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Feature Article

Does dance-based therapy increase gait speed in older adults with chronic lower extremity pain: A feasibility study

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ABSTRACT

A decreased gait speed in older adults can lead to dependency when the individuals are no longer able to participate in activities or do things for themselves. Thirty-seven senior apartment residents (31 females; Mean age = 80.6 years; SD = 8.9) with lower extremity pain/stiffness participated in a feasibility and preliminary efficacy study of 12 weeks (24 sessions). Healthy-Steps dance therapy compared to a wait-list control group. Small improvements in gait speed ([ES] = 0.33) were noted for participants completing 19–24 dance sessions. Improvements in gait speed measured by a 10 Meter Walk Test (0.0517 m/s) exceeded 0.05 m/s, a value deemed to be meaningful in community dwelling older adults. These feasibility study findings support the need for additional research using dance-based therapy for older adults with lower extremity pain.

A decreased gait speed in older adults can lead to dependency when the individuals are no longer able to participate in activities or do things for themselves.[1] Treatment of lower extremity pain focuses on diagnosing the cause and surgical or non-surgical interventions, as appropriate, to relieve symptoms and improve gait function.

Referred to as the "sixth vital sign,"[2] gait speed can predict adverse outcomes for older adults including hospitalization, requirement for a caregiver, and accidental falls.[3] Gait speed below 0.6 m/s is considered a "red flag" for decreased mobility in older adults and classifies the person as "household" walker.[2] This can impact an older adult's independence with activities of daily living (ADLs), thus the older adult is more likely to be hospitalized, need interventions to reduce the risk of falls, and is more likely to be discharged to a skilled nursing facility. Gait speeds between 0.6 and 1.0 m/s are considered "yellow flags," moving the older adult into the category of "limited community ambulation." Gait speeds over 1.0 m/s are considered "green flags" and indicate independence with ADLs; the older adult is less likely to be hospitalized and have an adverse event and is more likely to be discharged to home.[2] Typical gait speed in healthy adults is 1.3 m/s,[4] the same gait speed required to cross the street at an intersection at a stoplight in the United States.[4,5] Gait speed can be expected to be reduced due to normal joint and muscle aging in older adults; comfortable gait speed for an otherwise healthy 80–89 year old female is estimated between 0.80 and 1.5 m/s.[6–8] With an assistive device this decreases to 0.63 m/s and without an assistive device this increases to 0.91 m/s.[7]

There is accumulating evidence that physical exercise using dance may have a therapeutic effect on gait speed. Many older adults were engaged in dance as a social activity in the 1940's and 1950's. However, the use of dance as a therapy has been growing. Lee, Tabourne, and Harris[9] have recently reported that the universal, primal nature of dance entrances participants to stay involved in a therapeutic dance program. Dance can provide an outlet for older adults to enjoy leisure and, at the same time, enhance their physiological function. Dance-based therapy for older adults needs to be gentle, slow, and include options to be performed standing or sitting depending on fatigue or pain level, which can change day-to-day.

Integrating motor and cognitive components are key features of programs using music and dance as therapy.[10] Dance-based therapy

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is being integrated with conventional medical treatments for many conditions.[11,12] Dance is potentially non-invasive effective method to improve gait speed with the possibility of high adherence due to social engagement provided by group interaction.

Following use of dance-based therapy, there is evidence of improved balance and strength[10,11]; among healthy older adults, measurable increases in gait speed have been reported.[10–13] However, there is a gap in the literature regarding therapeutic dance-based programs for older adults with decreased gait speed resulting from lower extremity pain.

Healthy-Steps, also known as The Lebed Method (TLM) is a medically-based dance-based therapy program, based on movements that are used in physical and occupational therapy programs, which is recommended for populations with physical difficulties.[14] Using slow, rhythmic movements and low-impact, easy dance movements, Healthy-Steps can be done sitting or standing. Led by a trained and certified instructor, the Healthy-Steps method includes movements choreographed to the participants' generational music choices and is suitable for older adults with chronic disorders. Healthy-Steps has been used since 2000 internationally with populations who have lower extremity physical limitations, but has not been specifically tested with older adults who have lower extremity pain or self-reported osteoarthritis.[15–17]

Prior research tested Healthy-Steps with community dwelling older adults and noted small to medium effects in improving balance and mobility.[13,17] Results confirmed that older adults will 1) initially consent to participate in dance therapy, 2) continue to attend dance sessions, 3) express enjoyment during the dance sessions, and 4) demonstrate increased activity during the dance sessions.[17]

The purpose of this pilot study, however, was to focus specifically on the feasibility and impact of Healthy-Steps with older adults with known chronic lower extremity pain. The hypothesis was that 12 weeks (24 sessions) of dance-based therapy will increase gait speed in older adults with self-reported lower extremity pain, compared to no dance-based therapy sessions. Multiple measures of gait speed were used to inform future research.

Methods

Design

This study used a two-group pretest-posttest 12 week (24 sessions) Healthy-Steps intervention with a wait-list control group. The wait-list control group did not participate in the dance sessions during the study but continued normal activity and had an opportunity to participate in Healthy-Steps dance sessions after all of the posttest data were collected.

For this study, a specialty team of certified Healthy-Steps instructors (nurses, physical therapist, and music therapist) created a customized Healthy-Steps protocol, based on Healthy-Steps dance movements that could be safely performed by older adults with self-reported lower extremity pain and/or stiffness. Instructors conducted a 45-min session two times weekly for 12 weeks, for a total of 24 sessions. Each session began with a warm-up and included routines that could be completed sitting or standing. A chair was positioned behind each participant and reminders were given throughout each session to use slow, rhythmic movements and rest as needed. These safety measures, reminders and cues were used to decrease the risk for falls and to directly address fear of falling issues with participants. The Healthy-Steps dance protocol intervention included movements to potentially increase gait speed and reduce lower extremity pain when repeated multiple times over a 12-week period. These included dance-based movements to stretch lower extremities; shift weight from side to side; strengthen feet, thighs, and hips; and develop flexibility of hips, knees and thighs. The low-impact aerobic nature of the protocol helped to increase respirations, thus giving muscles oxygen to perform at full capacity.

The study was approved by an intuitional review board in a university setting. Strategies for recruitment included placing an announcement poster at the senior apartments, flyers distributed by the apartment management, and 30-min demonstration and information sessions by the principle investigator (PI) and Healthy-Steps instructors. To support retention in the study, all participants were compensated with a $10 Walgreen's gift card when pretest measurements were completed and a $30 Walgreen's gift card when posttests were completed.

Sample and screening

The PI or co-investigator contacted interested residents to conduct a phone screening for eligibility or schedule a face-to-face screening. Fifty-two older adults were interested in participating in the study and were screened; 37 were recruited, consented and enrolled, reaching 93% of the targeted goal when the study was closed to enrollment. Participants were eligible to participate in the study if they were: 1) adults 62 years and older; 2) able to read and write English; 3) living in one of two identified senior apartments; 4) could answer "yes" to the question: "In the past year, were there times when you had knee or hip pain or stiffness so it affected your function?"; 5) able to score <8 on the Short Blessed Test; 6) able to ambulate independently, with or without an assistive device; 7) available to attend the pretest–posttest and dance sessions (not traveling, etc.); 8) having no physical problem limiting participation in mild low impact, slow rhythmic movements during the dance sessions.

All participants completed baseline testing prior to group assignment. The participants were randomized to either the dance group plus continue normal exercise routine (walking, group exercise to videos, group exercise with live leader) or the wait-list control group, to continue normal exercise routine (walking, group exercise to videos, group exercise with live leader) with an opportunity to participate in dance-based therapy sessions after the study was finished. Randomization was done by computer-generated random numbers.

Measures

Descriptive information collected at baseline included age, gender, race, marital status, education, living situation, employment and volunteer status, income, chronic conditions (including arthritis), and use of an assistive device. Participants reported the presence of pain/stiffness (Yes/No) at baseline and post-intervention on the Functional Pain Scale (FPS),[18] and recorded what pain medications they were taking at baseline and post-intervention. Gait speed measurements were completed at baseline and the week the intervention was completed using several tests to determine the best measure to use in this population for a future study. First, the 8-foot walk (faster of two trials) was completed.[19] Participants were instructed to walk across a room at their usual gait speed. The Timed Up and Go (TUG) test was collected as an additional measure of gait speed, also measuring agility and dynamic balance.[20] Participants were instructed to get up from a chair, walk to an 8-foot targeted location, and return to sit in the chair. The mean value of two trials was used.

A dance-based therapy subgroup ($n = 8$) and wait-list control subgroup ($n = 8$) were randomly selected for additional pretest-posttest gait speed assessments using the GAITRite electronic walkway, after the initial allocation was completed (see Fig. 1).

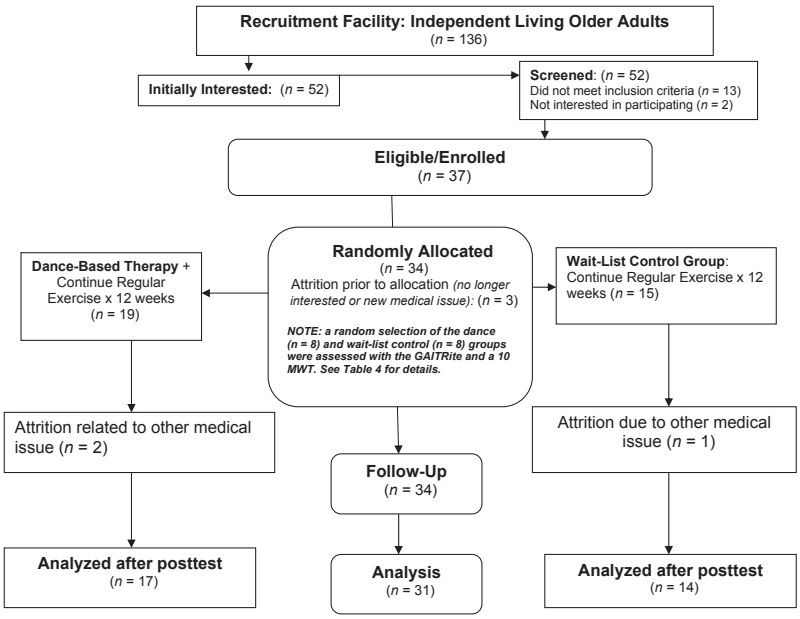

Fig. 1. Dance-based therapy: Recruitment, screening, eligibility enrollment, allocation, follow-up and analysis.

To explore the feasibility of an electronic gait speed instrument, two additional measurements of usual gait speed were completed on the subgroups: a 16-foot GAITRite electronic walkway assessment and the 10 Meter Walk Test (10 MWT). The GAITRite automatically measures gait speed (in seconds) using sensors imbedded in a walkway attached to a laptop computer. The distance walked is divided by the ambulation time reporting gait speed as velocity (cm/s).[2] The 10 MWT was used in conjunction with the GAITRite by embedding the GAITRite pathway in the middle, thus decreasing participant burden of completing two separate assessments. The mean value of two trials was used.

Fidelity

A primary certified Healthy-Steps instructor conducted 22 out of the 24 sessions. Two back-up instructors were trained on the same protocol for older adults with lower extremity pain. Fidelity of the treatment protocol was verified via video confirmation recorded at three points during the study (the first session, mid-way, and last week), and independently reviewed by two certified Healthy-Steps instructor consultants. In addition to treatment fidelity, design, training, delivery, receipt, and enactment fidelity were included[21] (see Table 1).

Statistical analysis

Baseline characteristics were compared between the groups to ensure balance. Distribution of continuous outcome variables was checked to ensure they were approximately normally distributed.

Change from baseline (pretest) to follow-up (posttest) was computed for continuous variables, and the rate of change between the dance group and wait-list control group was compared using a two-sample *t*-test. Wilcoxon rank-sum test was used for gait speed; Fisher's exact test was used for arthritis. Cohen's *d* as a measure of

Table 1
Treatment fidelity for dance-based therapy.

Design Fidelity	1. Dance-based protocol model used that has established evidence (Healthy-Steps) for mobility and older adults. Adapted for this study focused on subjects with self-reported lower extremity pain/stiffness. 2. Treatment dose established as two 45-min sessions of low-impact dance, 12 weeks duration for each subject. 3. Dance sessions were conducted to entire treatment group together (no subgroups or makeup sessions). 4. Three dance instructors trained to provide a back-up plan over-the 12 week intervention duration.
Training	1. Dance Therapy protocol was written as a Lesson Plan and included details for steps to do for each song. 2. All instructors referenced lesson plan during dance sessions. 3. All instructors were trained to the protocol by the same trainer. 4. Videotaping was completed at training to ensure all instructors were completing the same steps, same sequence, same frequency, same intensity and same duration. Fidelity of following Lesson Plan was verified by PI (also certified dance instructor) before intervention began.
Delivery	1. Instructors taught all subjects as one group at each session, so same intervention was delivered to each subject. 2. Instructors were videotaped on weeks 1, 6, and 12. 3. Videotape was independently reviewed by 2 certified dance instructors who concurred that delivery was consistent and followed initial Lesson Plan.
Receipt	1. 24 sessions offered to each subject. 2. Each session 45 min long and was comprised of same routine. 3. Attendance sheets maintained by instructors.
Enactment	1. Healthy-Steps dance program was incorporated into standard programming at the facility upon conclusion of the pilot study. 2. Twice weekly. 3. 45-minute sessions.

Table adapted from Resnick, B., Michael, K., Shaughnessy, M., Nahm, E.S., Sorkin, J., & Macko, R. Exercise intervention Research in Stroke: Optimizing outcomes through treatment fidelity. *Top Stroke Rehabil.* 2011 October; 18 (01):611–619. http://dx.doi.org/10.1310/tsr18s01-611.

effect size was computed for continuous variables, interpreted as 0.2−<0.5 as small, 0.5−<0.8 as medium, and ≥0.8 as large effect.[22]

Results

Participant characteristics

Thirty-seven senior apartment residents age range 62−93 (31 females; Mean age = 80.6 years; SD = 8.9) were randomized to 12 weeks (24 sessions) of Healthy-Steps dance-based therapy or wait-list control. Three participants dropped out because of non-study related medical issues. The resulting total was 34 participants: dance group (n = 19); wait-list control group (n = 15). All of the participants were White. The baseline characteristics of the groups were similar with the average age of the dance group at 79.4 (SD = 8.75) years and the wait-list control group at 81.7 (SD = 9.1) years (see Table 2).

Both groups reported multiple chronic conditions that could be the etiology of lower extremity pain/stiffness and gait speed reported in Table 3. The most common chronic condition was arthritis. Although the wait-list control group reported a significantly higher prevalence of arthritis (87%), there were no significant differences measured in the pre-assessment gait speed testing compared to the dance-based therapy group (42%). Seventy-nine percent of the dance-based therapy group used no assistive device compared to 67% of the wait-list control group.

A Fisher's exact test showed no statistically significant reduction in pain/stiffness between the two groups. However, compared to baseline, there was a suggestion of pain/stiffness reduction within the dance group (P = 0.094). The effect was found even greater in participants who attended more than 19 sessions (P = 0.077), but not statistically significant. The participants were questioned about the frequency of prescription and over-the counter pain medication usage at baseline and post-intervention. Pain medication usage was self-reported as reduced in the dance group by 39% compared to an increase of 21% in the wait-list control group.

Twenty-three percent of the participants attended 100% of the sessions, 65% attended over 75% of the sessions and 12% attended over 50% of the sessions. Overall average dance attendance was 21 out of 24 sessions (88%; SD = 2.81). There were no adverse events during the study.

Table 2
Baseline characteristics by group, n (%).

Characteristic	Dance-based therapy (n = 19)	Wait-list control (n = 15)	P-value[a]
Age (years), mean (SD)	79.4 (8.75)	81.7 (9.1)	0.385
Gender, % female	17 (89.5)	14 (93.3)	>0.99
Race, % White	19 (100)	15 (100)	
Marital status			0.533
Currently married	0 (0)	0 (0)	
Divorced	5 (26.3)	5 (33.3)	
Widowed	12 (63.2)	9 (60.0)	
Separated	0 (0)	1 (6.7)	
Never married	2 (10.5)	0 (0)	
Currently working for pay			>0.99
Employed part-time	1 (5.6)	1 (6.7)	
Retired	16 (88.9)	14 (93.3)	
Retired and working part-time	1 (5.6)	0 (0)	
Volunteering			0.573
Part time	13 (68.4)	8 (53.3)	
Full time	0 (0)	1 (6.7)	
Annual household income			0.578
Less than $15,000	13 (68.4)	8 (53.3)	
$15,000 to less than $25,000	4 (21.1)	6 (40.0)	
No response	2 (10.5)	1 (6.7)	

[a] P-value determined by Wilcoxon rank sum test (interval variables) or exact Chi-square test/Fisher's exact test (categorical variables).

Table 3
Chronic conditions at baseline by group, n (%).

Condition	Dance-based therapy (n = 19)	Wait-list control (n = 15)	P-value[a]
Arthritis/rheumatism	8 (42.1)	13 (86.7)	0.013[b]
Bone fractures/joint injury	4 (21.1)	2 (13.3)	0.672
Walking problem	5 (26.3)	8 (53.3)	0.16
Lung/breathing problem	3 (15.8)	5 (33.3)	0.417
Sleep problem	2 (10.5)	7 (46.7)	0.025
Depression	2 (10.5)	2 (13.3)	>0.99
Osteoporosis	5 (26.3)	6 (40.0)	0.475
Vision problem	3 (15.8)	6 (40.0)	0.139

[a] P-value determined by Fisher's exact test.
[b] Self-reported arthritis was significantly higher for no-dance group.

Gait speed measures

The 8-foot walk results showed a 7.25% pre-post change in the dance-based therapy group versus 3.5% in the wait-list control group; Effect Size (ES = 0.26). The 10 MWT pre-post results indicated 6.1% change for the dance group versus 3.6% for the wait-list control group; Effect Size (ES = 0.13). The Mean change in gait speed for the dance-based therapy group was 0.0517 m/s. The GAITRite velocity assessment and Timed Up and Go did not show any measureable changes. One participant in the dance group was excluded from the GAITRite analysis because she used different pre-post wheeled assistive devices (see Table 4).

Discussion

This pilot study confirmed the feasibility and preliminary efficacy of a 12-week (24 sessions) dance based-therapy intervention for older adults with self-reported lower extremity pain/stiffness. Participants initially agreed to participate in the dance sessions and continued to attend throughout the 12 weeks, with no complaints of pain during the sessions and no adverse effects reported. This study was not designed to test formal statistical hypotheses, thus the analyses and findings are exploratory in nature. Overall average dance attendance was 21 out of 24 sessions (88%; SD = 2.81). The efficacy of dance-based therapy with this population is measurable with gait speed using the 10 MWT walk test after 21 Healthy-Steps dance based therapy sessions.

The Healthy-Steps dance-based therapy intervention was customized for older adults with self-reported lower extremity pain or stiffness. This provided a safe movement routine that challenged the participants without adverse outcomes. This is important because many older adults are hesitant to join an activity, even if it is perceived to be beneficial, that may worsen their pain. In this study, there was evidence that pain and pain medication intake may have been reduced in the dance group.

This should be cautiously interpreted in this small feasibility study, however, our findings are similar to other researchers.[23] Hui, Chi, and Woo[24] found evidence of reduced pain as measured by the bodily pain subscale of the Short Form (36) Health Survey (SF-36) after 12 weeks (23 sessions) of dance. Further research is needed to investigate the effects of the Healthy-Steps dance therapy protocol for lower extremity pain in a larger sample of older adults.

The primary outcome measure, gait speed, was assessed with multiple measures. Small, but clinically meaningful change in gait speed for community dwelling older adults is estimated at 0.05 m/s.[25] In this pilot study, improvements in gait speed measured by a 10 MWT (0.0517 m/s) following participation in the

Table 4
Gait outcome measures: Dance-based therapy versus wait-list control.

Activity	Dance-based therapy				Wait-list control					
	n	Pretest mean (SD)	Posttest mean (SD)	% change	*n*	Pretest mean (SD)	Posttest mean (SD)	% change	*P*	ES
8ft walking speed (sec)	17	2.9 (0.70)	2.7 (0.65)	−7.2	14	3.3 (1.14)	3.1 (0.96)	−3.5	0.137	−0.26[a]
Timed Up and Go (s)	17	11.26 (3.08)	11.62 (3.44)	3.2	14	14.63 (6.84)	14.631 (6.56)	3.0	0.351	0.02
GAITRite subgroup										
10 Meter Walk Test (s)	8	11.35 (2.36)	10.46 (1.63)	−6.1	8	13.99 (6.10)	12.91 (4.55)	−3.6	−0.793	−0.13[a]
Velocity (cm/s)	7	99.53 (17.46)	104.70 (12.82)	6.7	8	84.60 (29.79)	88.44 (29.88)	9.0	0.772	−0.10

P values of dance-based therapy vs. wait group using Wilcoxon rank sum test based on percent change from pretest to posttest as an analysis variable.
[a] Effect Size (ES) in direction of dance group.

Healthy-Steps dance therapy exceeded 0.05 m/s, a value deemed to be meaningful in community dwelling older adults.[25] Therefore, this study with the 10 MWT provides a good measure for a larger, multi-site study.[2] Based on these results, multiple measures of gait speed are not necessary in future studies using Healthy-Steps, but rather, a single gait measure using a 10 MWT, should be considered. This will decrease measurement burden for the study participants.

A universal challenge beyond the initial participation in a movement exercise activity is continued participation.[12] The wait-list control group participants were offered dance-based therapy sessions following the completion of the study, and 50% of them chose to participate in these sessions. Many of the dance-based therapy group also expressed interest in continuing dance sessions following the study. Therefore, the facility began offering Healthy-Steps dance sessions as part of regular activities to all residents of the facility. The study retention and subsequent sustained programming suggest that dance-based therapy offers a person centered approach identifying activities older adults with lower extremity impairments will participate in long-term.[10,26]

Finally, establishing a therapeutic dose effect is important with intervention research. Because of the potential movement limitations of study participants with pain or stiffness, a protocol with the same level of intensity but a greater number of dance sessions needs to be considered in a future study and measured for dose effect. Other intervention timeframes should be considered, e.g. 2 additional weeks for makeup sessions or an extended timeframe of 28 weeks or longer should be considered. Future study should also include a mid-intervention measure of gait speed to analyze dose effect further, e.g. a 10 MWT, and perhaps a longitudinal research design.

Limitations

Although this study was exploratory, a major limitation was the small sample size which limits generalization of findings to the general population. The population recruited was 100% White, which represents the population of these senior apartments, but does not provide a representative sample of older adults with lower extremity pain. However, the wait-list control group study design, with participants randomly assigned to groups, provided rigor to this small study. The Research Assistant and Physical Therapist co-investigators collecting pre-post assessment data were blinded to the group assignments, strengthening the design.

The control group was not allowed to observe the dance sessions. The discussion of the dance classes among older adults living in the same apartments could not be controlled. Although using the same apartments for both groups during recruitment was an efficient process in this study, it poses a risk for contamination between groups which is not appropriate in a future study.

As typical in dance-based studies, most of the participants were female, posing an additional limitation. Future studies should include diversity in both race and gender. A major limitation to this study was the lack of verification of the etiology of the lower extremity pain/stiffness. The pain/stiffness could have resulted from multiple chronic etiologies. However, the goal was to improve gait speed, regardless of etiology. Considering the largest chronic condition reported was arthritis, a study focused on dance therapy and participants with a verified diagnosis of osteoarthritis should be considered. Future study needs to address this issue with a physician verified diagnosis or other confirmation.

Conclusions

Healthy-Steps dance-based therapy is a feasible option with preliminary efficacy for increasing gait speed for older adults with lower extremity pain/stiffness. The retention success during the study and the translation of dance therapy to regular programming at the facility following the study demonstrates older adults will attend sessions; this intervention has sustainability. These are promising outcomes to inform future research.

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