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CLINICAL INVESTIGATION

Does Walking Decrease the Risk of Cardiovascular Disease Hospitalizations and Death in Older Adults?

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OBJECTIVES: The purpose of this study was to determine whether walking is associated with a reduced risk of cardiovascular disease hospitalization and death in community-dwelling older men and women.

DESIGN: A prospective study, with follow-up time of 4 to 5 years (average 4.2 years).

SETTING: A western Washington health maintenance organization.

PARTICIPANTS: Men and women aged 65 years and older from a random sample of HMO enrollees invited by mail to participate in a health promotion intervention trial (36% accepted the invitation and completed questionnaires). This report is based on 1645 older adults without severe disability and without history of heart disease. Vital status ascertainment was complete (100%), and only 2.6% did not complete the follow-up.

MEASUREMENTS: Reported frequency and duration of walking for exercise, work, errands, pleasure, and hiking in the 2 weeks before baseline were used to classify hours of walking per week. The two main outcomes were: (1) cardiovascular disease hospitalizations with a discharge diagnosis of coronary (ICD-9-CM 410–414) or other cardiovascular diseases (ICD-9-CM 390–409, 415–448) documented by computerized hospitalization records and (2) death. Numerous potential confounding factors were considered, including age, sex, treated high blood pressure, current estrogen use and chronic disease score (ascertained by computerized medical and pharmacy records), and ethnicity, education, income, physical function, self-rated health status, smoking, alcohol intake, and body mass index (ascertained by self-report on the mailed questionnaire).

RESULTS: Walking more than 4 hours/week was associated significantly with a reduced risk of cardiovascular disease hospitalization in both sexes combined compared with walking less than 1 hour/week (age and sex-adjusted relative risk = 0.69; 95% confidence interval, 0.52–0.90). This association was not altered by adjustment for baseline cardiovascular risk factors and indicators of general health status. The association was present in all age groups, among those with and without physical limitations, and also among those who did and did not also participate in more vigorous physical activities. Walking more than 4 hours/week was also associated with a reduced risk of death (age and sex-adjusted relative risk = 0.73; 95% confidence interval, 0.48–1.10), however, this association was substantially diminished by adjustment for cardiovascular risk factors and measures of general health status.

CONCLUSIONS: Walking more than 4 hours/week may reduce the risk of hospitalization for cardiovascular disease events. The association of walking more than 4 hours/week with reduced risk of death may be mediated by effects of walking on other risk factors. These findings provide much stronger evidence than previously available for advising older men and women to embark on or maintain a sustained program of walking to prevent cardiovascular disease events.
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Cardiovascular disease (CVD) remains the leading cause of death in older adults, accounting for nearly one-half million fatalities and more than 3.5 million hospital admissions of those aged 65 and older in the United States each year.[1,2] Moreover, heart disease accounts for more disability in older people than any other single condition except arthritis.[3]

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Physical activity is a widely accepted means for reducing risk of CVD in adults of all ages. However, exercise recommendations in adults aged 65 and older are based on very little evidence of its benefits in this age group specifically and virtually no information in older women.[4] This is true, despite the fact that later life is when vulnerability to CVD is the greatest, and when levels of activity decline markedly among many older adults.[5]

The most common physical activity in later life is walking. In 1990, 52% of American men and 44% of American women aged 65 and older reported walking for exercise in the past 2 weeks.[6] Yet no studies, to our knowledge, have exam-

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ined whether walking is sufficient activity to reduce the future risk of CVD in older people. The purpose of this study was to determine whether walking is associated with a reduced risk of CVD hospitalization and death in community-dwelling older men and women without severe disability.

METHODS

The study population was recruited from a random sample of men and women aged 65 and older enrolled in Group Health Cooperative of Puget Sound (GHC). GHC is a large staff model health maintenance organization providing medical care to more than 370,000 people, including more than 40,000 older adults, in Western Washington. Subject recruitment was performed as part of a randomized controlled trial of a multicomponent health promotion intervention designed to reduce disability and falls. Details of the methods used have been reported previously.[7] The follow-up study and the embedded trial were approved by the Human Subjects Review Committees of the University of Washington and GHC. Briefly, mailed questionnaires were sent to age-eligible enrollees after primary care physicians excluded those too ill to participate (8%) from the random sample of 6050. Completed questionnaires and consent to participate in the randomized trial were received from 2178 (36%) subjects. Characteristics of those who participated were compared with nonrespondents in a previous report.[8] Although participants had somewhat higher levels of educational attainment and income, were less likely to smoke, and were more likely to participate in community activities than nonrespondents, the two groups had similar levels of several health status indicators.

In an effort to restrict this analysis to older adults without a previous history of clinically recognized coronary heart disease, subjects who self-reported a history of heart trouble on the baseline questionnaire, who had filled prescriptions for nitrates in the 12 months before baseline, or who had been hospitalized with a discharge diagnosis of CVD in the past 12 months (ICD-9-CM 390–448) were excluded (n = 433, 19.9% of the 2178 with completed questionnaires). In addition, 92 subjects (4.2%) were excluded because they failed to provide adequate information on their walking habits. Eight participants (0.4%) died before the start of the follow-up period and were therefore excluded. The final sample size for this analysis was 1645.

Study subjects were followed for CVD hospitalization and death for 4 to 5 (average of 4.2) years from their baseline in 1987–88 through June 30, 1992. Data on hospitalization episodes were extracted from GHC's computerized systems that track all hospitalizations of GHC enrollees. CVD hospitalizations were defined on the basis of a discharge diagnosis for coronary heart disease (ICD-9-CM 410–414) or other cardiovascular diseases (ICD-9-CM 390–409, 415–448). Vital status was ascertained through attempts to recontact subjects for follow-up information and through linkage with GHC membership databases and a death file maintained for deceased GHC enrollees (current and former) containing information from Washington State death certificates. Vital status was known for 100% of study participants. There were 359 CVD hospitalizations, 117 with CHD diagnoses and 242 with other CVD diagnoses (including 58 with hypertension, 48 with arrhythmias, 43 with stroke or transient ischemic attack, 30 with congestive heart failure and 63 with other miscellaneous CVD diagnoses); 32 subjects had both hospitalization events. Deaths in the cohort numbered 128 during the follow-up period. A total of 42 subjects (2.6%) terminated their GHC enrollment during the follow-up period and had not died according to the death certificate data. The latter group contributed follow-up time until the date of their disenrollment from GHC.

The baseline questionnaire contained 122 questions about demographic characteristics, physical and psychosocial health status, and health behaviors. Physical activity was assessed using an instrument adapted from the Minnesota Leisure Time Activity Questionnaire.[9] Subjects were asked to report activities they had performed in the previous 2 weeks from a list of 50 possibilities. Walking activity was described in five categories: walking for exercise, work, errands, pleasure, or hiking. For each category of walking, subjects were asked to complete a table reporting how many times in the past 2 weeks they did the activity and the average amount of time spent doing the activity on each occasion. Number of hours walked per week was calculated by multiplying frequency by duration, summing across the five walking categories, and dividing by two, yielding the amount per week. For analysis, the variable was grouped into three levels that approximated tertiles of the distribution: walking less than 1 hour per week, 1 to 4 hours per week, and more than 4 hours per week.

In order to evaluate whether walking was a surrogate for participation in more vigorous exercise and to compare walking with vigorous exercise in relation to CVD hospitalizations and death, a dichotomous variable for vigorous activity was defined indicating whether a subject reported performing any of the following activities in the previous two weeks: basketball, jogging, exercycling, bicycling, aerobics, swimming, rowing, field hockey, soccer, running, or calisthenics/general exercise.

A number of potential confounders were considered in the analysis. Demographic characteristics included age, gender, race (white, non-white), educational attainment (attended college, did not attend college), and income level (under $15,000 annually, at or above $15,000).

Self-reported health was measured by the question, "Would you say your health is excellent, good, fair, or poor?" taken from the Rand general health measures.[10] An early version of the Medical Outcomes Study (MOS) physical limitations scale measured limitations in physical tasks ranging from vigorous activities to self-care activities and was scored using a 7-point Guttman scale.[10–12] Our previous work has shown the MOS physical limitations scale to be a reliable, valid, and responsive indicator of health status.[12–13]

Smoking status was categorized as current, former, and never smoked. We used number of drinks per day when drinking to classify alcohol use (non-drinker, 1 drink/day, >1 drink/day). Body-mass index was calculated (weight in kg/height in meters^2) from self-reported current weight and height. The chronic disease score, a weighted score derived from drug prescriptions over a 1-year period ascertained through the GHC computerized pharmacy database, reflects the number and severity of up to 19 chronic conditions.[14] The measure has been shown to be an excellent predictor of disability, health care utilization, and mortality in older adults. We also used the GHC computerized pharmacy records to determine whether a subject had received prescriptions for antihypertensive medication or estrogen replacement therapy during the 12 months before baseline.[15]

Differences between walking groups in baseline characteristics were assessed using chi-square statistics. Age-adjusted hospitalization and mortality rates were calculated using the direct method, applying the stratum-specific rates based on person-years of follow-up to the age distribution of the entire cohort. For the purpose of evaluating the consistency of associations in important subgroups, Cox proportional hazards models were used to determine unadjusted relative risks for CVD hospitalizations and all-cause mortality after stratification by gender, age, and baseline level of physical function. Cox proportional hazards models were also used to evaluate the association between time spent walking and CVD hospitalization and death, after adjusting for age and sex only, and then for multiple covariates. Relative risks and corresponding 95% confidence intervals were calculated from the beta-coefficients and standard errors derived from these models. Tests for trend in the relative risks across categories of time spent walking were performed using an ordinal variable for the three walking categories in the proportional hazards models. The final multivariate models included variables that were significantly related to either CVD hospitalization or total mortality. An additional analysis was performed to evaluate interaction between time spent walking and participation in vigorous exercise by testing the addition of vigorous exercise and a cross-product term to the final multivariate model by means of a likelihood ratio chi-square test.[16]

RESULTS

Subjects who walked more than 4 hours per week were more likely to be younger, white, have higher incomes and have attended college compared with subjects who walked less than 1 hour per week (Table 1). Walking less than 1 hour per week was associated with being a current smoker, not drinking alcohol, and a higher prevalence rate of fair or poor self-reported health. Chronic disease score, reported physical limitations, use of antihypertensive medication, and body mass index were not significantly related to hours spent walking.

Age-adjusted rates of CVD hospitalization were lowest among persons who walked more than 4 hours per week, intermediate in those who walked 1 to 4 hours per week, and highest in those who walked less than 1 hour per week (41.9/1000 person-years, 52.3/1000 person-years, and 61.2/

Table 1. Baseline Characteristics of Study Participants According to Number of Hours Walked per Week, Group Health Cooperative, Seattle, WA, 1987–1988

	Number of Hours Walked per Week		
	<1 (n = 513)	1–4 (n = 571)	>4 (n = 561)
	percent		
Demographic characteristics			
Age group*			
65–69 years	33.3	39.0	40.1
70–74 years	29.4	31.9	31.9
75 and older	37.3	29.1	28.0
Sex (% women)	64.1	61.0	62.9
Non-white*	9.9	5.1	4.7
Attended college*	46.3	60.7	61.3
Income <$15,000*	41.5	35.7	28.4
Health and function characteristics			
Physical function (% ≥ 2 limitations)	42.0	36.7	36.1
Taking BP drugs	37.4	36.4	35.5
Fair/poor self-rated health*	16.1	8.1	9.6
Smoking status*			
Current	9.4	8.3	5.1
Former	29.4	41.3	38.0
Never	61.2	50.4	56.9
Alcohol use†*			
Non-drinker	43.6	28.6	29.6
1 drink/day	37.0	45.0	45.0
>1 drink/day	19.4	26.4	25.4
Chronic Disease Score			
0	24.6	25.4	24.8
1–2	31.4	27.7	29.6
≥ 3	44.1	46.9	45.6
Body Mass Index			
Lowest tertile	32.4	33.0	34.4
Second tertile	34.3	31.9	34.6
Highest tertile	33.4	35.1	31.0

* Chi-square test for between group differences, $P < .05$.
† Drinks per day on days when drinking.

1000 person-years, respectively; $P < .05$; data not shown). The same pattern of association was seen when rates of coronary heart disease and other CVD hospitalizations were examined separately (Figure 1). Rates of mortality from all causes were highest among those who walked less than 1 hour per week (22.8/1000 person-years) and the same in the two groups who walked 1 to 4 and more than 4 hours per week (16.2/1000 person-years; Figure 1).

When stratified by gender, age, and functional status, unadjusted relative risks of CVD hospitalization were consistent across subgroups, whereas associations of total mortality with walking were stronger in some subgroups than in others (Table 2). Note that the statistical power to detect significant associations within subgroups was limited for this analysis because of the small numbers of events occurring in some strata; however, the primary purpose of the analysis was to evaluate the consistency of associations, not their statistical significance. Relative risks were in the same direction (<1.0) and of a similar magnitude for men and women for CVD hospitalizations. However, the relative risk for total mortality associated with walking more than 4 hours per week was stronger and statistically significant only for women: relative risk (RR) = 0.45, 95% confidence interval (CI) 0.25–0.83 for women and 0.89, 95% CI 0.49–1.62 for men. Stratification by age group revealed that the relative risks for CVD hospitalization associated with walking more than 4 hours per week were similar in the two age groups: 0.59 (95% CI 0.39–0.89) in those aged 75 or older and 0.76 (95% CI 0.53–1.09) in those aged 65 to 74. In contrast, for total mortality, the relative risk associated with walking more than 4 hours per week was less than 1 and statistically significant only among persons aged 75 years and older (Table 2). Relative risks for CVD hospitalization and total mortality associated with walking more than 4 hours per week showed a somewhat greater reduction in risk among subjects with limited function compared with their higher functioning counterparts.

After adjustment for age and sex, participants who walked more than 4 hours per week at baseline were 31% less likely to be hospitalized for CVD during the follow-up period, compared with those who reported walking less than 1 hour per week (RR = 0.69, 95% CI 0.52–0.90). Simultaneous adjustment for the eight potential confounders did not substantially alter the relative risk of CVD hospitalization associated with walking more than 4 hours per week (Table 3; RR = 0.73, 95% CI 0.55–0.96). Variables that were significantly associated with increased risk of CVD hospitalization in the multivariate model included age, male gender, impaired physical function, number of chronic diseases, and fair/poor self-rated health. Relative risks associated with walking 1 to 4 hours per week compared with walking less were 0.86 and 0.90 in the age-adjusted and multivariate models, respectively, and the 95% confidence intervals included one. The results were very similar when coronary heart disease was examined separately from other CVD hospitalizations (Table 3).

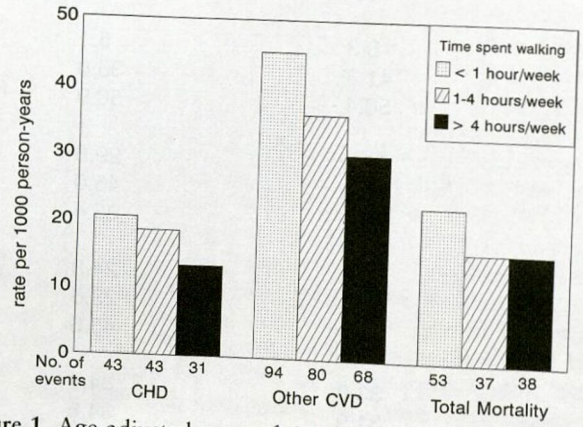

Figure 1. Age-adjusted rates of CVD hospitalization and death per 1000 person-years according to time spent walking among men and women aged 65 and older, Group Health Cooperative, Seattle, WA, 1987–1992.

Walking was also associated with a reduced risk of death from all causes; however, the relative risks observed for those walking more than 4 hours per week were not as strong as those presented above for CVD. Adjusting for age and sex, persons who walked more than 4 hours per week experienced a relative risk for death of 0.73 (95% CI 0.48–1.10) compared with their sedentary counterparts (Table 3). However, adjustment for the eight potential confounding factors diminished the protective association (RR = 0.91, 95% CI 0.58–1.42). Risk factors that were significantly associated with mortality in the multivariate model included: age, male gender, impaired physical function, chronic disease score, fair or poor self-rated health, and current smoking.

Cause of death information was available on all but two deceased subjects. Of the 128 deaths in the cohort, 46 (36 percent) had CVD as the underlying cause. Although the numbers were small, a strong protective association between CVD mortality and walking more than four hours per week vs. less than one hour was observed (age and sex adjusted RR = 0.45, 95% CI 0.21–0.95; data not shown). For those who walked 1 to 4 hours per week, the association was intermediate (RR = 0.58, 95% CI 0.29–1.15). Walking more than 4 hours per week was also significantly and independently associated with lower risk of total CVD, the combined endpoint that included CVD hospitalization or CVD death (multivariate-adjusted RR = 0.74, CI 0.56–0.98) (Table 3).

Age-adjusted rates of CVD hospitalization were lower among those who walked more than 4 hours per week whether or not they also reported participation in any vigorous activity (Figure 2). Adjustment for vigorous activity in the multivariate models did not alter the findings for either outcome, nor was there evidence of interaction between walking and participation in vigorous activity. When time spent walking was disaggregated into separate variables measuring average frequency of weekly walking and average duration of walks, both variables were significantly associated with CVD hospitalization in separate models. When included in the same model, the duration variable was consistently the better predictor (data not shown). To evaluate whether season had an impact on self-reported walking, we further adjusted for month at baseline. Again, the risk estimates for CVD hospitalizations and all-cause mortality were unchanged.

Current use of estrogen replacement therapy was slightly more common among women who walked 1 to 4 (25.3%) and more than 4 (24.1%) hours per week than among women who walked little or not at all (17.9%). Additional adjustment for current use of estrogen did not, however, alter the findings for walking in any way.

Table 2. Relative Risks Relating Time Spent Walking to Rates of Cardiovascular Disease Hospitalization and Death in Men and Women aged 65 and Older, Group Health Cooperative, Seattle, WA, 1987–1992

		Cardiovascular Disease Hospitalizations			Total Mortality		
	Sample Size	No. of CVD Hosps.	RR‡	95% CI‡	No. of Deaths	RR‡	95% CI‡
Gender							
Women							
<1 hour/week	329	74	1.0		32	1.0	
1–4 hours/week	348	58	0.72	(0.51–1.01)	17	0.50	(0.28–0.90)
>4 hours/week	353	53	0.63	(0.44–0.90)**	16	0.45	(0.25–0.83)**
Men							
<1 hour/week	184	48	1.0		21	1.0	
1–4 hours/week	223	55	0.94	(0.64–1.38)	20	0.78	(0.43–1.45)
>4 hours/week	208	39	0.67	(0.44–1.02)	22	0.89	(0.49–1.62)
Age group							
65–74 years							
<1 hour/week	322	59	1.0		16	1.0	
1–4 hours/week	405	68	0.91	(0.64–1.28)	16	0.81	(0.40–1.61)
>4 hours/week	404	58	0.76	(0.53–1.09)	23	1.13	(0.60–2.15)
75+ years							
<1 hour/week	191	63	1.0		37	1.0	
1–4 hours/week	166	45	0.81	(0.55–1.18)	21	0.63	(0.37–1.08)
>4 hours/week	157	34	0.59	(0.39–0.89)**	15	0.46	(0.25–0.84)**
Level of physical function							
High functioning†							
<1 hour/week	291	50	1.0		19	1.0	
1–4 hours/week	359	59	0.96	(0.66–1.40)	17	0.73	(0.38–1.41)
>4 hours/week	357	50	0.79	(0.54–1.17)	21	0.89	(0.48–1.65)
Limited functioning†							
<1 hour/week	211	70	1.0		33	1.0	
1–4 hours/week	208	54	0.74	(0.52–1.05)	20	0.60	(0.34–1.05)
>4 hours/week	202	42	0.56	(0.38–0.82)**	17	0.51	(0.28–0.92)*

* Test for trend, $P < .05$; ** Test for trend, $P < .01$.

† Function was classified as high for subjects who reported no limitations or limitation only in vigorous activity on the Medical Outcome Study (MOS) physical function scale; those reporting ≥ two limitations were classified as having limited function.

‡ Relative risk (95% confidence interval).

DISCUSSION

In this prospective study of older men and women, walking more than 4 hours per week was associated significantly with a reduced risk of CVD hospitalization. This association was not altered by adjustment for various CVD risk factors and indicators of general health status. The association was present in both sexes, both age groups, among those with and without physical limitations, and among those who did and did not also participate in vigorous activity. Walking more than 4 hours per week was also associated with a reduced risk of mortality from all causes; however, this association was diminished substantially by adjustment for CVD risk factors and measures of general health status.

A recent meta-analysis of 14 studies, in which physical activity levels were examined in relation to coronary heart disease independent of other CVD risk factors, found the overall rate ratio for inactivity was 1.37 (95% CI 1.27–1.48).[17] Few of these studies included adults older than age 65 or women. We recently reviewed prospective studies of the association between physical activity and death in older adults.[5] Of the eight studies reviewed, five found higher risks of death among the inactive, although measures of activity varied widely. Physical fitness levels, as measured by total treadmill time, have also been related to a reduced risk of death in older adults.[18] However, physical fitness levels are an attribute of individuals with a strong genetic component and may be associated with coronary disease independently of usual activity levels.[19]

A major difficulty in evaluating the epidemiologic evidence relating physical activity to coronary disease and death is the tremendous variability in how physical activity is measured. Most studies rely on composite measures derived from questionnaires,[20,21] some estimate kilocalorie expenditure or oxygen consumption,[22] and others grade physical activities by intensity.[19] Direct comparisons of the results observed among middle-aged men may have little application to older populations or to women, for whom the array and intensity of physical activities engaged in may differ considerably. Our findings focus specifically on time spent walking in a deliber-

Table 3. Adjusted Relative Risks Relating Time Spent Walking to Rates of Cardiovascular Disease Hospitalization and Death in Men and Women aged 65 and Older, Group Health Cooperative, Seattle, WA, 1987–1992

	Age and Sex Adjusted	Multivariate Adjusted‡
	Relative Risk† (95% confidence interval)	
Cardiovascular Disease Hospitalization (ICD-9-CM 390–448)		
Walked 1–4 hours/week	0.86 (0.66–1.11)	0.90 (0.69–1.17)
Walked >4 hours/week	0.69 (0.52–0.90)*	0.73 (0.55–0.96)*
Coronary Heart Disease (ICD-9-CM 410–414)		
Walked 1–4 hours/week	0.89 (0.58–1.37)	0.93 (0.60–1.44)
Walked >4 hours/week	0.64 (0.40–1.01)*	0.63 (0.38–1.03)
Other Cardiovascular Disease (ICD-9-CM 390–409, 415–448)		
Walked 1–4 hours/week	0.82 (0.61–1.10)	0.86 (0.63–1.17)
Walked >4 hours/week	0.69 (0.50–0.94)*	0.75 (0.55–1.04)
Total Cardiovascular Disease (ICD-9-CM 390–448 hospitalization or death)		
Walked 1–4 hours/week	0.87 (0.67–1.12)	0.90 (0.70–1.17)
Walked >4 hours/week	0.70 (0.54–0.92)*	0.74 (0.56–0.98)*
All-Cause Mortality		
Walked 1–4 hours/week	0.69 (0.46–1.06)	0.83 (0.53–1.29)
Walked >4 hours/week	0.73 (0.48–1.10)	0.91 (0.58–1.42)

† Reference group is subjects who walked <1 hour/week.
‡ Model adjusted for baseline characteristics: age, sex, functional status, smoking status, body-mass index, chronic disease score, self-rated health, and alcohol consumption.
* Significant test for trend, $P < .05$.

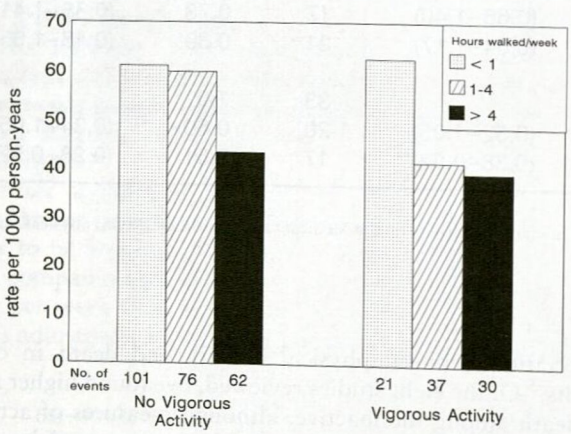

Figure 2. Age-adjusted rates of CVD hospitalization per 1000 person-years according to time spent walking and vigorous activity among men and women aged 65 and older, Group Health Cooperative, Seattle, WA, 1987–1992.

ate attempt to provide some information about this common form of exercise in older adults with respect to CVD endpoints and death.

The biological mechanisms through which physical activity might alter the risk of coronary events are not completely understood. Beneficial effects are most often attributed to favorable changes in lipoprotein levels with activity, especially via increasing or maintaining high density lipoprotein cholesterol (HDL-C) levels. Some observational studies support such an association,[23–25] even in postmenopausal women exhibiting low to moderate intensity activity levels.[23] However, several intervention trials have failed to show changes in lipid levels, specifically HDL-C, in response to activity programs that include walking tested among postmenopausal women.[26–28] Other plausible biological mechanisms exist, including effects of physical activity on reducing blood pressure levels,[29] increasing potassium levels,[30] reducing fibrinogen levels,[31] reducing body weight and central obesity,[25,32] improving endurance capacity,[32] and slowing the progression of coronary atherosclerosis.[33] In the present study, the association of walking with risk of death from all causes (but not CVD hospitalization or death) was attenuated by adjustment for heart disease risk factors and health status indicators such as self-perceived health status and chronic disease score. It is possible that some of the factors that were statistically adjusted are themselves affected by walking and, therefore, are intermediate risk factors in the causal pathway.

Epidemiologic studies of physical activity and heart disease or death are subject to two main biases.[34] The first is that those who avoid physical activity do so because of poor health, subclinical disease, or functional limitations caused by overt or subclinical chronic disease. We attempted to minimize this source of potential bias by excluding subjects with a history of heart problems, those on antianginal medication, those with evidence of CVD hospitalization, and those judged too ill to participate by their physicians. We further evaluated this possibility by examining the walking-heart disease association in those with and without functional limitations; the association was present in both groups and was somewhat stronger among those with functional limitations. Finally, we controlled statistically for a number

of indicators of general health status, including functional limitations, self-rated health, and chronic disease score. The association between walking and CVD hospitalization was not affected by these adjustments.

The second potential bias in epidemiologic studies of physical activity is that those who are active may have other health-promoting lifestyle behaviors. In the present study, statistical adjustment for smoking, alcohol consumption, and body mass index had no affect on the relative risks for CVD hospitalization. Nor was walking more than 4 hours per week a surrogate for more vigorous activity; walking had a similar protective association with CVD hospitalization both among those who did and did not participate in vigorous activity. We were not able to consider total or high density lipoprotein cholesterol levels, but total cholesterol level is an inconsistent risk factor for heart disease in older men and women.[35–37] Only randomized controlled trials can eliminate these sources of bias with relative certainty. The feasibility of doing such long-term trials for walking is enormously challenging,[34] and because many older adults already walk or may be advised to do so, contamination of the comparison group would be likely.

This study was conducted among predominantly white, middle-class, older adults, not unlike the surrounding population in the Puget Sound region. Nonetheless, the ability to generalize these findings to dissimilar subgroups of the population can only be determined by additional research. The totality of the current evidence on physical activity derives largely from such diverse and unique populations as men of Japanese ancestry in Honolulu,[20,21] and Harvard male alumni.[22] Our statistical power was limited for some endpoints. Strengths of our study include its prospective design, the high retention rate of study participants during follow-up, and the ascertainment of prescription medications, CVD hospitalization, and death through automated records.

Those who walked more than 4 hours per week in this study were less likely to be socioeconomically disadvantaged but no less likely to have objective indicators of poor health status. These findings suggest that the half of older Americans who do not walk regularly might benefit from initiating a sustained program of walking to prevent CVD events. More broadly, our findings contribute to the accumulating evidence that walking may extend the healthy and nondisabled part of life expectancy. Recent studies have shown that walking may prevent mobility losses[38] and hip fractures[39] in later life, two health events linked strongly to maintaining independence. Finally, these findings should be reassuring to those who already walk for exercise and wonder if they must do more to obtain benefits.

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