Published in final edited form as:
Res Q Exerc Sport. 2011 June ; 82(2): 365–370.

How Much Walking Is Needed To Improve Cardiorespiratory Fitness? An Examination of the 2007 ACSM/AHA Physical Activity Recommendations

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Abstract

Background—The 2007 American College of Sports Medicine (ACSM) and the American Heart Association (AHA) physical activity guidelines recommend adults engage in either 150 minutes of moderate intensity or 60 minutes of vigorous intensity physical activity per week to derive health benefits.

Purpose—In a 6-month clinical trial, we examined whether walking programs of moderate (leisurely-paced) and vigorous (fast-paced) intensity produced improvements in cardiorespiratory fitness as predicted by the ACSM/AHA guidelines.

Methods—Participants (N = 155) were instructed to walk 30 minutes per day on 5 or more days per week, at either a moderate or vigorous intensity level (45–55% or 65–75% of maximum heart rate reserve [HR_{res}]**,** respectively). Within each condition, we categorized participants based on their mean weekly amounts of exercise as reflected in written self-monitoring logs. Fitness was assessed by a maximal graded exercise test at pre- and post-treatment. This trial was conducted in Gainesville, FL between 1999 and 2003.

Results—Mean minutes of walking were related to changes in cardiorespiratory fitness in the vigorous (r = .47; p = < .001) but not moderate intensity condition (r = .07; p = .52). Within the vigorous intensity condition, significantly greater improvements in fitness were achieved by participants with high and medium amounts of accumulated exercise compared with those with low amounts of exercise.

Conclusions—Clinically meaningful improvements in cardiorespiratory fitness were observed in participants who walked a minimum of 60 minutes per week at a fast-pace but not those who walked at a leisurely-pace. These findings support the 2007 ACSM/AHA physical activity recommendations regarding vigorous, but not moderate, intensity physical activity for cardiorespiratory fitness.

Keywords

walking; exercise intensity; intensity; fitness; physical activity; physical activity guidelines

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The 2007 physical activity recommendations put forth by the American College of Sports Medicine (ACSM) and the American Heart Association (AHA) indicate that two approaches can be used to achieve the threshold of activity needed to derive health benefits (1). Individuals may engage in either moderate intensity activity for a minimum of 30 minutes on five days per week (150 min per week) or vigorous intensity activity for a minimum of 20 minutes on three days per week (60 min per week). However, it is currently unknown whether improvements in cardiorespiratory fitness can be achieved by sedentary adults who use walking as the mode of exercise to achieve the recommended amounts of moderate or vigorous physical activity (2).

We examined this question in the context of a randomized clinical trial in which sedentary adults were instructed to walk 30 minutes per day on five or more days per week at either a moderate (45%–55% heart rate reserve [HRres]) or vigorous intensity (65%–75% HRres). This study was conducted as an ancillary project to a two year randomized controlled trial examining the effects of different levels of prescribed walking on health and fitness (3). In line with the 2007 recommendations (1), we hypothesized that a) dose of walking would be positively associated with improvements in cardiorespiratory fitness in both intensity conditions, b) a minimum of 150 minutes per week of leisurely-paced (moderate intensity) or 60 minutes per week of fast-paced (vigorous intensity) walking would be required to produce clinically significant improvements in cardiorespiratory fitness (i.e., ≥ 5%), and c) the majority of participants who walked at or above current recommendations for moderate and vigorous intensity activity would obtain clinically significant improvements in cardiorespitaroy fitness.

Methods

Participants

In the main trial, participants were assigned to one of four exercise prescriptions using a randomized, factorial design, with two levels of intensity (45–55% versus 65–75% HRres) crossed with two levels of frequency (3–4 versus 5–7 days/week), controlling for mode of exercise (walking), daily duration (30 min), and setting (home-based). For the current study, data were analyzed only for participants assigned to high frequency conditions during the first six-months of the main study. Briefly, eligible participants (N = 155; 92 women) met the following inclusion criteria: 30 to 69 years of age with no major medical conditions, sedentary (< one hour of leisure-time physical activity per week), body mass index (BMI kg/m^2) between 19 and 45, and resting blood pressure below 140 mm Hg systolic and 90 mm Hg diastolic. Recruitment for this trial occurred between 1999 – 2000.

Baseline Assessment

During a baseline testing session, each participant underwent a medical examination and completed a symptom-limited maximal graded exercise test to determine maximum oxygen consumption (VO_{2max}; ml/min/kg) and maximum HR using the Bruce protocol (4). All participants repeated the maximal graded exercise test after six months of training.

Intensity prescriptions—A participant's performance during the treadmill test served as the basis for determining his or her training heart rate (THR) zone. The Karvonen formula (5) was used to calculate HR_{res} ($HR_{res} = HR_{max}$ − resting HR). In the moderate intensity conditions, the individualized THR zone was 45–55% $HR_{res,}$ which corresponded to "leisurely-paced" walking. In the vigorous intensity conditions, the individualized THR zone was 65–75% HR_{res}, which corresponded to "fast-paced" walking. To assist participants in walking within their prescribed THR zone, participants were provided with a heart rate (HR) monitor (Polar Beat; Polar Electro, Inc.; Port Washington, NY) and were instructed to wear and record their most frequently observed HR during each walking bout.

Frequency Prescriptions—The exercise training activity prescribed to all participants was walking within their individually tailored THR zone for 30 minutes per day (either in a continuous bout or in up to three bouts, each of at least 10 minute duration) for 5–7 days/ week.

Intervention

Details about the intervention procedures are reported elsewhere (3). Briefly, all participants received a standard exercise intervention program consisting of 11 group sessions over six months. Treatment sessions were conducted by counselors (counterbalanced by condition) with graduate training in exercise science and/or behavioral science. Participants were instructed in the use of daily training logs for self-monitoring the duration and intensity of each exercise bout.

Outcome Variable

Cardiorespiratory Fitness—Change in VO_{2max} between baseline and six months was the primary outcome measure for this study. Fitness improvements of 5% or greater were considered the threshold level to establish statistical and biological significance; previous findings indicate a 5% increase in cardiorespiratory fitness is associated with a 7.5% reduction in mortality (6).

Accumulation of Physical Activity

Participants were categorized into one of three levels (i.e., LOW, MEDIUM, and HIGH) of exercise accumulation based on mean weekly amounts of walking documented in their written training logs during months 2 through 6 of the trial. Exercise participation during the first month was not included because participants were instructed to gradually increase their exercise levels. For the moderate intensity condition, participants were divided into the following three groups: < 90 min per week ("LOW"), 90 to 149 min per week ("MEDIUM"), and ≥ 150 min per week ("HIGH"). For the vigorous intensity condition, the three groups were the following: < 60 min per week ("LOW"), 60 – 119 min per week ("MEDIUM"), and ≥ 120 min per week ("HIGH"). The number of minutes selected to represent the LOW, MEDIUM, and HIGH groups differed across the two intensity conditions (moderate vs. vigorous) in line with the 2007 ACSM/AHA physical activity guidelines (1).

Statistical Analyses

All analyses were conducted separately for participants assigned to the moderate and vigorous intensity conditions. Correlational analyses were initially conducted to examine if self-reported minutes of walking were related to changes in VO_{2max} over six months. Analyses of variance (ANOVAs) were then performed to determine if group categorization was related to changes in VO_{2max}. Next, chi-square analyses were used to compare the percentage of participants achieving clinically significant improvements in cardiorespiratory fitness by group assignment.

An intent-to-treat approach was used for the analyses of data from the exercise logs. Missing data were treated in a conservative fashion. The assumption was made that if a participant did not record an exercise bout in his or her log, the exercise did not occur. Only participants who completed the maximal graded exercise test at both baseline and six months were included in the analyses. Two individuals were identified as outliers (change in VO_2max > 3 SDs from study mean) and were removed from the study sample.

Results

The sample was predominantly Caucasian (n = 128; 82%); twelve participants were African American (8%), eight were Asian (5%), four were Hispanic (2%), and seven self reported “other” race/ethnicity or unknown (3%). There were no differences in any baseline variable between the groups.

Preliminary Analyses

Analyses of data from downloadable HR monitors worn by participants during selected weeks (i.e., weeks 5, 12, and 24) showed that the majority adhered to their exercise intensity prescriptions: 88% of participants in the moderate intensity and 71% of participants in the vigorous intensity conditions had mean HRs within their individually-prescribed THR.

Correlational Analyses

After adjusting for initial level of fitness, self-reported minutes of walking was significantly and positively correlated with changes in VO_{2max} in the vigorous intensity condition (r = .47; p = < .001) but not in the moderate intensity condition (r = .07; p = .52).

Fitness Change by Exercise Intensity and Accumulation

Changes in fitness according to weekly mean minutes of walking within the moderate and vigorous intensity conditions are presented in Table 1.

Moderate Intensity Conditions—Within the moderate intensity condition, the mean (SD) weekly minutes of walking for participants in the three groups was: LOW = 37.3 (37.6); MEDIUM = 127.8 (16.6); and HIGH = 173.3 (16.7). Fitness changes did not vary as a function of amount of exercise accumulated (see Figure 1, Panel A).

Vigorous Intensity Conditions—Within the vigorous intensity condition, the mean weekly minutes of walking by group was: LOW = 25.3 (5.8); MEDIUM = 91.2 (19.2); and

HIGH = 144.3 (17.3). The HIGH (10% [12]) and MEDIUM groups (6% [12]) demonstrated significantly greater improvements in fitness compared to the LOW group (−3% [10]; see Figure 1, Panel B). Furthermore, higher percentages of participants in the HIGH (71%) and MEDIUM group (60%) achieved significant improvements in cardio-respiratory fitness compared to the LOW group (19%; $p < .001$).

Discussion

In this study, we examined whether improvements in cardiorespiratory fitness were achieved by previously sedentary adults who used walking as the mode of exercise to achieve the amounts of moderate and vigorous physical activity recommended by the 2007 ACSM/AHA guidelines. There were two key findings. First, leisurely-paced (i.e., moderate intensity) walking was not associated with fitness benefits, even for participants who reported walking for more than 150 minutes per week. Second, fast-paced (i.e., vigorous intensity) walking of 60 – 119 minutes per week (mean = 91 min/wk) was associated with clinically meaningful improvements in cardiorespiratory fitness (mean = 6% increase in VO_{2max}). The majority of participants (60%) who walked at this level within the vigorous intensity condition achieved significant fitness improvements. Moreover, among participants who accumulated two or more hours per week of fast-paced walking (mean = 144 min/wk), 71% achieved clinically significant improvements of ≥ 5% increase in cardiorespiratory fitness.

The 2007 ACSM/AHA physical activity guidelines recommend that all healthy adults engage in a minimum of 150 minutes of moderate intensity or 60 minutes of vigorous intensity physical activity per week to obtain or maintain health benefits. Many of the health benefits associated with regular engagement in physical activity (e.g., reduced risk of cardiovascular disease) are mediated by improvements in cardiorespiratory fitness (7–10); thus, the amount and intensity of walking needed to improve cardiorespiratory fitness represents an important research and clinical question. Our finding that 60 minutes or more of fast-paced walking per week resulted in significant improvements in cardiorespiratory fitness is in line with current physical activity recommendations for vigorous intensity activity. Also consistent with current recommendations, higher amounts of vigorous walking were positively associated with larger improvements in cardiorespiratory fitness. With respect to moderate intensity activity, our findings indicated that even when accumulated at high levels (i.e., ≥ 150 min/wk), leisurely-paced walking did not result in significant improvements in cardiorespiratory fitness.

The findings from this study have implications for clinical practice. Provided there are no medical contraindications and exercise is gradually increased, clinicians should encourage their patients to walk for at least 60 minutes per week at a fast-pace to improve their cardiorespiratory fitness. To determine the intensity level at which they are walking, individuals should be encouraged to use a HR monitor during exercise bouts. Alternatively, individuals can use the Borg perceived exertion scale, a 15-item self-assessment tool, to estimate the intensity level at which they are walking (11). This method correlates highly with objective measures of exercise intensity (12–14).

We have previously reported on the effects of exercise prescriptions differing in intensity and frequency on changes in cardiorespiratory fitness in the short-term (15) and long-term (3). Prescriptions for high frequency, vigorous intensity exercise were associated with the largest improvements in cardiorespiratory fitness. In the present study, we investigated whether the 2007 ACSM/AHA recommendations apply to cardiorespiratory benefits that might be achieved by sedentary adults who use leisurely or fast-paced walking to achieve recommended amounts of moderate or vigorous intensity physical activity. In contrast to previous studies, participants were categorized into groups based on their reported weekly minutes of walking rather than their randomized condition. Additionally, we only included participants randomized to the high frequency conditions because the most recent physical activity guidelines state that a minimum of 5 days of moderate intensity physical activity is needed to achieve fitness benefits. These methodological differences from our previous studies likely account for the novel findings of the present study related to the dose (i.e., ≥ 60 min/wk) of vigorous intensity exercise needed to significantly improve cardiorespiratory fitness.

Relative to previous studies, this study had a number of strengths. First, participants' engagement in physical activity was assessed on a continuous basis rather than through retrospective reports. Other strengths include: randomized assignment to exercise conditions, the use of individualized THR prescriptions based on maximal exercise testing, the use of HR monitors to gauge intensity during exercise, the use of downloadable HR monitors to corroborate intensity levels, and appropriate control for mode and duration of prescribed exercise.

This study also had some potential limitations. First, our measure of exercise intensity and accumulation was derived from self-report daily exercise logs. However, the data from downloadable HR monitors provided supported the validity of this approach to assess exercise intensity. Second, our findings only inform about activity levels needed to produce changes in cardiorespiratory fitness; the levels of walking needed to produce changes in other health parameters may differ. Finally, our findings are limited to the benefits observed during the "adoption" phase (i.e., first 6 months) of exercise initiation and do not inform about the impact of activity level on changes in cardiorespiratory fitness over the longer-term.

Conclusion

In conclusion, our findings support the 2007 ACSM/AHA physical activity recommendations regarding vigorous, but not moderate, intensity physical activity for cardiorespiratory fitness. Leisurely-paced walking did not significantly improve cardiorespiratory fitness, even at high levels (i.e., ≥ 150 min per week). However, the majority of sedentary adults who engaged in fast-paced walking for at least 60 minutes per week obtained clinically meaningful improvements in cardiorespiratory fitness, and higher amounts of fast-paced walking resulted in a larger proportion of individuals achieving clinically meaningful benefits.

Acknowledgments

We are very grateful to our late colleague, Michael L. Pollock, Ph.D. for his inspiration and guidance in the development of this work, as well as the participants and staff of the Walking Project. This study was supported by the National Heart, Lung, and Blood Institute Grant HL 58873 and by the National Institutes of Health for the University of Florida's General Clinical Research Center Grant RR00082.

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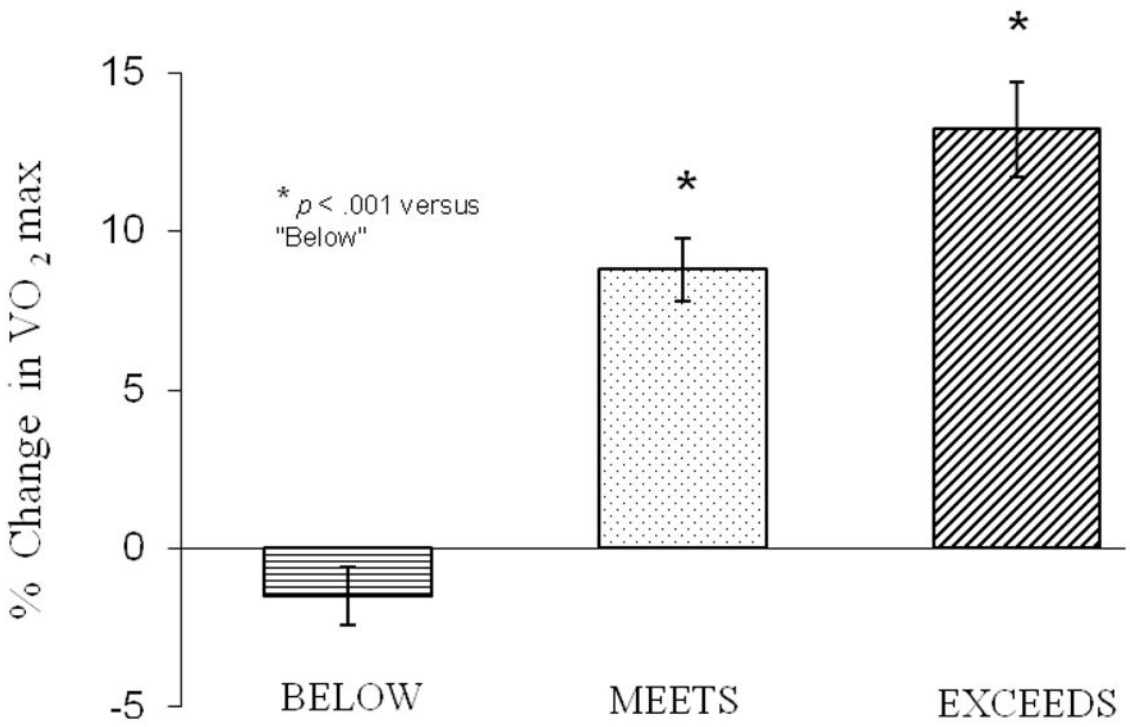

Figure 1.

Figure Percent change in cardiorespiratory fitness (VO_2max) according to group categorization in the moderate and vigorous intensity conditions. For the moderate intensity condition, participants were divided into the following three groups: < 90 min per week (“LOW”), 90 to 149 min per week (“MEDIUM”), and ≥ 150 min per week (“HIGH”). As presented in Panel A, cardiorespiratory fitness did not vary by group category in the moderate intensity condition. For the vigorous intensity condition, the three groups were the following: < 60 min per week (“LOW”), 60 – 119 min per week (“MEDIUM”), and ≥ 120 min per week (“HIGH”). As shown in Panel B, the HIGH (mean ± SE = 10 ± 2.0%) and MEDIUM groups (6 ± 2.1%) demonstrated significantly greater improvements in fitness compared to the LOW group (−3 ± 2.4%) in the vigorous intensity condition. This trial was conducted in Gainesville, FL between 1999 and 2003.

Table 1

Baseline Characteristics of Study Participants

	Group						Group			
	Below		Meets		Exceeds		Non-Responders		Responders	
	M	SD	M	SD	M	SD	M	SD	M	SD
Age (yrs)	48.1	9.3	51.2	6.5	50.8	9.3	49.5	9.2	51.0	8.2
Education (yrs)	16.5	4.4	14.8	3.2	16.8	3.9	16.4	4.5	16.0	3.4
Body mass index (kg/m^2)	28.0	5.8	29.4	5.3	27.8	5.1	28.4	4.9	28.2	5.6
VO_2Baseline (l/kg/min)	2.4	0.9	2.1	0.6	2.0	0.7	2.1	0.7	2.1	0.7
Sex										
Men (n)	7		12		22		19		22	
Women (n)	9		8		16		13		20	

Res Q Exerc Sport. Author manuscript; available in PMC 2014 August 08.