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ORIGINAL RESEARCH

Nondietary Cardiovascular Health Metrics With Patient Experience and Loss of Productivity Among US Adults Without Cardiovascular Disease: The Medical Expenditure Panel Survey 2006 to 2015

Martin Tibuakuu, MD, MPH; Victor Okunrintemi, MD, MPH; Nazir Savji, MD; Neil J. Stone [iD], MD; Salim S. Virani [iD], MD, PhD; Ron Blankstein, MD; Ritu Thamman [iD], MD; Roger S. Blumenthal [iD], MD; Erin D. Michos [iD], MD, MHS

BACKGROUND: The American Heart Association 2020 Impact Goals aimed to promote population health through emphasis on cardiovascular health (CVH). We examined the association between nondietary CVH metrics and patient-reported outcomes among a nationally representative sample of US adults without cardiovascular disease.

METHODS AND RESULTS: We included adults aged ≥18 years who participated in the Medical Expenditure Panel Survey between 2006 and 2015. CVH metrics were scored 1 point for each of the following: not smoking, being physically active, normal body mass index, no hypertension, no diabetes mellitus, and no dyslipidemia, or 0 points if otherwise. Diet was not assessed in Medical Expenditure Panel Survey. Patient-reported outcomes were obtained by telephone survey and included questions pertaining to patient experience and health-related quality of life. Regression models were used to compare patient-reported outcomes based on CVH, adjusting for sociodemographic factors and comorbidities. There were 177 421 Medical Expenditure Panel Survey participants (mean age, 45 [17] years) representing ~187 million US adults without cardiovascular disease. About 12% (~21 million US adults) had poor CVH. Compared with individuals with optimal CVH, those with poor CVH had higher odds of reporting poor patient-provider communication (odds ratio, 1.14; 95% CI, 1.05–1.24), poor healthcare satisfaction (odds ratio, 1.15; 95% CI, 1.08–1.22), poor perception of health (odds ratio, 5.89; 95% CI, 5.35–6.49), at least 2 disability days off work (odds ratio, 1.39; 95% CI, 1.30–1.48), and lower health-related quality of life scores.

CONCLUSIONS: Among US adults without cardiovascular disease, meeting a lower number of ideal CVH metrics is associated with poor patient-reported healthcare experience, poor perception of health, and lower health-related quality of life. Preventive measures aimed at optimizing ideal CVH metrics may improve patient-reported outcomes among this population.

Key Words: cardiovascular health ■ healthcare satisfaction ■ health-related quality of life ■ Life Simple 7 ■ patient-reported outcomes

In their 2020 Strategic Impact Goals aimed at reducing cardiovascular morbidity, mortality, and economic burden, the American Heart Association (AHA) recommended modifications in 7 established cardiovascular risk factors collectively known as the Life's Simple 7 (LS7) to promote ideal cardiovascular health (CVH).[1] The 7 metrics include current smoking, body mass index, physical activity, healthy diet score, total cholesterol, blood pressure, and fasting plasma glucose. Since its definition by the AHA in 2010, several epidemiologic studies have found that attaining an ideal CVH is not only associated with improved

CLINICAL PERSPECTIVE

What Is New?

- In a nationally representative sample of US adults without clinical cardiovascular disease, we examined the trends of nondietary measures of ideal cardiovascular health (CVH) over time and their associations with patient-reported outcomes about their healthcare experience.
- The prevalence of individuals reporting ideal CVH declined from 2006 to 2015, while the prevalence of poor CVH has increased. The prevalence of poor CVH trended up across all age groups, sexes, races/ethnicities, income level, and census regions.
- Poor CVH was associated with poor patient healthcare experience, poor perception of general health, poor health-related quality of life, and higher disability days off work.

What Are the Clinical Implications?

- These findings suggest that future research should evaluate whether a focus on measuring and improving CVH by healthcare providers improves patient-reported experience and satisfaction and thus improves consumer-reported metrics on patient-centered care.
- The American Heart Association's mission is to equitably increase healthy life expectancy by 2 years in the United States by 2030. Targeted preventive measures aimed at optimizing ideal CVH metrics may improve patient-reported outcomes among US adults without cardiovascular disease.

Nonstandard Abbreviations and Acronyms

AHA	American Heart Association
CVH	cardiovascular health
LS7	Life's Simple 7
MCS	Mental Component Score
MEPS	Medical Expenditure Panel Survey
PCS	Physical Component Score
PPC	patient-provider communication
PRO	patient-reported outcomes
SF-12	12-Item Short Form

cardiovascular outcomes but also with lower all-cause mortality and lower incidence of noncardiovascular adverse health outcomes such as cancers and cancer deaths.[2–8] Prior analyses from the Medical Expenditure Panel Survey (MEPS) data revealed that attaining ideal CVH reduces the number of emergency department visits, outpatient visits, and hospitalizations, with a corresponding reduction in healthcare expenditures among individuals with and without cardiovascular disease (CVD).[9]

In their latest mission statement, the AHA aims to equitably increase healthy life expectancy beyond current projections, from 66 years of age to at least 68 years of age across the United States and from 64 years of age to at least 67 years of age worldwide by 2030.[10] Favorable patient-reported outcomes (PROs) including patient healthcare experience, patient perception of health, and health-related quality of life (HRQoL) can facilitate care decisions, streamline care, and align patient and clinician goals for better outcomes and health equity.[11] However, data on the impact of PROs on CVH status have yet to be reported despite the tremendous focus on the effect of CVH on CVD and non-CVD outcomes over the past decade.[2–4,7,12–18]

The goal of this study was to demonstrate trends in CVH among US adults without CVD across a decade (2006–2015) and further examine the associations of CVH with several PROs including patient healthcare experience, patient perception of health, HRQoL, and loss of productivity from work. We hypothesized that poor CVH would be associated with worse PROs.

METHODS

Transparency and Openness Policy

The MEPS are publicly available data sets available from the Agency for Healthcare Research and Quality. While we are not directly providing data sets, our study findings should be easily reproducible from the methods described in paper.

Study Population and Design

This analysis was performed using data from the MEPS, an annual cross-sectional national survey of individuals and families, healthcare personnel, and employers that provides information on sociodemographic factors, medical conditions, healthcare resource use, and healthcare expenditures. The survey is sponsored by the Agency for Healthcare Research and Quality. Participants in each annual household component of the MEPS are randomly drawn from the previous year's National Health Interview Survey and consist of noninstitutionalized US civilians. Following the sample draw, participants are interviewed over the telephone, and data on sociodemographic characteristics, patient experience, medical conditions, prescription medications, health resource use, associated costs, and payment sources are obtained. Additional information on healthcare use and cost

are collected from physicians, hospitals, and pharmacies. The Agency for Healthcare Research and Quality then assigns a person-weight and variance estimation stratum to each respondent to generate a nationally representative sample.

Analyses for the present study were conducted using 10 years of MEPS data collected from January 1, 2006, to December 31, 2015. We included participants aged 18 years or older, with a positive sampling weight and without a diagnosis of CVD (Figure 1). CVD was defined as self-reported or *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) diagnosis of coronary artery disease (*ICD-9-CM* codes 410, 413, and 414), stroke (433–437), heart failure (428), cardiac dysrhythmias (427), or peripheral arterial disease (440, 443, and 447). This study was considered exempt from institutional review board approval by the US Department of Health and Human Services because the MEPS data are deidentified and publicly available.

Patient-Reported Outcomes
Patient-Provider Communication and Patient Satisfaction

Each year, MEPS participants respond to questionnaires assessing patient-provider communication (PPC) derived from the Consumer Assessment of Healthcare Providers and Systems survey.[19] The questions included (1) how often healthcare providers explained things in a way that was easy to understand; (2) how often providers showed respect for what they had to say; (3) how often providers spent enough

time with them; and (4) how often providers listened carefully to them. The responses to these questions were recorded on a 4-point Likert scale: 1, never; 2, sometimes; 3, usually; and 4, always. To conform with Consumer Assessment of Healthcare Providers and Systems definitions, we recoded responses as 1, never/sometimes; 2, usually; and 3, always. Responses were totaled into scores ranging from 4 to 12 and then weighted to generate average responses from 1 to 3, with 1 indicating poor PPC, 2 indicating average PPC, and 3 indicating optimal PPC.

Patient satisfaction was assessed via the answer to the following question: "Rate of healthcare from all doctors and other health providers," from 0 (worst health care possible) to 10 (best health care possible). To capture unsatisfied individuals, this variable was divided into quartiles (because of the skewness of individuals' responses), with those in the lowest quartile being designated as having "poor patient satisfaction."

HRQoL and Self-Perceived Health Status

HRQoL was assessed using the summary scores from the physical and mental health component (Physical Component Score [PCS] and Mental Component Score [MCS], respectively) from the 12-Item Short Form (SF-12) version 2 included in the MEPS. The PCS and MCS scores ranged from 0 (worst health status possible) to 100 (best health status possible) and was treated as a continuous variable. The SF-12 has been previously validated for its use in the MEPS.[20]

Self-perceived general health was surveyed at 3 different points each year, with the following possible responses provided on a 5 point Likert scale: 1, excellent; 2, very good; 3, good; 4, fair; and 5, poor. We averaged the responses to estimate a yearly self-perceived health estimate, which was then dichotomized into the following categories: "Poor" (average score of 5) or "Excellent/Good/Fair" (average score ≤4).

Loss of Productivity From Work

At the interview, participants were asked to report their annual disability days off work. An excess of 2 disability days off was used as markers for loss of productivity from work, as it was above the 95th percentile in our study population.

CVD Risk Factors and CVH Status

Six of the 7 components the AHA's LS7 were assessed in MEPS. These included not smoking, physically active (defined as 30 minutes or more of moderate- to vigorous-intensity exercise, 5 or more days per week), healthy weight (defined as body mass index<25 kg/m^2), no hypertension, no diabetes mellitus, and no dyslipidemia. Dietary habits were not assessed in MEPS.
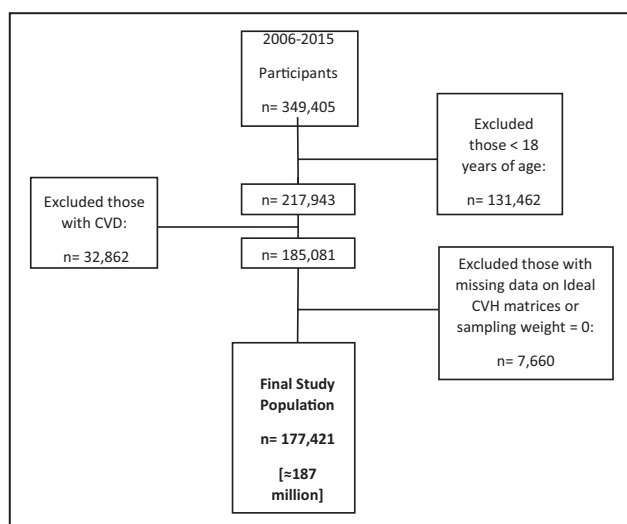

Figure 1. Flowchart of study opulation selection process, MEPS 2006 to 2015.
Error bars represent 95% CIs. CVD indicates cardiovascular disease; CVH, cardiovascular health; and MEPS, Medical Expenditure Panel Survey.

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Each ideal CVH metric was scored 0 if absent or 1 if present. Total scores were summed and categorized as optimal (5–6), average (3–4), and poor (0–2).

Other Variables

The sociodemographic factors considered in this study were sex (male or female), age category in years (18–39, 40–64, 65–74, or ≥75), self-reported race/ethnicities were defined as non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Asian, and non-Hispanic other (including American Indian/Alaska Native, other race, or multi-race), family income level (poor or very low income: <125% of the federal poverty level; low income: 125% to <200% of the federal poverty level; middle income: 200% to <400% of the federal poverty level; or high income: ≥400% of the federal poverty level), educational level (less than high school, high school or General Education Development equivalent, or college or higher), insurance status (public, private, or uninsured), and census region (Northeast, Midwest, South, or West).

Statistical Analysis

All analyses were conducted using Stata, version 15 (StataCorp LLC, College Station, TX). To describe trends in CVH status for the whole sample and by subgroups, we pooled the 10-year MEPS data into 2-year survey cycles (2006–2007, 2008–2009, 2010–2011, 2012–2013, and 2014–2015) for ease of analysis and reporting. To account for the complex MEPS sampling and survey design, we used Stata's svy prefix command to apply person-level weight to generate nationally representative estimates and their 95% CIs for the proportions of civilian noninstitutionalized adults in the United States.

Next, we pooled the 10-year MEPS data from 2006 to 2015, and descriptive statistics were used to summarize frequency distributions with corresponding weighted proportions by CVH status. Comparisons were made using the Kruskal-Wallis test for proportions. Finally, multivariable regression models accounting for age, sex, race/ethnicity, level of income, region, health insurance status, education level, and Charlson Comorbidity Index were used to determine the associations of CVH status with PROs. P values were 2-sided and considered statistically significant at $P<0.05$.

RESULTS

The analytic sample consisted of 177 421 MEPS participants, translating into 187 million US adults aged ≥18 years and without CVD (Figure 1). Of these, 20 403 participants (11.5%) had poor CVH, 79 662 participants (45%) had average CVH status and 77 356 participants (43.5%) had optimal CVH. These groups represent 25.5, 101.1, and 98.0 million US adults, respectively. The descriptive characteristics of the study sample by CVH status are shown in Table 1. Table 2 shows the prevalence of the PROs by CVH status.

Figure 2 displays the 10-year trends in CVH status for the total population. Overall, the proportion of US adults without CVD who reported ideal CVH declined from 46.2% in 2006 to 2007 to 42.5% in 2014 to 2015. In contrast, the proportion reporting poor CVH increased from 9.7% to 12.4% within that same period. Poor CVH increased for all age categories but was highest among older adults aged 65 to 74 years and ≥75 years (Figure 3A). Younger adults (18–39 years) had the lowest proportion of poor CVH across this 10-year period (Figure 3A). The proportion of participants reporting poor CVH increased for both men and women, with a lack offset differences across the 5 cycles (Figure 3B). Also, poor CVH trended up among all racial/ethnic groups but African Americans had the highest proportion of poor CVH across all 5 cycles, while Asians had the lowest proportion of poor CVH with 5.0% in 2006 to 2007 and 9.0% in 2014 to 2015 (Figure 3C). Similarly, disparities in poor CVH were found for participants with poor income, those with less than a high school education, and those from the South Census region (Figures 3D through 3F).

Patient Healthcare Experience

Table 3 shows the adjusted odds ratios (ORs) of the associations between CVH status with PROs. Overall, those with poor CVH and average CVH were more likely to report a poor healthcare experience, even after adjusting for sociodemographic factors and comorbidity. The odds of reporting poor PPC were higher for participants with poor CVH (OR, 1.14; 95% CI, 1.05–1.24) and average CVH (OR, 1.09; 95% CI, 1.03–1.16) when compared with participants with optimal CVH. Also, the odds of reporting poor patient satisfaction were higher for poor CVH (OR, 1.15; 95% CI, 1.08–1.22) and average CVH (OR, 1.08; 95% CI, 1.03–1.13) compared with ideal CVH.

Patient Perception of General Health

The odds of reporting the perception of an individual's health as being poor was higher among adults with poor CVH (OR, 5.89; 95% CI, 5.35–6.49) and average CVH (OR, 2.48; 95% CI, 2.30–2.67) compared with adults who were identified as having ideal CVH. Alternatively, each unit lower in the CVH metric was associated with >2-fold higher odds of reporting a poor perceived health status (OR, 2.42; 95% CI, 2.31–2.54).

Table 1. Characteristics of US Adults Without Cardiovascular Disease by Cardiovascular Health Status, MEPS 2006 to 2015

	Optimal CVH (5–6)	Average CVH (3–4)	Poor CVH (0–2)	P Value
Adults, n (%)	77 356 (43.5)	79 662 (45.0)	20 403 (11.5)	
Weighted sample, million	98.0	101.1	25.9	
Age category, y				<0.001
18–39	58.4	38.6	3.1	
40–64	35.0	49.3	15.7	
65–74	22.8	50.5	26.8	
≥75	20.8	53.4	25.8	
Family income level				<0.001
High income	46.3	43.3	10.4	
Middle income	43.5	45.1	11.4	
Low income	40.7	46.7	12.6	
Very low income	38.7	47.5	13.8	
Sex				<0.001
Female	45.5	43.1	11.4	
Male	41.5	46.8	11.7	
Race/Ethnicity				<0.001
Non-Hispanic White	43.8	44.4	11.8	
Black	36.4	49.4	14.2	
Asian	57.5	35.2	7.3	
Hispanic	43.1	47.4	9.5	
Health insurance status				<0.001
Uninsured	46.2	46.9	6.9	
Private	48.2	42.8	9.0	
Medicaid	37.9	47.0	15.1	
Medicare	21.0	51.1	27.9	
Education level				<0.001
Less than high school	38.1	47.6	14.3	
High school/GED	44.7	44.4	10.9	
Some college or higher	46.4	43.6	10.0	
Census region				<0.001
Northeast	45.2	43.6	11.2	
Midwest	42.5	45.7	11.8	
South	40.2	46.9	12.9	
West	48.3	42.3	9.4	

CVH indicates cardiovascular health; GED, General Education Development; and MEPS, Medical Expenditure Panel Survey.

Loss of Productivity from Work

Poor CVH was associated with 39% higher odds of reporting at least 2 disability days off work (OR, 1.39; 95% CI, 1.30–1.48) when compared with ideal CVH. Similarly, average CVH is associated with 22% higher odds of reporting at least 2 disability days off work (OR, 1.22; 95% CI, 1.18–1.27) when compared with ideal CVH.

Health-Related Quality of Life

When compared with adults with ideal CVH, those with poor CVH and average CVH were more likely to report lower HRQoL as measured by the SF-12 PCS and SF-12 MCS. Poor CVH was associated with a mean difference of −6.79 (95% CI, −7.06 to −6.52) in SF-12 PCS and −3.19 (95% CI, −3.43 to −2.95) in SF-12 MCS when compared with ideal CVH. Average CVH was associated with a mean difference of −2.56 (95% CI, −2.70 to −2.42) in SF-12 PCS and a mean difference of −1.45 (95% CI, −1.59 to −1.30) in SF-12 MCS when compared with ideal CVH. When modeled continuously, each unit lower in the CVH metric was associated with a mean difference of −3.17 (95% CI, −3.29 to −3.05) in SF-12 PCS and a mean difference of −1.56 (95% CI, −1.67 to −1.45) in SF-12 MCS.

Table 2. Prevalence of Patient-Reported Outcomes by Cardiovascular Health Status* Among US Adults Without Cardiovascular Disease, MEPS 2006 to 2015

	Optimal CVH (5–6) n = 77 356	Average CVH (3–4) n = 79 662	Poor CVH (0–2) n = 20 403	*P* value
Patient healthcare experience, %				
PPC				
Poor PPC (summary score)	12.6	12.9	12.6	0.47
Individual components of PPC				
Doctor never/sometimes listened to you	7.9	8.5	8.3	0.30
Doctor never/sometimes explained so you understood	6.3	7.2	7.4	<0.001
Doctor never/sometimes showed respect	6.4	7.0	7.2	0.05
Doctor never/sometimes spent enough time with you	12.3	12.1	11.2	0.02
Patient satisfaction with health care, %				
Poor patient satisfaction	23.8	24.0	23.7	0.68
Patient perception of general health, %				
Poor perceived health status	2.7	8.7	23.5	<0.001
Loss of productivity from work, %				
≥2 Disability days off work	32.5	35.6	35.9	<0.001
Health-related quality of life, mean (SD)				
SF-12 physical component score	37.5 (11.8)	40.3 (11.9)	44.4 (11.3)	<0.001
SF-12 mental component score	45.0 (12.1)	47.4 (11.8)	49.3 (10.9)	<0.001

CVH indicates cardiovascular health; MEPS, Medical Expenditure Panel Survey; and PPC, patient-provider communication.

*The 6 CVH metrics included not currently smoking, being physically active, normal body mass index, no hypertension, no diabetes mellitus, and no dyslipidemia; each scored as 1 or otherwise 0, for total maximum score of 6.

DISCUSSION

In this nationally representative sample of US adults without clinical CVD, we found that (1) the prevalence of individuals reporting ideal CVH declined from 2006 to 2015, while the prevalence of poor CVH increased; (2) the prevalence of poor CVH trended up across all age groups, sexes, races/ethnicities, income level, and census regions; (3) poor CVH was associated with
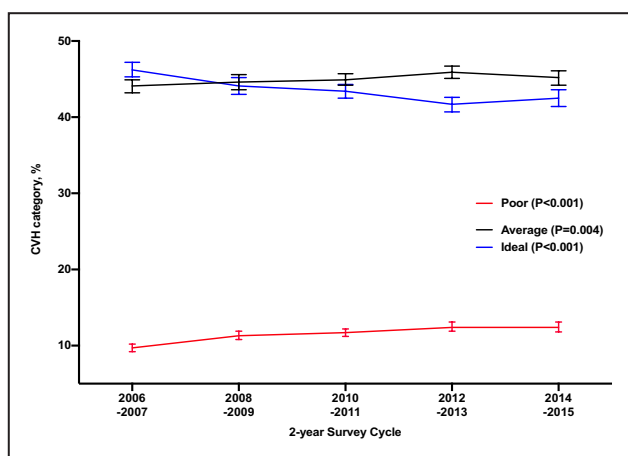
Figure 2. Trends in weighted proportion of US adults without CVD by cardiovascular health status, MEPS 2006 to 2015.
Error bars represent 95% CIs. CVD indicates cardiovascular disease; CVH, cardiovascular health; and MEPS, Medical Expenditure Panel Survey.

poor patient healthcare experience, poor perception of general health, poor HRQoL, and higher disability days off work.

The AHA's 2020 Strategic Goal placed emphasis on improving the CVH of all Americans by 20% while reducing deaths from CVD and stroke by 20% by the year 2020.[1] Although tremendous progress was made toward achieving this goal through a significant reduction in overall cigarette smoking prevalence and poor dietary habits, increases in blood pressure and prevalence of obesity were noted among US adults over the past decade.[10] The data from this representative sample of US adults also highlight this setback by showing that the prevalence of ideal CVH trended down, while poor CVH increased over time among US adults without CVD, with the highest prevalence among certain high-risk groups including older adults, Black individuals, poor individuals, those with low level of education, and those from the South region of the United States. As an extension of the 2020 Impact Goal, the AHA 2030 Impact Goal strives to equitably increase healthy life expectancy in the United States by at least 2 years by 2030 and the findings herein provide insights to potential avenues to achieving this monumental goal.[10]

Over the past decade, numerous studies have well documented the impact of ideal CVH on CVD[7,12,13,16–18,21–24] and non-CVD outcomes.[2,4,6,8,25] Also, the economic impact of ideal CVH was reported by Valero-Elizondo et al[9] using data from the MEPS. Overall, ideal CVH when
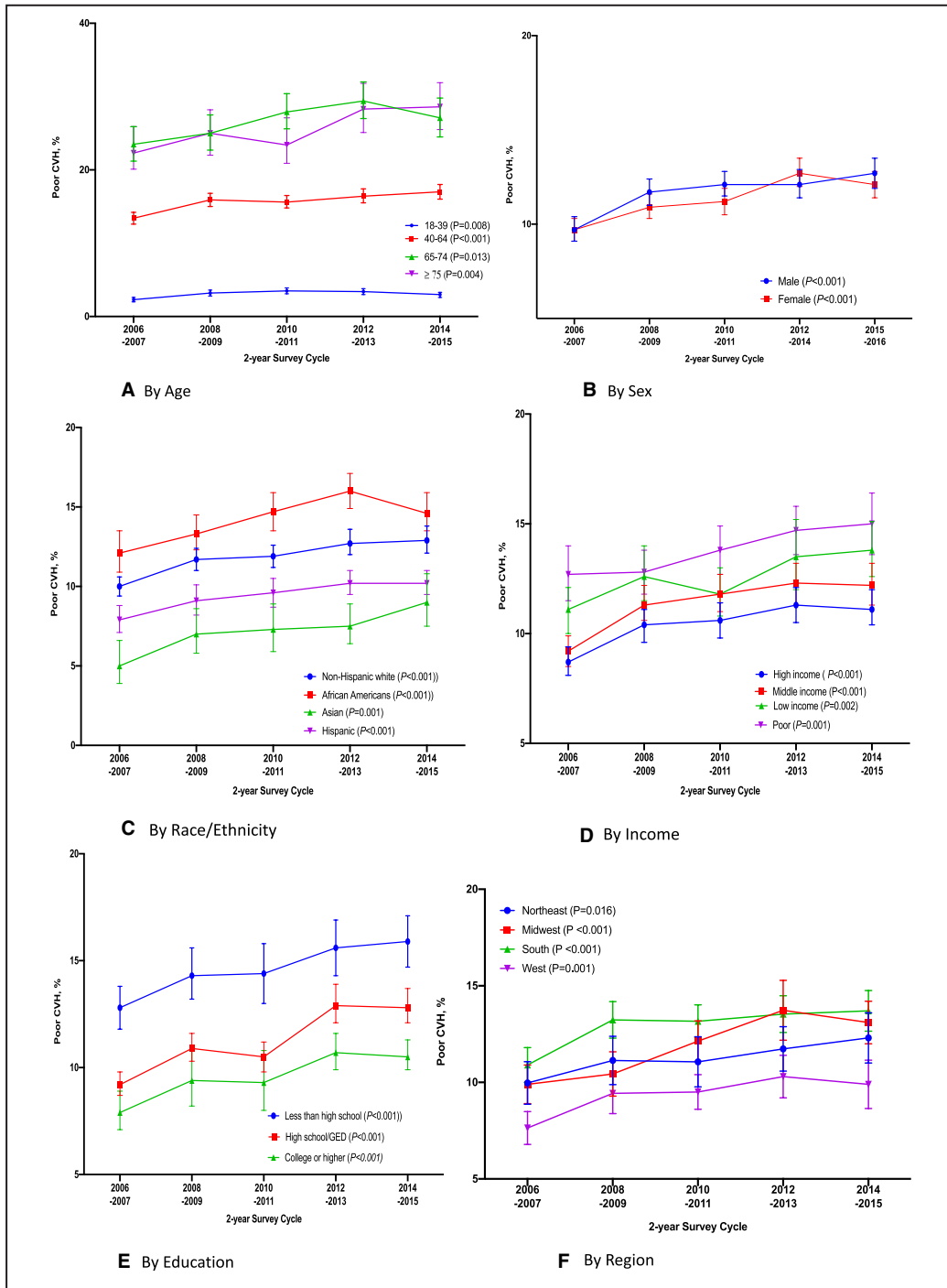
Figure 3.   Trends in weighted proportion of US adults without CVD reporting poor cardiovascular health by subgroups, MEPS 2006 to 2015.
A, By age; (**B**) by sex; (**C**) by race; (**D**) by income; (**E**) by education; (**F**) by region. Error bars represent 95% CIs. CVD indicates cardiovascular disease; CVH, cardiovascular health; and MEPS, medical expenditure panel survey.

compared with poor CVH was associated with less annual healthcare spending among participants with and without CVD, as well as lower odds of emergency department visits, outpatient visits, and hospitalization.[9] Since the creation of the AHA's 2020 Strategic Goals in 2010, the association of CVH with patient experience,

satisfaction, and quality of life, which are key components of this public health campaign, remains unknown. To our knowledge, this study is the first of its kind to use CVH to address this vital aspect of health care.

There are a couple of possible mechanisms that might explain why poor CVH is associated with poor

Table 3. Odds Ratios of Cardiovascular Health Status* by Patient-Reported Outcomes Among US Adults Without Cardiovascular Disease, MEPS 2006 to 2015

Variable	Optimal CVH (5–6) n = 77 356	Average CVH (3–4) n = 79 662	Poor CVH (0–2) n = 20 403
Patient healthcare experience (results reported in odds ratios[†] [95% CI])			
PPC			
Poor PPC (summary score)	1 (Ref)	1.09 (1.03 to 1.16)[‡]	1.14 (1.05 to 1.24)[‡]
Per 1-unit decrease in the CVH metric	1.07 (1.03 to 1.12)[‡]		
Individual components of PPC			
Doctor never/sometimes listened to you	1 (Ref)	1.15 (1.08 to 1.24)[‡]	1.21 (1.09 to 1.34)[‡]
Doctor never/sometimes explained so you understood	1 (Ref)	1.14 (1.06 to 1.22)[‡]	1.18 (1.07 to 1.30)[‡]
Doctor never/sometimes showed respect	1 (Ref)	1.14 (1.06 to 1.23)[‡]	1.22 (1.11 to 1.36)[‡]
Doctor never/sometimes spent enough time with you	1 (Ref)	1.07 (1.01 to 1.13)[‡]	1.07 (0.98 to 1.16)
Patient satisfaction with health care			
Poor patient satisfaction	1 (Ref)	1.08 (1.03 to 1.13)[‡]	1.15 (1.08 to 1.22)[‡]
Per 1-unit decrease in the CVH metric	1.07 (1.04 to 1.11)[‡]		
Patient perception of general health (results reported in odds ratios[†] [95% CI])			
Poor perceived health status	1 (Ref)	2.48 (2.30 to 2.67)[‡]	5.89 (5.35 to 6.49)[‡]
Per 1-unit decrease in the CVH metric	2.42 (2.31 to 2.54)[‡]		
Loss of productivity from work (results reported as odds ratios[†] [95% CI])			
≥2 Disability days off work	1 (Ref)	1.22 (1.18 to 1.27)[‡]	1.39 (1.30 to 1.48)[‡]
Health-related quality of life (results reported as mean difference[†] [95% CI])			
SF-12 physical component score	0 (Ref	−2.56 (−2.70 to −2.42)[‡]	−6.79 (−7.06 to −6.52)[‡]
Per 1-unit decrease in the CVH metric	−3.17 (−3.29 to −3.05)[‡]		
SF-12 mental component score	0 (Ref)	−1.45 (−1.59 to −1.30)[‡]	−3.19 (−3.43 to −2.95)[‡]
Per 1-unit decrease in the CVH metric	−1.56 (−1.67 to −1.45)[‡]		

CVH indicates cardiovascular health; MEPS, Medical Expenditure Panel Survey; PPC, patient-provider communication; and SF-12, 12-Item Short Form.

*The 6 CVH metrics included not currently smoking, being physically active, normal body mass index, no hypertension, no diabetes mellitus, and no dyslipidemia; each scored as 1 or otherwise 0, for total maximum score of 6.

[†]Adjusted for age, sex, race/ethnicity, level of income, region, health insurance status, education level, and Charlson Comorbidity Index.

[‡]Indicates statistically signifcant results (P<0.05).

PROs. First, studies have shown that a more favorable CVH status is associated with better physical health, mental health, and overall health.[4,15,25–30] España-Romero et al[25] reported that achieving 5 to 7 CVH metrics was associated with a 36% reduction in depression symptoms when compared with participants achieving 0 to 2 CVH metrics. Similarly, ideal CVH was predictive of functional status in the multiethnic Northern Manhattan Study even after controlling for incident vascular events.[26] Thus, the association of poor PROs among individuals with poor CVH reported herein could just be a reflection of their overall poor health status. Individuals with ideal CVH are generally less sick, with fewer comorbid conditions. Healthier individuals are more likely to be satisfied with their health care compared with those with multiple comorbid conditions who have a higher health resource use and healthcare expenditures and may also have higher expectations from their clinicians.

Second, another explanation of the association of poor PROs with poor CVH found in the present study is that a more patient-centered care approach can favorably impact overall health, whereas a suboptimal partnership between the patient and the clinician can impair delivering effective preventive interventions.[31] Some data suggest that good patient-provider relationships lead to adherence to medication and uptake of prevention services.[32–35] In a prior publication using data from MEPS, Okunrintemi et al[33] found that US adults with atherosclerotic CVD who reported poor patient-provider communication were 52% and 26% more likely to report lack of statin and aspirin use, respectively. Heisler et al also found that effective patient-provider communication improved self-management of diabetes mellitus and better glycemic control.[35]

Disability days off work is a surrogate marker for an individual's level of productivity. It is likely a function of an individual's overall physical and mental health. In general, an individual with ideal CVH is likely healthier, with fewer comorbid conditions, and hence less likely to take sick days/disability days off work, which could greatly impact an individual's productivity. Although this metric could be affected by various socioeconomic factors, the association between poor CVH and

increased likelihood of disability days off work persisted even after adjustments for some of these socioeconomic and demographic factors.

This is a cross-sectional study, so the direction of association between CVH and PROs cannot be determined. However, irrespective of the direction, the associations found in our study offer insights on the impact of ideal CVH on quality of life while suggesting a potential avenue for improving patient-centered care, a key metric closely monitored across the country by Consumer Assessment of Healthcare Providers and Systems and used in various pay-for-performance programs. Results from our analyses support the focus on LS7 metrics, especially among those yet to develop overt CVD, to improve quality of life. Alternatively, improving LS7 metrics could be a target for healthcare providers as a means of improving the overall health of their patients as well as improving their consumer-reported metrics on patient-centered care.

These findings must be interpreted in the context of this study's limitations. First, because the MEPS data included only the noninstitutionalized US adult population, these findings cannot be generalizable to institutionalized populations such as nursing home residents or incarcerated individuals. Second, the components of LS7 used in this study were self-reported and did not include information on dietary habits. Therefore, a modified scoring for CVH was used in lieu of the AHA's defined CVH classification system. Third, we assigned an equal weight of 1 to LS7 variables and therefore assumed linearity and additivity of these variables. Although it is unlikely that these variables are linear and additive, our modeling is consistent with prior data modeling on this subject.[3,28,29,36–39] Fourth, despite comprehensively controlling for important confounders, the associations found in this study may be attributed to residual confounding or other factors not considered in our analysis. Fifth, it was unclear how nonresponse rate in MEPS may affect these findings.

In conclusion, our analyses of a nationally representative cross-sectional survey of US adults without CVD from 2006 to 2015 found that poor CVH status was associated with poor PROs including patient experience, quality of life, and loss of productivity. These findings suggest that a focus on measuring and improving CVH by healthcare providers may improve patient care experience and satisfaction and thus improve consumer-reported metrics on patient-centered care. Most importantly, the AHA's mission is to equitably increase healthy life expectancy by 2 years in the United States by 2030.[10] Our findings suggest that this goal may be achieved by targeted preventive measures aimed at optimizing ideal CVH metrics to improve PROs among US adults without CVD and ultimately health equity.

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