Current Epidemiology Reports (2018) 5:262–271
https://doi.org/10.1007/s40471-018-0154-z

CARDIOVASCULAR DISEASE (R FORAKER, SECTION EDITOR)

Achieving Optimal Cardiovascular Health: a Social Epidemiological Approach

Tomás Cabeza de Baca[1] · Eva M. Durazo[2] · Fatima Rodriguez[3]

Published online: 21 June 2018

Abstract

Purpose of Review The American Heart Association (AHA) created the cardiovascular health (CVH) index to measure and monitor population-level reduction of cardiovascular disease (CVD) risk, with a goal of 20% reduction in CVD morbidity and mortality by 2020. Few U.S. adults meet all seven ideal CVH metrics (non-smoking behavior, healthy diet and body weight, active lifestyle, good cholesterol, glucose, and blood pressure scores), with 17% of men and women only achieving five or more ideal CVH metrics. This review describes the importance of considering sociodemographic, psychosocial, and behavioral factors as key strategies to achieve the AHA 2020 goals.

Recent Findings Men, racial/ethnic minorities, and individuals of lower socioeconomic status are less likely to achieve ideal CVH—which may start in early childhood. An emerging body of literature indicates that individuals with high-quality social relationships, positive childhood experiences and psychological functioning, along with lifestyle factors, may impact attainment of optimal CVH. For example, exploring the role of food insecurity in CVH attainment demonstrates the complex interplay between contextual factors and lifestyle behaviors that may promote or deter ideal CVH. Evidence also suggests that the CVH index has convergent validity with intermediate and hard endpoints of CVD. Interventions that seek to promote multi-system resiliency may help close the gap in attainment of the AHA 2020 goals.

Summary Research on psychosocial and behavioral factors suggests that social connections, psychological resources, and health-maintaining behaviors are important areas to target to improve CVH in minorities and other vulnerable groups.

Keywords Ideal cardiovascular health · Cardiovascular disease risk · Psychosocial factors · Socioeconomic status · Social epidemiology · Social determinants of health

This article is part of the Topical Collection on *Cardiovascular Disease*

✉ Tomás Cabeza de Baca
tomas.cabezadebaca@ucsf.edu

Eva M. Durazo
eva.durazo@ucsf.edu

Fatima Rodriguez
frodrigu@stanford.edu

[1] Division of Cardiology, Department of Medicine, University of California, San Francisco, 400 Parnassus Ave, Room AC-16, Box 0369, San Francisco, CA 94143, USA

[2] Department of Epidemiology and Biostatistics, University of California, San Francisco, 550 16th Street, San Francisco, CA 94158, USA

[3] Division of Cardiovascular Medicine and Cardiovascular Institute, Stanford University School of Medicine, Stanford University, Stanford, CA, USA

Introduction

Over 800,000 people in the United States (U.S.) annually succumb to complications attributed to cardiovascular disease (CVD) [1••]. Although CVD rates have steadily decreased over time, CVD still accounts for $329.7 billion in direct and indirect economic costs [1••]. Moreover, research indicates that CVD rates vary between different groups residing in the U.S., with higher rates among racial/ethnic minorities and low-income families [1••]. Importantly, CVD is largely preventable through lifestyle modifications and risk factor control. As such, the American Heart Association (AHA) has created the AHA 2020 Strategic Goals [2••] to address these disparities and ultimately reduce both CVD morbidity and mortality in the U.S. by 20% in the year 2020 [2••]. Upon the creation of the AHA 2020 Strategic Goals, a major question arose: How would the AHA and researchers track annual progress? In response, the AHA created cardiovascular health

(CVH), a standard measure and trackable index to assess progress towards the 2020 Strategic Goals.

The development of the CVH index to monitor population-level trends in disease risk was primarily informed by the concept of primordial prevention [2••, 3], which reorients researchers and policy-makers to focus on the prevention of risk factors as a means of disease prevention. By shifting the focus to modifying major behavioral and health risk factors, prevention of CVD should follow. The CVH index, a score based on attainment of seven modifiable risk factors, can be used to monitor individual- and population-level health trajectories in progression of CVD risk.

While the significance of social and psychological characteristics were acknowledged as profound forces in the etiology of CVH, they were ultimately not included in the creation of the CVH index [2••]. As such, this paper takes a social epidemiological approach [4]—in which we examine psychosocial determinants that may enhance or undermine individual- and population-level CVH, such as social capital and inequality factors and personal relationships [5]. Cardiovascular morbidity and mortality disproportionately affects disadvantaged groups in the U.S., particularly racial/ethnic minorities and lower-income individuals. As a result, there is likely a social gradient of health such that psychosocial, behavioral, and environmental factors have a profound impact on health through their influence on health behaviors and life experiences [6–8].

Similarly, Puterman and Epel [9] have put forth the concept of multi-system resiliency to organize and integrate major psychosocial and behavioral factors that promote healthy aging across the lifespan, including social connections, psychological resources, and health-maintaining behaviors (see Table 1 for a summary of this literature). Maintaining these three factors of healthy aging may dampen the inimical effect of stress over the lifetime and cultivate good health and longevity. Meanwhile, an absence of these three factors could accelerate aging, chronic disease, and somatic deterioration. While research on multi-system resiliency typically aggregates the three factors together to create a composite of health-enhancing factors, currently no research exists examining the association of multi-system resiliency on ideal CVH. Because of this, we examine each of the components of multi-system resiliency individually.

Figure 1 presents a conceptual schematic that visually illustrates the organization of the paper. Thus, we begin the review by defining the CVH index, and next, we examine sociodemographic factors (sex, race/ethnicity, and socioeconomic status) to identify vulnerable populations that may be most at risk for poor CVH. We then consider psychosocial and behavioral health-enhancing components (e.g., high-quality social connections and positive psychological resources) that may enhance CVH. Finally, we briefly review the association of CVH with intermediate and hard endpoints of CVD. We conclude by briefly discussing the importance of context and examining each of these factors within ecological models.

Cardiovascular Health

The AHA's CVH index was created to track empirically validated and modifiable indicators, including four lifestyle behaviors (smoking behavior, body mass index, physical activity, and healthy dietary factors) and three health factors (total cholesterol, blood pressure, and glucose), known as Life's Simple 7 ([2••]; see Table 2 for a complete description of CVH and its components).

Individually, each of the components is categorized into three different levels of CVH: *ideal*, *intermediate*, and *poor*, based on evidence-based cut-points. For instance, an individual who has never smoked or quit smoking over a year ago is categorized as ideal; a former smoker who quit less than a year ago is classified as intermediate; and a current smoker is categorized as poor on the smoking behavior metric.

Summed together, Life's Simple 7 creates an overall CVH score which can be categorized into ideal, intermediate, and poor categories [2••, 10], or examined as a continuous variable. Ideal CVH is defined by the AHA as the absence of CVD and the presence of ideal CVH on all seven components.

Sociodemographic Factors

Sex Differences Adults in the U.S. have CVH profiles that predominately fail to meet the Simple 7 criteria for "ideal" CVH, with 17% of individuals achieving an ideal CVH profile on five or more components [1••]. When disaggregated by sex, prevalence of five or more ideal CVH components is higher in U.S. women (21%) compared to men (13%) [1••]. Cross-sectional studies from China and Spain similarly find that a majority of adults fail to meet all seven components of ideal CVH, but women had higher proportions of ideal and intermediate CVH [11, 12].

Using the National Health Survey in the Republic of Srpska, Bosnia, and Herzegovina, Jankovic et al. [13] observed that younger women aged 18–39 years had three times the odds of attaining ideal CVH compared to men in the same age group. While they observed that middle-aged women aged 40–64 years had 2.25 times the odds of ideal CVH compared to men, there was no difference by sex for adults age 65 and over. Similarly, a cross-sectional study of middle-aged and older adults in France found that women had four times the odds of ideal CVH and two times the odds of having intermediate CVH compared to men [14•]. When testing interactions, the authors observed less of a sex difference in CVH with increasing socioeconomic deprivation and more of a sex difference in CVH with increasing levels of

Table 1 Brief summary of psychosocial factors and ideal cardiovascular health (in alphabetical order)

Authors	Cohort	N	Mean age	Female %	Study design	Factor	Cardiovascular health	Parameter estimate	95% CI
Boehm et al. [32•]	English Longitudinal Study of Ageing	4925	64.6	56.6	Long	Psychological well-being	Favorable (5 behavioral components)	0.05	0.02–0.08
Gaye et al. [39]	Paris Prospective Study III	9417	59.6	38.8	CS	Depressive symptoms (≥ 7) or current antidepressant use	Intermediate (3–4 components)	0.70	0.58–0.83
Gaye et al. [39]	Paris Prospective Study III	9417	59.6	38.8	CS	Depressive symptoms (≥ 7) or current antidepressant uses	Ideal (5–7 components)	0.56	0.41–0.75
Hernandez et al. [42]	Multi-Ethnic Study of Atherosclerosis	5134	63.6[1]	53.1[1]	CS	Optimism (IV quartile)	Intermediate (8–11 points)	1.51	1.25–1.28
Hernandez et al. [42]	Multi-Ethnic Study of Atherosclerosis	5134	63.6[1]	53.1[1]	CS	Optimism (IV quartile)	Ideal (12–14 points)	1.92	1.30–2.85
Leung et al. [58••]	National Health and Nutrition Examination Survey	7802	20–65[2]	51.7	CS	Food insecurity	Ideal components (≥ 3)	0.73	0.60–0.89
Leung et al. [58••]	National Health and Nutrition Examination Survey	7802	20–65[2]	51.7	CS	Food insecurity	Ideal components (≥ 4)	0.69	0.59–0.80
Leung et al. [58••]	National Health and Nutrition Examination Survey	7802	20–65[2]	51.7	CS	Food insecurity	Ideal components (≥ 5)	0.63	0.49–0.81
Leung et al. [58••]	National Health and Nutrition Examination Survey	7802	20–65[2]	51.7	CS	Food Insecurity	Ideal components (≥ 6)	0.50	0.30–0.84
Li et al. [40]	Chinese Sample	6851	40.6[1]	48.5	CS	Depression (IV quartile)[a]	Ideal (4–5 components)	0.58	0.43–0.78
Loucks et al. [41]	New England Family Study	382	47.0	57.0	CS	High dispositional mindfulness (> 5 score)	Ideal (4+ components)	1.86	1.08–3.19
Mathews et al. [15]	The Baptist Health South Florida Employee Study	9056	43.0	74.0	CS	Stress (favorable/unfavorable)	Ideal/intermediate (9–14 points)	0.58	0.50–0.66[W]
Mathews et al. [15]	The Baptist Health South Florida Employee Study	9056	43.0	74.0	CS	Depression (yes/no)	Ideal/intermediate (9–14 points)	0.58	0.43–0.78[W]
Mathews et al. [15]	The Baptist Health South Florida Employee Study	9056	43.0	74.0	CS	Low life satisfaction (favorable/unfavorable)	Ideal/intermediate (9–14 points)	0.55	0.43–0.70[W]
Mathews et al. [15]	The Baptist Health South Florida Employee Study	9056	43.0	74.0	CS	Hopelessness (yes/no)	Ideal/intermediate (9–14 points)	0.46	0.31–0.66[W]
Mathews et al. [15]	The Baptist Health South Florida Employee Study	9056	43.0	74.0	CS	Sadness (yes/no)	Ideal/intermediate (9–14 points)	0.47	0.32–0.68[W]
Mathews et al. [15]	The Baptist Health South Florida Employee Study	9056	43.0	74.0	CS	Anxiety (yes/no)	Ideal/intermediate (9–14 points)	0.54	0.41–0.71[W]
Mathews et al. [15]	The Baptist Health South Florida Employee Study	9056	43.0	74.0	CS	Stress (favorable/unfavorable)	Ideal/intermediate (9–14 points)	0.63	0.50–0.81[M]
Mathews et al. [15]	The Baptist Health South Florida Employee Study	9056	43.0	74.0	CS	Depression (yes/no)	Ideal/intermediate (9–14 points)	0.44	0.26–0.76[M]
Matthews et al. [36]	Pittsburgh Youth Study	307	33.1	0.0	Long	Adolescent academic achievement	Adult ideal (continuous)	− 0.13	n/a
Matthews et al. [36]	Pittsburgh Youth Study	307	33.1	0.0	Long	Parental quality X race interaction	Adult ideal (continuous)	− 0.19	n/a
Pulkki-Råback et al. [33]	Cardiovascular Risk in Young Finns Study	1089	10.2	56.2	Long	Favorable psychosocial composite	Adult ideal	0.15	n/a
Saiz et al. [59]	Survey of the Health of Wisconsin	2935	44.2[1]	50.0	CS	Food insecurity	Ideal/intermediate	0.53	0.31–0.92
Serlachius et al. [69]	Cardiovascular Risk in Young Finns Study	1113	31.8	58.0	Long	Dispositional pessimism	Ideal	− 0.08	n/a
Slopen et al. [31]	Midlife and Aging in the United States Study	1255	54.6	56.2	Retro/ CS	Positive childhood experiences (quartile 2)	Ideal (continuous)	0.32	n/a

Table 1 (continued)

Authors	Cohort	N	Mean age	Female %	Study design	Factor	Cardiovascular health	Parameter estimate	95% CI
Slopen et al. [31]	Midlife and Aging in the United States Study	1255	54.6	56.2	Retro/ CS	Positive childhood experiences (quartile 3)	Ideal (continuous)	0.64	n/a
Slopen et al. [31]	Midlife and Aging in the United States Study	1255	54.6	56.2	Retro/ CS	Positive childhood experiences (quartile 4)	Ideal (continuous)	0.61	n/a
Slopen et al. [31]	Midlife and Aging in the United States Study	1255	54.6	56.2	Retro/ CS	College or more	Ideal (continuous)	0.82	n/a
Slopen et al. [31]	Midlife and Aging in the United States Study	1255	54.6	56.2	Retro/CS	Depression	Ideal (continuous)	− 0.35	n/a
Slopen et al. [31]	Midlife and Aging in the United States Study	1255	54.6	56.2	Retro/CS	Social support	Ideal (continuous)	0.34	n/a
Veromaa et al. [31]	PORi To Aid Against Threats	732	48.0	100.0	CS	Any psychosocial risk factor	Ideal (5–7 components)	$p = 0.03$	n/a
Veromaa et al. [31]	PORi To Aid Against Threats	732	48.0	100.0	CS	Social isolation (yes/no)	Ideal (5–7 components)	$p = 0.06$	n/a
Veromaa et al. [31]	PORi To Aid Against Threats	732	48.0	100.0	CS	Depression (yes/no)	Ideal (5–7 Components)	$p < 0.001$	n/a
Veromaa et al. [31]	PORi To Aid Against Threats	732	48.0	100.0	CS	Type D personality (Yes/No)	Ideal (5–7 components)	$p = 0.049$	n/a

Long longitudinal, *CS* cross-sectional, *Retro* retrospective, *95% CI* 95% confidence intervals

[a] Cardiovascular Health is predictor in model; WDisaggregated by women; MDisaggregated by Men

[1] Descriptive information was calculated by authors based on data available in the article

[2] Age range was reported

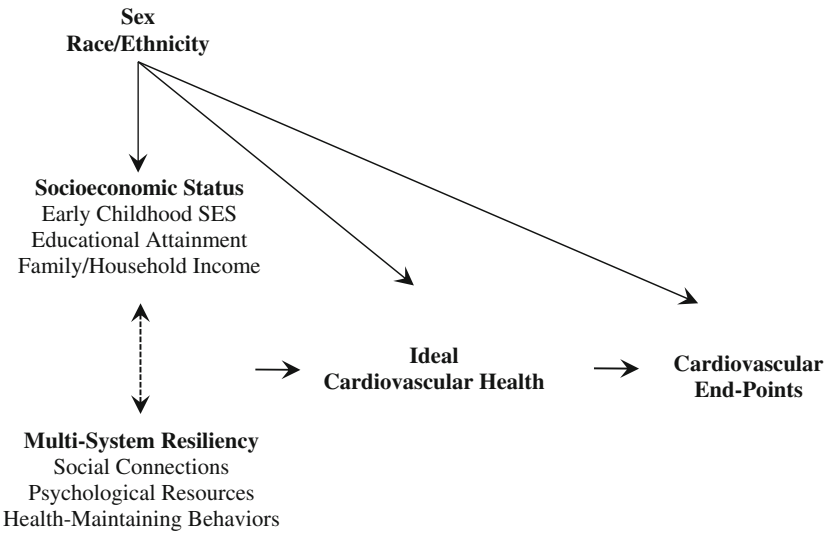

Fig. 1 Conceptual schemata of the proposed pathways between sociodemographic factors, multi-system resiliency, ideal cardiovascular health, and cardiovascular endpoints

education. While this study could not determine why there were such drastic sex differences, in particular for ideal CVH, the authors hypothesize that women interact with the health care system more often than men throughout their life course, offering opportunities for health education and prevention [15].

Race/Ethnicity Disparities in CVH by race/ethnicity follow similar patterns as to the racial/ethnic disparities for CVD: non-Hispanic whites (whites) have better CVH, followed by Latinos, and African Americans tend to have the poorest CVH [16–19]. Little research is available for the U.S. Asian population and its subgroups. When available, Asians, as a collective group, have higher levels of ideal CVH compared to whites [19]. It is important to note that, like Latinos, there is much heterogeneity (i.e., within-group differences) that may differentially impact CVH.

In a recent study using the National Health and Nutrition Examination Survey (NHANES), Brown et al. [18] found that less than 40% of whites, 25% of Mexican Americans, and 15% of African Americans in the U.S. have optimal CVH, demonstrating a clear disparity in ideal CVH. While disparities have decreased over time, this was attributed to a decline in the optimal CVH of whites and not an improvement in CVH for the other groups [18]. Another NHANES study found that the racial/ethnic disparities were even more pronounced by sex [20]. Black women had consistently worse CVH profiles compared to white women at each survey time-point. Mexican American women had worse CVH compared to white women for most survey time-points, yet racial/ethnic differences were smaller and mostly non-significant in men [20].

African Americans have been found to have the lowest scores of ideal CVH. Findings from the Jackson Heart Study demonstrated that neither sex met all seven ideal CVH factors,

Table 2 Criteria and components of ideal cardiovascular health

	Cardiovascular health		
Component	Poor	Intermediate	Ideal
Current smoking	Yes	Former smoker ≤12 months	Never or quit > 12 months
Body mass index	≥ 30 kg/m^2	25–29.9 kg/m^2	< 25 kg/m^2
Physical activity	0	Moderate activity: 1–149 min/week *or*	Moderate activity: ≥ 150 min/week *or*
	0	Vigorous activity: 1–74 min/week *or*	Vigorous activity: ≥ 75 min/week *or*
	0	Moderate + vigorous: 1–149 min/week	Moderate + vigorous: ≥ 150 min/week
Diet	0–1 components	2–3 Components	4–5 components
Total cholesterol	≥ 240 mg/dl	200–239 mg/dl	<200 mg/dl
Blood pressure	SBP ≥ 140 mmHg *or*	SBP 120–139 mmHg *or*	SBP < 120 mmHg *and*
	DBP ≥ 90 mmHg	DBP 80–89 mmHg	DBP < 80 mmHg
Fasting plasma glucose	≥ 126 mg/dl	100–125 mg/dl	< 100 mg/dl

(Table adapted from Lloyd-Jones et al. [2••])

and 0.3% of men and 0.6% of women met six ideal CVH components [21]. Additionally, the number of ideal CVH components attained in this population decreased with age. Especially low scores were attributed to poor diet, physical activity, and body mass index (BMI) among all adults. Among a study of children up to age 11 using NHANES data, Ning et al. found that black boys and girls had the lowest prevalence of ideal CVH components, with similar levels for white and Mexican American boys and higher attainment of ideal CVH among Mexican American and white girls [22].

While research has found that Latinos exhibit poorer overall CVH compared to whites, there is much more to be understood according to Latino ethnic subgroup. Fewer than 1% of Latinos met all seven ideal CVH components and 6% met six, according to data from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) [23]. Poorer CVH profiles were observed in older adults and males [23]. Lower CVH scores were attributed to poor diet and body weight profiles. There were also significant differences by Latino subgroups living in the U.S.; South Americans had the best CVH scores, followed by Mexicans, Cubans, and Puerto Ricans.

There is limited research on the attainment of ideal CVH among Asians in the U.S., although they generally have better CVD outcomes compared to other racial/ethnic groups. A community sample of Vietnamese, Chinese, and Korean Asians produced the poorest CVH component scores for physical activity, diet, and glucose levels, with 65% of participants classified as overweight/obese using the Asian BMI criteria [24]. Korean-origin adults had the poorest CVH profile across the different measured components [24]. Additionally, Asian immigrants with a longer duration of residence in the U.S. had lower CVH as compared to those who had newly immigrated [24]. A study of South Asians from the Indian sub-continent found that no participants had all seven ideal CVH components, with 4.7% achieving six components [25]. In particular, this population of South Asians failed to meet ideal profiles for diet, blood pressure, and cholesterol [25].

Accordingly, there is much variation by ethnic subgroups for the U.S. Asian and Latino populations of which we are only beginning to uncover. By the limited availability of research, there is much more work to be done to understand the disparities in ideal CVH by race/ethnicity.

Socioeconomic Status Individuals with low education levels and low income are at greater risk of poor CVH [1••, 17]. Specifically, low-income adults have an inverse linear relationship with ideal CVH; adults with a low family income (below federal poverty level) had 70% lower odds of reaching five to seven ideal CVH components compared to adults with a high family income [17]. Adults with less than 12 years of education had 78% lower odds of meeting five to seven ideal CVH components compared to those with 12 years of education or greater. Similar findings for education were observed in a study in the Republic of Srpska, Bosnia, and Herzegovina [26]. A longitudinal study in Denmark found that over time, education became an important modifier for women in particular, with the difference in ideal CVH increasing by 500% between the highest- and lowest-educated women [27].

Evidence suggests that socioeconomic status in childhood may influence CVH trajectories in adulthood. A Finnish cohort with a 32-year follow-up found that, when traditional risk factors were accounted for, parental socioeconomic status predicted offspring CVH. Additional analyses found that socioeconomic status in adulthood mediated the association, but childhood socioeconomic position was still a predictor for CVH [28]. Similarly, adolescents who had a more educated mother (defined by the authors as higher secondary education or higher education university degree) obtained higher levels of CVH when compared to adolescents with mothers of lower education [29].

Multi-system Resiliency

Social Connections A body of work exists documenting the health-enhancing effects of high-quality social connections on indices of health. To our knowledge, limited work has been documented on the effect of social connections on CVH. A cross-sectional study of female municipal workers from Finland found that social isolation (i.e., the lack of social connection) was most prevalent in women with two or fewer ideal CVH components, followed by those with three to four and five to seven, respectively, at ideal levels; accounting for age and educational attainment attenuated this association ($p = .06$) [30]. In the Midlife in the U.S. (MIDUS) survey, social support (partner, family, and friends) was associated with greater levels of ideal CVH ($B = 0.34$), even when accounting for other psychosocial and demographic factors [31].

Psychological Resources An English longitudinal study on older adults found that greater psychological well-being, an aggregated psychological resource variable including control, autonomy, pleasure, and self-realization, was associated with favorable CVH across three time-points measured over approximately 10 years [32•]. Interestingly, there was no interaction between time and well-being, suggesting that well-being was not contingent on rate of change; however, favorable CVH in older adults appeared to be temporally stable.

Research on Finnish children (mean age = 10.2) found evidence to suggest that favorable childhood psychosocial composite measures of socioeconomic status, household quality, and self-regulatory and adjustment assessments, predicted better adult CVH over 25 years later [33]. In the MIDUS survey, recalled positive childhood experiences were associated with higher levels of CVH, even when controlling for age, sex, race, and other psychosocial factors [31]. Additional analyses demonstrated that the association between positive childhood

experiences and ideal CVH was fully mediated by adult educational attainment, depression, and social support, suggesting that nurturing and predictable early childhood experiences may orient individuals toward prioritizing time, resources, and effort toward greater increased psychological resources, health-maintenance, and high-quality social connections [9, 34, 35]. The impact of parental quality may be especially important to the CVH of racial/ethnic minorities [36]. Additional research suggests that early childhood factors which promote the development of psychological resources in adulthood, including family emotional climate and self-control, can positively impact ideal CVH in adulthood (reviewed and discussed in [37]).

Depression, a major psychosocial risk factor previously implicated in the progression of CVD risk [38], was found to diminish the likelihood of attaining intermediate CVH by 30% and ideal CVH by 44% [39]. Other work continues to support that depression may be an important risk factor for diminished CVH [30, 31, 40], while dispositional mindfulness and optimism have both been correlated with better CVH [41, 42].

Health-Maintaining Behaviors A prospective study utilizing the Nurses' Health Study II found that young women who maintained a healthy lifestyle had a 92% lower risk of CHD and a 66% lower risk of CVD when compared to women with no healthy lifestyle factors. Furthermore, women with one or more clinical CVD risk factor (such as hypertension or diabetes) and one healthy lifestyle factor had a lower risk of CHD compared to women with no healthy lifestyle factors, with a risk decreasing in a dose-response fashion as the number of healthy lifestyle factors increased. This demonstrates that following a healthy lifestyle in young adulthood can serve as a preventive measure for CVD risk later in life [43].

CVH research examining the importance of health-maintaining behaviors has focused on the emergence of healthy habits early in the lifespan, identifying diet and physical activity as important childhood and adolescent CVH behaviors to consider [22, 44]. For instance, children between the ages of 5 and 11 failed to achieve an ideal diet (prevalence of four or five ideal diet components: 0.03% boys; 0.05% girls), with the majority of children falling into the poor diet category (one or fewer ideal diet components; 85.5% boys; 83.1% girls) [22]. Similarly, European adolescents who watched television for two or more hours a day—a potential proxy for inactive lifestyle behaviors—had lower ideal CVH scores than adolescents who watched two or fewer hours of television daily [29].

CVD Endpoints and Cardiovascular Health

CVH denotes an emergent construct of cardiovascular risk factors that are derived from a series of behavioral/lifestyle and biological domains. The composite measure was designed to monitor the annual progression of population-level CVH to ensure that the 2020 Strategic Goals put forth by the AHA were being met. As with any construct, it is important to examine convergent and predictive validity of a measure (i.e., does CVH predict other cardiovascular endpoints?). Here, we briefly summarize an emerging body of research that examines the association between CVH and intermediate endpoints (anatomic/pathophysiological) and hard endpoints (CVD events).

Intermediate Endpoints Ideal CVH and 21-year positive change in ideal CVH have been identified as predictors of decreased pulse wave velocity [45]. There was a gradient effect observed between the number of ideal CVH components and concentric and eccentric left ventricle hypertrophy (LVH): fewer ideal CVH components were associated with an increased prevalence of LVH [46]. There was additionally a substantial risk of concentric LVH (OR 5.90; 95% CI 2.77, 12.55) and eccentric LVH (OR 3.24; 95% CI 2.36, 4.47) abnormalities in individuals with poor CVH, compared to intermediate-ideal CVH [46]. Higher levels of ideal CVH have also been associated with a lower risk of venous thromboembolism [47], carotid intima-media thickness [48], and incident coronary artery calcification [49] and with an 8% decrease in incident carotid plaque [50]. Ideal CVH is also associated with novel biological markers such as telomere length. When compared to ideal CVH, intermediate ($B = -2.37$; 95% CI −4.41, −0.33) and poor ($B = -3.41$; 95% CI −5.97, −0.84) CVH were associated with a significant shortening of telomere length, even when controlling for sociodemographic factors and C-reactive protein [51].

Hard Endpoints Meta-analytic data of six studies ($N = 142{,}137$) found a 19% reduction in CVD-related death (HR_{pooled} 0.81, 95% CI 0.75, 0.87) and an 11% reduction in all-cause mortality with the presence of each additional ideal CVH component (HR_{pooled} 0.89, 95% CI 0.86, 0.93) [52••]. Other meta-analytic studies have also found decreased risk of CVD and stroke events, and CVD death with greater presence of ideal CVH [53, 54]. Multi-Ethnic Study of Atherosclerosis data revealed that heart failure risk decreases with increasing CVH [55] The association between ideal CVH and lower risk of CVD has been documented across diverse racial/ethnic groups [55, 56].

Heart of the Matter: Addressing Ecological Forces—an Example of Food Insecurity

Although a large body of literature exists to suggest the importance of health-maintaining behaviors in fostering CVH, the environment in which an individual resides may particularly influence health-maintaining behaviors. For instance, an emerging body of research is examining the impact of food insecurity on CVH. Food insecurity is defined as inconsistent

and unpredictable access to and consumption of nutritionally dense food and has been linked to poor diet quality in economically disadvantaged individuals [57].

Consistent with that finding, data from NHANES demonstrated that a greater perception of food insecurity dose-dependently decreased the odds of obtaining ideal CVH [58••]. A large Wisconsin sample also found an association between greater food insecurity and poorer CVH [59]. Among both sexes, food insecurity was negatively associated with ideal smoking behavior [58••], suggesting that stressful life circumstances which include instances of food-related anxiety may orient behavior toward reward-seeking or self-medicating [60], such as consumption of nicotine products [61, 62]. Taken together, the results suggest that food insecurity may be a proxy for resource-disadvantaged communities with built environments that preclude high-quality diets and/or physical activity [63, 64], which in turn influences CVH [65].

Therefore, identifying communities with food insecurity may serve as a marker for needing assistance in maintaining CVH, particularly in early childhood. As such, public health and policy initiatives informed by a social epidemiological framework could improve CVH in communities with food insecurity by targeting social and ecological factors beginning in early childhood that bolster social connections and reduce psychosocial stressors and resource inequalities. Stronger neighborhood ties would theoretically increase the quality of social relationships, but may also perpetuate neighborhood pride and political engagement which in turn would improve the quality of the built environment (e.g., safer neighborhoods, increased park space, and access to grocery stores with nutritious food choices).

Additionally, interventions could target household and parenting quality by eliminating family-level burden through food assistance programs, by financial and budgeting counseling, and by increasing psychological resources. California Food is Medicine Coalition (www.calfimc.org) is a statewide pilot program which provides nutrition assistance to low-income patients recovering from congestive heart failure. CALFIMC is an example of a medically and ecologically informed public health intervention that seeks to eliminate chronic health burden by addressing patient nutrition needs. Past research examining this paradigm in other patients with chronic disease have shown an improvement in healthcare costs, hospital readmissions, and psychosocial health outcomes [66–68]. As such, through non-clinical public health approaches to improving the health of diverse communities, we could move from treating disease to promoting ideal CVH.

Conclusions

Achievement of ideal CVH through the promotion of healthy lifestyle habits is a national priority. Although much work has documented the importance of these factors (normal blood pressure, normal cholesterol levels, healthy body weight, normal glucose levels, not smoking, eating healthy, and exercising regularly) in reducing adverse cardiovascular endpoints, limited literature exists on the role of social factors in promoting CVH. This review summarized that attainment of CVH may be particularly challenging for men, racial/ethnic minorities, and those of low socioeconomic status. We then described the importance of a constellation of positive life factors, which include maintenance of high-quality relationships, promotion of psychological functioning, and pursuit of an active lifestyle—known collectively as multi-system resiliency—in promoting CVH. Future research, clinical interventions, and public health policies should incorporate an ecological-informed framework that can mitigate sociodemographic vulnerabilities while integrating health-enhancing factors to promote CVH.

Funding Information Dr. Durazo was supported by a National Institute on Aging grant T32AG049663. Dr. Rodriguez was funded in part by the Center of Excellence Faculty Fellowship, Stanford University, the US Department of Health and Human Services, the Hispanic Center of Excellence.

Compliance with Ethical Standards

Conflict of Interest Tomás Cabeza de Baca, Eva M. Durazo, and Fatima Rodriguez declare no conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance •• Of major Importance

1.•• Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, et al. Heart Disease and Stroke Statistics—2018 Update: A Report From the American Heart Association. Circulation. 2018;137:e67–492. **This is comprehensive summary from the American Heart Association reports the reports prevalence rates of CVD and includes information regarding the Life's Simple 7.**

2.•• Lloyd-Jones DM, Hong Y, Labarthe D, Mozaffarian D, Appel LJ, Van Horn L, et al. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic impact goal through 2020 and beyond. Circulation. 2010;121:586–613. **Lloyd-Jones et al. articulate the creation of the CVH index and review the conceptual factors and goals considered in its design.**

3. Gillman MW. Primordial prevention of cardiovascular disease. Circulation. 2015;131:599–601.

4. Berkman LF, Kawachi I, Glymour MM, editors. Social epidemiology. Second edition. Oxford: Oxford University Press; 2014.

5. von dem Knesebeck O. Concepts of social epidemiology in health services research. BMC Health Serv Res [Internet]. 2015;15. Available from: http://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-015-1020-z.
6. Adler NE, Stewart J. Health disparities across the lifespan: meaning, methods, and mechanisms: health disparities across the lifespan. Ann N Y Acad Sci. 2010;1186:5–23.
7. Adler NE, Boyce T, Chesney MA, Cohen S, Folkman S, Kahn RL, et al. Socioeconomic status and health: the challenge of the gradient. Am Psychol. 1994;49:15–24.
8. Williams DR, Mohammed SA, Leavell J, Collins C. Race, socioeconomic status, and health: complexities, ongoing challenges, and research opportunities: race, SES, and health. Ann N Y Acad Sci. 2010;1186:69–101.
9. Puterman E, Epel E. An intricate dance: life experience, multisystem resiliency, and rate of telomere decline throughout the lifespan. Soc Personal Psychol Compass. 2012;6:807–25.
10. Folsom AR, Yatsuya H, Nettleton JA, Lutsey PL, Cushman M, Rosamond WD. Community prevalence of ideal cardiovascular health, by the American Heart Association definition, and relationship with cardiovascular disease incidence. J Am Coll Cardiol. 2011;57:1690–6.
11. Bi Y, Jiang Y, He J, Xu Y, Wang L, Xu M, et al. Status of cardiovascular health in Chinese adults. J Am Coll Cardiol. 2015;65:1013–25.
12. Graciani A, Leon-Munoz LM, Guallar-Castillon P, Rodriguez-Artalejo F, Banegas JR. Cardiovascular health in a southern Mediterranean European country: a nationwide population-based study. Circ Cardiovasc Qual Outcomes. 2013;6:90–8.
13. Janković J, Marinković J, Stojisavljević D, Erić M, Vasiljević N, Janković S. Sex inequalities in cardiovascular health: a cross-sectional study. Eur J Pub Health. 2016;26:152–8.
14.• Simon M, Boutouyrie P, Narayanan K, Gaye B, Tafflet M, Thomas F, et al. Sex disparities in ideal cardiovascular health. Heart. 2017;103:1595–601. **This paper documents in a French sample that women are more likely to have greater cardiovascular health, compared to men.**
15. Mathews L, Ogunmoroti O, Nasir K, Blumenthal RS, Utuama OA, Rouseff M, et al. Psychological factors and their association with ideal cardiovascular health among women and men. In: J Womens Health; 2018.
16. Pilkerton CS, Singh SS, Bias TK, Frisbee SJ. Changes in cardiovascular health in the United States, 2003–2011. J Am Heart Assoc [Internet]. 2015;4. Available from: http://jaha.ahajournals.org/content/4/9/e001650.abstract.
17. Caleyachetty R, Echouffo-Tcheugui JB, Muennig P, Zhu W, Muntner P, Shimbo D. Association between cumulative social risk and ideal cardiovascular health in US adults: NHANES 1999–2006. Int J Cardiol. 2015;191:296–300.
18. Brown AF, Liang L-J, Vassar SD, Escarce JJ, Merkin SS, Cheng E, et al. Trends in racial/ethnic and nativity disparities in cardiovascular health among adults without prevalent cardiovascular disease in the United States, 1988 to 2014. Ann Intern Med. 2018;168:541.
19. Siliki Mbassa RA, Zaslavsky AM, Williams DR, Natalie SB, Buring J, Albert MA. Abstract 18364: cumulative psychosocial stress and ideal cardiovascular health in women: data according to race/ethnicity. Circulation. 2016;134:A18364.
20. Pool LR, Ning H, Lloyd-Jones DM, Allen NB. Trends in racial/ethnic disparities in cardiovascular health among US adults From 1999–2012. J Am Heart Assoc [Internet]. 2017;6. Available from: http://jaha.ahajournals.org/content/6/9/e006027.abstract.
21. Djoussé L. Relation between modifiable lifestyle factors and lifetime risk of heart failure. JAMA. 2009;302:394.
22. Ning H, Labarthe DR, Shay CM, Daniels SR, Hou L, Van Horn L, et al. Status of cardiovascular health in US children up to 11 years of age: the National Health and Nutrition Examination Surveys 2003-2010. Circ Cardiovasc Qual Outcomes. 2015;8:164–71.
23. González HM, Tarraf W, Rodríguez CJ, Gallo LC, Sacco RL, Talavera GA, et al. Cardiovascular health among diverse Hispanics/Latinos: Hispanic Community Health Study/Study of Latinos (HCHS/SOL) results. Am Heart J. 2016;176:134–44.
24. Patterson F, Zhang G, Davey A, Tan Y, Ma GX. American Heart Association's ideal cardiovascular health metrics in underrepresented Asian Americans. J Community Health. 2016;41:1282–9.
25. Talegawkar SA, Jin Y, Kandula NR, Kanaya AM. Cardiovascular health metrics among South Asian adults in the United States: prevalence and associations with subclinical atherosclerosis. Prev Med. 2017;96:79–84.
26. Janković S, Stojisavljevi D, Jankovi J, Eri M, Marinkovi J. Association of socioeconomic status measured by education, and cardiovascular health: a population-based cross-sectional study. BMJ Open. 2014;4:e005222.
27. Olsen GS, Holm A-SS, Jørgensen T, Borglykke A. Distribution of ideal cardiovascular health by educational levels from 1978 to 2006: a time trend study from the capital region of Denmark. Eur J Prev Cardiol 2014;21:1145–1152.
28. Savelieva K, Pulkki-Råback L, Jokela M, Kubzansky LD, Elovainio M, Mikkilä V, et al. Intergenerational transmission of socioeconomic position and ideal cardiovascular health: 32-year follow-up study. Health Psychol. 2017;36:270–9.
29. Henriksson P, Henriksson H, Labayen I, Huybrechts I, Gracia-Marco L, Ortega FB, et al. Correlates of ideal cardiovascular health in European adolescents: the HELENA study. Nutr Metab Cardiovasc Dis. 2018;28:187–94.
30. Veromaa V, Kautiainen H, Saxen U, Malmberg-Ceder K, Bergman E, Korhonen PE. Ideal cardiovascular health and psychosocial risk factors among Finnish female municipal workers. Scand J Public Health. 2017;45:50–6.
31. Slopen N, Chen Y, Guida JL, Albert MA, Williams DR. Positive childhood experiences and ideal cardiovascular health in midlife: associations and mediators. Prev Med. 2017;97:72–9.
32.• Boehm JK, Soo J, Chen Y, Zevon ES, Hernandez R, Lloyd-Jones D, et al. Psychological well-being's link with cardiovascular health in older adults. Am J Prev Med. 2017;53:791–8. **Analyses from the English Longitudinal Study of Ageing highlight the importance of psychological well-being on the progression of ideal cardiovascular health (including smoking status, diabetes, blood pressure, cholesterol, and BMI) in older adults.**
33. Pulkki-Råback L, Elovainio M, Hakulinen C, Lipsanen J, Hintsanen M, Jokela M, et al. Cumulative effect of psychosocial factors in youth on ideal cardiovascular health in adulthood: the cardiovascular risk in young Finns study. Circulation. 2015;131:245–53.
34. Ellis BJ, Del Giudice M. Beyond allostatic load: rethinking the role of stress in regulating human development. Dev Psychopathol. 2014;26:1–20.
35. Cabeza de Baca T, Wahl RA, Barnett MA, Figueredo AJ, Ellis BJ. Adversity, adaptive calibration, and health: The case of disadvantaged families. Adapt Hum Behav Physiol 2016;2:93–115.
36. Matthews KA, Boylan JM, Jakubowski KP, Cundiff JM, Lee L, Pardini DA, et al. Socioeconomic status and parenting during adolescence in relation to ideal cardiovascular health in Black and White men. Health Psychol. 2017;36:673–81.
37. Sood E, Gidding SS. Childhood psychosocial determinants of cardiovascular health. Curr Cardiovasc Risk Rep. 2016;10:20.
38. Rosengren A, Hawken S, Ôunpuu S, Sliwa K, Zubaid M, Almahmeed WA, et al. Association of psychosocial risk factors with risk of acute myocardial infarction in 11 119 cases and 13 648 controls from 52 countries (the INTERHEART study): case-control study. Lancet. 2004;364:953–62.
39. Gaye B, Prugger C, Perier MC, Thomas F, Plichart M, Guibout C, et al. High level of depressive symptoms as a barrier to reach an ideal cardiovascular health. The Paris Prospective Study III Sci Rep 2016;6.

40. Li Z, Yang X, Wang A, Qiu J, Wang W, Song Q, et al. Association between ideal cardiovascular health metrics and depression in Chinese population: a cross-sectional study. Sci Rep [Internet]. 2015;5. Available from: http://www.nature.com/articles/srep11564.
41. Loucks EB, Britton WB, Howe CJ, Eaton CB, Buka SL. Positive associations of dispositional mindfulness with cardiovascular health: the New England Family Study. Int J Behav Med. 2015;22:540–50.
42. Hernandez R, Kershaw KN, Siddique J, Boehm JK, Kubzansky LD, Diez-Roux A, et al. Optimism and cardiovascular health: Multi-Ethnic Study of Atherosclerosis (MESA). Health Behav Policy Rev. 2015;2:62–73.
43. Chomistek AK, Chiuve SE, Eliassen AH, Mukamal KJ, Willett WC, Rimm EB. Healthy lifestyle in the primordial prevention of cardiovascular disease among young women. J Am Coll Cardiol. 2015;65:43–51.
44. Pacor JM, Younus A, Malik R, Osondu CU, Aziz M, Ogunmoroti O, et al. Prevalence of ideal cardiovascular health metrics in children & adolescents: a systematic review. Prog Pediatr Cardiol. 2016;43:141–6.
45. Aatola H, Hutri-Kahonen N, Juonala M, Laitinen TT, Pahkala K, Mikkila V, et al. Prospective relationship of change in ideal cardiovascular health status and arterial stiffness: the cardiovascular risk in young Finns study. J Am Heart Assoc. 2014;3:e000532.
46. Chang Y, Li Y, Guo X, Li T, Chen Y, Dai D, et al. The association of ideal cardiovascular health and left ventricle hypertrophy in rural population of northeast China: a cross-sectional observational study. Medicine (Baltimore). 2017;96:e6050.
47. Olson NC, Cushman M, Judd SE, McClure LA, Lakoski SG, Folsom AR, et al. American Heart Association's Life's Simple 7 and risk of venous thromboembolism: the Reasons for Geographic and Racial Differences in Stroke (REGARDS) study. J Am Heart Assoc. 2015;4:e001494.
48. Kulshreshtha A, Goyal A, Veledar E, McClellan W, Judd S, Eufinger SC, et al. Association between ideal cardiovascular health and carotid intima-media thickness: a twin study. J Am Heart Assoc. 2014;3:e000282.
49. Hwang S-J, Onuma O, Massaro JM, Zhang X, Fu Y-P, Hoffmann U, et al. Maintenance of ideal cardiovascular health and coronary artery calcium progression in low-risk men and women in the Framingham Heart Study. Circ Cardiovasc Imaging. 2018;11:e006209.
50. Guo L, Cheng L, He W, Ju Y, Zhao X. Ideal cardiovascular health and incidence of carotid plaque among middle-aged and elderly adults. J Stroke Cerebrovasc Dis. 2018;27:391–6.
51. Gebreab SY, Manna ZG, Khan RJ, Riestra P, Xu R, Davis SK. Less than ideal cardiovascular health is associated with shorter leukocyte telomere length: the National Health and Nutrition Examination Surveys, 1999–2002. J Am Heart Assoc. 2017;6:e004105.
52.•• Aneni EC, Crippa A, Osondu CU, Valero-Elizondo J, Younus A, Nasir K, et al. Estimates of mortality benefit from ideal cardiovascular health metrics: a dose response meta-analysis. J Am Heart Assoc. 2017;6:e006904. **This meta-analysis documents the dose-response linear risk reduction in cardiovascular and all-cause mortality with the increase in ideal cardiovascular health components.**
53. Fang N, Jiang M, Fan Y. Ideal cardiovascular health metrics and risk of cardiovascular disease or mortality: a meta-analysis. Int J Cardiol. 2016;214:279–83.
54. Guo L, Zhang S. Association between ideal cardiovascular health metrics and risk of cardiovascular events or mortality: a meta-analysis of prospective studies. Clin Cardiol. 2017;40:1339–46.
55. Ogunmoroti O, Oni E, Michos ED, Spatz ES, Allen NB, Rana JS, et al. Life's Simple 7 and incident heart failure: the multi-ethnic study of atherosclerosis. J Am Heart Assoc. 2017;6:e005180.
56. Dong C, Rundek T, Wright CB, Anwar Z, Elkind MSV, Sacco RL. Ideal cardiovascular health predicts lower risks of myocardial infarction, stroke, and vascular death across whites, blacks, and Hispanics: the northern Manhattan study. Circulation. 2012;125:2975–84.
57. Leung CW, Epel ES, Ritchie LD, Crawford PB, Is LBAFI. Inversely associated with diet quality of lower-income adults. J Acad Nutr Diet. 2014;114:1943–1953.e2.
58.•• Leung C, Tester J, Laraia B. Household food insecurity and ideal cardiovascular health factors in US adults. JAMA Intern Med. 2017;177:730. **Leung et al. find an association between food insecurity and decreased cardiovascular health in a U.S. sample.**
59. Saiz AM, Aul AM, Malecki KM, Bersch AJ, Bergmans RS, LeCaire TJ, et al. Food insecurity and cardiovascular health: findings from a statewide population health survey in Wisconsin. Prev Med. 2016;93:1–6.
60. Cabeza de Baca T, Albert MA. Psychosocial stress, the unpredictability schema, and cardiovascular disease in women. under review
61. Slopen N, Kontos EZ, Ryff CD, Ayanian JZ, Albert MA, Williams DR. Psychosocial stress and cigarette smoking persistence, cessation, and relapse over 9–10 years: a prospective study of middle-aged adults in the United States. Cancer Causes Control. 2013;24:1849–63.
62. Torres OV, O'Dell LE. Stress is a principal factor that promotes tobacco use in females. Prog Neuro-Psychopharmacol Biol Psychiatry. 2016;65:260–8.
63. Baek J, Sánchez BN, Berrocal VJ, Sanchez-Vaznaugh EV. Distributed lag models: examining associations between the built environment and health. Epidemiology. 2016;27:116–24.
64. Renalds A, Smith TH, Hale PJA. Systematic review of built environment and health. Fam Community Health. 2010;33:68–78.
65. Unger E, Diez-Roux AV, Lloyd-Jones DM, Mujahid MS, Nettleton JA, Bertoni A, et al. Association of neighborhood characteristics with cardiovascular health in the multi-ethnic study of atherosclerosis. Circ Cardiovasc Qual Outcomes. 2014;7:524–31.
66. Gurvey J, Rand K, Daugherty S, Dinger C, Schmeling J, Laverty N. Examining health care costs among MANNA clients and a comparison group. J Prim Care Community Health. 2013;4:311–7.
67. Palar K, Napoles T, Hufstedler LL, Seligman H, Hecht FM, Madsen K, et al. Comprehensive and medically appropriate food support is associated with improved HIV and diabetes health. J Urban Health. 2017;94:87–99.
68. Berkowitz SA, Terranova J, Hill C, Ajayi T, Linsky T, Tishler LW, et al. Meal delivery programs reduce the use of costly health care in dually eligible Medicare and Medicaid beneficiaries. Health Aff (Millwood). 2018;37:535–42.
69. Serlachius A, Pulkki-Råback L, Elovainio M, Hintsanen M, Mikkilä V, Laitinen TT, et al. Is dispositional optimism or dispositional pessimism predictive of ideal cardiovascular health? The Young Finns Study Psychol Health. 2015;30:1221–39.