Life's Essential 8 cardiovascular health metrics and long-term risk of cardiovascular disease at different stages: A multi-stage analysis

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To the Editor: To motivate health promotion by prevention of modifiable risk factors and further reduce the burden of cardiovascular disease (CVD), the American Heart Association (AHA) recently updated and modified the Life's Simple 7 (LS7) cardiovascular health (CVH) metrics to Life's Essential 8 (LE8).[1] A recent study conducted in China and other countries reported that the lower LE8 score was associated with a higher risk of atherosclerotic CVD incidence and death.[2] However, whether CVH has different effects on acute coronary heart disease (CHD) and stroke, and more importantly, on the stage of CVD incidence or further progression to death remains unclear. This information is of great importance for clarifying the role of CVH in primary and secondary prevention.

Therefore, we evaluated the association of CVD incidence and death with the new LE8 score using 13-year follow-up data from a population-based cohort study. Importantly, we used a multi-state model to investigate the potentially different impacts of the LE8 score on transitions from a healthy state to CVD and subsequently to death.

The study was carried out according to the *Declaration of Helsinki* and approved by the ethics committee of Beijing Anzhen Hospital, Capital Medical University (No. ks2019029). All participants signed to indicate their informed consent.

The study participants were recruited from the Chinese Multi-provincial Cohort Study,[3] an ongoing longitudinal cohort study. From 2007 to 2008, 11,387 participants from six of the 11 provinces of China were invited for a re-examination. Of the 11,387 participants, 723 died, 627 were lost to follow-up, 4076 refused, and the remaining 5961 participants took part in the re-examination. Participants were excluded for the following reasons: established CVD (n = 479), incomplete data on CVH metrics in LE8 and other covariates at baseline (n = 229), and underweight (body mass index [BMI] <18.5 kg/m^2) with an unhealthy clinical condition (including chronic catabolic illnesses and eating disorders) (n = 12). Finally, the remaining 5241 participants with follow-up data until December 31, 2020 were included in this study [Supplementary Figure 1, http://links.lww.com/CM9/C289]. All participants were followed up for incident fatal or non-fatal acute coronary events, stroke events, and other-cause death every 1–2 years by active interviewing, supplemented with linkage to local disease surveillance systems. The details of the risk factor measurement and case ascertainment are shown in the Supplementary Material, http://links.lww.com/CM9/C289.

According to the AHA Presidential Advisory in 2022,[1] the LE8 CVH metrics include four health behaviors (diet, physical activity, nicotine exposure, and sleep health) and four health factors (BMI, blood lipids, blood glucose, and blood pressure). The definitions and scoring for diet, physical activity, and sleep health were modified as shown in Supplementary Table 1, http://links.lww.com/CM9/C289. Each LE8 CVH metric was scored on a scale of 0–100 points, and the unweighted average of all components was defined as the LE8 score, which also ranges from 0 to 100 points. As recommended in the AHA Presidential Advisory, the scores of 0–49, 50–79, and 80–100 were considered low, moderate, and high CVH, respectively.[1] Since only 8.4% of the participants in our study had an LE8 score of 80–100, we used the cutoff value of 70, which was approximately equal to the upper quartile (70.63), to define the moderate and high CVH to achieve sufficient statistical power.

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A unidirectional multi-state model with Markov proportional hazards was further performed to evaluate the role of the LE8 score in the temporal disease progression from a baseline healthy state (free of CVD) to CVD, and death. Four transition stages were constructed [Supplementary Figure 2, http://links.lww.com/CM9/C289]: baseline healthy state to CVD (Transition A), CVD to CVD death (Transition B), CVD to non-CVD death (Transition C), and baseline healthy state to non-CVD death (Transition D). We calculated the probabilities of becoming a CVD survivor, dying of CVD, and dying of non-CVD causes from enrollment to the end of follow-up using the Aalen–Johansen estimates. The details of other statistical analysis are shown in Supplementary Material, http://links.lww.com/CM9/C289.

Among the 5241 participants, the mean age was 60.9 ± 7.7 years and 52.2% (2737/5241) were female [Supplementary Table 2, http://links.lww.com/CM9/C289]. The median (interquartile range) LE8 score in this population was 61.3 (51.3, 70.6) [Supplementary Figure 3, http://links.lww.com/CM9/C289]. Overall, 21.4% (n = 1119) of the participants had an LE8 score of <50, and they were more likely to be male, be a drinker, have a higher proportion of family history of CVD, and a lower education level and income level. There was a significant and positive dose–response relationship between the LE8 score and the health level of each LE8 CVH metric. Among all LE8 metrics, the prevalence of participants with a metric score of <50 was the highest for diet, followed in descending order by blood pressure, sleep health, blood lipids, nicotine exposure, physical activity, blood glucose, and BMI.

During a median follow-up of 13.3 years and 64,286 person-years of observation, 680 first CVD events (303 acute CHD events and 413 acute stroke events), 203 CVD deaths, and 470 non-CVD deaths were recorded. Kaplan–Meier curves showed significant differences in the CHD incidence, stroke incidence, CVD incidence, CVD mortality, and non-CVD mortality among the three LE8 score categories [Supplementary Figure 4, http://links.lww.com/CM9/C289]. Per 10-point increase in the LE8 score was associated with a 28%, 29%, 29%, 31%, and 7% decrease in the risk of CHD, stroke, CVD, CVD death, and non-CVD death, respectively. Compared with participants with an LE8 score of <50, those with a score of ≥70 had a significantly lower risk of CHD (hazard ratio [HR]: 0.28, 95% confidence intervals [CIs]: 0.19–0.42), stroke (HR: 0.28, 95% CI: 0.20–0.38), CVD (HR: 0.29, 95% CI: 0.22–0.37), and CVD death (HR: 0.32, 95% CI: 0.20–0.50) [Supplementary Table 3, http://links.lww.com/CM9/C289]. Per 10 points higher LE8 score was also related to a lower risk of all-cause death (HR: 0.85, 95% CI: 0.80–0.90).

The multi-state analyses showed that per 10-point increase in the LE8 score was associated with a 29% decrease in the risk of CVD incidence (Transition A; HR: 0.71, 95% CI: 0.67–0.75), an 8% decrease in the risk of non-CVD death (Transition D; HR: 0.92, 95% CI: 0.85–0.99) among participants free of CVD [Figure 1], and a 17% (HR: 0.83, 95% CI: 0.69–0.99) decrease

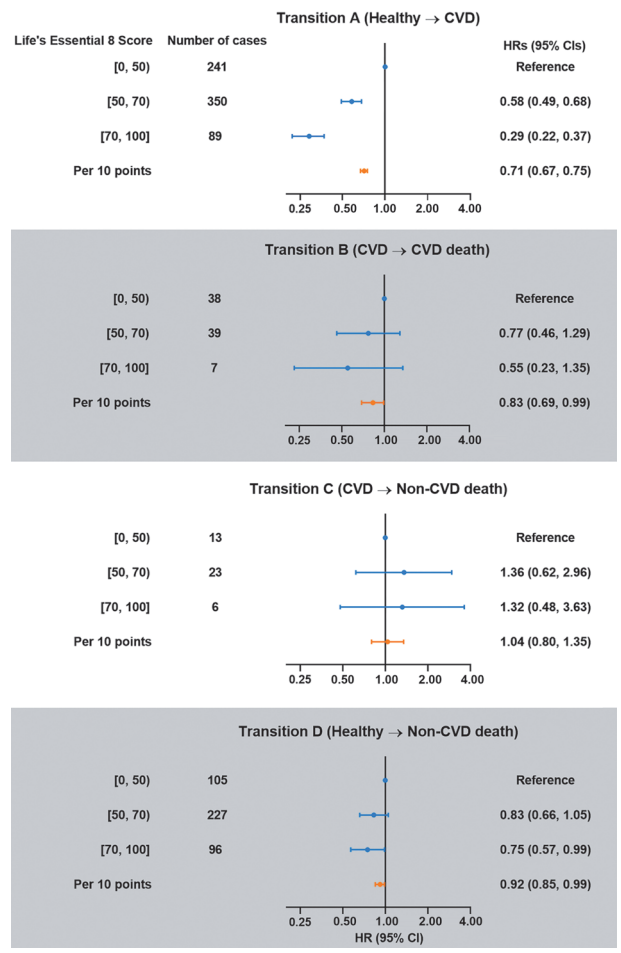

Figure 1: The association of Life's Essential 8 score transitions from a healthy state to CVD and death in the multi-stage model among participants without CVD at baseline. The HRs (95% CIs) were adjusted for age, sex, education, income, current drinking, and family history of CVD. The horizontal axis has been $\log_2$-transformed. CI: Confidence interval; CVD: Cardiovascular disease; HR: Hazard ratio.

in the risk of subsequent CVD death among those who survived from the first CVD event (Transition B). The LE8 score was not associated with subsequent non-CVD death in participants with CVD (Transition C). The results were not substantially altered in the sensitivity analyses [Supplementary Table 4, http://links.lww.com/CM9/C289]. At the 10-year follow-up, the probability in state of CVD survivor or death was 24.7% in participants with an LE8 score of <50, which was 2.7 times higher than that in those with an LE8 score of ≥70 (9.0%) [Supplementary Figure 5, http://links.lww.com/CM9/C289]. The probability of CVD-death after CVD was 7.4 times higher in participants with an LE8 score of <50 than that in those with LE8 score ≥70.

In this multicenter prospective cohort study, we explored the role of LE8 in different development stages of CVD. We found that a higher LE8 score was associated with a lower risk of CVD incidence, CVD death, and non-CVD death. Moreover, LE8 played important roles in the transitions from healthy state to CVD, and may be associated with the transition from CVD to CVD death. Our data emphasize the predominant role of the AHA's LE8 for primary and secondary prevention of CVD.

The evidence supporting the importance of an ideal CVH for the prevention of CVD is strong, compelling, and continuously growing. A meta-analysis of 13 studies based on 10 cohorts showed that participants with higher numbers of LS7's ideal CVH metrics had a lower risk of CVD and all-cause mortality.[4] Recent studies also found that the LE8 score was associated with CVD incidence and death.[2] Our study has expanded further to quantify the impact of the LE8 score on CHD incidence, stroke incidence, total CVD incidence, CVD death, and non-CVD death. In the present study, 56% of the non-CVD deaths were attributed to cancer. Recent evidence demonstrated that many risk factors are shared by CVD and cancer, and most of them are the metrics of LE8, including hypertension, hyperlipidemia, diabetes mellitus, obesity, smoking, diet, and physical activity. Previous studies also found that CVH defined by LS7 was associated with the risk of cancer mortality, which could support our findings about the association of LE8 with non-CVD death.

Our study had several potential limitations. First, we used the LE8 score at baseline and did not account for the potential change in the CVH score over time. However, previous studies showed that the level of LS7 score or lifestyle factors changed little during the follow-up, regardless of the development of CVD. Therefore, use of the baseline LE8 score may not exert significant bias. Second, compared with the AHA definition of health metrics, we introduced some minor modifications of sleep, diet, smoking, and physical activity for practical reasons. Especially, due to lack of relevant data, we used snoring frequency rather than sleep duration to define sleep health. Sleep health is a multidimensional construct,[1] and snoring, one of the unhealthy sleep behaviors, serves as an important risk factor for CVD. In our previous study, snoring was also found to be associated with carotid artery intima–media thickness and plaque.[5] Therefore, the LE8 in which sleep health is defined by snoring could capture the CVH of the population. Third, we did not collect information on treatment after the development of CVD. Fourth, we did not use a validated diet questionnaire, such as the Dietary Approaches to Stop Hypertension diet score or Mediterranean Eating Pattern for Americans. However, most of the validated dietary questionnaires were derived from and applicable to Western populations; the dietary questionnaire in our study was a closer match to the dietary pattern of the Chinese population.

In conclusion, favorable levels of CVH as defined by the LE8 score are associated with a lower risk of CVD incidence and CVD death. This effect becomes evident, particularly in the transition from a stage of being free from CVD to developing the first CVD event, and to a lesser extent, in the progression from the first CVD events toward subsequent CVD death. Our findings emphasize the application of the AHA's LE8 in the whole process of CVD prevention.

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Conflicts of interests

None.

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