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Crystal G. Bennett & Madeleine E. Hackney

To cite this article: Crystal G. Bennett & Madeleine E. Hackney (2017): Effects of line dancing on physical function and perceived limitation in older adults with self-reported mobility limitations, *Disability and Rehabilitation*, DOI: [10.1080/09638288.2017.1294207](https://doi.org/10.1080/09638288.2017.1294207)

To link to this article: <http://dx.doi.org/10.1080/09638288.2017.1294207>



Published online: 25 Feb 2017.



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ORIGINAL ARTICLE

Effects of line dancing on physical function and perceived limitation in older adults with self-reported mobility limitations

Crystal G. Bennett^a and Madeleine E. Hackney^{b,c}

^aSchool of Nursing, University of West Florida, Pensacola, USA; ^bAtlanta VA Medical Center, Center for Visual & Neurocognitive Rehabilitation, Atlanta, USA; ^cDepartment of Medicine, Division of General Medicine and Geriatrics, Emory University School of Medicine, Atlanta, USA

ABSTRACT

Introduction: Older adults with mobility limitations are at greater risk for aging-related declines in physical function. Line dancing is a popular form of exercise that can be modified, and is thus feasible for older adults with mobility limitations.

Purpose: The purpose of this study was to assess the effects of 8 weeks of line dancing on balance, muscle strength, lower extremity function, endurance, gait speed, and perceived mobility limitations.

Methods: An experimental design randomly assigned older adults to either an 8-week line dancing or usual care group. The convenience sample consisted of 23 participants with mobility limitations (age range: 65–93 years). The intervention used simple routines from novice line dance classes. At baseline and at 8 weeks, balance, knee muscle strength, lower extremity function, endurance, gait speed, and mobility limitations were measured. ANCOVA tests were conducted on each dependent variable to assess the effects of the intervention over time.

Results: Results found significant positive differences for the intervention group in lower extremity function ($p < 0.01$); endurance ($p < 0.01$); gait speed ($p < 0.001$); and self-reported mobility limitations ($p < 0.05$).

Conclusions: Eight weeks of line dancing significantly improved physical function and reduced self-reported mobility limitations in these individuals. Line dancing could be recommended by clinicians as a potential adjunct therapy that addresses mobility limitations.

ARTICLE HISTORY

Received 12 July 2016
Revised 7 February 2017
Accepted 8 February 2017

KEYWORDS

Exercise; dance; muscle strength; gait; endurance

► IMPLICATIONS FOR REHABILITATION

- Line dancing may be an alternative exercise for older adults who need modifications due to mobility limitations.
- Line dancing incorporates cognitive and motor control.
- Line dancing can be performed alone or in a group setting.
- Dancing improves balance which can reduce risk of falls.

Introduction

With aging, mobility tasks frequently become increasingly difficult and may result in activity limitations, participation restrictions and ultimately, the loss of independence. Two-thirds of those over 65 years report serious difficulty walking and climbing a flight of stairs [1]. Exercise has been found to delay progression of disability [2] and decrease the risk for mobility limitations [3,4] in community-dwelling older adults. However, many older adults have limitations, which make exercise challenging. Fear of falling or injury, lack of time and enjoyment, and lack of social support are also significant barriers to exercise participation [5]. However, dance is an aerobic exercise that may be acceptable to older adults because it involves group socialization and [6], is often accessible to older adults in their communities [7].

Dance is a complex motor activity that involves cognitive control. Dance, like walking, balance training, and strength training, requires the integration of sensory, motor control and musculo-skeletal systems and uses lower extremity large muscle groups [8]. In contrast to walking, dance involves multi-directional changes, attention and movement to musical beats, and engages memory

with a complex motor pattern [8–10]. Further, dance involves dynamic balance control while coordinating a movement in response to music and with other dance participants [11]. Dance requires constant feedback from the visual system to guide body movements in relation to visual objects such as other dancers [8]. Dance also actively and intensively uses the auditory system to synchronize movement to music and verbal commands from the instructor [12].

Research into dance's benefits have reported improved static and dynamic balance [11–16], knee extensor muscle strength [17], lower extremity function [10,11,13,18–22], endurance [10,11,13,15,16], and gait speed [11,13,16]. Adults who perceive having difficulty with mobility activities may restrict their participation in activities such as exercise and thus placing them at risk for further declines. One small study of contemporary dance revealed significant reductions in perceived degree of difficulty with performing activities of daily living after dance participation [23]. Line dancing is a simple aerobic exercise that can be modified specifically for those with mobility limitations. Group dance, such as line dancing, increases social interaction and exercise adherence among participants [6,24]. Further, line dancing does

not require a partner and can be modified to meet the individual needs of the participant. Whether line dancing would have a similar effect on strength, balance, endurance, and perceived mobility limitations is uncertain. This study addresses an important gap in knowledge regarding the effects of dance on participants' perceptions of limitations with mobility tasks, as well as knowledge related to the effects of line dancing on mobility. Gathering this information will aid the development of therapies that address issues stemming from mobility limitations as well as the perceptions related to mobility limitation.

The purpose of this study was to assess the effects of 8 weeks of line dancing on balance, muscle strength, lower extremity function, endurance, gait speed, and perceived mobility limitations. We hypothesized that the line dance intervention group would improve in balance, knee muscle strength, lower extremity function, endurance, and gait speed compared with a usual care group. In addition, reductions in perceived mobility limitations were expected for the dance intervention group.

Methods

This study was approved by the Institutional Review Board at the University of Florida. All participants provided written informed consent prior to participation.

An experimental design randomly assigned older adults to either an 8-week line dancing or usual care group. In a preliminary study, eight weeks of line dancing was sufficient to observe significant improvements in balance and lower extremity function in 10 older adults [22]. At pretest and immediately after the 8-week intervention, measures were collected for balance, muscle strength, lower extremity function, endurance, gait, and perceived mobility limitations.

Inclusion/Exclusion Criteria. The convenience sample was sedentary, non-disabled community-dwelling adults, age 65 years and older. *Inclusion criteria* included: exercising fewer than 90 min a week, self-reported difficulty walking $\frac{1}{4}$ mile or climbing a flight of stairs, ability to follow and understand directions and willingness to be randomized. *Exclusion criteria* included: use of an ambulatory assistive device; neurological conditions (e.g., Parkinson's disease or stroke); use of portable oxygen, internal cardiac defibrillator, or myocardial infarction within the previous 6 months.

Recruitment. Participants were recruited from the Northwest Florida community through advertisement via local senior centers, healthcare clinics, and church organizations. Participants from the pilot study were not invited to participate in this study. Interested potential participants contacted the Principal investigator (PI) by phone and were screened by the PI for eligibility using a pre-approved script. For eligible and interested persons, an appointment was made to obtain written consent and collect baseline data. The PI used a randomized block design of 4 to randomize participants by a computer following collection of written informed consent and prior to testing. At the baseline visit, subjects were screened again for eligibility and information about health history. Prior to starting the intervention, the line dancing participant obtained written approval from their healthcare provider to participate in the dance classes. Testing and line dancing took place at a community center located in a rural community in Northwest Florida, with adequate space and flooring suitable for line dancing and testing.

Because there were no dance intervention studies that examined perceived mobility limitations as an outcome, estimations for sample were based on other outcomes. Sample size was based upon a preliminary line dance study that used single leg standing

balance [22]. In a preliminary line dancing study, an effect size of 1.17 was found for one leg standing balance in older adults with mobility limitations [22]. The effect size from this study was used in power analysis. Using the POWER procedure in SAS software (version 9.2, Cary, N.C.) and assuming a level of significance of 0.05, a two-sided test, and power of 0.80, the detectable effect size was 0.91 for 20 subjects per group that also allowed for 20% attrition.

Dance intervention

The 8 week line dancing intervention was a low impact dance program (i.e., one foot was always in contact with the floor), previously considered appropriate for older adults with mobility limitations [22]. Line dancing classes met 1 h twice a week for 8 weeks. The classes were taught by a dance instructor with more than 15 years of experience teaching line dancing to older adults, who had taught line dance classes in the pilot study and assisted in the design of the dance intervention for the present study. The line dance intervention used simple routines from novice line dance classes. The dance routines varied with each class and new movements were added with each routine, recommended for community dance classes for older adults [11,14]. Line dancing involved continuous integrated movements of the legs and trunk, weight transfers and postural control. Choreographed movements included walking forward/backward, side to side, turns, pivots, grapevine patterns, shuffles, knee flexion, stepping and stomping. The line dancing session included 8 specific choreographed dance routines performed to music. The dances were taught by progressing from easy to more complex dance movements. Previously learned dances were repeated the following week. Participants learned and performed the dances at a slower tempo prior to performing the choreography at a moderate pace.

Modifications

The dance steps were modified so all participants could engage [11,25]. Modifications were documented each session on a participant log. The instructor and the PI observed participants for difficulty with the movements and introduced a similar but less challenging movement as a replacement. For example, one participant had difficulty performing the grapevine pattern of the feet (alternate stepping across and behind other foot in successive steps) and the movement was changed to side to side steps to allow the participant to safely continue dancing. Although three participants needed modifications, nine participants were able to perform the steps without difficulty.

Procedures

Each group class included 10 minutes of warm-up, 40 minutes of dancing and 10 minutes of cool-down. The warm-up session included seated stretching. The line dancing portion included learning new dances, practice time, a break and reviewing dances learned in previous classes. During dancing, the Borg Rating of Perceived Exertion Scale (RPE) [26] was used to monitor safety. Participants were instructed to self-monitor and taught to rate exertion of line dancing on a scale range of 6 (no exertion) to 20 (maximum exertion). None of the participants reported a Borg rating of 15 or higher indicating heavy to maximal exertion.

The line dance instructor gave verbal instructions and visual cues (e.g., pointing finger to left to indicate traveling left) while demonstrating the movements. When teaching new steps, the instructor demonstrated facing the participants before facing the opposite direction. The instructor and her assistant were always

visible to the participant during the dancing. Participants were asked to wear supportive and comfortable shoes for the classes.

Safety monitoring

For safety, participants were told that if at any time they felt light-headed, dizzy, weak or tired, short of breath or had chest pains, they should stop dancing and sit to rest for 5 min. One participant complained of being tired halfway through a line dance class, but after resting for 10 min was able to resume dancing. The PI, a registered nurse, was on site and an automatic external defibrillator (AED) was available for each dance class. The investigator and line dance instructor had cell phones for immediate access to emergency services if needed during the classes. The participants were asked to provide emergency contact information.

Adherence

Adherence to line dancing was essential to ensure the participant received an adequate amount of the intervention. Attendance was monitored and recorded for each dance class. The investigator greeted the participants at each dance session and offered an opportunity for questions. Those participants who did not inform the investigator of their absence were contacted by telephone to let them know they were missed at class and to ascertain if barriers to participation can be addressed. Participants in the usual care group were called at start of intervention and every 2 weeks to provide an opportunity to ask questions and be acknowledged for their continued participation in the study.

Usual care group

Participants in the usual care group were instructed to continue their normal daily activities during the study period but not begin regular exercise program while in the study. Participants were instructed to complete a daily activity log. The usual care group was offered free line dance classes for 8 weeks after the study ended.

Testing protocol

The PI administered all of the tests. The tests were administered within 4 weeks of intervention starting (pre) and within 1 week of completion of intervention (post). Balance was measured by the 14-item Berg Balance Scale (BBS) [27] that evaluates performance on common balance tasks. Participants were rated on a 5-point scale for the ability to perform the task. These ratings were summed for a total score ranging from 0 to 56 with higher scores indicating better performance. The BBS has been found to have high inter (ICC = 0.98) and intra-rater reliability (ICC = 0.98) in a community dwelling elderly population [28].

Muscle strength of knee extensors and knee flexors of dominant side were measured because adequate knee strength is essential for mobility tasks [29]. The Nicholas Manual hand-held dynamometer (Model: BK-7454) measured muscle strength and was zeroed prior to each measurement following manufacturer instructions. The participant sat in a chair and was tested with knee at an 80° flexion for assessing knee extensors and at 90° flexion for knee flexors. The dynamometer was placed at the front lower leg proximal to ankle for knee extensors and to the posterior of the lower leg proximal to ankle for knee flexors. Participants were shown a demonstration of the movements prior to testing. Participants were instructed to increase their effort gradually using maximum effort to move their lower extremity while the dynamometer was held in place for 5 s as this has shown to be

adequate to achieve maximum effort [30]. The force of each muscle group in kilograms was measured twice and the mean of the tests were used. Muscle strength was normalized for participant's body weight where the muscle strength in kg is divided by the participant's weight in kilograms. Test-retest reliability was high for knee extensors (0.99–1.00) and knee flexors (0.98–0.99) in community dwelling older adults with a history of falls [31].

The Short Physical Performance Battery (SPPB) is a valid and reliable measure of lower extremity function and has been used in multi-center RCTs of older adults. Tasks of the SPPB include 5XSTS, a tandem, a semi-tandem, and side by side stance held for max of 10 s, and timed 4 m walk. Scores of 1 to 4 for each test (5XSTS, balance stances, and timed 4 meter walk) were assigned based on time (quartiles) of performance [32]. A summary score (0–12) was calculated by adding the scores of each test. Test-retest correlations were 0.97 for balance, 0.89 for gait speed, and 0.73 for time to get up from chair [33].

The 400 m walk has been used as an objective measure of endurance in large studies such as the Lifestyle Interventions and Independence for Elders (LIFE) study with community dwelling older adults. Test-test reliability for inability to complete the 400 m walk is high (0.91–0.93). Older adults who stopped to rest during the 400 m walk were found to be five times more likely to develop mobility limitations than those who did not stop [34]. Participants who are unable to complete the 400 m walk within a 15 min time period or who are unable to complete it without rest periods or assistance are considered to have major mobility limitations [35]. Participants were instructed to walk the 400 m distance at their usual pace. The number of minutes needed to complete the 400 m walk (a measure of endurance) and the ability to complete the walk in 15 minutes was recorded (dichotomous variable). Gait speed (meters/second) was computed using data from the 400 m walk. In the current study, one participant in the usual care group at pretest did not complete the 400 m walk in 15 min due to stopping to rest. Since 15 min is the maximum time allowed for the test, the participant was instructed to stop walking and 15 min was recorded. The distance walked in meters was also recorded.

Perceived mobility limitation was assessed by asking participants to rate difficulty performing mobility tasks listed on the Fried Preclinical Disability (PCD) Screening [36]: “getting out of a car”, “getting out of bed”, “walking down a flight of stairs”, “walking around home”, “walking one-half mile”, “walking a 1/4 mile”, and “climbing a flight of stairs”. Participants rated difficulty from (0) “no difficulty” to (5) “extreme difficulty”. Scores were summed for mobility tasks. The individual ratings for these tasks were used to determine mobility limitations. As such, a participant with a rating of difficulty (a score of 4) for either difficulty walking a quarter of a mile or climbing a flight of stairs was considered to have mobility limitations.

Covariates

Depression, balance confidence, and balance were used as covariates in analyses. Depressive symptoms were assessed using the 15-item Geriatric Depression Scale-Short Form (GDS-S) [37]. The GDS long form and the GDS-S have been found to be highly correlated ($r=0.89$) in assessing depressive symptoms supporting the use of the GDS-S [38]. Respondents provided “yes” and “no” responses to whether they have symptoms of depression. There are 10 items which when answered “yes” and 5 items when answered “no” indicate depressive symptoms. Participants are asked how they have felt in the past week only. Those with a

score of greater than 5 were referred to their healthcare provider as this indicates clinical depression [39].

Balance confidence was assessed using the Falls Efficacy Scale (FES) [40] that is based on self-efficacy theory. The FES has 10 items that asks subjects to rate their level of confidence in performing common everyday activities such as “walking around house”, and “getting in and out of bed” without falling. Subjects rated confidence from (1) “very confident” to (10) “not confident at all”. Higher scores indicate low balance confidence that has been associated with higher risk of preclinical disability [41]. Test-retest reliability was good at 0.71. Reliability and validity has been established in community dwelling older adults [40].

Data analysis

Data were entered into the Statistical Package for the Social Sciences (SPSS Ver. 21) for analysis. Descriptive statistics were used to describe the characteristics of the sample. Analysis of covariance (ANCOVA) with the pretest as a covariate was used to assess the effects of line dance intervention over time. The independent variables were dance or usual care group. Significance was determined using an alpha of 0.05.

Assumptions for ANCOVA were tested and included normal distribution of data, homogeneity of variance, and sphericity. Assumption of homogeneity of variance was determined by a non-statically significant Levene’s test. Assumptions of normal distribution and sphericity were determined by a non-statistically significant Shapiro–Wilks test and Mauchley’s test.

An evaluation of the utility of the covariates (depressive symptoms and balance confidence) and the dependent variables were tested by correlation coefficients between the covariates and the dependent variables at posttest. If the correlation coefficient was significant between the covariate and the dependent variable, then the covariate was included in the analysis.

Analysis of variance (ANOVA) with pretest as a covariate was used to assess the effects of line dancing on balance, muscle strength, lower extremity function, endurance, gait, and perceived mobility limitations. Prior to this analysis, assumptions of normality and homoscedasticity were assessed. The Levene’s test was not significantly different for any of the outcomes that indicated that the assumption of homoscedasticity was met. Normality was assessed by examining the dependent variables for skewness, kurtosis, and a non-significant Kolmogorov–Smirnov (K–S) test.

The K–S tests were significant for the BBS. Thus, the BBS was included as a covariate. In addition, Pearson’s correlations were used to examine the efficacy of potential covariates (depressive symptoms and balance confidence) with the outcomes. In spite of violations of normality, ANCOVA was used to assess the effects of the line dance intervention because this statistic is robust against violations of normality. ANCOVA was used to assess the effects of dance while controlling for the effects of depressive symptoms, balance confidence, and the BBS.

Results

Forty-five older adults were screened for eligibility to participate but twenty-two were excluded because they reported use of assistive devices ($n=4$), having a pacemaker or MI within past six months ($n=1$), or exercising 90 min or more per week ($n=17$). Twenty-three community dwelling older adults who met inclusion criteria, and signed a consent form were enrolled in the study and randomized to either the usual care group ($n=11$) or the dance group ($n=12$). The sample consisted of 3 males and 20 females whose age ranged from 65 to 93 years ($M=73.4$, $SD=8.4$). There

Table 1. Demographics.

	Total frequency (%) ($n=23$)	Usual care frequency (%) ($n=11$)	Dance frequency (%) ($n=12$)	Chi Square
Gender				
Female	20 (87)	10 (90.9)	10 (83.3)	0.590
Male	3 (13)	1 (9.1)	2 (16.7)	
Race				
Caucasian	21 (91.3)	11 (100)	10 (83.3)	0.156
Black	2 (8.7)	0 (0)	2 (16.7)	
Marital status				
Married	9 (39.1)	4 (36.4)	5 (41.7)	0.404
Widowed	7 (30.4)	3 (27.2)	4 (33.3)	
Divorced	6 (26.1)	4 (36.4)	2 (8.3)	
Never married	1 (4.4)	0 (0)	1 (8.3)	
Education				
Grade 8	1 (4.3)	0 (0)	1 (8.3)	0.579
Grade 9	1 (4.3)	1 (9.1)	0 (0)	
Grade 10	1 (4.3)	0 (0)	1 (8.3)	
Grade 11	9 (39.1)	4 (36.4)	5 (41.7)	
Grade 12	5 (21.7)	3 (27.3)	2 (16.7)	
Post HS	1 (4.3)	1 (9.1)	0 (0)	
Associate degree	1 (4.3)	1 (9.1)	0 (0)	
College grad	3 (13)	1 (9.1)	2 (16.7)	
Master’s degree	1 (4.3)	0 (0)	1 (8.3)	
Doctoral degree	0 (0)	0 (0)	0 (0)	
Living status				
Lives alone	13 (56.5)	5 (45.5)	8 (66.7)	0.305
Lives with someone	10 (43.5)	6 (54.5)	4 (33.3)	

Table 2. Health status characteristics.

	Total frequency (%) ($n=23$)	Usual care frequency (%) ($n=11$)	Dance frequency (%) ($n=12$)	Chi square
High blood pressure	17 (73.9)	8 (72.3)	9 (75)	0.901
Peripheral vascular disease	5 (21.7)	4 (36.4)	1 (8.3)	0.104
Diabetes	7 (30.4)	5 (45.4)	2 (16.7)	0.134
Neuropathies	7 (30.4)	4 (36.4)	3 (25)	0.554
Respiratory disease	4 (17.4)	3 (27.3)	1 (8.3)	0.231
Osteoporosis	6 (26.1)	3 (27.3)	3 (25)	0.901
Arthritis	15 (65.2)	8 (72.3)	7 (58.3)	0.469
Depression	6 (26.1)	2 (18)	4 (33.3)	0.408
Joint replacement	6 (26.1)	4 (36.4)	2 (16.7)	0.283
Other conditions not listed	15 (65.2)	7 (63.4)	8 (66.7)	0.879

were no significant differences in the demographic (Table 1) and health status characteristics (Table 2) between groups at baseline. In this study, there were no drop-outs and no line dance participants missed more than 2 dance classes. Thus, all dance participants received at least 80% of the dance sessions. Each participant recorded the type of activity and minutes spent doing the activity on a daily activity log form kept in a folder. The usual care group reported spending an average of 28 min per week engaging in physical activity. When controlling for time spent dancing, the dance group reported spending 32 min per week engaging in physical activity, per week.

The line dancing group had significantly greater knee extensor strength but not knee muscle flexor strength. Intraclass correlations for knee flexor strength at pretest were $ICC=0.790$, knee flexor strength at posttest $ICC=0.903$, knee extensor strength at pretest $ICC=0.822$ and at posttest $ICC=0.758$. The line dancing group had significantly greater SPPB scores, endurance, and gait speed (Table 4). The line dancing group had significantly greater gait speed (Table 4). When balance confidence and BBS was controlled, the line dancing group had lower perceived mobility limitations trending toward significance (Tables 3 and 4). The line

dancing group had significantly reduced self-reported difficulty climbing a flight of stairs but not a significant difference for difficulty walking a quarter of mile (Table 4). A moderate effect size of 0.54 was noted for the SPPB and an effect size of 0.46 was noted for perceived mobility limitations.

Discussion

Interestingly, dance improved knee extensor but not knee flexor strength. Body weight was not significantly different from pre- to post-test, thus the gains in knee extensor strength may not have been influenced by decreased body weight. The knee extensors were more involved in the line dancing movements than the knee flexors and may account for differences in strength of the muscle groups [20]. In a 12-week study of Korean dance, significantly greater strength in the knee extensors also was found but not knee flexor strength [17]. Similar patterns in muscle strength have been found for aerobic and balance training where knee extensors and knee flexors were likewise involved [42–46]. Line dancing significantly improved lower extremity function and was consistent with findings of a pilot study that also used the SPPB [23].

Because line dancing is aerobic in nature, improvements in endurance were expected. Line dancing significantly improved endurance. In fact, those in the line dancing group had improved endurance while it declined for the usual care group. Similar findings were found when the distance in the six min walk was used to assess endurance [10,11,15,16], in contrast to the 400 m walk used in the present study. The finding of improved endurance is of clinical importance, as those with greater endurance may lower their risk of having a new mobility limitation [4,34,47].

After the 8 week intervention, the mean gait speed of the dance group was 1.00 m/s – placing these participants at risk of mobility limitations, yet they were above the major disability threshold of 0.6 m/s [48]. In contrast, the usual group had a lower mean gait speed of 0.72 m/s at post-test placing them at a higher risk of mobility limitations.

Line dancing may have reduced perceived mobility limitations. Similar improvements in disability were found in a 12-week dance study that included a greater number of mobility tasks [23]. Despite, faster times to complete the 400 m walk (1/4 mile), line dancing did not significantly reduce perceived difficulty walking

this distance. In contrast, line dancing did significantly reduce perceived difficulty in climbing a flight of stairs.

Limitations

The small sample size limits the generalizability of these findings to other older adults with mobility limitations. In spite of not achieving our sample size, we did detect significant findings, which do speak to the potential robustness of the intervention's effects. However, the impact of not achieving our sample size means our study was underpowered to detect the expected effects, undermining the reliability of our study findings. Low power also reduces the likelihood that a statistically significant result reflects a true effect, resulting in the potential overestimates of effect size and low reproducibility of the results. Improving reproducibility is in fact a priority of rehabilitation research. Future studies must be adequately powered to achieve this goal. This study had few male participants which again limits the generalizability to other older males. Those who chose to participate may be healthier and may perceive line dancing to be more beneficial compared with those who did not participate. For this feasibility study, it was important to maximize the safety of the intervention for all, and explore ways to modify the program to suit minor mobility problems, so it was considered prudent not to include those with more severe impairments. Future studies will address the needs of individuals with greater mobility difficulties. There were a greater number of participants in the dance group that were living alone compared with the usual care group, which may have impacted findings in unknown ways, given that studies have shown older adults living independently are healthier than those who are not. Because the data collector was not blinded to group a subject was randomized to, there may be potential bias in the assessments of study outcomes. A greater weekly frequency or number of weeks for line dancing may potentially increase the effects on outcomes that were not found to be significant in this study. Regarding scalability, a moderate effect size ($r = 0.46$) was found for the primary outcome of perceived mobility limitations. To improve the scalability of this intervention, a horizontal approach is needed for expansion of the program. Using this approach, the intervention can be implemented with diverse groups of older adults in various settings. The amount of regular physical activity was not impacted by this short term dance program. Future studies with longer term interventions should examine the impact on physical activity.

Clinical implications

Line dancing is feasible and appropriate modifications to the movements can enable the older adult with mobility limitations to

Table 3. Differences between the groups for the BBS.

	Pretest		Post test	
	Usual Care Mean (SD)	Dance Mean (SD)	Usual Care Mean (SD)	Dance Mean (SD)
Berg Balance Scale	48.6 (5.62)	48.1 (7.94)	47 (6.18)	50.4 (4.56)

Table 4. ANCOVA differences between groups.

	Pretest		Post Test		F test
	Usual Care Mean (SD)	Dance Mean (SD)	Usual Care Mean (SD)	Dance Mean (SD)	
Knee extensor strength (kg)	0.09 (0.03)	0.11 (0.03)	0.09 (0.03)	0.14 (0.04)	6.44*
Knee flexor strength (kg)	0.07 (0.03)	0.09 (0.04)	0.08 (0.03)	0.11 (0.06)	1.42
SPPB Score	7.73 (1.90)	6.75 (2.37)	7.18 (2.08)	9.17 (2.32)	9.38**
Gait speed during 400 m walk (m/s)	0.75 (0.19)	0.86 (0.27)	0.72 (0.13)	1.00 (0.25)	18.03***
Endurance (Minutes needed to complete the 400 m walk)	9.53 (2.57)	8.63 (3.17)	9.64 (2.09)	7.05 (1.96)	12.53**
Perceived mobility limitations	10.64 (6.00)	8.25 (6.67)	9.27 (5.31)	4.17 (4.43)	4.06
Perceived difficulty walking 1/4 mile	1.00 (1.18)	0.58 (0.79)	0.55 (0.82)	0.17 (0.39)	0.23
Perceived difficulty climbing stairs	3.64 (1.12)	3.08 (1.93)	3.27 (1.00)	1.75 (1.42)	8.20*

Table 4 presents ANCOVA differences between groups.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

perform the dance. However, several factors must be considered for implementation of the intervention. The line dance instructor must plan for modifications as part of the line dance choreography and observe participants for difficulty during the line dance classes so that another movement can be substituted. In this study, the line dance instructor was experienced at monitoring participants for difficulty and introduced a new movement when indicated. This will allow the participants to continue to dance and may prevent participant drop-out. Another factor to consider is the location of the intervention. In a rural setting there are often few community centers and little to no public transportation. Whereas, in the urban setting, the barriers may be adequate and safe parking, increased distance from parking lot or transit stop to the class. It is recommended that the location of the dance program be on site of a community or senior center, rehabilitation center, or faith-based community center as these settings often have adequate lighting, accessible parking, and nearby transit stops. If conducting the intervention in a rural setting, it is recommended that a centralized location where older adults may receive services such as congregate meals, be considered to improve adherence. In order to improve sustainability of the dance class, funding sources will need to be explored to cover expenses and support from community stakeholders and organizations will be needed.

Conclusion

In conclusion, eight weeks of line dancing improved knee muscle strength, lower extremity function, gait speed, endurance, and perceived mobility limitations. Current recommendations are for older adults to participate in at least 150 min per week of moderate intensity aerobic exercise [49]. In spite of this recommendation, many older adults do not achieve the minimum recommended amount of exercise. Line dancing involves socialization that may increase enjoyment and promote adherence while incorporating dynamic balance control and the use of lower extremity large muscle groups to improve physical function, and reduce perceived mobility limitations that threatens the independence of older adults.

Acknowledgements

We acknowledge Dr. Beverly Roberts for study design and statistical consultation.

Disclosure statement

There are no apparent conflicts of interest in terms of honoraria received, speaker forums, consultant roles, stocks, royalties, expert testimony, board memberships, patents, or personal relationships of any of the authors.

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