Circulation

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Editorial

Cardiovascular Health and Protection Against CVD
More Than the Sum of the Parts?

Donald M. Lloyd-Jones, MD, ScM, FAHA

Five years ago, the American Heart Association (AHA) launched a bold new initiative to begin promoting "cardiovascular health" in individuals and the population, in addition to continuing its decades-long fight to reduce cardiovascular and stroke mortality and decrease cardiovascular disease (CVD) risk. This shift in priorities came as a result of a "quiet revolution,"[1] turning the adverse-outcomes-oriented and risk-focused perspective on its head, and instead focusing on creating the opportunity for promoting and preserving attributes associated with healthy, CVD-free longevity. The first-ever formal definition for this construct of cardiovascular health, published in 2010,[2] was based on a broad review of the literature designed to determine groups of factors associated with excellent prognosis in long-term CVD-free survival and quality of life. It was designed to be simple, accessible, and actionable, allowing all patients, clinicians, and communities to focus on improving cardiovascular health. And it was crafted in a way so that it could be measured in the broad US population and major subgroups, monitored over time, and influenced by the AHA portfolio of programs.[2] Although the entire spectrum of cardiovascular health was captured (from birth through living with CVD), a critical observation was the recognition of an "ideal cardiovascular health" phenotype that consisted of the simultaneous presence of ideal levels of 7 health behaviors and health factors: smoking status, physical activity, eating pattern, body weight, and blood cholesterol, blood glucose, and blood pressure levels.

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In the 5 years since publication of the definition of cardiovascular health, numerous investigators have examined the prevalence of levels of ideal cardiovascular health in diverse populations from around the globe.[3–8] In countries with more developed economies, it seems to be a universal finding that the prevalence of truly ideal cardiovascular health in adults is rare (often <1%). Although it appears that most of us are born with the potential for ideal cardiovascular health, in the United States, fewer than half of all adolescents have retained ≥5 of the 7 metrics at ideal levels, with steady declines in prevalence thereafter, until ideal cardiovascular health is vanishingly rare at >60 years of age.[9] Recent data suggest that this is much more a function of the loss of healthy lifestyle and behavior attributes during young adulthood rather than an inevitable consequence of aging or heredity. There are even positive indications that improving lifestyle can make a large difference in preserving ideal cardiovascular health, that small changes can have an impact, and that it is never too late, although earlier implementation is clearly better.[10–12]

A number of studies have also examined the prospective associations of different levels of cardiovascular health with short-term and long-term cardiovascular and noncardiovascular outcomes. Table 1 provides a summary of the outcomes favorably associated with greater cardiovascular health to date. Findings have consistently demonstrated that having more of the 7 components at ideal levels is associated with lower risk for fatal and nonfatal cardiovascular events in all race/sex subgroups studied, with extremely low incidence rates in those with ideal cardiovascular health (ie, all 7 metrics at ideal levels). Intriguing data also reveal associations with lower risk for incident cancer, better cognition in younger and older adults, less depression, better quality of life, enhanced compression of morbidity, and even lower healthcare charges, among other outcomes.[4,7,13–18] It is certainly intuitive that lower levels of cardiovascular risk factors and better health behaviors should be associated with lower risk for CVD. And yet, one of the tantalizing impressions when one examines data on this ideal cardiovascular health concept is that the whole may indeed be greater than the sum of the parts.

In this issue of *Circulation*, Xanthakis et al[19] from the Framingham investigators provide the latest pieces of evidence linking greater cardiovascular health to favorable outcomes with regard to CVD incidence. The major contribution these authors make is in filling some of the gaps in our understanding about the mechanisms underlying the association of greater cardiovascular health with lower disease incidence. One may legitimately ask: Do people with better cardiovascular health simply develop less subclinical disease (atherosclerosis or vascular or myocardial damage) over time and therefore they are at lower CVD risk just because of that? Or is there possibly more to it?

Xanthakis et al characterized 2680 mostly middle-aged Framingham Study participants with regard to their cardiovascular health status on all 7 metrics at baseline. Consistent with the approach taken by many other investigators, they created a simple score from 0 to 7 points indicating how many cardiovascular health metrics each participant had at ideal levels. They then examined associations of the score with various serological markers of inflammation, coagulation, and target-organ damage, as well as measures of subclinical CVD, including

Table.   Domains of Improved Outcomes With Which Greater Levels of Cardiovascular Health (as defined by the American Heart Association)[2] Have Been Associated Prospectively

All-Cause (total) Mortality	End-Stage Renal Disease
CVD, coronary, stroke mortality	Atherosclerosis and arterial stiffness in younger adults
Nonfatal CVD events	Cognitive function in younger and older adults
Coronary heart disease	Depression
Stroke	Quality of life
Incident cancer	Compression of morbidity
Venous thromboembolism	Medicare charges

CVD indicates cardiovascular disease.

increased carotid intima-media thickness or stenosis, evidence of left ventricular hypertrophy or systolic dysfunction, microalbuminuria, or low ankle-brachial index. As expected, on average, most of the serum biomarkers were within normative ranges in this sample. Having a higher cardiovascular health score was significantly associated with modestly lower levels of aldosterone, C-reactive protein, D-dimer, fibrinogen, growth-differentiation factor 15, homocysteine, and plasminogen activator-inhibitor 1. In other words, greater cardiovascular health was associated with lower levels of adverse biomarkers. An interesting finding was a positive association of the cardiovascular health score with natriuretic peptide levels within the normative range, which the authors plausibly suggest may be attributable to enrichment of the sample at higher scores for those with lower body mass index, as well more women, 2 factors associated with higher natriuretic peptide levels.[19]

A higher cardiovascular health score was also associated with lower odds of having subclinical disease. For each 1 point higher in the score, the odds of having any subclinical disease measure were 23% lower. Higher scores were even less likely to be associated with evidence for multiple aspects of subclinical disease. Therefore, it may come as no surprise that Xanthakis et al observed a significantly lower risk for CVD events (coronary heart disease, stroke or transient ischemic attack, heart failure, or claudication) among those with higher cardiovascular health scores, with a hazard ratio of 0.77 per 1-point higher on the cardiovascular health score and a generally linear relationship across the range of scores.[19] In this study, compared with someone with 0 points, someone with 1 point was, on average, at 23% lower risk for CVD over 16 years; someone with 2 points was at 41% [1-(0.77×0.77] lower risk; and so on.

However, the innovative aspect of the authors' analysis is that they then adjusted for the significant biomarkers and subclinical disease measures, which might be expected to completely attenuate the association between the cardiovascular health score and incident CVD because they represent likely intermediary factors in the pathway from cardiovascular health to disease. But even after adjustment for the biomarkers and subclinical disease measures, the cardiovascular health score remained independently and significantly associated with lower risk for CVD (hazard ratio, 0.87; 95% confidence interval, 0.78–0.97 for each 1 point higher in the score).

What are we to make of this? To be sure, we must be cautious and recognize the potential for residual confounding. The vast majority of CVD events are of course preceded by evidence of vascular or myocardial alterations or damage, and the measures available to the authors for this analysis incompletely represent all of the causal pathways involved in the transition from cardiovascular health to CVD. Nonetheless, the Framingham investigators have provided the most interesting data to date examining potential mechanisms underlying the construct of cardiovascular health. Their data suggest that there might be additional intangible benefits of the cardiovascular health phenotype, perhaps related to other aspects of a healthy lifestyle, or the tendency for longer exposure to favorable levels of cardiovascular health metrics among those with greater cardiovascular health (because it is easier and more common to preserve it than restore it).

Such speculations require further investigation. In the meantime, these data provide even more strong and compelling evidence that, regardless of the mechanism, promotion of cardiovascular health must be advanced immediately and forcefully as a key part of the national agenda at every level of policymaking, across all healthcare and public health systems, and for all segments of the population. Only with maximal effort can we blunt the substantial burden of CVD and CVD-related costs that are impending over the next decades.[20] To promote and achieve a culture of health in which all Americans, and particularly our youth, can achieve healthy longevity, where cardiovascular health is poor, we must improve it; where it is intermediate, we must restore it; and where ideal, we must preserve it.

Disclosures

None.

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