DOES PEDOMETER GOAL SETTING IMPROVE PHYSICAL ACTIVITY AMONG NATIVE ELDERS? RESULTS FROM A RANDOMIZED PILOT STUDY

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Abstract: We examined if step-count goal setting resulted in increases in physical activity and walking compared to only monitoring step counts with pedometers among American Indian/Alaska Native elders. Outcomes included step counts, self-reported physical activity and well-being, and performance on the 6-minute walk test. Although no significant between-group differences were found, within-group analyses indicated that elders significantly improved on the majority of step count, physical activity, health-related quality of life, and 6-minute walk outcomes.

INTRODUCTION

Escalating rates of physical inactivity in the general U.S. population are a major public health concern (National Center for Health Statistics, 2003), with American Indians/Alaska Natives (AI/ANs) reporting among the lowest levels of leisure-time activity and exercise relative to all other racial/ethnic groups (Belza et al., 2004; Centers for Disease Control and Prevention [CDC], 2004; 2005; Coble & Rhodes, 2006; Crespo, Smit, Anderson, Carter-Pokras, & Ainsworth, 2000). Studies using objective measures of physical activity have also noted that the majority of AI/ANs fail to meet recommended levels of physical activity set forth by the CDC and the American College of Sports Medicine (Storti et al., 2009). Physical inactivity is an established risk factor for obesity, hypertension, diabetes, and cardiovascular disease, all of which are prevalent health problems among older AI/ANs (Galloway, 2005; Liao, Tucker, & Giles, 2004).

Interventions designed to promote physical activity can be associated with improvements in disease risk factors and chronic medical conditions (Miller, Balady, & Fletcher, 1997; Whelton, Chin, Xin, & He, 2002). Walking is among the most preferred forms of exercise for adults (CDC, 2004; Rafferty, Reeves, McGee, & Pivarnik, 2002) and is an ideal physical activity for sedentary or older individuals given its availability and low risk for injury (Eyler, Brownson, Bacak, & Housemann, 2003; Hootman et al., 2001). Several community (Baker et al., 2008; Iwane et al., 2000; Merom et al., 2007; Sequeira, Rickenbach, Wietlisback, Tullen, & Schultz, 1995; Stovitz, VanWomer, Center, & Bremer, 2005) and workplace (Dishman, DeJoy, Wilson, & Vandenberg, 2009) studies have explored the use of pedometers as a portable, inexpensive method to increase physical activity among inactive populations. The step-counting function of pedometers can also be used to motivate individuals to increase physical activity, especially when they are encouraged to record daily step counts and set specific step-count goals (Farmer, Croteau, Richeson, & Jones, 2006; Hultquist, Albright, & Thompson, 2005; Moreau et al., 2001). A recent meta-analytic study concluded that pedometer users increase their overall levels of physical activity by approximately 27% from baseline, older populations reduce body mass index significantly, and users who set a step-count goal also reduce body mass index significantly (Bravata et al., 2007).

A previous randomized trial to increase physical activity among AI/AN elders in primary care compared those who monitored their daily physical activities with those who monitored their daily physical activities with the use of a pedometer (Sawchuk et al., 2008). Both groups were given a booklet that contained daily self-monitoring forms to track their physical activities. Although no between-group differences were found on self-reported and behavioral measures of physical fitness and exercise, all participants reported significant increases in the frequencies of leisure walking, all exercise activities, and exercises of moderate intensity. Furthermore, all participants also increased their weekly caloric expenditure for all exercise-related activities over the course of the study. None of the participants, however, were specifically instructed in activity goal setting, which has been found to be an important factor in increasing activity in other studies (Bravata et al., 2007).

Therefore, we conducted a pilot study using pedometers to increase walking, physical activity, and fitness levels over 6 weeks in a newly recruited sample of older AI/AN primary care patients. All elders were given pedometers and basic instruction in physical activity monitoring and recording daily step counts in a diary; half were also instructed to increase their step counts by at least 5% each week. We hypothesized that all elders would report significant increases in self-reported physical activities and well-being, and enhanced performance on the 6-minute walk test of fitness from baseline to the 6-week assessment. Furthermore, we predicted that elders in the goal-setting group would report significantly greater increases in these outcomes relative to their counterparts who did not receive any instruction in setting step-count goals.

METHODS

Participants and Procedures

All pilot study procedures were conducted between May and November 2007 at the Seattle Indian Health Board, a large urban primary care medical facility for AI/ANs in the greater metropolitan Seattle area. Elders were recruited through advertisements in the primary care clinics, Native health fairs, and by word of mouth. Potential participants were screened for age and AI/AN race prior to completing a brief telephone interview to determine final study eligibility. Inclusion criteria included 1) being 50-85 years of age, 2) reporting a sedentary lifestyle, assessed by responding "no" to the question "Have you been physically active for the past 6 months?" 3) being able to walk without assistance, 4) denying medical contraindications to walking, 5) having access to a phone for weekly contacts, and 6) living within a 2-hour drive from the study site. Of note, the term "elder" is acceptable in many AI/AN cultures, communities, and families for individuals aged 50 years and older as it denotes a certain status within the community beyond that of chronological age. Approvals for this pilot study were obtained from both the Human Subjects Division at the University of Washington and the Privacy Board at the Seattle Indian Health Board.

All participants completed two face-to-face 60- to 90-minute study visits with a research assistant at the Seattle Indian Health Board, spaced 6 weeks apart. All participants also received 5- to 10-minute phone calls each week from the research assistant. The purpose of these calls was to bolster continued participation in the study, address any study-related concerns, engagement with physical activity and exercise, and reaffirm the date and time of their final study visit. For participants in the step-count goal-setting group, time was spent setting a new weekly step-count goal of 5% above their previous week's average.

During the first visit, the study purpose and procedures were verbally described to the participant, and written informed consent was obtained. A structured interview was conducted to collect additional demographic and medical information, followed by completion of self-report measures of physical activity and health-related quality of life. The research assistant measured each participant's height and weight, and then randomly assigned each individual to either the monitoring only (MO) or the goal-setting (GS) group. Allocation to the study groups was determined by an independent statistician using a random number table, with elders block randomized by body mass index.

All participants were trained in the use of a pedometer, shown how to read the step counter, and shown how to record their total daily step count on the activity-monitoring forms. GS participants were given additional instruction to use the first week as a baseline to assess their average weekly step count; they were also instructed that each subsequent week would involve setting a goal to increase their weekly step count totals by 5%. Weight and stride length were used to calibrate the pedometer for each individual participant. We then assessed general health status and ambulatory functioning, resting oxygen saturation, heart rate, and blood pressure, and obtained the Borg-Dyspnea scale prior to completing the 6-minute walk test of fitness. Following completion of the 6-minute walk, all participants were compensated with a $40 grocery gift card. After completing the week 4 telephone call, all participants were mailed another $40 grocery gift card for compensation.

At the second visit, the research assistant reviewed the daily activity-monitoring forms, re-administered the self-report measures on physical activity and health-related quality of life, and reassessed height and weight. Changes in health status and ambulatory functioning since starting the study, resting oxygen saturation, heart rate, blood pressure, and the Borg-Dyspnea scale were measured prior to completing the 6-minute walk. Following completion of the walk, participants were debriefed and compensated with a $60 grocery gift card.

Self-reported Physical Activity and Health

All participants were given a booklet that contained daily self-monitoring physical activity forms, including a space for recording their total daily step counts. We calculated a weekly step count average for each participant as a means of assessing the effectiveness of the goal-setting manipulation.

The Community Healthy Activities Model Program for Seniors (CHAMPS) Questionnaire is a 41-item measure assessing a range of light, moderate, and vigorous physical activities in leisure, work, exercise, and chore-related domains (Stewart et al., 1997). Respondents report their weekly frequency and duration of participation in activities over the previous 4 weeks, yielding 4 primary summary scores: total weekly caloric expenditure for all exercise activities; total weekly caloric expenditure for moderate-intensity exercise-related activities; weekly frequency of all exercise-related activities; and weekly frequency of moderate-intensity exercise-related activities. The CHAMPS has excellent psychometric characteristics and has been used extensively with older adults as an outcome measure for physical activity interventions (Harada, Chiu, King, & Stewart, 2001; Stewart et al., 2001), including with AI/AN elders (Sawchuk et al., 2008).

The Short Form-36 of the Medical Outcomes Survey (SF-36) is a 36-item measure of health-related quality of life across 8 domains: Physical Functioning, Role-Physical (i.e., difficulties with work or daily activities secondary to physical health problems), Bodily Pain, General Health, Vitality, Social Functioning, Role-Emotional (i.e., difficulties with work or daily activities secondary to emotional health problems), and Mental Health (Ware & Sherbourne, 1992). Two higher-order component summary scores (mental and physical component scores) are derived from the 8 scales of the SF-36. Respondents rate their health-related functioning over the last 4 weeks. The SF-36 has well-established reliability and validity (Ware & Sherbourne, 1992), and has been used with diverse patient populations (Schlenk et al., 1998; Yost, Haan, Levine, & Gold., 2005), elderly (Chapman, Duberstein, & Lyness, 2007; Hu, 2007; Wolinsky, Wan, & Tierney, 1998), and AI/AN samples (Beals et al., 2006; Johnson, Nowatzki, & Coons, 1996; Sawchuk et al., 2008).

We also asked participants to report on the presence or absence of the following health conditions: arthritis/osteoporosis, asthma, cancer, diabetes, heart disease/stroke, hypertension, and hyperlipidemia.

Performance-based Physical Activity Measure

The 6-minute walk test (6MWT) was used as our primary behavioral outcome of fitness. The 6MWT has been widely used as a reliable and valid measure of fitness in healthy (Harada, Chiu, & Stewart, 1999; Harada et al., 2001; Simonsick. Montgomery, Newman, Bauer, & Harris, 2001) and medically compromised (Bittner et al., 1993; Peeters & Mets, 1996; Montgomery & Gardner, 1998) older adults. Participants were instructed to walk around 2 traffic cones on opposite ends of a 40-foot corridor, unassisted, while covering as much distance as possible within the 6-minute time frame. Each lap equaled 80 feet in distance. Following a standardized administration protocol (Peeters & Mets, 1996), the research assistant provided encouragement at fixed intervals during the walk, and recorded the total number of laps completed. At the end of 6 minutes, a marker was placed on the ground next to the subject, and total distance was calculated in feet with a rolling tape measure.

Materials

A Yamax Digiwalker model SW-701 pedometer was used to monitor total daily step counts. The Yamax SW-701 has been found to be sensitive and reliable in recording step counts (Crouter, Schneider, Karabulut, & Bassett, 2003; Schneider, Crowder, & Bassett, 2004; Schneider, Crouter, Lukajic, & Bassett, 2003), even among overweight and moderately obese individuals (Swartz, Bassett, Moore, Thompson, & Strath, 2003).

All participants completed a daily diary in which they recorded their total daily step counts and listed engagement in specific physical activities. Participants in the GS group also had a space to record whether or not they had achieved their daily step-count goal.

A portable digital scale was used to assess weight, and a tape measure against a wall was used to measure height. Body mass index was calculated using the following formula: weight in kg/height in meters^2.

Statistical Analyses

Initial descriptive analyses compared demographics, body mass index, medical conditions, physical activities (pedometer step counts, 6MWT, CHAMPS), and health-related quality of life (SF-36) for the MO and GS groups. Means and standard deviations (including 95% confidence intervals) were used for continuous variables and percent distributions were used for categorical variables. *T*-tests and Fisher's Exact tests were used to examine group differences in the continuous and categorical variables at baseline. Independent group *t*-tests were used to examine differences in cumulative 6-week step count data.

Our outcome analysis was an intention-to-treat approach, which uses all available longitudinal data and does not eliminate persons with missing assessments. Generalized Estimating Equations was used to determine if the 2 groups had significantly different patterns of change from baseline to 6-week assessment. We believe Generalized Estimating Equations to be the most efficient way to simultaneously examine both longitudinal (time) and group (treatment) effects. We assumed subjects to be a random effect, and for group and time to be fixed effects, in the models. We first tested a group by time interaction model. A significant interaction would imply that the treatment groups differed in their pattern of change over time. In the event that the interaction was not statistically significant, we refit a main effects model with group and time effects. A significant group effect would indicate that, collapsed over time, the groups had statistically different mean values. A significant time effect would indicate that over the 6-week study period, participants changed significantly on the outcome variables (e.g., increased step counts; walked a greater distance on the 6-minute walk). Because this was a randomized design, and the groups did not differ statistically on any of the study variables at baseline, no covariates were used. The level of statistical significance was set at 0.05. We analyzed the data using SPSS (version 18.0) statistical software.

RESULTS

Participant Characteristics

A total of 48 elders were screened for eligibility; 42 met study inclusion criteria, and 36 (86%) were randomized into either the MO group, N = 19, or the GS group, N = 17. Thirty-two subjects completed the 6-week assessment and the step diary. Four people failed to complete the 6-week assessments and step diaries. Two individuals dropped out from each group, to end up with N = 17 in the MO group and N = 15 in the GS group with complete longitudinal data. Pilot study completers and those who did not complete the study did not differ significantly on any demographic, physical activity, or health-related quality of life variable. As shown in Table 1, the MO and GS groups were similar in demographic features, BMI, and prevalence of reported current medical conditions.

Table 1
Participant Characteristics by Total Sample and Group Randomization

	Total Sample (N = 36)	Monitoring Only (N = 19)	Goal Setting (N = 17)	Fisher's Exact Test - *t*(34)
Female, %	69	68	71	1.00
Married, %	28	26	29	1.00
Age, mean years (SD)	61 (8.9)	61 (8.4)	62 (9.8)	.81
BMI 30 and over, %	69	74	65	.72
BMI, mean (SD)	31 (6.5)	31 (6.8)	30 (6.3)	.61
Some college education, %	56	63	47	.50
Employed, %	14	21	6	.34
Income$5,000 or less, %	36	37	35	1.00
Medical Conditions, %				
Arthritis/Osteoporosis	47	58	35	.20
Asthma	14	21	6	.34
Cancer	6	5	6	1.00
Diabetes	22	32	12	.24
Heart Disease/Stroke	8	16	0	.23
Hypertension	31	16	47	.07
Hyperlipidemia	22	26	18	.70
1 or more conditions	72	74	71	1.00
2 or more conditions	44	47	41	.75
Medical conditions, mean # (SD)	44 1.5 (1.3)	47 1.7 (1.5)	41 1.2 (1.1)	.26
Current smoker, %	40	39	41	1.00

Between-Group Comparisons on Outcome Measures

Table 2 presents the between-group comparisons on data generated from the step count diaries, 6MWT, the CHAMPS and the SF-36 from baseline to the 6-week assessments. The MO and GS groups did not significantly differ on any measure at baseline. Although the total number of steps across the 6-week trial and the average number of steps per day were all higher in the GS group, these group differences did not reach statistical significance due to the large variability in these indices. Similarly, although GS participants covered a greater mean distance during the 6MWT at the 6-week assessment, this difference did not reach a level of statistical significance. The mean CHAMPS caloric and frequency of activity measures and the SF-36 scores also did not differ by group. A review of the step count data for the GS group noted that, approximately 47% of the time, participants were able to reach their goal of increasing their step counts by 5% from the previous week.

Table 2
Self-reported Step Counts, 6-minute Walk Performance, CHAMPS, and SF-36 at Baseline and 6 Weeks by Group Status

	Monitoring Only (N = 19)		Goal Setting (N = 17)		
Measures	**Baseline Mean (95% CI)**	**6 Weeks Mean (95% CI)**	**Baseline Mean (95% CI)**	**6 Weeks Mean (95% CI)**	
Step Counts from Diary					
Steps per day	4760 (2853-6667)	5324 (3026-7622)	4768 (2650-6885)	5986 (3760-8211)	B: $t(30) = -0.01$, p = 99 6W: $t(30) = -0.44$, $p = .66$
Total steps for 5 weeks	--	177,677 (103,438-215,915)	--	197,567 (126,955-268,180)	6W: $t(30) = -0.41$, $p = .68$
Steps per day for 5 weeks	--	5076 (2955-7198)	--	5644 (3627-7662)	6W: $t(30) = -0.44$, $p = .68$
6-minute Walk					
Total distance in feet	1137 (1028-1245)	1223 (1060-1387)	1094 (995-1192)	1237 (1055-1419)	B: $t(34) = 0.61$, $p = .54$ 6W: $t(26) = -0.12$, $p = .91$
CHAMPS					
Caloric expenditure per week in all exercise-related activities	7979 (3773-12186)	9945 (6371-13520)	7475 (2794-12155)	8491 (4457-12525)	B: $t(34) = 0.17$, $p = .87$ 6W: $t(30) = 0.58$, $p = .57$
Caloric expenditure per week in moderate-intensity exercise-related activities	3808 (1223-6393)	3736 (1720-5753)	3020 (624-5417)	3527 (993-6061)	B: $t(34) = 0.47$, $p = .64$ 6W: $t(30) = 0.14$, $p = .89$

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Table 2, Continued
Self-reported Step Counts, 6-minute Walk Performance, CHAMPS, and SF-36 at Baseline and 6 Weeks by Group Status

	Monitoring Only (N = 19)		Goal Setting (N = 17)		
Measures	**Baseline Mean (95% CI)**	**6 Weeks Mean (95% CI)**	**Baseline Mean (95% CI)**	**6 Weeks Mean (95% CI)**	
Exercise activities, # per week	18 (12-24)	28 (18-39)	15 (10-21)	21 (14-28)	B: *t*(34) = 0.79, *p* = .43 6W: *t*(30) = 1.28, *p* = .21
Moderate-intensity exercise ctivities, # per week	7 (3-10)	13 (6-20)	5 (2-8)	7 (3-11)	B: *t*(34) = 0.68, *p* = .50 6W: *t*(30) = 1.48, *p* = .15
SF-36 Subscale and Component Factor Scores					
Physical Functioning	60 (45-74)	72 (59-84)	72 (61-82)	76 (64-88)	B: *t*(34) = -1.40, *p* = .19 6W: *t*(30) = -0.60, *p* = .55
Role Functioning - Physical	58 (38-78)	69 (48-90)	64 (43-85)	72 (51-92)	B: *t*(30) = -0.46, *p* = .64 6W: *t*(30) = -0.60, *p* = .55
Role Functioning - Emotional	63 (41-85)	58 (37-79)	73 (51-95)	73 (53-93)	B: *t*(32) = -0.68, *p* = .50 6W: *t*(29) = -0.21, *p* = .83
Social Functioning	62 (56-68)	82 (70-93)	63 (55-70)	85 (75-95)	B: *t*(34) = -0.15, *p* = .88 6W: *t*(30) = -0.02, *p* = .99
Bodily Pain	46 (42-50)	45 (40-50)	45 (40-49)	45 (39-51)	B: *t*(34) = 0.54, *p* = .59 6W: *t*(30) = -0.02, *p* = .99
Mental Health	64 (56-72)	65 (55-74)	69 (59-79)	79 (72-86)	B: *t*(34) = -0.82, *p* = .42 6W: *t*(30) = -2.43, *p* = .02
Vitality	51 (43-60)	58 (49-67)	59 (49-68)	66 (58-74)	B: *t*(34) = -1.21, *p* = .23 6W: *t*(30) = -1.40, *p* = .17
General Health	58 (50-67)	61 (49-72)	67 (55-78)	73 (65-82)	B: *t*(34) = -1.26, *p* = .22 6W: *t*(30) = -1.83, *p* = .17
Physical Health Component Score	39 (36-43)	43 (39-47)	42 (39-46)	44 (41-46)	B: *t*(34) = -1.10, *p* = .28 6W: *t*(30) = -0.18, *p* = .86
Mental Health Component Score	46 (41-50)	47 (41-52)	47 (42-53)	53 (48-58)	B: *t*(34) = -0.53, *p* = .60 6W: *t*(30) = -1.79, *p* = .08

Within-Group Comparisons on Outcome Measures

The Generalized Estimating Equations models revealed no significant group by time interactions, indicating no differential change over the 6-week assessments between the MO and GS groups. Main effect models also failed to show group effects for any measure. In contrast, significant main effects of time were detected for many of the measures when the groups were collapsed to conduct within-subjects analyses. Table 3 presents data from the total sample demonstrating a trend level ($p = 0.09$) increase in the average number of pedometer steps per day from baseline to 6 weeks.

Furthermore, Generalized Estimating Equation modeling detected a time effect [Wald's statistic = 10.73, $p < 0.001$], indicating that participants in both groups significantly increased the distance walked on the 6MWT from baseline to follow-up (mean = 106 feet, SD = 169). Additionally, on the CHAMPS, significant increases in the weekly frequency of all exercise activities ($p = 0.01$) and in the number of moderate intensity exercise activities ($p = 0.02$) were observed. Notable increases over time were observed in the SF-36 Physical Functioning ($p = 0.08$), Mental Health ($p = 0.06$), and General Health ($p = 0.09$) subscales. The largest changes were for the Social Functioning scale, which improved more than 20 points in the 6-week period ($p < 0.001$), and for the Vitality scale ($p = 0.007$). The Physical Component ($p = 0.057$) and Mental Health Component ($p = .04$) scores both increased.

Table 3
Time-analysis of Self-reported Step Counts, 6-minute Walk Performance, CHAMPS, and SF-36 at Baseline and 6 Weeks for the Combined Sample

Measures	Baseline Mean (95% CI) (N = 36)	6 Weeks Mean (95% CI) (N = 32)	Time Effect Wald Chi-Square Df = 1, (*p*-value)
Step Counts from Diary			
Average number of steps per day for baseline and week 6	4763 (3428-6098)	5634 (4117-7151)	2.82 (.09)
6-minute Walk			
Total distance in feet	1116 (1046-1187)	1230.2 (1116-1344)	10.73 (.001)
CHAMPS			
Caloric expenditure per week in all exercise-related activities	7789 (4770-10712)	9264 (6928-11799)	0.85 (.36)
Caloric expenditure per week in moderate-intensity exercise-related activities	3300 (1748-5124)	3638 (2134-5142)	0.05 (.82)
Exercise activities, # per week	17 (13-21)	25 (18-31)	6.02 (.01)
Moderate-intensity exercise activities, # per week	6 (4-8)	10 (6-14)	5.37 (.02)
SF-36 Subscale and Component Factor Scores			
Physical Functioning	65 (56-74)	74 (66-82)	3.02 (.08)
Role Functioning - Physical	61 (47-74)	70 (56-84)	2.38 (.12)
Role Functioning - Emotional	67 (53-82)	66 (52-80)	0.17 (.68)
Social Functioning	62 (58-67)	83 (76-90)	39.41 (.001)
Bodily Pain	45 (43-48)	45 (41-49)	0.05 (.82)
Mental Health	66 (60-72)	71 (65-78)	3.51 (.06)

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Table 3, Continued
Time-analysis of Self-reported Step Counts, 6-minute Walk Performance, CHAMPS, and SF-36 at Baseline and 6 Weeks for the Combined Sample

Measures	Baseline Mean (95% CI) (N = 36)	6 Weeks Mean (95% CI) (N = 32)	Time Effect Wald Chi-Square Df = 1, (*p*-value)
Vitality	55 (49-61)	62 (56-68)	7.28 (.007)
General Health	62 (56-69)	66 (59-74)	2.89 (.09)
Physical Health Component Score	41 (38-43)	43 (41-46)	3.61 (.057)
Mental Health Component Score	47 (43-50)	50 (46-53)	4.38 (.04)

DISCUSSION

We investigated the use of pedometers as a simple, inexpensive method for increasing walking in a primary care sample of AI/AN elders. Previous studies with pedometers have found that diary keeping and step-count goal setting are influential factors in increasing physical activity (Bravata et al., 2007; Farmer et al., 2006; Hultquist et al., 2005; Moreau et al., 2001). All elders in our pilot study were given pedometers and diaries to record daily step counts, with approximately half given additional instruction in setting weekly goals to increase their step counts by 5%. Although all elder participants significantly increased their average daily step counts and total number of steps over 6 weeks, contrary to our hypothesis, setting weekly step-count goals did not confer an advantage over those who only monitored their physical activity and daily steps.

A recent study assessed average daily step counts across a 1-week period among AIs participating in the Strong Heart Family Study (Storti et al., 2009). Mean daily step counts for men and women, respectively, across the following age groups were noted: 4561 and 4582 (50-59 years); 4321 and 3653 (60-69 years); and 3768 and 3770 (70 years and older). Significant trends also were found for declining step counts with increasing age and BMI (Storti et al., 2009). Although our small sample size precluded stratifying average step counts by sex and age, our average daily step count of 4763 at baseline appears comparable to that of the Strong Heart Family cohort, with elders increasing their step counts, on average, by 900 steps per day by the end of the pilot study.

Self-reported measures of physical activity and health-related quality of life also failed to reveal any between-group differences. All participants, regardless of group assignment, significantly increased their weekly frequency of all exercise activities and exercise activities of moderate intensity as assessed by the CHAMPS. Furthermore, all participants reported significant improvements on the Social Functioning, Vitality, and Mental Health Composite subscales, with many other scales trending towards significance. These findings support other studies noting that monitoring physical activities can promote meaningful health-behavior changes (Gleeson-Kreig, 2006; Sawchuk et al., 2008; Speck & Looney, 2001; Stovitz et al., 2005), through increasing awareness of modifiable health habits, providing feedback on progress, and creating an external reminder for personal accountability (Bravata et al., 2007).

We also assessed changes across the 6-week pilot study with the 6MW, a brief, safe, and sensitive measure of physical functioning for both healthy and medically compromised adults that can be easily integrated into health care settings (Enright et al., 2003). Although no between-group differences were found, both groups significantly increased their total distance by an average of 1.25 laps. Both groups traveled an average distance comparable to similar-aged, healthy adults (Sanderson & Bittner, 2006) and other AI/AN Indian elders (Sawchuk et al., 2008) by the end of the pilot trial. Although the present sample size precludes such analyses, future research should examine if any demographic, health, and social variables differentially predict performance on the 6MWT. Greater body mass index, comorbid illness, current smoking status (Enright et al., 2003; Sanderson & Bittner, 2006), and lower levels of education (Sawchuk et al., 2008) have been found to be associated with lower 6MWT performance. The 6MWT can also be re-assessed across time to benchmark improvements and declines in physical functioning, which could be a useful, inexpensive method suitable for use in underfunded community clinics.

In contrast to earlier research (Bravata et al., 2007; Farmer et al., 2006; Hultquist et al., 2005; Moreau et al., 2001), providing additional step-count goal setting did not improve physical activity and walking behavior. Directive prescriptions of exercise intensity and frequency (Duncan et al., 2005), enhancing motivational efforts (Merom et al., 2009), and promoting walking groups (Krieger, Rabkin, Sharify, & Song, 2009) may be useful adjuncts in physical activity trials using pedometers. Hence, increasing the intensity of the intervention through these means could yield greater differences between our MO and GS groups. Furthermore, culturally relevant activity prescription and promotion efforts that enhance socialization may be particularly important for older AI/ANs (Belza et al., 2004; Coble & Rhodes, 2006; Henderson & Ainsworth, 2003; Thompson, Wolfe, Wilson, Pardilla, & Perez, 2003). Populations also vary in personal, social, and environmental barriers to physical activity and exercise (Owen, Humpel, Leslie, Bauman, & Sallis, 2004; Pan et al., 2009), with these barriers often amplified among older and medically compromised individuals (Dawson, Hillsdon, Boller, & Foster, 2007). Older AI/ANs report challenges in establishing and maintaining physically active lifestyles, citing chronic health conditions, restricted access to transportation and recreational facilities, financial difficulties, limited social support, and isolation (Belza et al., 2004). Addressing these barriers through motivational and problem-solving efforts (Krieger et al., 2009; Merom et al., 2009) will be key in order to reach recommended physical activity levels for older adults.

LIMITATIONS

Our pilot study has several limitations. First, we had a small sample size rendering limited power to detect significant between-group differences. Because the study was explicitly a pilot, we did not report extensive data regarding statistical power. Howerver, several outcome variables were trending towards significance, and a larger sample size would have offered greater statistical power to assess the effect of the intervention. Second, both the MO and GS groups received attention, education, and feedback over the course of the study through the use of in-person interviews, telephone calls, and daily activity diaries. We did not include a no-treatment or attention-control condition, and thus changes observed in the present study may have been due largely to the act of self-monitoring, rather than specifically tracking step counts with a pedometer. Demand characteristics, social desirability, measurement reactivity, and monetary incentives can influence physical activity outcomes during randomized trials (Finkelstein, Brown, Brown, & Buchner, 2008; Speck & Looney, 2001; Stovitz et al., 2005). A more refined assessment of the value of pedometers in promoting increased physical activity would require inclusion of a control arm. Third, we did not assess the sustainability of physical activity changes over the longer term (Bravata et al., 2007), though intervention length is not consistently associated with improved health outcomes. Finally, although elders in the MO and GS groups increased their daily step counts by an average of 600 and 1200 steps per day, respectively, the magnitude of this change is modest and still falls short of national benchmarks for daily physical activity levels. Additional factors, such as increasing motivational enhancement, finding ways to reduce or eliminate barriers to physical activity, encouraging walking partners, and prescribing higher step-count goals may be interventions that could further bolster leisure-time physical activity levels. In spite of these limitations, this pilot study contributes to the scant literature examining physical activity promotion efforts among AI/AN elders.

CONCLUSION

Few efforts have examined the promotion of physical activity among AI/ANs in general, and AI/AN elders in particular. Although medical illnesses and disease risk factors are disproportionately high among AI/AN populations, walking can help reverse the trajectory of these negative health outcomes. Walking can easily be promoted and disseminated in primary care and community settings through low-cost methods that address relevant barriers to physical activity and exercise. The longer-term durability of walking promotion programs remains unclear.

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REFERENCES

Baker, G., Gray, S.R., Wright, A., Fitzsimons C., Nimmo, M., Lowry, R….The Scottish Physical Activity Research Collaboration (2008). The effect of a pedometer-based community walking intervention "Walking for Wellbeing in the West" on physical activity levels and health outcomes: A 12-week randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity, 5*, 44. doi:10.1186/1479-5868-5-44

Beals, J., Welty, T.K., Mitchell, C.M., Rhoades D.A., Yeh, J.A., Henderson, J.A….Buchwald, D. (2006). Different factor loadings for SF36: The Strong Heart Study and the National Survey of Functional Health Status. *Journal of Clinical Epidemiology, 59*, 208-215. doi:10.1016/j.jclinepi.2005.07.010

Belza, B., Walwick, J., Shiu-Thornton, S., Schwartz, S., Taylor, M., & LoGerfo, J. (2004). Older adult perspectives on physical activity and exercise: voices from multiple cultures. *Preventing Chronic Disease, 1*, 1-12. Retrieved from http://www.cdc.gov/pcd

Bittner, V., Weiner, D.H., Yusuf, S., Rogers, W.J., McIntyre, K.M., Bangdiwala SI…The SOLVD Investigators. (1993). Prediction of mortality and morbidity with a 6-minute walk test in patients with left ventricular dysfunction. *Journal of the American Medical Association, 270*, 1702-1707. doi: 10.1001/jama.1993 03510140062030

Bravata, D.M., Smith-Spangler, C., Sundaram, V., Gienger A.L., Lin, N., Lewis, R….Sirard, J. (2007). Using pedometers to increase physical activity and improve health: A systematic review. *Journal of the American Medical Association, 298*, 2296-2304. doi: 10.1001/jama.298.19.2296

Centers for Disease Control and Prevention (2004). Prevalence of no leisure time physical activity—35 states and the District of Columbia, 1998-2002. *Morbidity and Mortality Weekly Report, 53*, 82-86. Retrieved from http://www.cdc.gov/mmwr

Centers for Disease Control and Prevention (2005). Trends in leisure-time physical inactivity by age, sex, and race/ethnicity—United States, 1994-2004. *Morbidity and Mortality Weekly Report, 54*, 991-994. Retrieved from http://www.cdc.gov/mmwr

Chapman, B., Duberstein, P., & Lyness, J.M. (2007). Personality traits, education, and health-related quality of life among older adult primary care patients. *Journal of Gerontology, Series B, Psychological Sciences and Social Sciences, 62*, 343-352. Retrieved from http://psychsocgerontology.oxfordjournals.org

Coble, J.D., & Rhodes, R.E. (2006). Physical activity and Native Americans: A review. *American Journal of Preventive Medicine, 31*, 36-46. doi: 10.1016/j.amepre2006.03.004

Crespo, C., Smit, K., Anderson, R., Carter-Pokras, O., & Ainsworth, B.E. (2000). Race/ethnicity, social class and their relation to physical inactivity during leisure time: Results from the Third National Health and Nutrition Examination Survey 1988-1994. *American Journal of Preventive Medicine, 18*, 46-53. Retrieved from http://www.ajpmonline.org

Crouter, S.E., Schneider, P.L., Karabulut, M., & Bassett, D.R. (2003). Validity of 10 electronic pedometers for measuring steps, distance, and energy cost. *Medicine in Science, Sports, and Exercise, 35*, 1455-1460. Retrieved from http://journals.lww.com/acsm-msse

Dawson, J., Hillsdon, M., Boller, I., & Foster, C. (2007). Perceived barriers to walking in the neighborhood environment: A survey of middle-aged and older aged adults. *Journal of Aging and Physical Activity, 15*, 318-335. Retrieved from http://journals.humankinetics.com/japa-back-issues

Dishman, R.K., DeJoy, D.M., Wilson, M.G., & Vandenberg, R.J. (2009). Move to improve: A randomized workplace trial to increase physical activity. *American Journal of Preventive Medicine, 36*, 133-141. doi: 10.1016/j.amepre.2008.09.038

Duncan, G.E., Anton, S.D., Sydeman, S.J., Newton, R.L., Corsica, J.A., Durning, P.E.…Perri, M.G. (2005). Prescribing exercise at varied levels of intensity and frequency. *Archives of Internal Medicine, 165*, 2362-2369. Retrieved from http://archinte.ama-assn.org

Enright, P.L., McBurnie, M.A., Bittner, V., Tracy, R.P., McNamara, R., Arnold, A., & Newman, A.B. (2003). The 6-minute walk test: A quick measure of functional status in elderly adults. *Chest, 123*, 387-398. Retrieved from http://chestjournal.chestpubs.org

Eyler, A.A., Brownson, R.C., Bacak, S.J., & Housemann, R.A. (2003). The epidemiology of walking for physical activity in the United States. *Medicine in Science, Sports, and Exercise, 35*, 1529-1536. Retrieved from http://journals.lww.com/acsm-msse

Farmer, B.C., Croteau, K.A., Richeson, N.E., & Jones, D.B. (2006). Using pedometers as a strategy to increase the daily step counts of older adults with chronic illness. *Home Healthcare Nurse, 24*, 449-456. Retrieved from http://journals.lww.com/homehealthcarenurseonline

Finkelstein, E.A., Brown, D.S., Brown, D.R., & Buchner, D.M. (2008). A randomized trial of financial incentives to increase physical activity among sedentary older adults. *Preventive Medicine, 47*, 182-187. Retrieved from http://www.sciencedirect.com/science

Galloway, J.M. (2005). Cardiovascular health among American Indians and Alaska Natives: Successes, challenges, and potentials. *American Journal of Preventive Medicine, 29*, 11-17. doi: 10.1016/j.amepre.2005.07.023

Gleeson-Kreig, J.M. (2006). Self-monitoring of physical activity: Effects on self-efficacy and behavior in people with type 2 diabetes. *Diabetes Education, 32*, 69-77. doi: 10.1177/0145721705284285

Harada, N.D., Chiu, V., King, A.C., & Stewart, A.L. (2001). An evaluation of three self-report physical activity instruments for older adults. *Medicine in Science, Sports, and Exercise, 33*, 962-970. Retrieved from http://journals.lww.com/acsm-msse

Harada, N.D., Chiu, V., & Stewart, A.L. (1999). Mobility-related function in older adults: Assessment with a 6-minute walk test. *Archives of Physical Medicine and Rehabilitation, 80*, 837-841. Retrieved from http://www.archives-pmr.org

Henderson, K.A., & Ainsworth, B.E. (2003). A synthesis of perceptions about physical activity among older African American and American Indian women. *American Journal of Public Health, 93*, 313-317. doi: 10.2105/AJPH.93.2.313

Hootman, J.M., Macera, C.A., Ainsworth, B.E., Martin, M., Addy, C.L., & Blair, S.N. (2001). Association among physical activity level, cardiorespiratory fitness, and risk of musculoskeletal injury. *American Journal of Epidemiology, 154*, 251-258. doi:10.1093/aje/154.3.251

Hu, J. (2007). Health-related quality of life in low-income older African Americans. *Journal of Community Health and Nursing, 24*, 253-265. doi: 10.1080/07370010701645901

Hultquist, C.N., Albright, C., & Thompson, D.L. (2005). Comparison of walking recommendations in previously inactive women. *Medicine in Science, Sports, and Exercise, 37*, 676-683. Retrieved from http://journals.lww.com/acsm-msse

Iwane, M., Arita, M., Tomimoto, S., Satani, O., Matsumoto, M., Mivashita, K., & Nishio, & I. (2000). Walking 10,000 steps/day or more reduces blood pressure and sympathetic nerve activity in mild essential hypertension. *Hypertension Research, 23*, 573-580. doi: 10.1291/hypres.23.573

Johnson, J.A., Nowatzki, T.E., & Coons, S.J. (1996). Health-related quality of life of diabetic Pima Indians. *Medical Care, 34*, 97-102. Retrieved from http://journals.lww.com/lww-medicalcare

Krieger, J., Rabkin, J., Sharify, D., & Song, L. (2009). High point walking for health: Creating built and social environments that support walking in a public housing community. *American Journal of Public Health, 99*, 593-599. doi: 10.2102/AJPH.2009.164384

Liao, Y., Tucker, P., & Giles, W.H. (2004). Health status among REACH 2010 communities: 2001-2002. *Ethnicity and Disease, 14*, 9-13. Retrieved from http://www.ishib.org/ED_index.asp

Merom, D., Bauman, A., Phongsavan, P., Cerin, E., Kassis, M., Brown, W….Rissel, C. (2009). Can a motivational intervention overcome an unsupportive environment for walking -- findings from the Step-by-Step Study. *Annals of Behavioral Medicine, 38*, 137-146. doi: 10.1007/s12160-009-9138-z

Merom, D., Rissel, C., Phongsavan, P., Smith, B.J., van Kemonade, C., Brown, W.J., & & Bauman, A.E. (2007). Promoting walking with pedometers in the community: the Step by Step Trial. *American Journal of Preventive Medicine, 32*, 290-297. doi: 10.1016/j.amepre.2006.12.007

Miller, T.D., Balady, G.J., & Fletcher, C.F. (1997). Exercise and its role in the prevention and rehabilitation of cardiovascular disease. *Annals of Behavioral Medicine, 19*, 220-229. doi:10.1007/BF02892287

Montgomery, P.S., & Gardner, A.W. (1998). The clinical utility of a six-minute walk test in peripheral arterial occlusive disease patients. *Journal of the American Geriatric Society, 46*, 706-711. Retrieved from http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1532-5415/issues

Moreau, K.L., Degarmo, R., Langley, J., McMahon, C., Howley, E.T., Bassett, D.R., & Thompson, D.L. (2001). Increasing daily walking lowers blood pressure in postmenopausal women. *Medicine in Science, Sports, and Exercise, 33*, 1825-1831. Retrieved from http://journals.lww.com/acsm-msse

National Center for Health Statistics (2003). Health, United States, 2003. Hyattsville, Maryland. Retrieved from http://www.cdc.gov/nchs/hus.htm

Owen, N., Humpel, N., Leslie, E., Bauman, A., & Sallis, J.F. (2004). Understanding environmental influences on walking: review and research agenda. *American Journal of Preventive Medicine, 27*, 67-76. doi: 10.1016/j.amepre.2004.03.006

Pan, S.Y., Cameron, C., DesMeules, M., Morrison, H., Craig, C.L., & Jiang, X. (2009). Individual, social, environmental, and physical environmental correlates with physical activity among Canadians: a cross-sectional study. *BMC Public Health, 9*, 21. doi: 10.1186/1471-2458-9-21

Peeters, P., & Mets, T. (1996). The 6-minute walk as an appropriate exercise test in elderly patients with chronic heart failure. *Journal of Gerontology, 51*, 147-151. doi: 10.1093/geroma/51A.4.M147

Rafferty, A.P., Reeves, M.J., McGee, H.B., & Pivarnik, J.M. (2002). Physical activity patterns among walkers and compliance with public health recommendations. *Medicine in Science, Sports, and Exercise, 34*, 1255-1261. Retrieved from http://journals.lww.com/acsm-msse

Sanderson, B., & Bittner, V. (2006). Practical interpretation of 6-minute walk data using healthy adult reference equations. *Journal of Cardiopulmonary Rehabilitation, 26*, 167-171. Retrieved from http://journals.lww.com/jcrjournal

Sawchuk, C.N., Charles, S., Wen, Y., Goldberg, J., Forquera, R., Roy-Byrne, P., & Buchwald, D. (2008). A randomized trial to increase physical activity among Native elders. *Preventive Medicine, 47*, 89-94. doi: 10.1016/j.ypmed.2008.03.011

Schlenk, E.A., Erlen, J.A., Dunbar-Jacob, J., McDowell, J., Engberg, S., Sereika, S.M….Bermier, M.J. (1998). Health-related quality of life in chronic disorders: a comparison across studies using the MOS SF-36. *Quality of Life Research, 7*, 57-65. doi: 10.1023/A-1008836922089

Schneider, P.L., Crouter, S.E., & Bassett, D.R. (2004). Pedometer measures of free-living physical activity: Comparison of 13 models. *Medicine in Science, Sports, and Exercise, 36*, 331-335. Retrieved from http://journals.lww.com/acsm-msse

Schneider, P.L., Crouter, S.E., Lukajic, O., & Bassett, D.R. (2003). Accuracy and reliability of 10 pedometers for measuring steps over a 400-m walk. *Medicine in Science, Sports, and Exercise, 35*, 1779-1784. Retrieved from http://journals.lww.com/acsm-msse

Sequeira, M.M., Rickenbach, M., Wietlisback, V., Tullen, B., & Schultz, Y. (1995). Physical activity assessment using a pedometer and its comparison to a questionnaire in a large population survey. *American Journal of Epidemiology, 142*, 989-999. Retrieved from http://aje.oxfordjournals.org

Simonsick, E.M., Montgomery, P.S., Newman, A.B., Bauer, D.C., & Harris, T. (2001). Measuring fitness in healthy older adults: The health ABC long distance corridor walk. *Journal of the American Geriatrics Society, 49*, 1544-1548. doi: 10.1046/j.1532-5415.2001.4911247x

Speck, B.J., & Looney, S.W. (2001). Effects of a minimal intervention to increase physical activity in women: Daily activity records. *Nursing Research, 50*, 374-378. Retrieved from http://journals.lww.com/nursingresearchonline

Stewart, A.L., Mills, K.M., King, A.C., Haskell W.L., Gillis, D., & Ritter, P.L. (2001). CHAMPS physical activity questionnaire for older adults: outcomes for interventions. *Medicine in Science, Sports, and Exercise, 33*, 1126-1141. Retrieved from http://journals.lww.com/acsm-msse

Stewart, A.L., Mills, K.M., Sepsis, P.G., King, A.C., McLellan, B.Y., Roitz, K., & Ritter, P.L. (1997). Evaluation of CHAMPS, a physical activity promotion program for older adults. *Annals of Behavioral Medicine, 19*, 353-361. doi: 10.1007/BF02895154

Storti, K.L., Arena V.C., Barmada M., Bunker C.H., Hanson, R.L., Laston, S.L…Kriska, A.M. (2009). Physical activity levels in American-Indian adults: The Strong Heart Family Study. *American Journal of Preventive Medicine, 37*, 481-487. doi: 10.1016/j.amepre.2009.07.019

Stovitz, S.D., VanWormer, J.J., Center, B.A., & Bremer, K.L. (2005). Pedometers as a means to increase ambulatory activity for patients seen at a family medicine clinic. J*ournal of the American Board of Family Practice, 18*, 335-343. Retrieved from http://www.jabfm.org

Swartz, A.M., Bassett, D.R., Moore, J.B., Thompson, D.L., & Strath, S.J. (2003). Effects of body mass index on the accuracy of an electronic pedometer. *International Journal of Sports Medicine, 24*, 588-592. doi: 10.1055/s-2003-43272

Thompson, J.L., Wolfe, V.K., Wilson, N., Pardilla, M.N., & Perez, G. (2003). Personal, social, and environmental correlates of physical activity in Native American women. *American Journal of Preventive Medicine, 25*, 53-60. doi: 10.1016/S0749-3797(03)00165-x

Ware, J.E., & Sherbourne, C.D. (1992). The MOS 36-item short form health survey (SF-36). I: conceptual framework and item selection. *Medical Care, 30*, 473-483. Retrieved from http://journals.lww.com/lww-medicalcare

Whelton, S.P., Chin, A., Xin, X., & He, J. (2002). Effect of aerobic exercise on blood pressure: A meta-analysis of randomized controlled trials. *Annals of Internal Medicine, 136*, 493-503. Retrieved from http://www.annals.org

Wolinsky, F.D., Wan, G.J., & Tierney, W.M. (1998). Changes in the SF-36 in 12 months in a clinical sample of disadvantaged older adults. *Medical Care, 36*, 1589-1598. Retrieved from http://journals.lww.com/lww-medicalcare

Yost, K.J., Haan, M.N., Levine, R.A., & Gold, E.B. (2005). Comparing SF-36 scores across three groups of women with different health profiles. *Quality of Life Research, 14*, 1251-1261. doi: 10.1007/s11136-004-6673-8

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