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Further understanding of ideal cardiovascular health score metrics and cardiovascular disease

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Abstract

Introduction: The American Heart Association (AHA) introduced the construct of "cardiovascular health (CVH)", to focus on primordial prevention to reduce the burden of cardiovascular disease (CVD). The CVH score includes 7 health and behavioral metrics (smoking, physical activity, body mass index, diet, total cholesterol, blood pressure, blood glucose), which are characterized as being ideal, intermediate, or poor.

Areas covered: In this review, we describe the utility of the CVH score for monitoring and promoting wellness, overall and by key sociodemographic groups, and for tracking of temporal trends.

Expert commentary: Notably, the 7 factors are all modifiable, which differs from 10-year CVD risk scores that include non-modifiable components such as age, sex, and race. Numerous epidemiological studies have shown that achievement of a greater number of ideal CVH metrics is associated with lower incidences of CVD, cardiovascular mortality, and all-cause mortality. Longer duration of favorable CVH is associated with greater longevity and compressed morbidity. Nevertheless, the prevalence of favorable CVH is low, with <20% of U.S. adults meeting ≥5 metrics at ideal levels and significant racial/ethnic disparities persist. Many challenges must be overcome to improve CVH at individual and societal levels if the AHA Impact Goals are to be fully realized.

Keywords

cardiovascular health; prevention; atherosclerotic cardiovascular disease; heart failure

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1. Introduction

In 2010, the American Heart Association (AHA) released their 2020 Impact Goals, which stated the goal to reduce deaths from cardiovascular disease (CVD) in the United States (U.S.) by 20% and improve the health of all Americans by 20% [1]. Towards this goal, the AHA introduced the construct of cardiovascular health (CVH), characterized by 7 health behaviors and health factors called the Life's Simple 7 (LS7) metrics [1]. Favorable CVH is generally considered as having achieved the ideal criteria for at least 5 of these 7 metrics. This construct emphasized the primordial prevention of CVD (i.e., preventing the onset of risk factors) and shifted the focus to the promotion of wellness and health rather than on the treatment of disease [2].

Building on this framework, in 2020, the AHA recently released their 2030 Impact Goals which stated goals of improving health equity in diverse populations and focusing on mental well-being in addition to physical health. Notably, the primary 2030 Impact Goal was to equitably increase healthy life expectancy from age 66 to age 68 years in the U.S. and from 64 to 67 years globally [3]. This is a critical goal in light of data showing that despite 6 decades of prior progress in achieving life extension, the U.S. life expectancy has stalled since 2010 and even declined since 2014 [4]. This stalling in U.S. life expectancy has been attributed to plateauing of progress in CVD death rates [5], and even an increase in CVD death rates in young to middle-aged adults, particularly women [6,7]. Unfortunately AHA surveys from 2009 to 2019 identified a decline in women's awareness that heart disease was the leading cause of death (from 65% to 44% awareness) [8]. This lack of awareness was greatest among historically marginalized racial/ethnic groups and among younger adults, of whom might benefit the most from primordial prevention. Thus, continued effort towards cardiovascular health promotion, using the framework of the 7 CVH metrics, is more critical than ever.

In this review, we will further the understanding of the CVH score in CVD prevention by describing its utility in public health research and clinical practice for the monitoring and promotion of cardiovascular wellness in the U.S. population, overall and by key sociodemographic groups, and for the tracking of temporal trends in the metrics, in efforts towards achieving the AHA's 2030 Impact Goals.

2. Selection of the 7 CVH metrics

The process of how the specific 7 CVH metrics were selected has been previously described [1]. Briefly, in 1999, a task force was appointed by the AHA Board of Directors to develop the 2010 AHA Impact Goal. This Task Force decided to begin with a process of a survey, that was administered to approximately 170 scientists from various AHA scientific councils, to review risk factors, risk behaviors and disease states and then rank order them in the importance that these factors need to be addressed to have significant effect on reducing CVD. Among disease states, coronary heart disease (CHD) and stroke were ranked the highest importance. Among risk factors, smoking, high blood pressure, high cholesterol, and physical activity were ranked the most important, in that order, and then obesity and diabetes were added to this list. That is how the 7 CVH metrics were chosen.

3. Definition of favorable CVH

A person is considered to have optimal or favorable CVH by meeting a greater number of metrics at the “ideal” level for each of the specific criteria for the 7 modifiable risk factors, which include smoking, body mass index (BMI), physical activity, diet, cholesterol, blood pressure and blood glucose (Figure 1) [1,9,10]. Typically, in most analyses, points are assigned to each category of the LS7 metrics with 0 indicating poor; 1, intermediate; and 2, ideal for each factor (Table). The points are summed to yield a total CVH score ranging from 0 to 14 [11]. Total CVH scores of 0–8, 9–10, and 11–14 are considered as inadequate, average, and favorable CVH, respectively, but studies are highly variable in their definition and threshold utilized for having favorable CVH [12–14]. For example, other studies have simply counted the number of ideal metrics from 0 to 7, with favorable CVH typically considered if ≥5 metrics at the ideal level are achieved. The use of these 7 CVH metrics and the total CVH score has been used as surveillance tools to measure CVH, CVD mortality, incidence and outcomes in the general population and track national trends over time [1,9,10].

4. Epidemiology of favorable CVH

Unfortunately, very few U.S. adults are considered to be in optimal or favorable CVH by the LS7 score [15,16]. Data from the 2011–2016 National Health and Nutrition Examination Survey (NHANES) found that the CVH of the U.S. adults is predominantly unfavorable, with 59% having a low/unfavorable score (score 0–8) and only 7.3% of adults having a high CVH score (score 12–14) [17]. Similarly, in the 2013–2014 NHANES survey, only 13% of U.S. adults met ideal levels in 5 metrics, 5% of adults met ideal levels in 6 metrics, and virtually 0% met ideal levels for all 7 metrics [18]. Most U.S. adults (~62%) have 3 or fewer of the 7 metrics in the ideal range [18]. Approximately 92% of U.S. adults have 1 or more metric at poor level, and 36% of adults have 3 or more metrics at poor level. Women are more likely to have more ideal CVH metrics than men across all age groups [18]. The prevalence of meeting ≥5 ideal metrics was 14.8% for men and 21.5% for women (Figure 2). Black and Hispanic adults have poorer CVH than White adults. Asian adults had the greatest prevalence of ≥5 ideal metrics at 29.0%, followed by White (19.4%), Hispanic (14.2%), and Black (10.6%) adults [18] (Figure 2). The prevalence of achieving favorable CVH may be even worse in rural communities [19]. Furthermore, over the decade from 2006 to 2015, the prevalence of meeting ideal status for all CVH metrics declined in the U.S. population [20]. Indeed, there remains great opportunity to improve the CVH status of U.S. adults. A prior AHA statement specifically addressed the critical need to improve CVH among Black adults [21], who experience the most disparities in health equity.

5. CVH status and future CVD

Numerous epidemiologic studies have demonstrated that the achievement of a greater number of ideal CVH metrics is associated with a lower risk of incident CVD, generally in a linear dose-response manner [22–24]. In a meta-analysis including 12 cohort studies and 210,443 adults, individuals who met 3–4 ideal metrics had a 47% lower risk of incident CVD [HR 0.53 (95% CI 0.47, 0.59)] and those that met 5–7 ideal metrics had a 72%

decreased risk of incident CVD [HR 0.28 (0.23, 0.33)], compared to those achieving only 0–2 metrics. This emphasizes the point that even if all metrics of CVH are not ideal, there is still meaningful CVD risk reduction in intermediate compared with poor CVH status [22].

Greater CVH, on basis of LS7 score, is inversely associated across various specific CVD outcomes including a lower risk of incident CHD [25], stroke [25,26], heart failure [27–29], atrial fibrillation [13,30], and peripheral artery disease [31] (Figure 3).

Achieving favorable CVH is associated with a number of other important endpoints [32], including lower risk of adverse pregnancy outcomes [33] and cognitive impairment [34], outcomes which are discussed more below, and with a lower risk for all-cause and CVD mortality [16,35,36] (Figure 3). Specifically, a meta-analysis of 9 studies found that the presence of favorable CVH (generally defined as total CVH score ≥10 or ≥5 ideal metrics) was associated with a 45% lower risk of all-cause mortality, a 75% lower risk of cardiovascular mortality, an 80% lower risk of CVD, and a 69% lower risk of stroke [35].

A recent study by Bundy et al examined the impact of what achieving optimal CVH status would be on the U.S. population; for this analysis, the authors utilized the incidence rates of CVD events from 7 U.S. cohorts associated with CVH scores and then applied those rates to NHANES data (2011–2016) to determine nationally representative estimates [17]. The authors determined that the achievement of optimal CVD for adults with low or moderate CVH could prevent an estimated 2 million CVD events each year. Even modest gains in CVH could have big impact [37]. Even if U.S. adults with low CVH were able to move from low to just moderate CVH status, an estimated 1.2 million CVD events could be prevented each year [17].

6. Racial/ethnic differences

As mentioned earlier, there are significant disparities in the prevalence of ideal CVH metrics by race/ethnicity. Across NHANES cycles from 1999 through 2012, the mean CVH scores were lower (by 0.93 points on average) for non-Hispanic Black women than White women at every survey, and Hispanic women had significant lower mean score (0.71 lower) than White women at nearly almost every survey cycle [38]. For men, the racial/ethnic differences in CVH score was less pronounced. Another study that examined the change in CVH score from 1988 to 2014 showed that the racial/ethnic disparities in CVH persisted throughout this period but narrowed in gap, largely due to worsening CVH in White adults and not from improved CVH in Black or Hispanic adults [39].

Nevertheless, the benefits of CVH with improved outcomes have been demonstrated across racial/ethnic groups. For example, in the Jackson Heart Study, Black adults with ≥3 of the 7 metrics optimal had a 47% lower risk of incident heart failure compared to those with <3 metrics achieved [29]. Among Hispanic adults, higher ideal CVH metrics was associated with decreased risk of CHD and stroke [40].

7. Non U.S. populations

The CVH score has been applied to other non-U.S. populations. Even outside of the U.S., the prevalence of favorable CVH is also low, and greater CVH scores are associated with reduced risks of CVD and mortality in these populations too [41–47]. For example, among a community in China, there was a strong inverse relationship between the number of ideal health metrics and cumulative incidence of CVD events over 4-years of follow-up [45]. However only 9% of this Chinese population met criteria for ≥5 ideal metrics and the majority (69%) met criteria for ≤3 ideal metrics [45]. In a population from Australia, each increment in ideal metrics was associated with a 21% lower odds of prevalent CVD [OR 0.79 (0.73, 0.84)], and compared to inadequate scores, those with optimal scores had a 66% lower odds of CVD [0.34 (0.22, 0.54)] [46]. Similarly, in a population from Spain, individuals achieving ≥4 ideal CVH metrics were 66% less likely to develop incident CVD over a 4.8-year follow-up [OR 0.34 (0.21, 0.53)] [47]. Together these studies emphasize the message that while the LS7 construct might have been put forth by the AHA, a coordinated global effort is needed [41].

8. Duration of favorable CVH

The duration of one's lifetime spent meeting ideal levels of CVH metrics also matters. It has been known for a long time from large epidemiologic cohorts that individuals with low levels of CVD risk factors early in life (young and middle-age adulthood) have decreased risk for cardiovascular and all-cause mortality, and that favorable CVH is associated with longevity [48]. Even the presence of one single risk factor by middle-age (age 55) is associated with increased lifetime risk of CVD compared to someone with all risk factors optimal [49]. By an index age of 45, the lifetime risk of CVD is already 20%; however, those with an optimal risk profile by this age experienced 14 more years free of CVD compared to individuals who already had 2 major risk factors [50]. Indeed, as far as CVD prevention is concerned, it is better to start young [51,52].

Using longitudinal data from the Framingham Heart Offspring Study conducted from 1991 to 2015 (median follow-up 16 years), participants initially at mid-life with a greater duration of favorable CVH across study visits were less likely (by 14–23%) to develop subsequent adverse cardiometabolic outcomes of incident hypertension, incident diabetes, chronic kidney disease, and death compared to those who spent same amount of time in poor CVH [53]. Additionally, data from the CARDIA (Coronary Artery Risk Development in Young Adults) study of adults aged 18–30 years, demonstrated that the presence of high CVH in young adulthood was associated with very low rates of developing premature CVD or mortality over next 32 years [54]. Among these young adults, comparing high vs low CVH status, there was an 86% and 93% reduced risk for subsequent CVD and CVD mortality, respectively, and for combined moderate/high CVH vs low CVH, there was 27% and 19% lower risks, respectively [54]. This underscores the importance of starting health promotion early in life and the need to optimize CVH from childhood through young adulthood.

Notably a healthy cardiovascular risk profile frequently tracks throughout life. Young adults with healthy lifestyle factors are more likely to have favorable CVH profile in middle-age

too [55]. Unfortunately, awareness of cardiovascular risk factors remains suboptimal in young adults, with <25% of adults aged 18–39 with borderline levels of risk factors being aware of their risk [56].

9. Pregnancy and CVH

Improving CVH among young adult population should also translate to improve maternal and fetal outcomes too. Data from NHANES 1999 to 2014 showed that less than 1 in 10 pregnant women aged 20 to 44 had high CVH, and the CVH health status for pregnant women was on average worse than for non-pregnant women [57]. Given that the leading cause of maternal mortality is CVD, and that maternal mortality is on the rise in the U.S., and is disproportionately higher in Black women [58], there is much more that needs to be done to optimize the health of expectant mothers. Notably a more favorable CVH profile at 24–32 weeks' gestation is associated with a lower risk for several adverse pregnancy outcomes such as preeclampsia [33]. Pregnancy has also been defined as a window into future CVH and numerous longitudinal studies have documented that adverse pregnancy outcomes, specifically hypertensive disorders of pregnancy (gestational hypertension, pre-eclampsia), gestational diabetes, preterm delivery, and small for gestational age delivery, are in turn associated with maternal CVD even decades after the index pregnancy [59–63], highlighting the importance of taking a reproductive history for CVD prevention [64].

The CVH of mothers is associated with the subsequent CVH of their offspring [65]. Thus, it is critical to support women before, during, and after pregnancy to optimize maternal and offspring CVH [37]. CVH promotion should be encouraged pre-conception, during pregnancy and during the "4th trimester" post-delivery. Women with a history of multiple live births may be particularly vulnerable to a decline in their own CVH with each delivery. Data from the Multi-Ethnic Study of Atherosclerosis (MESA) found that women with a history of grand multiparity (≥5 live births) were less likely to be in ideal CVH compared to nulliparous women at middle to older ages [66], which tracks along with the increased CVD risk also noted for grand multiparity [67].

10. Secondary CVD prevention

Although we think of the CVH construct for the primordial and primary prevention of CVD, studies have suggested after myocardial infarction that closer adherence to optimal levels of the 7 CVH metrics is associated with better prognosis [68], encouraging the use of this framework even in secondary prevention populations.

11. Non-CVD

Although the construct of the CVH score was derived for the promotion of cardiovascular wellness and the prevention of CVDs, having an optimal CVH score has also been associated with a decreased risk for non-cardiovascular diseases such as decreased risk for cancer, chronic kidney disease, pneumonia, venous thromboembolism, and chronic obstructive pulmonary disease [32,69].

Health promotion is not just about living longer, it is about living longer free of morbidity. A prior study of over 25,000 adults showed that having more favorable CVH in mid-life not only extended survival by 4 years but postponed the onset of morbidity from any cause and from cardiovascular causes by 4.5 and 7 years, respectively [70]. In other words, favorable CVH compresses morbidity to later in life and for shorter duration.

Additionally, we discuss the following non-CVD factors of cognitive health, psychological health, and quality of life below.

11.1 Cognitive function and CVH

Low or poor CVH is also associated with greater risk of cognitive impairment in later life [34,71]. In the Atherosclerosis Risk in Communities (ARIC) study, better CVH in mid-life as assessed by the LS7 metrics, was associated with better cognitive performance at mid-life and reduce cognitive decline over next subsequent 20 years [72]. Favorable CVH at mid-life is also associated with a lower risk of dementia [34]. However even among older adults aged ≥65 years, having a greater number of ideal CVH metrics was linked with lower rates of cognitive decline and dementia [73], suggesting that optimizing CVH even later in life can still confer benefits.

11.2 Psychological health and CVH

There is a strong “mind-body” connection between mental health and physical health [74,75]. In cross-sectional analyses, individuals with more psychological stress and depression were found to be less likely in ideal CVH [76,77]. Among women in mid-life, perceived stress and less rewarding social roles were both associated with having fewer CVH metrics in the ideal range, with longitudinal analyses showing greater stress was associated with lower likelihood of maintaining normal glucose and a normal BMI [78]. Other prospective studies have found that individuals with great ideal CVH metrics had reduced odds of developing depressive symptoms [79], suggesting bidirectional relationship between psychological and CVH. Although a causal relationship cannot be determined, the findings are at least suggestive that improving psychological health may be one strategy to improve CVH.

11.3 Quality of life

Having a greater number of ideal CVH metrics is also associated with better patient reported outcomes including a better self-perception of health [14], a better health-related quality of life, and a more favorable healthcare experience [20]. Thus, preventive measures aimed at optimizing ideal CVH metrics may in turn improve patient experience.

12. Healthcare expenditures

Being in ideal CVH is also associated with reduced health care costs [80,81]. Using cross-sectional data from the 2012 Medical Expenditure Panel Survey which examined 6 of the CVH metrics (diet data were not available), individuals without CVD who had optimal CVH profiles had $4031 lower healthcare expenditures than those with poor CVH profiles, and the difference was even greater ($5946) for those with established CVD [81]. In longitudinal

studies, more favorable CVH in midlife was associated with reduced cumulative and annual healthcare costs during Medicare eligibility years (i.e., after age 65) [70].

13. Social determinants of health

There also has been an established link between social determinants of health and CVH. Increasing numbers of social risk factors has been associated with decreased odds of achieving ideal CVH metrics among U.S. adults [82]. For example, both higher educational attainment and a higher household income-to-poverty ratio are consistently associated with greater prevalence of meeting ≥5 ideal CVH metrics [15]. Data from MESA found that factors related to the neighborhood environment, including the walking/physical activity environment, availability of physical activity resources, favorable food stores, and neighborhood socioeconomic status were associated with a higher odds of favorable CVH status (scores 11–14) [83].

A recent AHA statement outlined the importance of housing on CVH and well-being [84]. Employment status has also been linked to CVH scores. Among Hispanic/Latino adults, younger males who were employed had a higher prevalence of an optimal CVH score. On the other hand, Hispanic/Latino women who were unemployed or were homemakers were less likely to meet the ideal CVH metrics [85].

Race is a social construct, either self-identified or assigned by society. Some of aforementioned racial/ethnic disparities in CVH status may be attributed to health inequities related to social determinants of health and structural racism. Prior work from MESA suggested social factors such as neighborhood factors only accounted for a modest difference in the disparities in CVH status by race/ethnicity [86], but no one single social factor or composite score can likely capture all of the social risk contributing to these gaps. A powerful recent statement by the AHA identified structural racism as a fundamental driver of health disparities [87], and highlighted the role that clinicians, scientists, and public health officials can play to be allies and promote anti-racism in order to achieve health equity across the population.

Life course social determinants are important factors to consider and should be further integrated into our approach to CVH promotion.

14. Acculturation and CVH

Acculturation is the process of consciously or subconsciously incorporating the behaviors, customs, values, language of a new country. Voluntary immigrants from minority racial/ethnic groups may have better CVH compared to native-born residents in the U.S. Some studies have examined the degree of acculturation with CVH metrics [39,88–90].

In a cross-sectional study from the MESA study from 6 U.S. communities which included over 6,000 adults free of clinical CVD, greater U.S. acculturation was associated with poorer CVH [88]. Specifically, U.S.-born participants were less likely to have optimal CVH scores compared to foreign-born participants, after accounting for sociodemographic factors [88]. Participants who spoke Chinese or other foreign languages at home had greater odds of

having optimal CVH scores compared to participants who spoke English. There was also an inverse association between years lived in the U.S. and the CVH score [88].

Similarly, in another cross-sectional study using 2011–2016 NHANES data of Asian Americans and Latinos found that after adjusting for demographic and socioeconomic factors, participants who spoke their native languages at home were less likely to be in the poor/intermediate category for the CVH metrics of smoking and blood pressure compared to those who spoke English at home [89]. Another cross-sectional study using a community health survey from 2011 to 2014 examined the length of residence in the U.S. and CVH among Afro-Caribbean immigrants in New York City. This study found that after adjusting for sociodemographic factors, immigrants of Guyanese and Haitian origin who had lived in the U.S. for ≥10 years had a higher prevalence of being in the poor/intermediate category of the CVH score compared to those who had lived in the U.S. for less than 10 years [90].

Thus, the available data suggest that greater U.S. acculturation and more years lived in the U.S. are associated with poorer CVH. The CVH score can be one way to monitor CVH among immigrant populations and highlights the need to develop culturally tailored programs that promote CVH and wellness among immigrant populations.

15. Biomarkers

Biomarkers are subclinical indicators of physiological and pathological processes [91] and can help facilitate early detection and prognostication of CVD [92]. Not surprisingly, greater CVH scores have shown an inverse relationship with subclinical biomarkers of disease [93–97]. For example, in the MESA study, even after adjusting for sociodemographic factors, poor CVH status was found to be associated with higher levels of the inflammatory markers of GlycA, high sensitivity C-reactive protein (hsCRP), and interleukin-6 (IL-6), as well as with higher levels of the risk markers of fibrinogen, D-dimer, homocysteine and high-sensitivity cardiac troponin T [94,95], although a direct association was found between CVH score and N-terminal pro-B-type natriuretic peptide [95]. In the Framingham Study, the authors similarly found inverse association of CVH score with CVD subclinical biomarkers except for a direct association with natriuretic peptides, and concluded that the inverse association of CVH with incident clinical CVD events was at least partly attributable to the favorable relationship of CVH with these subclinical biomarkers of risk [97]. Together, these studies suggest that the generally favorable association of CVH with biomarkers of CVD risk may be an intermediary step in the progression to clinical CVD events and may offer a window of opportunity for more intensive preventive efforts. However, it remains unclear if biomarkers would provide additional information in monitoring or clinical prediction above and beyond assessment of CVH.

16. Subclinical atherosclerotic disease

Similar to biomarkers, multiple studies have demonstrated an inverse association between ideal CVH scores and measures of subclinical cardiovascular disease [93,96–107]. For example, there is also an inverse relationship between the number of ideal CVH metrics and the prevalence of coronary artery calcium (CAC) in adults [106,107], which is a surrogate

marker of the total burden of coronary atherosclerosis and prognostic of future CVD risk [108]. In the MESA study, adults with moderate and high CVH scores had a 43% and 71% lower odds of having prevalent CAC (CAC score >0) compared to adults with low CVH scores [93]. Additionally, some studies have also found that higher CVH scores were associated with a lower prevalence and incidence of aortic calcification [109,110].

In the Young Fins study, children and young adults (ages 12–24) with better CVH had decreased prevalence of subclinical atherosclerosis, as assessed by CAC and increased carotid intimal medial thickness, once they reached middle age [105], emphasizing the importance that prevention and optimization of CVH should begin early in life. In this study, individuals who started with low CVH but improved their CVH over the follow-up also had lower prevalence of subclinical vascular disease than those with remained at low CVH, thus demonstrating the importance of regaining CVH even if it is initially lost [105].

17. Atherosclerotic CVD Risk Scores vs CVH Score

Most prevention guidelines recommend starting a clinician-patient risk discussion with the estimation of an individual's 10-year risk for atherosclerotic CVD to guide decisions regarding preventive therapies [111]. After calculation of 10-year risk, individuals are then classified as being at low (<5%), borderline (5–<7.5%), intermediate (7.5–<20%), or high (≥20%) risk for atherosclerotic CVD, and this risk estimation can be further fine-tuned by considering "risk-enhancing" factors and the selective use of CAC among the borderline and intermediate risk groups [111]. Limitations of 10-year CVD risk estimation tools, such as the Pooled Cohort Equations, include that they are heavily driven by non-modifiable factors such as age, sex, and race/ethnicity and can both over- and under-estimate risk among certain populations [112,113]. The advantage of the CVH score is that it considers only modifiable factors, and thus discussion with individuals about their CVH score would be beneficial to emphasize the things that individuals can directly change. However, to really combat the epidemics of CVD, strategies need to move beyond an individual-based (n of 1) approach, especially when tremendous societal pressures are stacked against the optimization of CVH.

18. Expert opinion

In sum, there is robust and ample data about the benefits of CVH for longevity, reduced risk for CVD, and protection from a variety of non-cardiovascular chronic diseases. Despite this, the worsening trends of CVH in U.S. adults suggest effective translational promoting CVH in clinical practice is lacking. Multiple organizations including the AHA and U.S. Preventive Services Task Force (USPSTF) have put forth recommendations on behavioral counseling and population-based approaches for improving the lifestyle components of the CVH score [111,114,115], but their effectiveness has been variable. Since favorable CVH metrics tend to cluster together, comprehensive health promotion strategies are likely to more effective than focusing on any one single measure [116], and community partnerships outside of healthcare professionals should be leveraged [117]. A team-based approach to prevention should be employed [111].

Entire psychological, social, and community factors should be addressed to combat structural and systemic barriers to health inequities. Large population based structural changes are warranted related to access to healthcare, access to healthy food sources, transportation modalities, working hours, structural racism, and poverty. There are a lot of advantages of using the CVH construct in its simplicity of just 7 measures and its demonstrated strong prognostic value, to track population health over time. However, many challenges still remain and must be overcome to improve CVH at the individual and the societal level if the AHA 2030 Impact Goals are to be fully and equitably realized.

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Annotation: '*' – of interest, or "**" – of considerable interest

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Article highlights

- The cardiovascular health (CVH) is characterized by 7 health behaviors and health factors that are all modifiable.
- A greater number of ideal CVH metrics and higher composite scores are associated with lower incidences of cardiovascular disease (CVD), cardiovascular mortality, non-cardiovascular diseases, and all-cause mortality
- Even modest gains in CVH across the population can have large impact in reducing CVD events.
- Maternal CVH influences offspring CVH; it is important to support CVH of women before, during, and after pregnancy
- Longer duration spent in optimal CVH is association with longevity and compressed morbidity

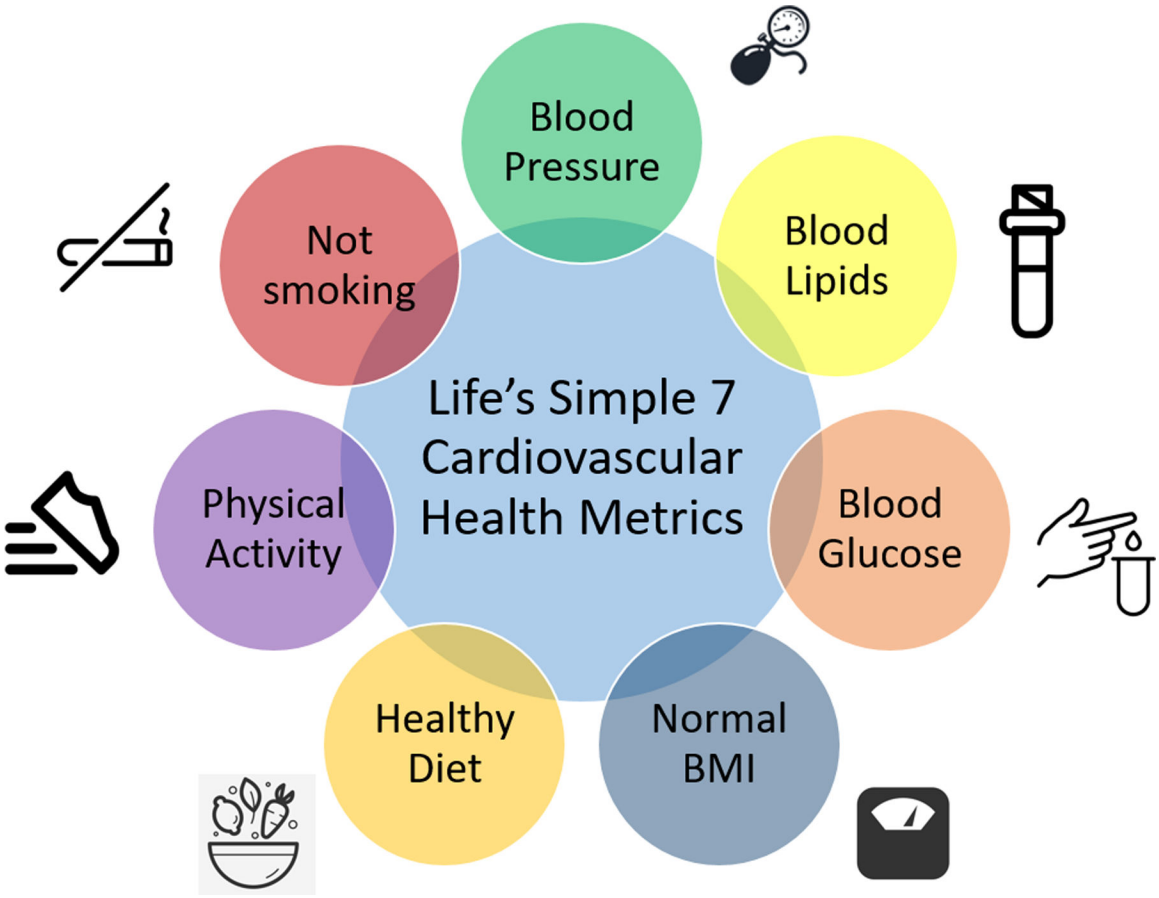
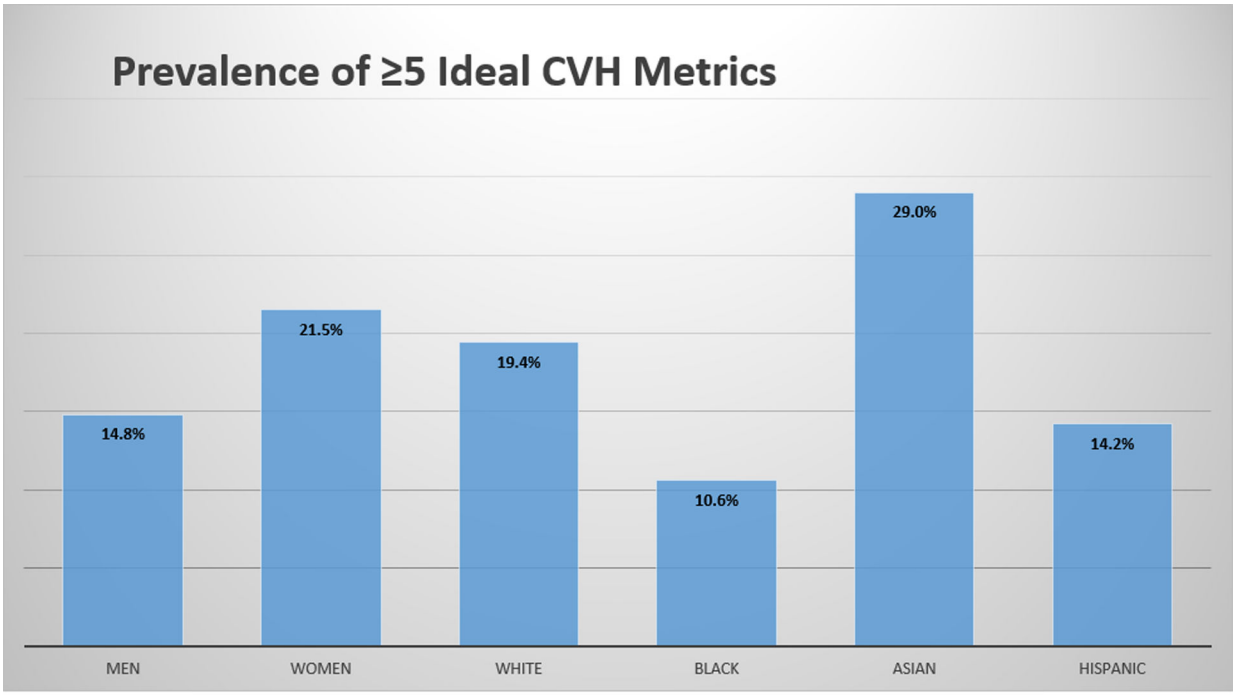


Figure 1: The 7 modifiable health and behavioral metrics included in the CVH score
Abbreviations: CVH, cardiovascular health; BMI, body mass index



Based on 2013-2014 data from the National Health and Nutrition Examination Survey (NHANES) and adapted from Benjamin EJ et al. Heart Disease and Stroke Statistics—2019 Update: A Report From the American Heart Association, Circulation Volume: 139, Issue: 10, Pages: e56-e528.

Figure 2: Prevalence of having 5 of more CVH metrics at ideal levels in the U.S. Population by Sex and Race/Ethnicity

Abbreviations: CVH, cardiovascular health

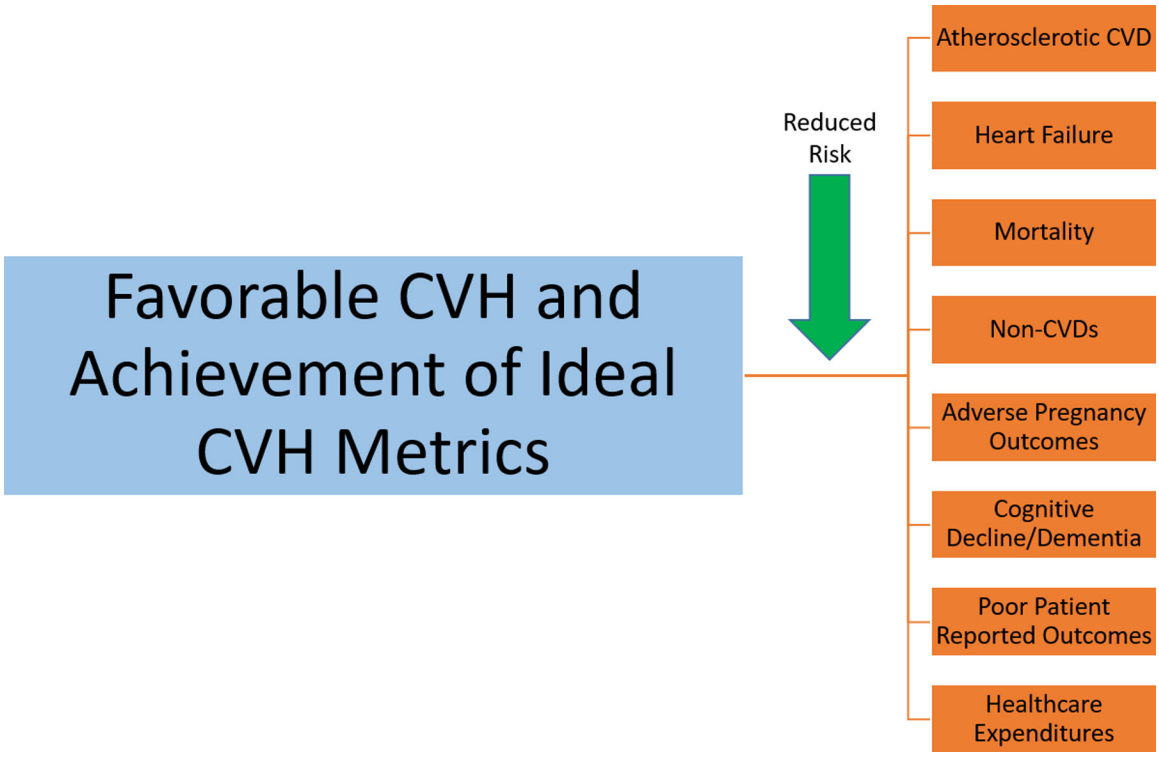


Figure 3: Outcomes Inversely Associated with Greater CVH Score

Abbreviations: CVH, cardiovascular health; CVD, cardiovascular disease

Table:

The seven metrics of CVH characterized by poor, intermediate, or ideal status.

CVH metrics	Point	Definition
Smoking	0	Current smoker
	1	Former smoker, quit ≤12 months ago
	2	Never smoker or quit >12 months ago
Body Mass Index	0	≥30 kg/m^2
	1	25.0–29.99 kg/m^2
	2	<25.0 kg/m^2
Physical Activity	0	No exercise
	1	1–149 min of moderate exercise or 1–74 min of vigorous exercise/week
	2	150+ min of moderate exercise or 75+ min of vigorous exercise/week
Diet	0	0–1 components of healthy diet
	1	2–3 components of healthy diet
	2	4–5 components of healthy diet
Total Cholesterol	0	≥240 mg/dL
	1	200–239 mg/dL or treated to <200mg/dL
	2	<200 mg/dL, unmedicated
Blood Pressure	0	SBP ≥140 mmHg or DBP ≥90 mmHg
	1	SBP 120–139 mmHg or DBP 80–89 mmHg or treated to <120/80 mm Hg
	2	<120/80 mm Hg, unmedicated
Blood Glucose	0	≥126 mg/dL fasting
	1	100–125 mg/dL fasting or treated to <100 mg/dL
	2	<100 mg/dL fasting, unmedicated

Adapted from Adapted from Lloyd Jones et al [1] and Unger et al [83].

Abbreviations: CVH, cardiovascular health; DBP, diastolic blood pressure, and SBP, systolic blood pressure. Poor=0 points; Intermediate=1 point; ideal=2 points.