

# Influence of pedometers on habitual physical activity patterns in patients with vascular disease

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## Abstract

**Background:** Pedometers are used to measure physical activity and motivate individuals to be more active. Little is known regarding the impact of the conditions when issuing a pedometer. We explored the influence of pedometers on daily physical activity in patients with cardiovascular disease, with and without additional information, direction, or encouragement.

**Methods:** Subjects included males (n=45) and females (n=5) (mean age 70.9 ± 7.4 years) with abdominal aortic aneurysm (AAA) disease from the AAA STOP trial. The No Contact (NC) group (n=25) was mailed a packet containing a pedometer, 12 monthly log sheets, and 12 postage-paid return envelopes, but no letter or instructions. Interviews were conducted after 12 months. The Exercise Treatment (ET) group (n=25) received their pedometers at their first study visit; the pedometers were set up for each individual and goals were discussed. Additionally, they received weekly follow-up and reminders to use their pedometers and increase their daily physical activity.

**Results:** Twelve of the 25 (48%) NC subjects returned ≥6 monthly logs. Energy expenditure significantly differed between the NC and ET groups at both the 12-month (1331.8 ± 244.1 kcals/week vs. 2357.3 ± 369.6 kcals/week, respectively, p=0.02) and 24-month follow-up (1053.6 ± 227.3 kcals/week vs. 2371.9 ± 434.6 kcals/week respectively, p=0.01). Only 8% (2/25) in the NC group changed their exercise routine due to the pedometer, while 16% (4/25) increased their exercise volume due to wearing the pedometer.

**Conclusions:** Receiving a pedometer did not aid in increasing daily physical activity in adults with vascular disease. Education, goal setting, and encouragement are needed to supplement the use of a pedometer to increase energy expenditure.

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## Introduction

Current national and international recommendations for physical activity state that older adults should accumulate 150 minutes of moderate-to-vigorous physical activity weekly, or if unable to achieve this due to chronic illness, that they do what their ability permits [1]. The prevalence of adults meeting this recommendation varies widely depending on the

measurement tool. For example, data from the 2005-2006 National Health and Nutrition Examination Survey (NHANES) using self-reported physical activity showed that 62% of adults met the guidelines compared to only 10% when measured by accelerometry [2]. Increasing the amount of daily physical activity is widely recognized to have a beneficial influence on many physiological measures,

including exercise capacity, blood pressure and glycemic control [3, 4].

A common tool for measuring physical activity is the pedometer. Pedometers are a relatively inexpensive way to measure physical activity and have been shown to be reliable and valid in a variety of populations, including healthy and overweight adults [5], children and adolescents [6], and patients with cardiovascular disease [7]. Pedometers simply measure the volume of physical activity performed via the number of steps taken during ambulatory movement. Most pedometers register steps taken with the use of a horizontal lever arm that moves up and down due to vertical acceleration at the hip. Notable limitations of pedometers include the fact that they do not take into account exercise intensity nor can they quantify upper body activity.

Pedometers have also been used as motivational tools as they can influence people to increase their amount of daily physical activity. Many studies, both randomized controlled trials [3, 4, 8, 9] and observational [10-13], have used pedometer-based goal setting to help increase the amount of daily physical activity, while other studies have simply issued pedometers without incorporating goals [14-16]. Others have compared visible feedback to blinded conditions to determine whether simply the act of wearing a pedometer, without knowing how many steps had been taken, influenced the amount of daily physical activity achieved [17, 18]. Each of these approaches to one extent or another has been demonstrated to favorably influence energy expenditure. The ease of use, low cost, and multiple ways of influencing physical activity levels makes pedometers a feasible tool in many different settings. However, little is known regarding the conditions surrounding issuing a pedometer, such as whether directions are given and whether the goals of wearing the pedometer are explained

Pedometers are currently widely available; they are frequently given to customers at restaurants, meetings, sporting goods stores, and elsewhere under the auspices that they will increase a person's physical activity level. However, few individuals have the support, guidance, and goals set for them in order to use a pedometer to increase activity. Therefore, the purpose of this study was to explore the influence of

pedometers, with no additional information, direction, or encouragement, on the level of daily physical activity in patients with vascular disease. This was compared to a group who received a pedometer along with education, encouragement, and other resources to increase physical activity. Additionally, we examined differences in expected benefits and perceived barriers to exercise between those who responded to receiving the pedometer and those who did not.

## Methods

### *Subjects*

The sample was a convenience subgroup of the abdominal aortic aneurysm AAA STOP trial. AAA STOP was a randomized, prospective, longitudinal trial designed to test the efficacy of up to 3 years of exercise training on modifying AAA biology and early disease progression; details of the trial are provided elsewhere [19]. Fifty subjects (mean age  $70.9 \pm 7.4$  years) with AAA were included (mean AAA diameter  $3.6 \pm 0.5$  cm). Twenty-five subjects were placed in the No Contact (NC) group and 25 were randomized to the Exercise Treatment (ET) group. Subjects were recruited from the VA Palo Alto Health Care System (VAPAHCS), Stanford University, or Kaiser Permanente of Northern California with known small AAA, defined as an aortic diameter  $\geq 3.0$  and  $< 5.0$  cm. Recruitment procedures and all study-related activities were reviewed and approved in advance by Institutional Review Boards (IRBs) at Stanford University (including VAPAHCS), as well as the Kaiser Permanente Division of Research, and an independent Data Safety Monitoring Board (DSMB) organized by the National Heart, Lung, and Blood Institute. Study visits were performed at the VAPAHCS where questionnaires (health history, activity, etc.), exercise tests, and blood panels were performed.

### *Measurements*

All subjects were included in this sub-study who were enrolled for a one-year period as part of the larger trial. Following a baseline visit, each NC subject was mailed a packet containing a pedometer (Omron 720-ITC, Bannockburn, IL), 12 monthly log sheets, and 12

postage-paid, return envelopes. No letter or instructions were included in this packet. The log sheets were pre-filled with the subject's name, study identification number, and the month and year to avoid any confusion as to the period being recorded. The log sheets included a chart with the numerical day of the month and a column for the daily pedometer step count to be recorded. During the 12-month follow-up visit, subjects in the NC group filled out a survey regarding their expected benefits and perceived barriers to exercise. In addition, an investigator interviewed each subject regarding the ease of using the pedometers, their ability to wear the pedometer daily, any change in their normal routine due to wearing the pedometer, and future use of the pedometer. The 25 NC subjects were classified as responders or non-responders based on the number of pedometer logs returned (responders:  $\geq 6$  logs, i.e.,  $\geq 50\%$  of the logs sent); non-responders:  $< 6$  logs, i.e.,  $< 50\%$  of the logs sent). Subjects in the ET group received a pedometer at their first study visit. During that visit the pedometers were set up for the subject by an investigator, log sheets were given, and the goal of increasing their daily physical activity was explained to each subject. Additionally, for subjects in the ET group, weekly discussions (in person or over the phone) were completed by the investigators to encourage compliance with the study and ascertain the weekly pedometer data (steps/week). Subjects in the ET group did not fill out the survey regarding their expected benefits and perceived barriers to exercise and were not interviewed regarding their use of the pedometer at the 12-month follow-up visit.

To examine the influence of receiving the pedometer on activity patterns, differences in weekly energy expenditure (kcal/week), as measured by the Veterans Physical Activity Questionnaire (VAPAQ) [20], were analyzed at the 12-month and 24-month follow-up evaluations. The VAPAQ is a detailed, 5-page instrument that has been modified from the Harvard Alumni studies [21]. The VAPAQ was administered by experienced interviewers and took approximately 15-minutes to complete. The VAPAQ takes into consideration intensity, duration, and frequency, and separately quantifies recreational and occupational activities. Metabolic costs of all activities were computed, and energy expenditure was expressed in kcal/week. Metabolic costs of physical

activities were estimated from the American College of Sports Medicine (ACSM) compendium of physical activities [22].

### *Analysis*

Descriptive characteristics were calculated for the total sample, the NC group (as a whole and as responders vs. non-responders), and the ET group. Differences between the NC group and the ET group and between the responders and non-responders within the NC group were compared using one-way analysis of variance (ANOVA). Differences in categorical variables (clinical information, questionnaire data) were examined by the chi-square test.

### **Results**

Descriptive characteristics of the total sample, the NC group, and the ET group are shown in Table 1. The majority (84%) of the sample was white, with the remaining being African American (6%), Latino (6%), Pacific Islanders (2%), or Asian (2%). The NC group had significantly lower baseline and 12-month weight compared to the ET group. Within the NC group, the responder group consisted of one female and 11 males, and the non-responder group consisted of one female and 12 males. Of the non-responders, 11 subjects returned no logs, while two returned less than six logs. Ten of the responders returned all 12 logs, with two responders returning 11 and 9 logs, respectively. There were no significant differences between responders and non-responders in descriptive characteristics, clinical characteristics, or medications (data not shown).

While there was no significant statistical difference between the average steps taken each month between the groups (NC:  $5172.2 \pm 3363.5$  steps; ET:  $6760.7 \pm 3834.7$  steps), there were significant differences in energy expenditure between the ET and NC groups at both 12- and 24-months as measured by the VAPAQ (Table 2), with subjects in the ET group having greater energy expenditure. When examined by responder/non-responder groups, there was a significant difference between non-responders and the ET group at the 12-month follow-up, and there were

significant differences between both NC sub-groups and the ET group at the 24-month follow-up.

The results of the survey focusing on expected benefits and perceived barriers to exercise are shown in Table 3. Only NC group subjects filled out this survey.

**Table 1.** Descriptive characteristics of the no contact (NC) and exercise treatment (ET) groups [Mean (SD)]

	No Contact	Exercise Treatment	Total Sample
Gender	2 female 23 male	3 female 22 male	5 female 45 male
Baseline Age (years)	72.0 (7.5)	69.8 (7.2)	70.9 (7.4)
Baseline Height (in)	70.0 (3.2)	69.2 (3.2)	69.6 (3.2)
Baseline Weight* (lb.)	186.0 (28.2)	204.0 (28.6)	195.0 (29.5)
Baseline AAA size (cm)	3.6 (0.6)	3.6 (0.4)	3.6 (0.5)
Baseline PAQ (kcal/day)	1342.2 (1137.0)	1907.9 (1569.6)	1625.0 (1386.2)
Baseline VO2max (ml/kg/min)	20.8 (7.4)	20.6 (6.5)	20.7 (6.8)
12 month Weight* (lb.)	184.0 (25.5)	202.6 (28.8)	193.9 (28.6)
12 month PAQ* (kcal/day)	1331.8 (1220.4)	2357.3 (1810.5)	1834.1 (1607.7)
12 month VO2max (ml/kg/min)	20.3 (7.1)	21.8 (6.4)	21.0 (6.7)
24 month Weight (lb.)	187.7 (39.5)	199.9 (22.0)	194.1 (31.7)
24 month PAQ* (kcal/day)	1053.6 (1016.7)	2371.9 (1894.4)	1695.8 (1631.7)
24 month VO2max (ml/kg/min)	18.5 (5.5)	22.3 (6.3)	20.1 (6.1)
Average Monthly Steps	5172.2 (3363.5)	6760.7 (3834.7)	6190.5 (3708.5)

\* Significant difference between NC and ET and usual care (p<0.05)

The only significant difference between responders and non-responders was in response to the statement “Exercise helps me stay in shape” with 75% of

responders answering that they agreed, while only 23.1% of non-responders answered similarly.

**Table 2.** Comparison of weekly energy expenditure between no contact (NC) and exercise treatment (ET) groups [Mean (SE)]

	Baseline	12 Month Follow-Up	24 Month Follow-Up
PAQ (kcal/week)			
<i>Exercise Treatment</i>	1907.9 (313.9)	2357.3 (369.6)*	2371.9 (434.6)#
<i>No Contact</i>	1342.2 (227.4)	1331.8 (244.1)	1053.6 (227.3)
PAQ (kcal/week)			
<i>Exercise Treatment</i>	1907.9 (313.9)	2357.3 (369.6)	2371.9 (434.6)
<i>Responders</i>	1547.9 (411.5)	1592.4 (455.0)	940.4 (341.7)##
<i>Non-responders</i>	1152.3 (222.1)	1091.3 (209.6)**	1146.3 (316.6)##

\*Significant difference between NC and ET group (p = 0.024)

#Significant difference between NC and ET group (p = 0.010)

\*\* Significant difference between non-responders and exercise training group (p = 0.058)

##Significant difference between responders/non-responders and exercise training group (p = 0.035)

Seventy-seven percent of non-responders strongly agreed with the statement, while only 16.7% responders strongly agreed. NC subjects were also asked a series of questions regarding their experience with the pedometers. There were significant differences between responders and non-responders on three of the five questions (Table 4). Significantly more responders (100% vs. 39%) found the pedometer easy to set up and use. All responders answered yes to the question “Did you use your pedometer regularly”, while 31% of non-responders answered yes as well. Ninety-two percent of responders agreed that they would continue to use their pedometer, while 31% of non-responders answered similarly. Two of the twelve (17%) responders answered that they changed their exercise routine due to wearing the pedometer. Four of the twelve (33%) responders stated that they increased their exercise volume due to wearing the pedometer, while only one non-responder stated that they increased their exercise because of the pedometer.

**Table 3.** Expected benefits and perceived barriers to exercise analyzed by chi-square test

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Exercise helps me stay in shape*					
<i>Responders</i>	1 (8.3%)			9 (75%)	2 (16.7%)
<i>Non-responders</i>				3 (23.1%)	10 (76.9%)
Exercise makes me feel better in general					
<i>Responders</i>	1 (8.3%)			8 (66.7%)	3 (25%)
<i>Non-responders</i>				5 (38.5%)	8 (61.5%)
I lack motivation to exercise					
<i>Responders</i>	1 (8.3%)	3 (25%)	2 (16.7%)	5 (41.7%)	1 (8.3%)
<i>Non-responders</i>	3 (23.1%)	5(38.5%)	1 (7.7%)	3 (23.1%)	1 (7.7%)
I am too lazy to exercise					
<i>Responders</i>	1 (8.3%)	4 (33.3%)	4 (33.3%)	3 (25%)	
<i>Non-responders</i>	5 (38.5%)	5 (38.5%)	1 (7.7%)	2 (15.4%)	
Exercise helps me to maintain good health					
<i>Responders</i>	1 (8.3%)			8 (66.7%)	3 (25%)
<i>Non-responders</i>			1 (7.7%)	3 (23.1%)	9 (69.2%)
I'm too busy to exercise					
<i>Responders</i>	2 (16.7%)	6 (50%)	3 (25%)		1 (8.3%)
<i>Non-responders</i>	7 (53.8%)	4 (30.8%)	1 (7.7%)	1 (7.7%)	
Exercise helps me maintain proper body weight					
<i>Responders</i>			4 (33.3%)	7 (58.3%)	1 (8.3%)
<i>Non-responders</i>			2 (15.4%)	6 (46.2%)	5 (38.5%)
I don't have enough time to exercise					
<i>Responders</i>	2 (16.7%)	8 (66.7%)	1 (8.3%)		1 (8.3%)
<i>Non-responders</i>	5 (38.5%)	4 (30.8%)	1 (7.7%)	1 (7.7%)	2 (15.4%)
Exercise helps improve my appearance					
<i>Responders</i>		1 (8.3%)	3 (25%)	7 (58.3%)	1 (8.3%)
<i>Non-responders</i>			2 (15.4%)	5 (38.5%)	5 (38.5%)
I am too tired to exercise					
<i>Responders</i>	2 (16.7%)	7 (58.3%)	3 (25%)		
<i>Non-responders</i>	4 (30.8%)	6 (46.2%)	2 (15.4%)	1 (7.7%)	
Exercise interferes with work					
<i>Responders</i>	2 (16.7%)	9 (75%)		1 (8.3%)	
<i>Non-responders</i>	4 (30.8%)	7 (53.8%)	2 (15.4%)		
Exercise helps to enhance my self-image and confidence					
<i>Responders</i>			2 (16.7%)	8 (66.7%)	2 (16.7%)
<i>Non-responders</i>			1 (7.7%)	8 (61.5%)	4 (30.8%)
Exercise has a positive psychological effect					
<i>Responders</i>			1 (8.3%)	10 (83.3%)	1 (8.3%)
<i>Non-responders</i>			1 (7.7%)	7 (53.8%)	5 (38.5%)
Exercise is too inconvenient					
	2 (16.7%)	9 (75%)			1 (8.3%)



<i>Responders</i>	5 (38.5%)	5 (38.5%)	2 (15.4%)	1 (7.7%)	
<i>Non-responders</i>					
I don't exercise because of bad weather					
<i>Responders</i>	2 (16.7%)	10 (83.3%)			
<i>Non-responders</i>	1 (7.7%)	10 (76.9%)	2 (15.4%)		
I don't exercise because I don't have the proper facilities					
<i>Responders</i>	2 (16.7%)	10 (83.3%)			
<i>Non-responders</i>	4 (30.8%)	8 (61.5%)		1 (7.7%)	
Exercise reduces stress and helps me relax					
<i>Responders</i>		1 (8.3%)	2 (16.7%)	8 (66.7%)	1 (8.3%)
<i>Non-responders</i>			2 (15.4%)	5 (38.5%)	6 (46.2%)
I exercise for fun and enjoyment					
<i>Responders</i>		1 (8.3%)	7 (58.3%)	4 (33.3%)	
<i>Non-responders</i>		2 (15.4%)	4 (30.8%)	3 (23.1%)	4 (30.8%)
Exercise is boring					
<i>Responders</i>	1 (8.3%)	4 (33.3%)	4 (33.3%)	1 (8.3%)	1 (8.3%)
<i>Non-responders</i>	4 (30.8%)	1 (7.7%)	5 (38.5%)	3 (23.1%)	
I become too fatigued when I exercise					
<i>Responders</i>	2 (16.7%)	7 (58.3%)	2 (16.7%)	1 (8.3%)	
<i>Non-responders</i>	4 (30.8%)	5 (38.5%)	3 (23.1%)	1 (7.7%)	
Exercise helps me cope with life's pressures					
<i>Responders</i>		3 (25%)	1 (8.3%)	7 (58.3%)	1 (8.3%)
<i>Non-responders</i>		1 (7.7%)	3 (23.1%)	4 (30.8%)	
Exercise helps me lose weight					
<i>Responders</i>		2 (16.7%)	3 (25%)	6 (50%)	1 (8.3%)
<i>Non-responders</i>					5 (38.5%)
Family obligations restrict my ability to exercise					
<i>Responders</i>	3 (25%)	9 (75%)			
<i>Non-responders</i>	4 (30.8%)	6 (46.2%)	2 (15.4%)	1 (7.7%)	
I am limited when I exercise due to my health					
<i>Responders</i>	2 (16.7%)	6 (50%)	3 (25%)	1 (8.3%)	
<i>Non-responders</i>	3 (23.1%)	6 (46.2%)	1 (7.7%)	3 (23.1%)	
Exercise lets me have contact with friends and persons I enjoy					
<i>Responders</i>		1 (8.3%)	5 (41.7%)	6 (50%)	
<i>Non-responders</i>		1 (7.7%)	6 (46.2%)	4 (30.8%)	2 (15.4%)

\* Significantly different responders vs. non-responders. (p=0.01)

## Discussion

The purpose of this study was to explore the influence of issuing a pedometer, with no additional information, direction, or encouragement, on the level of daily physical activity in patients with vascular disease. Additionally, by examining differences

between those who turned in a pedometer log versus those who did not, we hoped to better understand why some individuals use a pedometer without any of the support often discussed in the literature and others do not. The results demonstrated that receiving a pedometer alone did not influence subjects to increase their physical activity level.

**Table 4.** Results from subject interview regarding use of the pedometer analyzed by chi-square test

	Yes	No
Did you find the pedometer easy to set up and use?*		
<i>Responders</i>	12 (100%)	0 (0%)
<i>Non-responders</i>	5 (38.5%)	8 (61.5%)
Did you wear your pedometer regularly?*		
<i>Responders</i>	12 (100%)	0 (0%)
<i>Non-responders</i>	4 (30.8%)	9 (69.2%)
Did you change your exercise routine because you were wearing your pedometer?		
<i>Responders</i>	2 (16.7%)	10 (83.3%)
<i>Non-responders</i>	0 (0%)	13 (100%)
Did you increase the amount of exercise you normally do because you were wearing your pedometer?		
<i>Responders</i>	4 (33.3%)	8 (66.7%)
<i>Non-responders</i>	1 (7.7%)	12 (92.3%)
Will you continue to use your pedometer?*		
<i>Responders</i>	11 (91.7%)	1 (8.3%)
<i>Non-responders</i>	4 (30.8%)	9 (69.2%)

\*Significantly different responders vs. non-responders (p<0.001)

The significantly lower weekly energy expenditure at both the 12-and 24-month follow-up visits in the NC group showed that these subjects did not significantly change their exercise pattern over the study period, even with the addition of the pedometer. One factor that has been shown to influence the use of a pedometer is the setting of a goal. Research has shown that participants who are given a specific step goal (e.g. 10,000 steps/day) [18, 23] tend to increase their daily physical activity over those participants who do not have a specific goal [15, 24]. The mere act of receiving the pedometer, with no instructions or goals for wearing it, did not appear to have an influence on the subjects' overall levels of physical activity in the current study.

To better assess the impact of receiving the pedometer on energy expenditure, NC subjects were analyzed

based on the number of monthly step logs returned. Significant differences in descriptive, clinical, or medication use between responders and non-responders may have helped explain why one subject recorded their steps and returned their logs, while another subject did not; however, no significant differences in these factors were observed between groups.

When asked about their experience with the pedometer, there were significant differences observed between responders and non-responders. The benefit and influence of the pedometer in this population may be attributed to the ease with which the subject found setting up and using the pedometer. All 12 responders found the pedometer easy to set up and use, which translated into all of them wearing their pedometers regularly and returning their logs. Interestingly, 38.5% of the non-responders also found the pedometer easy to set up, and 30.8% stated that they wore their pedometer regularly. There seemed to be a disconnect, though, as only 15% of non-responders returned any logs. The lack of encouragement, reminders, or further instructions may have led to this disconnect between using the pedometer and reporting its use by filling out and returning the monthly logs. Previous studies [25, 26] have examined minimal contact, i.e., weekly email or phone calls with no other subject-researcher interaction, to encourage using the pedometer and increasing daily physical activity. Dinger et al. [26] showed that even with minimal contact, a significant increase in minutes of total walking was achieved. Subjects in the present study were not contacted between their normally scheduled visits, removing any influence or contact between subjects and researchers in regard to wearing the pedometer.

The instructions that accompany pedometers may influence the use of the pedometer as well. Since subjects in the NC group were given no materials (goals, reasons behind using a pedometer, encouragement to use the pedometer, etc.) other than the manufacturer's instructions to set up the pedometer, this may have had an influence on whether the subjects used the pedometer and their perception of ease of use. Wallace et al. [27] examined instructions for a variety of pedometers and found that the readability (Flesch-Kinkaid score) ranged from an 8th to 11th grade reading level and that the average

text size was 6.9, with an range of four to 11 point. The average baseline age of the subjects was 72 years. With advancing age, vision problems become more common [28], which may have influenced understanding the instructions and thus the use of the pedometers among NC subjects in the current study (mean age: 71 years-old). The ET subjects did not have to set up their own pedometers as the investigators did so for them.

This study was limited in that a convenience sample was used instead of randomly selected participants. Additionally, due to the make-up of the sample, we were not able to analyze the data by males and females to determine if there were gender differences. Subjects in the ET group were not interviewed as to their use of the pedometer and the influence of the regular contact with the investigators. Better understanding of the different levels of support – from minimal (setting up the pedometer) to more intensive (weekly phone calls) – may help in designing future studies. This sub-study clearly suggests that more is needed to increase daily physical activity than just the possession of a pedometer. The use of pedometers has been shown to motivate individuals to become more active, but the results of this study stress the point that encouragement, both written and verbal, and follow-up are needed in order to increase daily physical activity.

## References

1. United States Department of Health and Human Services. 2008 Physical Activity Guidelines for Americans. [Internet]. 2008. Available from: <http://www.health.gov/paguidelines/pdf/paguide.pdf>.
2. Tucker JM, Welk GJ, Beyler NK. Physical activity in u.s. Adults compliance with the physical activity guidelines for Americans. *Am J Prev Med*. 2011;40:454-61.
3. Araiza P, Hewes H, Gashetewa C, Vella CA, Burge MR. Efficacy of a pedometer-based physical activity program on parameters of diabetes control in type 2 diabetes mellitus. *Metabolism*. 2006;55:1382-7.
4. Moreau KL, Degarmo R, Langley J, McMahon C, Howley ET, Bassett DR, et al. Increasing daily walking lowers blood pressure in postmenopausal women. *Med Sci Sports Exerc*. 2001;33:1825-31.
5. Holbrook EA, Barreira TV, Kang M. Validity and reliability of Omron pedometers for prescribed and self-paced walking. *Med Sci Sports Exerc*. 2009;41:670-4.
6. Jago R, Watson K, Baranowski T, Zakeri I, Yoo S, Baranowski J, et al. Pedometer reliability, validity and daily activity targets among 10- to 15-year-old boys. *J Sports Sci*. 2006;24:241-51.
7. Walsh JT, Charlesworth A, Andrews R, Hawkins M, Cowley AJ. Relation of daily activity levels in patients with chronic heart failure to long-term prognosis. *Am J Cardiol*. 1997;79:1364-9.
8. de Blok BM, de Greef MH, ten Hacken NH, Sprenger SR, Postema K, Wempe JB. The effects of a lifestyle physical activity counseling program with feedback of a pedometer during pulmonary rehabilitation in patients with COPD: a pilot study. *Patient Educ Couns*. 2006;61:48-55.
9. Talbot LA, Gaines JM, Huynh TN, Metter EJ. A home-based pedometer-driven walking program to increase physical activity in older adults with osteoarthritis of the knee: a preliminary study. *J Am Geriatr Soc*. 2003;51:387-92.
10. Chan CB, Ryan DA, Tudor-Locke C. Health benefits of a pedometer-based physical activity intervention in sedentary workers. *Prev Med*. 2004;39:1215-22.
11. Kilmer DD, Wright NC, Aitkens S. Impact of a home-based activity and dietary intervention in people with slowly progressive neuromuscular diseases. *Arch Phys Med Rehabil*. 2005;86:2150-6.
12. Sidman CL, Corbin CB, Le Masurier G. Promoting physical activity among sedentary women using pedometers. *Res Q Exerc Sport*. 2004;75:122-9.
13. Swartz AM, Strath SJ, Bassett DR, Moore JB, Redwine BA, Groër M, et al. Increasing daily walking improves glucose tolerance in overweight women. *Prev Med*. 2003;37:356-62.
14. Izawa KP, Watanabe S, Omiya K, Hirano Y, Oka K, Osada N, et al. Effect of the self-monitoring approach on exercise maintenance during cardiac rehabilitation: a randomized, controlled trial. *Am J Phys Med Rehabil*. 2005;84:313-21.
15. Ornes LL, Ransdell LB, Robertson L, Trunnell E, Moyer-Mileur L. A 6-month pilot study of effects of a physical activity intervention on life satisfaction with a sample of three generations of women. *Percept Mot Skills*. 2005;100:579-91.
16. VanWormer JJ, Boucher JL, Pronk NP, Thoennes JJ. Lifestyle behavior change and coronary artery disease: effectiveness of a telephone-based counseling program. *J Nutr Educ Behav*. 2004;36:333-4.
17. Butler L, Dwyer D. Pedometers may not provide a positive effect on walking activity. *Health Promotion Journal of Australia*. 2004;15:134-6.
18. Hultquist CN, Albright C, Thompson DL. Comparison of walking recommendations in previously inactive women. *Med Sci Sports Exerc*. 2005;37:676-83.



19. White J, Dalman R. Gaining new insights into early abdominal aortic aneurysm disease. *The Permanente Journal*. 2008;12:10-4.
20. Myers J, Kaykha A, George S, Abella J, Zaheer N, Lear S, et al. Fitness versus physical activity patterns in predicting mortality in men. *Am J Med*. 2004;117:912-8.
21. Paffenbarger RJ, Hyde R, Wing A, Hsieh C. Physical activity, all-cause mortality, and longevity of college alumni. *N Engl J Med*. 1986;314:605-13.
22. Ainsworth BE, Haskell WL, Leon AS, Jacobs DR, Montoye HJ, Sallis JF, et al. Compendium of physical activities: classification of energy costs of human physical activities. *Med Sci Sports Exerc*. 1993;25:71-80.
23. Schneider PL, Bassett DR, Thompson DL, Pronk NP, Bielak KM. Effects of a 10,000 steps per day goal in overweight adults. *Am J Health Promot*. 2006;21:85-9.
24. Ransdell LB, Robertson L, Ornes L, Moyer-Mileur L. Generations Exercising Together to Improve Fitness (GET FIT): a pilot study designed to increase physical activity and improve health-related fitness in three generations of women. *Women Health*. 2004;40:77-94.
25. Heesch KC, Dinger MK, McClary KR, Rice KR. Experiences of women in a minimal contact pedometer-based intervention: a qualitative study. *Women Health*. 2005;41:97-116.
26. Dinger MK, Heesch KC, McClary KR. Feasibility of a minimal contact intervention to promote walking among insufficiently active women. *Am J Health Promot*. 2005;20:2-6.
27. Wallace LS, Bielak K, Linn B. Are English-language pedometer instructions readable? *J Phys Act Health*. 2010;7:375-80.
28. Addis VM, DeVore HK, Summerfield ME. Acute visual changes in the elderly. *Clin Geriatr Med*. 2013;29:165-80.