Improving Physical Function and Blood Pressure in Older Adults Through Cobblestone Mat Walking: A Randomized Trial

Fuzhong Li, PhD, K. John Fisher, PhD,* and Peter Harmer, PhD†*

OBJECTIVES: To determine the relative effects of cobblestone mat walking, in comparison with regular walking, on physical function and blood pressure in older adults.

DESIGN: Randomized trial with allocation to cobblestone mat walking or conventional walking.

SETTING: General community in Eugene, Oregon.

PARTICIPANTS: One hundred eight physically inactive community-dwelling adults aged 60 to 92 (mean age ± standard deviation = 77.5 ± 5.0) free of neurological and mobility-limiting orthopedic conditions.

INTERVENTION: Participants were randomized to a cobblestone mat walking condition (n = 54) or regular walking comparison condition (n = 54) and participated in 60-minute group exercise sessions three times per week for 16 consecutive weeks.

MEASUREMENTS: Primary endpoint measures were balance (functional reach, static standing), physical performance (chair stands, 50-foot walk, Up and Go), and blood pressure (systolic, diastolic). Secondary endpoint measures were Short Form-12 physical and mental health scores and perceptions of health-related benefits from exercise.

RESULTS: At the 16-week posttest, differences between the two exercise groups were found for balance measures ($P = .01$), chair stands ($P < .001$), 50-foot walk ($P = .01$), and blood pressure ($P = .01$) but not for the Up and Go test ($P = .14$). Although significant within-group changes were observed in both groups for the secondary outcome measures, there were no differences between intervention groups.

CONCLUSION: Cobblestone mat walking improved physical function and reduced blood pressure to a greater extent than conventional walking in older adults. Additional benefits of this walking program included improved health-related quality of life. This new physical activity may provide a therapeutic and health-enhancing exercise alternative for older adults. **J Am Geriatr Soc 2005.**

Key words: physical activity; balance; physical performance; blood pressure

From the *Oregon Research Institute, Eugene, Oregon; and †Department of Exercise Science, Willamette University, Salem, Oregon.

Address correspondence to Fuzhong Li, PhD, Oregon Research Institute, 1715 Franklin Boulevard, Eugene, OR 97403. E-mail: fuzhongl@ori.org

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The growing segment of the population that is aged 65 and older in the United States[1] has considerable health problems, particularly declining physical function and increased frailty and disability,[2,3] although many of these problems are preventable through behavioral interventions. Mounting research evidence suggests that participation in regular physical activity for older adults is associated with multiple health benefits, including improved muscle function and balance and reduction in blood pressure.[4–8] Unfortunately, optimal exercise prescriptions for older adults are not well established. Many conventional exercise programs (e.g., aerobic exercise, weight/resistance training) are unappealing, overly physically challenging, costly, or inconvenient. Thus, there is a need to develop simple and readily accessible effective exercise programs that will reduce chronic disease problems associated with the aging process, increase physical and psychological function, and consequently, benefit longevity and quality of life of older adults.

There is increasing research interest in evaluating the use of complementary and alternative, low-tech and low-impact forms of exercise, such as tai chi[9] and yoga,[10] for improving physical and psychological function in older adults. Stone walking is an example of one such activity. In a pilot study,[11] the health benefits of a stone-walking activity in which participants walked on a mat of fixed synthetic river stones (referred to as a cobblestone mat) was explored. It was postulated that the surfaces of the cobblestones would provide stimulation to acupoints located on the soles of the feet to elicit therapeutic responses that may contribute to healthy aging. In this 8-week preliminary investigation, it was found that participants in the cobblestone mat walking condition showed significantly greater improvements on a number of self-reported measures of physical and mental health than control condition participants. Results also showed improved measures of perceived balance control and blood pressure. Although promising, the data offered only preliminary support for cobblestone mat walking as an alternative exercise modality for promoting health-related outcomes in older adults but provided initial justification for the development of an efficacy trial.

Therefore, building upon that pilot work, the primary objective of this study was to further examine the effects of cobblestone mat walking on functional parameters of bal-

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ance, physical performance, and blood pressure, in a larger sample of older adults. Measures of quality of life and perceptions of exercise benefits were also included as secondary outcomes. The effects of cobblestone mat walking were compared with those of conventional walking on the aforementioned primary and secondary endpoint measures through a 16-week randomized intervention trial. On the basis of pilot data, it was hypothesized that cobblestone mat walking would significantly improve the primary and secondary outcome measures.

METHODS

Study Design

The study was a parallel-group, randomized trial involving two arms: cobblestone mat walking and conventional walking. Each arm consisted of a 60-minute exercise session conducted three times per week for 16 consecutive weeks. Primary outcome measures were physical function (balance, physical performance) and blood pressure, and secondary outcome measures were health-related quality of life, collected at baseline and at the 16-week study termination. Two trained assessors conducted all study outcome assessments. These assessors were aware of the group assignment; thus, the study was not blinded. The institutional review board of the Oregon Research Institute approved the research protocol.

Participants

The trial was targeted at healthy, physically inactive, independent-living older adults. Participants were recruited in Eugene, Oregon, from an existing database of subjects from previously completed studies, community-wide promotion involving direct mailings and newspaper advertisements, and word of mouth. Inclusion criteria for the study were aged 60 and older, being an independent ambulator, and having a physician's approval. Individuals were excluded from the study if they had participated in regular and structured physical activity in the previous 3 months. Other exclusion criteria included cognitive impairment ($<$24 on the Mini-Mental State Examination);[12] progressive or debilitating conditions that would limit participation in low- to moderate-intensity exercise; severe foot or ankle problems, including edema, or history of injuries in these areas; and evidence of any other progressive or unstable neurological or medical conditions (including diabetic neuropathy).

Procedures

Prospective participants received a phone contact and were screened to establish their interest and initial eligibility. Those who met the initial study criteria and agreed to participate were scheduled for a face-to-face interview for further evaluation, which included the mental and physical status examinations. Because it was impractical to recruit the planned number of study participants at the same time and to assign them into study conditions within a short timeframe, a staggered-in recruitment scheme in which participants were recruited, screened, and assigned into study conditions in six waves was used.

Randomization

Once the individuals qualified per study criteria and provided informed consent, baseline assessments were made and subjects were then randomized to a cobblestone mat walking (mat walk) or a conventional walking (conventional walking) comparison condition, using a computer-generated random number sequence with an allocation ratio of 1:1. Permuted block randomization with variable block size was used to ensure that the number of subjects in the two treatment arms was balanced with each wave of recruitment. Assignments were sealed in sequentially numbered, opaque envelopes and opened by a research assistant after the participant's baseline assessment. The assistants who conducted the study assessments did not have access to the randomization list.

Interventions

Cobblestone Mat Walking

Participants were trained to walk on synthetic mats, each of which was 6 feet long and 1.5 feet wide. The mats contained hard plastic replicas of smooth, small- to medium-sized river stones embedded randomly on the surface.[11] These mats were placed on padded foam underlays. Participants were introduced to the activity during the first class session and given the opportunity to experiment with walking on the mats. Subsequent sessions consisted of warm-up exercises, walking on the mats, and cool-down exercises. The warm-up and cool-down exercises consisted of light walking and stretches of all the major muscle groups and joints.

The core training protocol involved various timed intervals of mat walking.[11] After an initial warm-up walk, the format of mat walking progressed as follows: "in place" on the mat, during which participants initially stepped on and off the mat and then began to step in place continuously on the mat; around a circular path formed by an alternating pattern of mat-space-mat-space such that approximately every other step was on a mat, with participants walking continuously in one direction; and along a path formed by the mats being placed end to end with no space between them to make a large rectangular track (approximately 24 feet in length), around which participants walked continuously, occasionally reversing direction.

Mat walking time per each 1-hour class session increased from 6 minutes to 12 minutes during the initial 2-week acclimation period and progressed gradually but incrementally to a maximum of 30 minutes per session over the ensuing 14 weeks. During each session, multiple sets of three to seven timed intervals were performed, with actual mat walking time for each interval ranging from 3 minutes to 10 minutes. The number of intervals was gradually decreased over the 16 weeks as the duration of each interval increased.

Wooden foot rollers were introduced in the warm-ups and were used to provide a soothing experience between mat walking intervals.[11] Participants sat in chairs and moved their feet over the rollers. All sessions were conducted in the presence of an instructor, who provided training instructions, supervision, and encouragement, and a research assistant. Breaks of 2 to 3 minutes were allowed between intervals of mat walking to drink water and for social interaction. Cotton socks were provided to participants to reduce discomfort and for sanitary purposes.

Conventional Walking

This walking program was designed to provide a comparable walking activity to that of the mat walk condition with respect to exercise intensity, attention, and training intervals. Walking was chosen because it represents a standard exercise routinely recommended by primary care physicians for this population.

This activity consisted of a self-paced, timed interval walking program, which was initially 6 minutes in duration and gradually increased to a maximum of 30 minutes over the 16-week period. The warm-up and cool-down protocol used in the mat walk condition was also used in this group. To be comparable to the cobblestone group, walking was organized in an incremental fashion with two breaks of 2 to 3 minutes within each walking session. Walking was conducted in a group format in the neighborhood outside the laboratory when possible and in an exercise room in inclement weather. Similar to the mat walk exercise protocol, foot rollers were used during the warm-up and cool-down period of each session. A walk leader and a research assistant were present at each walk session.

Exercise Intensity Monitoring

Walking intensity was closely monitored and controlled to ensure equivalence across the two exercise conditions by instructing participants in both groups to walk at a pace at which their level of exertion was characterized as being "fairly moderate to somewhat hard" (equivalent to 11–13 on the Borg (6–20) Scale).[13] The exercise intensity was periodically checked during the course of intervention.

Primary Endpoint Measure: Balance

Two measures were used to assess balance: functional reach[14] and standing balance.[15] The functional reach test assesses the maximal distance an individual can reach forward beyond arm's length while maintaining a fixed base of support in the standing position.[14] The average of three trials was used, with higher values indicating better balance. Standing balance was evaluated using three different and progressively more difficult stances: side-by-side stance (feet side by side, touching), semitandem stance (one foot placed forward with the heel in line with, and adjacent to, the toes of the other foot), and tandem stance (heel of one foot directly in front of and touching the toes of the other foot). The ability to perform each stance was measured in seconds, but each participant's balance score on this measure was determined by the highest level successfully completed, ranging from 0 (side-by-side stand task not attempted, tried but unable, or held from 0 to 9 seconds) to 4 (held 10 seconds on the full tandem stand task), with higher scores indicating better balance.[15]

Physical Performance

Three measures were used to assess physical performance: time to rise from a chair (chair stands),[16,17] 50-foot speed walk,[18] and Up and Go test.[19] The repeated chair stand test was performed using an armed, straight-back chair with a seat approximately 16 inches high at the front edge. Participants were first asked to stand up from the chair one time (a warm-up trial). If successful, participants were then asked to stand up and sit down five times as quickly as possible and were timed from their initial sitting position to the final standing position at the end of the fifth stand. The 50-foot walk measures the time taken to walk 50 feet. The Up and Go measures the time taken to rise from a chair, walk 10 feet (3 meters), return, and sit down.

Resting Blood Pressure

Blood pressure measurements were collected according to criteria implemented in other trials.[20,21] After a 5-minute rest, blood pressure was measured three times (3 minutes apart), in the seated position, on the right arm of the participant with a random zero sphygmomanometer. The mean values for systolic and diastolic pressure were used to define an individual's blood pressure values.

Secondary Endpoint Measure: Quality of Life

This outcome was operationalized using of the Short Form-12 scale.[22] The SF-12 contains 12 items, divided into two components (mental and physical), with component summary scores ranging from 0 to 100, with higher scores indicating better mental and physical health. In addition, the Vitality Plus Scale,[23] containing nine items, was used to assess accumulated health-related benefits resulting from exercise (e.g., sleep, energy, feeling good). Scores on the Vitality Plus Scale range from 9 to 45, with higher scores indicating greater well-being.

Other Measures at Baseline

Participants completed questionnaires that collected their demographic characteristics, health status, medical conditions, and habitual physical activity information.[24] Weight and height were recorded using a digital scale (Detecto 6800, Webb City, MO) and a stadiometer (Bodymeter, Seca, Culver City, CA), respectively. Body mass index was calculated as weight in kilograms divided by the square of participants' height in meters. Resting pulse rate was determined using radial artery palpation for 30 seconds and multiplying the rate by 2.

Adverse Events

Based on the pilot study[11] and the study safety monitoring plan, exercise safety was closely monitored in this trial. After each exercise session, participants were questioned about the presence of any adverse effects, such as musculoskeletal complaints or discomfort. Modifications in training protocol were made individually as necessary. Any discomfort reported during the classes was recorded. Instructors also monitored participants for symptoms of any discomfort or signs of falling.

Sample Size

Sample size estimates were calculated a priori to determine statistical power to detect between-group differences on the primary endpoints. A sample size of 45 subjects in each group was required to give the study 80% power, at a 5% significance level, to detect a mean between-group difference of 1.5 ± 2.5 inches on the functional reach test[25] and 5.0 ± 8.0 mmHg in systolic blood pressure[26] at the end of 16 weeks of intervention. After accounting for a planned

18% dropout rate,[11] 108 participants constituted the estimated sample size.

Data Analyses

Baseline demographic descriptors and primary and secondary outcome measures were compared between intervention groups, using analysis of variance for continuous variables, chi-square test for categorical variables, or tests for proportions. Independent *t* tests were used to compare baseline variables between study participants who discontinued the study and those who remained.

All analyses of endpoint measures were conducted on an intention-to-treat basis so that all participants were included according to original treatment assignment and analyzed regardless of adherence to treatment or dropout status.[27] The major objective of the study was to compare the effects of cobblestone mat walking on change in physical function and blood pressure in older adults with those of regular walking. Repeated measures analysis of variance (ANOVA) was therefore used to compare pre- and postintervention changes in outcome measures. All outcome variables were normally distributed, thus meeting the basic assumption for ANOVA. Analyses were conducted with and without adjustments for important baseline covariates (e.g., sex, living condition, health status) using ANOVA or analysis of covariance (ANCOVA) models. When demographic covariates (age, sex, education, living condition, health status) were included in the ANCOVA models, the results were not changed. Therefore, results from these models are not reported. Between-group pre- and postintervention change scores on the primary and secondary outcome variables and their 95% confidence intervals were also computed. No subgroup or supplemental analyses were performed per the a priori analysis plan. SPSS 10.0 (SPSS Inc., Chicago, IL) was used for all statistical analyses. To adjust for multiple comparisons, a Bonferroni correction was applied for between-group comparison tests. All *P*-values were two-sided.

RESULTS

The recruitment, randomization, and retention flow chart for the study is shown in Figure 1. The study used a staggered recruitment strategy, which lasted 9 months (September 2003 through May 2004). A total of 494 individuals responded to the study promotion. Sixty-four percent (n = 314) of these were not assessed because they did not

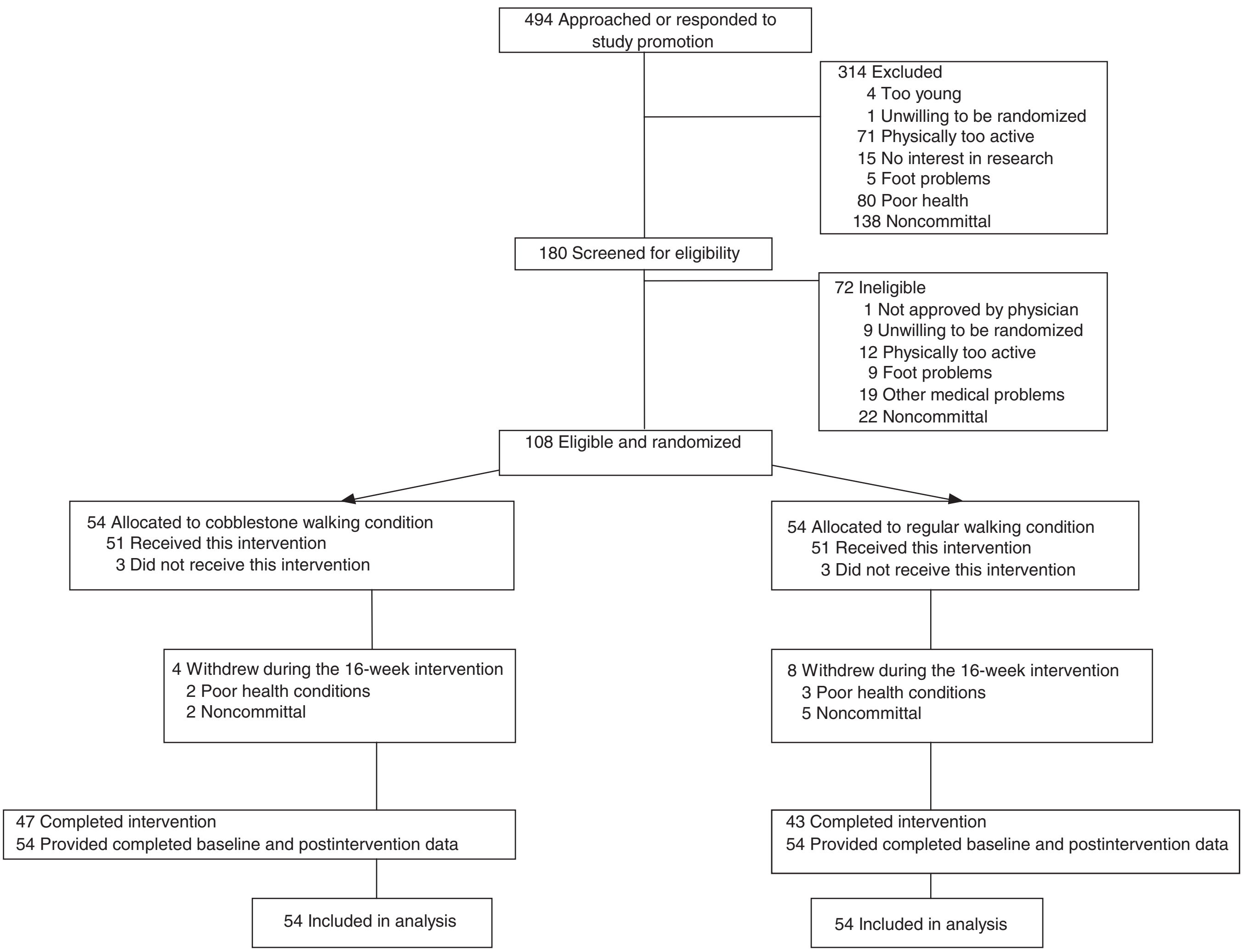

Figure 1. Flow-chart describing the participant recruitment and intervention process.

meet the screening criteria (n = 81), reported poor health (n = 80) or a lack of interest (n = 15), or were unable to commit to the length of the study (n = 138). One hundred eighty individuals (36%) met the initial criteria and were screened. Of these, 108 individuals were randomized into the study conditions: 54 to mat walk and 54 to conventional walking. Of the randomized participants, six (3 in mat walk, 3 in conventional walking) did not attend any intervention session (2 could not commit to the study duration, 2 could not attend due to deteriorating health conditions, 1 had a time conflict, and 1 had a transportation problem).

Baseline Participant Characteristics

Baseline data on demographic, anthropometric, health status, medical, and habitual physical activity characteristics of the study participants are shown in Table 1. Analyses assessing the comparability of the two experimental groups indicated that they were well matched with regard to baseline descriptors. In addition, there were no statistical differences in primary outcomes or demographic variables (e.g., sex, living situations) assessed at baseline between those who completed the study (n = 90) and those who did not (n = 18).

Attrition, Compliance, and Adverse Events

Twelve participants (12/102, 12%) withdrew (4 in mat walk; 8 in conventional walking), excluding no-shows (n = 6), during the 16-week intervention period. Most dropouts occurred within the first week of the study (42%). Common reasons for dropout were medical (health) problems unrelated to study participation (n = 5) and personal reasons related to the study (e.g., time commitment, inconvenience) (n = 7).

Attendance at the intervention sessions was the measure of class compliance. Compliance rates across the 16-week period (48 sessions) were calculated for all participants who completed the trial (n = 90). The median class compliance for the whole study was 39 sessions, ranging from 22 to 48 (mean = 39) for the mat walk condition and from 24 to 48 (mean = 37) for the conventional walking condition ($P = .15$). Seventy-four percent of the mat walk participants and 58% of the conventional walking participants attended 75% sessions or more ($P = .17$).

No adverse events or falls were observed during the intervention. Nine mat walk participants reported discomfort or tender feet resulting from walking at one point during the early stage of the intervention, but no participants in this condition dropped out of the study because of foot complaints or other exercise-induced discomfort.

Intervention Effects on Primary Outcomes

Intervention-group statistics (mean ± standard deviation) at baseline and postintervention and between-group differences from pretest to posttest (mean difference score, standard error of estimate, 95% confidence interval) on the primary outcomes are presented in Table 2. At the end of the 16-week intervention, mat walk participants exhibited significant pre- to postintervention improvements in functional reach ($t = 4.89$, $P < .001$), and static standing ($t = 4.21$, $P < .001$). No within-group pre- to posttest changes on the two balance measures were observed for the conventional walking group. Both groups showed pre- to postintervention improvements on two physical performance measures (50-foot walk speed: $t = -4.08$, $P < .001$, for mat walk; $t = -2.87$, $P = .006$, for conventional walking; Up and Go: $t = -4.31$, $P < .001$, for mat walk; $t = -1.96$, $P = .05$, for conventional walking). Only the mat walk group showed a pre- to posttest change in chair stands ($t = -5.42$, $P < .001$). Both groups showed pre- to postintervention reductions in blood pressure (systolic blood pressure: $t = -6.03$, $P < .001$, for mat walk; $t = -2.46$, $P = .01$, for conventional walking; diastolic blood pressure: $t = -5.72$, $P < .001$, for mat walk; $t = -3.35$, $P = .001$, for conventional walking).

In group comparisons, there were differences in the improvements from the baseline assessment for balance.

Table 1. Baseline Characteristics of Study Participants by Randomized Groups

Characteristic	Mat Walking (n = 54)	Regular Walking (n = 54)	*P*-value*
Female, n (%)	33 (61)	40 (74)	.14
Age, mean ± SD	72.31 ± 7.9	72.28 ± 7.1	.98
White, n (%)	51 (94)	50 (93)	.83
≥high school education, n (%)	54 (100)	52 (96)	.13
Household income <$35,000, n (%)	32 (59)	35 (65)	.45
Living alone, n (%)	26 (48)	21 (39)	.34
Body mass index, kg/m^2, mean ± SD	27.90 ± 6.6	27.35 ± 4.32	.61
Resting pulse, beats/min, mean ± SD	64.92 ± 8.2	64.71 ± 8.5	.89
Habitual Physical Activity, mean ± SD†	113.87 ± 62.19	113.95 ± 64.91	.99
Health status, mean ± SD‡	3.37 ± 0.89	3.61 ± 0.76	.14
Common medical conditions, mean ± SD§	1.94 ± 1.4	2.0 ± 1.3	.83
Taking medication, n (%)	32 (59)	36 (67)	.60

* Comparison of mat walk and regular walk groups.
† Taken from the Physical Activity Scale for the Elderly.[24]
‡ Measured on a 5-point Likert scale: 1 = poor and 5 = excellent, higher scores indicating better health.
§ Measured out of nine possible common medical conditions (e.g., diabetes mellitus, hypertension, depression).
SD = standard deviation.

Table 2. Outcome Scores by Group at Baseline and Postintervention

Endpoint	Baseline: Mat Walking (n = 54) Mean ± SD	Baseline: Regular Walking (n = 54) Mean ± SD	Between-Group *P*-value*	Postintervention: Mat Walking (n = 54) Mean ± SD	Postintervention: Regular Walking (n = 54) Mean ± SD	*P*-value† Group × Time Interaction	Mean Difference Between Groups‡: Mean Difference ± Standard Error of the Estimate (95% Confidence Interval)
Primary							
Functional reach, inches	11.08 ± 3.42	10.63 ± 3.20	.48	12.89 ± 2.67	11.17 ± 2.68	.01	1.27 ± 0.53 (0.22–2.31)
Static standing (range 0–4)	3.39 ± 0.83	3.52 ± 0.82	.42	3.87 ± 0.39	3.57 ± 0.60	.009	0.43 ± 0.16 (0.11–0.75)
Chair stands, seconds	10.67 ± 3.43	11.05 ± 3.91	.59	9.40 ± 2.62	10.98 ± 3.99	< .001	− 1.21 ± 0.32 (− 1.84 to − 0.57)
50-foot walk speed, seconds	11.69 ± 3.02	12.04 ± 2.31	.50	10.60 ± 2.45	11.62 ± 2.32	.01	− 0.66 ± 0.26 (− 1.18 to − 0.15)
Up and Go, seconds	6.39 ± 1.55	6.88 ± 1.80	.13	5.87 ± 1.23	6.62 ± 1.65	.14	− 0.26 ± 0.18 (− 0.62 to − 0.09)
Systolic blood pressure, mmHg	135.02 ± 13.51	134.65 ± 14.84	.89	125.98 ± 13.17	130.97 ± 11.45	.01	− 5.33 ± 2.13 (− 9.55 to − 1.12)
Diastolic blood pressure, mmHg	78.59 ± 11.06	77.46 ± 8.84	.56	72.83 ± 10.63	74.89 ± 7.63	.008	− 3.19 ± 1.27 (− 5.70 to − 0.67)
Secondary							
SF-12 physical component summary score (range 0–100)	59.26 ± 25.46	58.91 ± 21.26	.93	66.32 ± 23.77	65.05 ± 19.97	.80	0.93 ± .55 (− 6.12–7.97)
SF-12 mental component summary score (range 0–100)	65.12 ± 20.43	65.43 ± 20.06	.93	73.75 ± 18.52	73.42 ± 19.25	.87	0.63 ± 4.02 (− 7.34–8.61)
Vitality Plus Scale (range 9–45)	33.46 ± 6.91	34.13 ± 6.09	.59	36.00 ± 5.69	36.26 ± 5.62	.70	0.41 ± 1.07 (− 1.71–2.52)

* Independent *t* test.
† Repeated measures (times) analysis of variance with one between-subject factor (group).
‡ Calculated based on the between-group difference (change) score from pretest to posttest.
SD = standard deviation; SF-12 = 12-item Short Form.

Mat walk participants' scores on the two balance tests improved significantly more than those in the conventional walking group: functional reach ($F_{1,106} = 5.75$, $P = .01$) and static standing ($F_{1,106} = 3.86$, $P = .009$). Similar findings were observed on blood pressure measures; mat walk participants experienced significantly greater reductions in systolic ($F_{1,106} = 6.29$, $P = .01$) and diastolic ($F_{1,106} = 7.20$, $P = .008$) blood pressure than conventional walking participants. With respect to physical performance measures, the mat walk group performed better than the conventional walking group on chair stands ($F_{1,106} = 14.16$, $P < .001$) and the 50-foot walk speed test ($F_{1,106} = 6.51$, $P = .01$), but no difference was found between the two conditions on the Up and Go measure ($F_{1,106} = 2.18$, $P = .14$) (Table 2).

Intervention Effects on Secondary Outcomes

Mat walk and conventional walking participants reported significant pre to post (within-group) improvements in the SF-12 physical ($t = 2.68$, $P = .01$, for mat walk; $t = 2.57$, $P = .01$, for conventional walking) and mental ($t = 3.01$, $P = .004$, for mat walk; $t = 2.83$, $P = .007$, for conventional walking) component summary scores and the Vitality Plus Scale score ($t = 3.57$, $P = .001$, for mat walk; $t = 2.67$, $P = .01$, for conventional walking), although no differences between the two experimental groups were found for SF-12 physical scores ($P = .80$), mental scores ($P = .87$), or the Vitality Plus Scale scores ($P = .70$) (Table 2).

DISCUSSION

This randomized trial was designed to examine whether cobblestone mat walking, a new exercise modality, could improve physical function and reduce blood pressure better than conventional walking in physically inactive community-dwelling older adults. After a 16-week intervention, mat walk participants were found to have improved significantly more on two balance measures, physical performance measures of chair stands and 50-foot walk, and blood pressure than those in the conventional walking group. There were no differences in the Up and Go physical performance measure between the two groups or in the secondary outcomes of quality of life. The latter findings were possibly attributable to the fact that both programs offered participants ample opportunity for social interaction and companionship, which were expected to have a positive effect on the measures of quality of life.

The finding that mat walk improved older adults' balance and physical performance suggests that the activity was appropriate for achieving desired gains in balance performance and functional mobility. It was hypothesized that this particular exercise would significantly affect balance because walking on these mats required more attention to maintaining balance while standing and transferring weight during locomotion. Although not measured in this study, the exercise may have affected proprioceptive and kinesthetic awareness, making participants more conscious of their postural limitations and requiring them to make appropriate postural adjustments.

The observed reductions in blood pressure consolidate findings from the pilot study,[11] which showed that an 8-week intervention resulted in a significantly greater reduction in resting diastolic blood pressure than in the controls and a significant pretest to posttest reduction in systolic blood pressure for those in the experimental group. The combined results suggest that this foot-stimulation activity (applying pressure to the soles of the feet) may be a useful nonpharmacological approach for preventing or controlling hypertension in older adults.

This cohort of older adults tolerated the training program well. Although initial discomfort from walking on the mats was observed in some of the participants, there were no adverse effects or exercise-related falls or injuries in this study, suggesting that it is a safe and acceptable exercise modality for older adults. In addition, from the study's exit interviews, participants in the mat walk group expressed satisfaction with and continued interest in the activity. In this respect, potential home- or outdoor-based mat walking should be evaluated in future investigations. Using portable mats such as those in this study has the advantage of not being limited by weather, space, or time constraints. It is also a safe activity, provided that individuals have no severe foot or ankle problems.

This study has a few notable limitations. First, research assessors were aware of participants' intervention status, which was a potential source of bias in the outcome assessments, but none of the research assistants were aware of any participants' previous measurement scores or the study hypotheses or were involved in any data entry or analyses. The potential assessment bias produced by the lack of blinding was also reduced by using standardized and validated objective performance evaluations in the primary outcome measures because they were least susceptible to recording, recall, or observer bias. Second, the current study lacks well-defined muscular strength measures, which precludes the evaluation of the contribution of muscle strength to change in physical function. Although the nature and workloads of the interventions are unlikely to have produced differential strength gains in the two groups in this study, future studies should consider a battery of muscle strength tests to evaluate the possibility that improvements in muscle strength may have mediated improvements in balance and physical performance measures, at least in part. Similarly, the study did not consider more rigorous laboratory-based balance measures, which may be used to elucidate possible mechanisms by which this activity can improve balance control. Finally, a substantial proportion of screened individuals (64%) did not meet the entry criteria and were not recruited. Thus, the results should be considered in the context of the specific eligibility criteria set by the study.

In conclusion, the findings from this study suggest that cobblestone mat walking is safe and acceptable, improves physical function, and reduces blood pressure in older adults. The efficacy of this alternative walking exercise in improving health-related quality of life was also substantiated. In addition, this new activity confirmed its utility for maintaining and promoting functional mobility and overall health status in older adults and thus provides an effective, therapeutic, and health-enhancing community exercise alternative.

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