9 score quartiles with cardiovascular and all-cause mortality after multiple imputation.

	Model 1 HR (95% CI)	*P*-value	Model 2 HR (95% CI)	*P*-value	Model 3 HR (95% CI)	*P*-value
Cardiovascular mortality						
LC9						
Q1	ref		ref		ref	
Q2	0.555(0.468,0.658)	<0.0001	0.525(0.443,0.623)	<0.0001	0.582(0.494,0.685)	<0.0001
Q3	0.656(0.528,0.815)	<0.001	0.634(0.505,0.795)	<0.0001	0.755(0.607,0.939)	0.012
Q4	0.318(0.253,0.400)	<0.0001	0.343(0.272,0.433)	<0.0001	0.467(0.376,0.581)	<0.0001
P for trend		<0.0001		<0.0001		<0.0001
All-cause mortality						
LC9						
Q1	ref		ref		ref	
Q2	0.673(0.594,0.762)	<0.0001	0.642(0.568,0.725)	<0.0001	0.704(0.626,0.791)	<0.0001
Q3	0.648(0.575,0.730)	<0.0001	0.631(0.561,0.709)	<0.0001	0.736(0.659,0.822)	<0.0001
Q4	0.348(0.298,0.406)	<0.0001	0.371(0.317,0.433)	<0.0001	0.478(0.412,0.556)	<0.0001
P for trend		<0.0001		<0.0001		<0.0001

Model 1 (crude model): no covariates were adjusted for. Model 2: adjusted for age, sex, ethnicity, and education. Model 3: adjusted for age, sex, ethnicity, education, alcohol use, marital status, poverty income ratio (PIR), family history of diabetes, family history of cardiovascular disease (CVD), antidiabetic drugs, antihypertensive drugs, and antihyperlipidemic drugs.

Abbreviations: CI, confidence interval; HR, hazard ratio.