International Journal of Cardiology 168 (2013) 1905–1909

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Prevention of heart failure in older adults may require higher levels of physical activity than needed for other cardiovascular events ☆

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ARTICLE INFO

Article history:
Received 23 July 2012
Received in revised form 13 December 2012
Accepted 25 December 2012
Available online 4 February 2013

Keywords:
Physical activity
MET-minutes
Incident heart failure
Older adults

ABSTRACT

Background: Little is known if the levels of physical activity required for the prevention of incident heart failure (HF) and other cardiovascular events vary in community-dwelling older adults.
Methods: We studied 5503 Cardiovascular Health Study (CHS) participants, age ≥65 years, free of baseline HF. Weekly metabolic equivalent task-minutes (MET-minutes), estimated using baseline total leisure-time energy expenditure, were used to categorize participants into four physical activity groups: inactive (0 MET-minutes; n = 489; reference), low (1–499; n = 1458), medium (500–999; n = 1086) and high (≥1000; n = 2470).
Results: Participants had a mean (±SD) age of 73 (±6) years, 58% were women, and 15% African American. During 13 years of follow-up, centrally-adjudicated incident HF occurred in 26%, 23%, 20%, and 19% of participants with no, low, medium and high physical activity, respectively (trend $p<0.001$). Compared with inactive older adults, age–sex–race-adjusted hazard ratios (95% confidence intervals) for incident HF associated with low, medium and high physical activity were 0.87 (0.71–1.06; $p=0.170$), 0.68 (0.54–0.85; $p=0.001$) and 0.60 (0.49–0.74; $p<0.001$), respectively (trend $p<0.001$). Only high physical activity had significant independent association with lower risk of incident HF (HR, 0.79; 95% CI, 0.64–0.97; $p=0.026$). All levels of physical activity had significant independent association with lower risk of incident acute myocardial infarction (AMI), stroke and cardiovascular mortality.
Conclusion: In community-dwelling older adults, high level of physical activity was associated with lower risk of incident HF, but all levels of physical activity were associated with lower risk of incident AMI, stroke, and cardiovascular mortality.

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1. Introduction

Physical activity has been shown to reduce the risk of incident cardiovascular events including incident heart failure (HF) [1–4]. However, the association of physical activity expressed as metabolic equivalent task-minutes (MET-minutes) with incident HF and other cardiovascular events in community-dwelling older adults has not been previously studied. The United States Department of Health and Human Services' 2008 Physical Activity Guidelines for Americans categorized physical activity into three categories based on weekly MET-minutes: 1–499, 500–999, and ≥1000 and recommended that physical activity at 1–499 MET-minutes per week would provide some health benefits, physical activity at 500–999 MET-minutes per week would provide substantial health benefits, and physical activity at ≥1000 MET-minutes per week would provide additional health benefits [5]. Therefore, the purpose of the current study is to determine the association of physical activity by weekly MET-minutes categories with incident HF and other cardiovascular events in community-dwelling older adults and to examine if these associations varied by levels of physical activity.

☆ Funding/support: Dr. Allman is supported in part by NIH/NCRR grant 5UL1 RR025777.
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0167-5273/$ – see front matter. Published by Elsevier Ireland Ltd.
http://dx.doi.org/10.1016/j.ijcard.2012.12.053

2. Methods

2.1. Data source and study participants

Sponsored by the National Heart, Lung and Blood Institute (NHLBI), the Cardiovascular Health Study (CHS) is an ongoing, prospective, community-based epidemiologic study of cardiovascular disease risk factors in older adults. CHS participants included 5888 community-dwelling older adults, aged 65 years and older, and were recruited from Forsyth County, North Carolina, Sacramento County, California, Washington County, Maryland, and Pittsburgh County, Pennsylvania. The rationale and design of the CHS have been previously reported [6]. Participants were recruited from a random sample of Medicare-eligible older adults in two phases. An initial cohort of 5201 participants was recruited between 1989 and 1990, and a second cohort of 687 African American participants were recruited between 1992 and 1993 [6]. The current analysis is based on a public-use copy of the CHS data. Of the 5888 CHS participants, 93 did not consent to be included in the de-identified public-use data. Of the remaining 5795 participants, 20 without data on baseline physical activity (kilocalories of energy expended per week in leisure-time) and 272 with baseline prevalent HF were excluded and the final cohort was comprised of 5503 CHS participants.

2.2. Physical activity and other baseline characteristics

Baseline leisure-time physical activity was assessed using a modified Minnesota Leisure-Time Activities questionnaire, which evaluated frequency and duration of 15 different activities during a 2 week period and was used to estimate kilocalories of energy expended per week [7]. MET-minutes were calculated by following formula, total kilocalories per week = total MET-minutes per week × 0.0175 × body weight in kilogram. Based on the MET-minutes cutoffs used in the 2008 Physical Activity Guidelines for Americans, we categorized participants into four physical activity groups: inactive (0; n = 489), low (1–499; n = 1458), medium (500–999; n = 1086), and high (≥1000; n = 2470) [5]. Data on other characteristics (Table 1) were collected at baseline. Missing values for covariates were imputed based on values predicted by age, sex and race.

2.3. Incident heart failure and other cardiovascular events

The primary outcome for this study was incident HF during 13 years of follow-up. Incident HF was centrally-adjudicated by the CHS Events Committee [8–15]. The process began with self-reports of physician-diagnosed HF, which was then confirmed by review of medical records for symptoms, signs, medications, and other evidence

Table 1
Baseline characteristics by physical activity categories.

Mean (±SD) or n (%)	Physical Activity in MET-minutes/week				
	0 (n = 489)	1–499 (n = 1458)	500–999 (n = 1086)	≥1000 (n = 2470)	p Value for linear trend
Age, years	75 (±6)	74 (±6)	73 (±5)	73 (±5)	<0.001
Female	316 (65%)	877 (60%)	612 (56%)	1375 (56%)	<0.001
African American	103 (21%)	358 (25%)	154 (14%)	225 (9%)	<0.001
Education higher than high school	186 (38%)	577 (40%)	475 (44%)	1130 (46%)	<0.001
Income >25 K	157 (32%)	477 (33%)	401 (37%)	1012 (41%)	<0.001
Alcohol, drinks per week	2.0 (±6.5)	2.3 (±6.6)	2.6 (±6.6)	2.6 (±6.2)	0.134
Smoke, pack-years	19 (±31)	18 (±26)	18 (±27)	17 (±26)	0.277
Never eat chicken skin	325 (67%)	942 (65%)	733 (68%)	1799 (73%)	<0.001
Body mass index, kg/m^2	27 (±4)	28 (±4)	27 (±4)	26 (±4)	<0.001
Systolic blood pressure, mm Hg	140 (±23)	138 (±22)	136 (±21)	135 (±21)	<0.001
Diastolic blood pressure, mm Hg	72 (±12)	72 (±11)	71 (±11)	70 (±11)	<0.001
Medical problems					
Coronary heart diseases	111 (23%)	272 (19%)	183 (17%)	393 (16%)	<0.001
Acute myocardial infarction	52 (11%)	122 (8%)	84 (8%)	184 (7%)	0.032
Angina pectoris	96 (20%)	231 (16%)	147 (14%)	321 (13%)	<0.001
Hypertension	326 (67%)	923 (63%)	636 (59%)	1330 (54%)	<0.001
Diabetes mellitus	106 (22%)	272 (19%)	165 (15%)	315 (13%)	<0.001
Stroke	42 (9%)	65 (4%)	35 (3%)	71 (3%)	<0.001
Atrial fibrillation	16 (3%)	36 (2%)	17 (2%)	46 (2%)	0.038
Left ventricular hypertrophy by electrocardiogram	37 (8%)	69 (5%)	42 (4%)	91 (4%)	0.001
Left ventricular systolic dysfunction by echocardiogram	44 (9%)	111 (8%)	90 (8%)	165 (7%)	0.070
Arthritis	306 (63%)	773 (53%)	548 (51%)	1228 (50%)	<0.001
Chronic obstructive pulmonary disease	81 (17%)	200 (14%)	140 (13%)	265 (11%)	<0.001
Cancer	67 (14%)	230 (16%)	161 (15%)	335 (14%)	0.208
Geriatric problems					
Activity of daily living	0.39 (±0.9)	0.15 (±0.5)	0.08 (±0.4)	0.06 (±0.3)	<0.001
Instrumental activity of daily living	0.86 (±1.2)	0.43 (±0.8)	0.30 (±0.6)	0.18 (±0.5)	<0.001
Blocks walked last week	13 (±30)	20 (±32)	38 (±46)	56 (±66)	<0.001
Time to walk 15 ft	6.9 (±3.1)	6.1 (±2.4)	5.7 (±1.8)	5.4 (±2.0)	<0.001
Mini mental state examination score	26.8 (±3.4)	27.3 (±3.0)	27.8 (±2.4)	27.8 (±2.4)	<0.001
Depression score	6.0 (±5.3)	5.2 (±4.7)	4.5 (±4.3)	4.1 (±4.2)	<0.001
Loss of balance	150 (31%)	377 (26%)	237 (22%)	502 (20%)	<0.001
Frequent fall	35 (7%)	54 (4%)	34 (3%)	57 (2%)	<0.001
Orthostatic dizziness	149 (31%)	317 (22%)	235 (22%)	425 (17%)	<0.001
Laboratory measures					
Serum cholesterol, mg/dL	219 (±42)	211 (±40)	211 (±38)	212 (±38)	0.001
Serum triglyceride, mg/dL	152.7 (±96.4)	141.3 (±70.8)	142.0 (±82.5)	134.7 (±72.8)	<0.001
Serum creatinine, mg/dL	1.01 (±0.46)	0.98 (±0.45)	0.95 (±0.39)	0.93 (±0.31)	<0.001
Serum potassium, mEq/L	4.1 (±0.40)	4.1 (±0.39)	4.2 (±0.37)	4.2 (±0.37)	0.001
Serum glucose, mg/dL	116 (±42)	115 (±40)	111 (±38)	107 (±32)	<0.001
Serum albumin, g/dL	4.0 (±0.3)	4.0 (±0.3)	4.0 (±0.3)	4.0 (±0.3)	0.176
Serum uric acid, mg/dL	6.0 (±1.7)	5.8 (±1.5)	5.7 (±1.5)	5.5 (±1.4)	<0.001
Serum C-reactive protein, mg/dL	5.7 (±7.8)	5.6 (±9.3)	4.4 (±8.0)	4.0 (±7.3)	<0.001
Serum interleukin-6, pg/mL	2.6 (±1.7)	2.4 (±1.9)	2.1 (±1.6)	2.0 (±1.8)	<0.001
Serum insulin, μIU/mL	18.8 (±25.3)	18.9 (±29.6)	16.1 (±20.7)	15.2 (±21.6)	<0.001
Fibrinogen, mg/dL	337 (±74)	331 (±69)	320 (±65)	316 (±62)	<0.001
Serum coagulation factor-VII, %	129 (±33)	124 (±29)	124 (±28)	122 (±29)	<0.001
Hemoglobin, g/dL	13.9 (±1.38)	13.9 (±1.43)	14.1 (±1.29)	14.1 (±1.31)	<0.001
Platelet count, 10^3/μL	260 (±89)	250 (±72)	245 (±69)	252 (±76)	0.001

Abbreviation: MET, metabolic equivalent task; SD, standard deviation.