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Cardiovascular Health and Incident Cardiovascular Disease and Cancer: The Women's Health Initiative

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Abstract

Introduction—The American Heart Association's “Simple 7” offers a practical public health conceptualization of cardiovascular health (CVH). CVH predicts incident cardiovascular disease (CVD) in younger populations, but has not been studied in a large, diverse population of aging postmenopausal women. The extent to which CVH predicts cancer in postmenopausal women is unknown.

Methods—Multivariable Cox regression estimated hazard ratios and 95% CIs for the association between CVH and incident CVD, any cancer, and cancer subtypes (lung, colorectal, and breast)

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among 161,809 Women's Health Initiative observational study and clinical trial participants followed from 1993 through 2010. Data were analyzed in 2013. CVH score was characterized as the number (0 [worst] to 7 [best]) of the American Heart Association's ideal CVH behaviors and factors at baseline: smoking, BMI, physical activity, diet, total cholesterol, blood pressure, and fasting glucose.

Results—Median follow-up was approximately 13 years. Fewer minorities and less educated women achieved ideal CVH, a common benchmark. In adjusted models, compared with women with the highest (best) CVH scores, those with the lowest (worst) CVH scores had nearly seven times the hazard of incident CVD (6.83, 95% CI=5.83, 8.00), and 52% greater risk of incident cancer (1.52, 95% CI=1.35, 1.72). Ideal CVH was most strongly inversely associated with lung cancer, then colorectal cancer, and then breast cancer.

Conclusions—Lower ideal CVH is more common among minority and less educated postmenopausal women, and predicts increased risk of CVD and cancer in this population, emphasizing the importance of prevention efforts among vulnerable older adults.

Introduction

In 2010, the American Heart Association introduced the “Simple 7” cardiovascular health (CVH) metric, combining health behaviors (current smoking, BMI, physical activity, and healthy diet) and health factors (total cholesterol, blood pressure, and fasting glucose).¹ One-point increases on the CVH scale correspond to a lower risk of mortality (all-cause,^{2,3} cardiovascular disease [CVD],^{2–4} and cancer^{3,5}) and incident CVD,⁶ stroke,⁷ and cancer.⁵ Community-based studies have used this metric to characterize the prevalence of ideal CVH,^{4,8,9} yet the extent to which the CVH metric predicts CVD and cancer in postmenopausal women remains unknown. The authors examined the CVH of a geographically and ethnically diverse older population to assess its relationship with incident CVD and cancer, including cancer subtypes. Given the immense burden of chronic disease in the U.S., the CVH metric may assist public health professionals and healthcare providers to improve assessment of risk, direct guideline-based treatment, and augment prevention efforts.

Methods

This study used data from the Women's Health Initiative (WHI) observational study and clinical trials. The WHI study was overseen by ethics committees at each clinical center and the coordinating center; its methods are described thoroughly elsewhere.^{10,11} Participants provided informed consent and contributed data to the current analysis through December 31, 2010.

Of 161,809 participants, 145,385 had complete CVH data available for analysis. Of those, 115,306 reported no history of myocardial infarction, stroke, coronary bypass surgery, percutaneous transluminal coronary angioplasty, or angina. For cancer outcomes, the 129,149 women who reported no history of cancer were studied (allowing non-melanomatous skin cancer).

Final disease diagnoses, including CVD- or cancer-related deaths, were classified by WHI physician adjudicators following review of medical records, death certificates, and autopsy reports.¹²

Time of incident CVD was defined at the first occurrence of myocardial infarction, stroke, coronary bypass surgery, percutaneous transluminal coronary angioplasty, angina, or CVD-related death. Time of incident cancer was defined at the first occurrence of any cancer, except non-melanomatous skin cancer, or cancer-related death. Time to incident lung ($n=1,655$), colorectal ($n=1,752$), and breast ($n=7,377$) cancer was ascertained.

Measures of CVH appear in Table 1.¹ The CVH score represents the number of ideal CVH behaviors and factors present at baseline, with a score of 0 as the worst and 7 as the best. All CVH data were self-reported at baseline, except for blood pressure and anthropometric data.¹¹ Self-reported questions assessed diabetes and cholesterol. If a woman answered *yes* to a history of diabetes or was treated for high blood cholesterol, she was not considered in ideal CVH for those metrics.^{11,12}

Whether a woman was an observational study or clinical trial participant was included along with age at baseline (50– 59, 60– 69, and 70– 79 years). Race/ethnicity was defined as: white (not of Hispanic origin), Hispanic/Latina, black or African American, and other (American Indian, Alaska Native, or Asian/Pacific Islander).

Family CVD or cancer history meant an immediate relative had a heart attack, or a female or immediate male relative had cancer. Level of education was assigned as the highest grade completed in school (less than a high school diploma or GED, equivalent to a high school diploma or GED, vocational or some college experience, or a college diploma or higher level of education), and marital status as presently married or in a marriage-like relationship, or never married, divorced or separated, or widowed.

Baseline characteristics were described and age-adjusted incidence rates for CVD and cancer (per 10,000 women) were estimated. The association was evaluated between an ideal CVH score and the hazard of incident CVD and cancer, respectively, among those free of disease at baseline using Cox regression to estimate age-adjusted and multivariable-adjusted hazard ratios and 95% CIs. The ideal CVH score categories 0–1 and 6–7 were collapsed owing to sparse data in the worst and best CVH categories.

In the time-to-event analyses, observations were censored for deaths that were not CVD- or cancer-related, or if the participant was lost to follow-up. The aforementioned analyses were repeated specifically for lung, colorectal, and breast cancers. Analyses were conducted with SAS, version 9.2 in 2013.

Results

Women with an ideal CVH score were younger (50–59 years, 47%) and married (69%, Table 2). The median length of follow-up among 115,306 women free of CVD at baseline was 12.9 years, and among 129,149 women free of cancer at baseline, 12.7 years.

Approximately 300 women (<1%) had an ideal CVH score of 7 in both CVD- and cancer-free groups at baseline (data not shown). Among those in ideal CVH, 92% were white (Table 2). There were also disparities in CVH by educational attainment; among those in ideal CVH, 1% had less than a high school education compared with a high school education (9%) and more than a high school education (90%, Table 2).

Age-adjusted rates of incident CVD steadily decreased with increasing number of CVH behaviors and factors at ideal levels (Figure 1). The multivariable-adjusted hazard of CVD was inversely related to the ideal CVH score (Figure 2). Characteristics associated with lower CVD risk in the fully adjusted model included: younger age (50–59 years, 0.24, 95% CI=0.23, 0.25; 60–69 years, 0.54, 95% CI=0.53, 0.55), being married or partnered (0.84, 95% CI=0.82, 0.85), and having no family history of CVD (0.76, 95% CI=0.74, 0.77).

Rates of incident cancer decreased with increasing number of CVH behaviors at ideal levels with no clear dose–response trend in a favorable direction across strata of increasing CVH factors (Figure 1). The multivariable-adjusted hazard of cancer was also inversely related to ideal CVH score (Figure 2). Characteristics associated with lower cancer risk included: younger age (50–59 years, 0.63, 95% CI=0.62, 0.64; 60–69 years, 0.84, 95% CI=0.83, 0.86), Hispanic/Latina descent (0.85, 95% CI=0.79, 0.90), being married or partnered (0.94, 95% CI=0.93, 0.96), and no family history of cancer (0.88, 95% CI=0.87, 0.90).

Lung and colorectal cancers exhibited stronger inverse associations with the ideal CVH score than did breast cancer (Figure 2).

Discussion

A favorable risk factor and behavior profile, as expressed by a higher ideal CVH score, predicts a lower risk of CVD and cancer in postmenopausal women. The magnitude of effect of ideal CVH score was more pronounced for CVD than cancer. Among cancers, ideal CVH was most strongly inversely related to lung cancer, followed by colorectal and finally breast cancer.

The uniquely large sample of postmenopausal women in WHI supported minority subgroup analyses, and ideal CVH for five or more of the seven behaviors and factors was lowest among African Americans (9%), followed by Hispanic/Latinas (17%), other races (24%), and whites (27%). Unadjusted analyses also underscored the clear relationship between higher educational attainment and higher CVH health score.

Limitations

Self-reported CVH data and this study's definition of ideal CVH for fasting blood glucose and cholesterol factors reflect the limitations of the data set, and may have misclassified some women for these particular metrics. Also, this work focused only on **ideal** CVH. More research is needed to capture the broader spectrum of CVH and its effects on the primary, secondary, and tertiary prevention of CVD and cancer.

Conclusions

This study adds to the growing literature linking ideal CVH to chronic diseases, and emphasizes the need for providers who care for older patients, particularly those with sociodemographic vulnerabilities, to address CVH.

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Figure 1.

Age-adjusted incidence rate (per 100 women) of CVD (left) and cancer (right), according to the number of ideal CVH factors (total cholesterol, blood pressure, glucose) and behaviors (smoking, BMI, physical activity, healthy diet score): WHI study participants.

Figure 2.

Multivariable-adjusted hazard ratios and 95% CI for incident CVD and cancer (left), and cancer subtypes (right), including death, by ideal CVH score: WHI study participants. Full models are adjusted for OS/CT enrollment, age, race/ethnicity, marital status, education, and family history of CVD or cancer, respectively.

Table 1
Measures of CVH: 4 Health Behaviors and 3 Health Factors¹

	Poor health	Intermediate health	Ideal health
Health behaviors			
Smoking status	Yes	Former 12 months	Never or quit >12 months
BMI	30 kg/m ²	25-29.9 kg/m ²	<25 kg/m ²
Physical activity	None	1-149 min/wk moderate or 1-74 min/wk vigorous or 1-149 min/wk moderate + vigorous	150 min/wk moderate or 75 min/wk vigorous or 150 min/wk moderate + vigorous
Healthy diet score ^a	0–1 components	2–3 components	4–5 components
Health factors			
Total cholesterol	240 mg/dL	200-239 mg/dL or treated to goal	<200 mg/dL
Blood pressure	Systolic 140 mm Hg or Diastolic 90 mm Hg	Systolic 120-139 mm Hg or Diastolic 80-89 mm Hg or treated to goal	Systolic <120 mm Hg Diastolic <80 mm Hg
Fasting plasma glucose	126 mg/dL	100-125 mg/dL or treated to goal	<100 mg/dL

^aOne point for each of the following healthy diet score components: 4.5 cups/day of fruits and vegetables; 2 3.5-ounce servings/week of fish; 3 1-ounce servings/day of whole grains; <1,500 mg/day of sodium; and 36 ounces/week of sugar-sweetened beverages.

Table 2
Characteristics (n, %) of WHI Participants at Baseline (n=145,385) by Ideal CVH Score

	0-1 n=2,690	2 n=16,253	3 n=48,639	4 n=43,174	5 n=25,738	6-7 n=8,891
Age (years)						
<50-59	664 (25)	4,012 (25)	14,576 (30)	14,242 (33)	9,867 (38)	4,202 (47)
60-69	1,268 (47)	7,844 (48)	22,599 (46)	19,270 (45)	11,081 (43)	3,535 (40)
70->79	758 (28)	4,397 (27)	11,464 (24)	9,662 (22)	4,790 (19)	1,154 (13)
Race/ethnicity						
White	1,826 (68)	12,154 (75)	38,987 (80)	36,503 (85)	22,811 (89)	8,161 (92)
Hispanic/ Latina	118 (4)	728 (4)	2,058 (4)	1,625 (4)	745 (3)	178 (2)
Black	598 (22)	2,574 (16)	5,649 (12)	2,948 (7)	923 (4)	167 (2)
Other	138 (5)	754 (5)	1,842 (4)	1,988 (5)	1,195 (5)	364 (4)
Marital status						
Married	1,300 (48)	8,837 (54)	29,142 (60)	27,509 (64)	17,243 (67)	6,165 (69)
Not married	1,374 (51)	7,326 (45)	19,260 (40)	15,493 (36)	8,387 (33)	2,701 (31)
Education						
<HS	315 (12)	1,452 (9)	3,151 (6)	1,765 (4)	542 (2)	107 (1)
HS	635 (24)	3,533 (22)	9,670 (20)	6,936 (16)	3,229 (13)	785 (9)
Some college	1,107 (41)	6,682 (41)	19,339 (40)	16,273 (38)	8,705 (34)	2,564 (29)
College grad	618 (23)	4,463 (27)	16,099 (33)	17,893 (41)	13,069 (51)	5,385 (61)