

## Dancing for Balance

### Feasibility and Efficacy in Oldest-Old Adults With Visual Impairment

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- ▶ **Background:** Fall risk increases with age and visual impairment, yet the oldest-old adults (>85 years) are rarely studied. Partnered dance improves mobility, balance, and quality of life in older individuals with movement impairment.
- ▶ **Objective:** The aim of the study was to determine the feasibility and participant satisfaction of an adapted tango program amongst these oldest-old adults with visual impairment. Exploratory analyses were conducted to determine efficacy of the program in improving balance and gait.
- ▶ **Methods:** In a repeated-measures, one-group experimental design, 13 older adults (7 women; age:  $M = 86.9$  years,  $SD = 5.9$  years, range = 77–95 years) with visual impairment (best eye acuity:  $M = 0.63$ ,  $SD = 0.6$  logMAR) participated in an adapted tango program of twenty 1.5-hour lessons, within 11 weeks. Feasibility included evaluation of facility access, safety, volunteer assistant retention, and participant retention and satisfaction. Participants were evaluated for balance, lower body strength, and quality of life in two baseline observations, immediately after the program and 1 month later.
- ▶ **Results:** Twelve participants completed the program. The facility was adequate, no injuries were sustained, and participants and volunteers were retained throughout. Participants reported enjoyment and improvements in physical well-being. Exploratory measures of dynamic postural control ( $p < .001$ ), lower body strength ( $p = .056$ ), and general vision-related quality of life ( $p = .032$ ) scores showed improvements following training.
- ▶ **Discussion:** These older individuals with visual impairment benefitted from 30 hours of tango instruction adapted for their capabilities.
- ▶ **Key Words:** dance • exercise • oldest-old • rehabilitation • visual impairment

Many oldest-old adults (aged 85 years and older) have sensory, motor, and cognitive impairments, leading to reduced independence (Dodge et al., 2008). Lower activity levels and declining mobility in oldest-old adults (Dodge et al., 2008) are even more pronounced among adults with vision loss (Ray, Horvat, Croce, Mason, & Wolf, 2008). In older adults with balance and vision impairments, fall rates are three

times the rate of older adults without either impairment (Kulmala et al., 2009).

Exercise programs with dynamic balance practice and adaptation to environmental demands (Hirsch, Toole, Maitland, & Rider, 2003) can favorably affect balance in older adults (Wolf et al., 2003). The American College of Sports Medicine (ACSM) recommends seniors participate in 150 minutes per week of aerobic activity, strengthening, and activities to

improve balance (e.g., tai chi). For functionally limited older adults, intensity and duration of physical activity should be low at outset and tailored to tolerance (Chodzko-Zajko et al., 2009). However, it is unclear which physical activities can improve the deficits of oldest-old adults

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with vision loss and fall risk (Ray & Wolf, 2008), and they therefore have limited participation (Dodge et al., 2008).

Dance, being enjoyable and motivating (Belardinelli, Lacialaprice, Ventrella, Volpe, & Faccenda, 2008), may effectively address motor and cognitive deficit and encourage participation through socialization in oldest-old adults with visual loss. Fall risk and quality of life (QOL) improved in people with Parkinson's disease after adapted tango (Hackney & Earhart, 2009, 2010a; Hackney, Kantorovich, Levin, & Earhart, 2007).

The primary aim of this investigation was to determine the feasibility and acceptability of an adapted tango program for oldest-old adults with vision loss. It was hypothesized that the intervention would be feasible, would be acceptable to participants with few modifications, would have high retention and that participants could attend twenty, 1.5-hour adapted tango lessons within 12 weeks. A secondary aim was to assess balance and QOL measures to inform the design of future efficacy studies.

For oldest-old adults with vision loss, activity limitations from visual and motor impairments, exacerbated by environment, can present participation barriers in social activities. In clinical care, the physical and social environment and psychological factors of the patient must be considered (Noreau, Fougeyrollas, Post, & Asano, 2005). The International Classification of Functioning, Disability and Health model supports social participation and involvement in a life situation for disabled individuals. Here, measures of participation included time spent in adapted tango and the emotional and motivational aspects of participation (Noreau et al., 2005), such as program satisfaction and vision-related QOL (Mangione et al., 2001). Adapted tango was intended to reduce activity limitations for oldest-old adults with visual loss by addressing motor deficits and removing environmental and contextual barriers prohibiting participation (e.g., overly challenging dance steps, lack of transportation).

## Methods

This study used a one-group, repeated-measures double pretest and removed treatment with a 1-month follow-up design. The Emory University Institutional Review Board and the VA Research and Development Committees approved this study. All participants provided written consent.

***Additional measures of physical and cognitive function are described in Document, Supplemental Digital Content 2, <http://links.lww.com/NRES/A89>.***



## Setting and Participants

Evaluation and intervention took place at the Atlanta VA Medical Center and a senior living facility. Participants were recruited via VA participant registry and research social information sessions. Inclusion criteria were diagnosed visual impairment, age of >75 years, no neurological disease, mental status score of  $\geq 8$  points (Pfeiffer, 1975), and ability to walk >10 feet with assistance. Participants were screened for general health and assessed for motor and visual limitations. The composite physical function index was used to assess the ability to perform daily activities (Rose, 2010). Corrected binocular visual acuity was measured with the Early Treatment for Diabetic Retinopathy Study acuity chart, with established methods (Bailey, Bullimore, Raasch, & Taylor, 1991). Stereoacuity (depth perception) was assessed using the Howard-Dolman type apparatus (Knight, Apsey, Jackson, & Dennis, 1998; see Document, Supplemental Digital Content 1, for more information, <http://links.lww.com/NRES/A88>).

## Adapted Tango Dance Intervention

The 12-week adapted tango program was modified to accommodate participants' visual loss as follows: (a) escorting participants to dance classes; (b) describing steps audibly and explicitly; (c) increasing emphasis on tactile communication between partners; and (d) increasing time per class from 1 to 1.5 hours to accommodate an added break, achieve at least 150 minutes (as recommended by the ACSM), have more time for warm-up, and for recalling steps.

Participants were told that they were participating in classes to learn how

dance affects older adults with visual loss, to come twice per week, to attend twenty 1.5-hour lessons within 12 weeks, to make up missed classes as soon as possible (four classes per week were offered to them), and not to change exercise routines during the study. The instructor, a certified personal trainer and dance instructor, taught progressive lessons, provided modifications as needed, and introduced new steps each class. Participants were paired with partners without vision loss: spouses and friends or volunteer assistants (undergraduate students who were taught safety and guarding techniques).

Tango classes began with upbeat music for 15-minute standing dance-based warm-ups. As well as increasing body temperature, the goal of the warm-up was to move all joints, enhance body segment awareness, and increase confidence in participants that they could complete very simple movements to specified rhythms. Participants danced in a frame (holding elbows facing one another). Men and women both led and followed to ensure participants had the same motor and cognitive demands during classes. As needed, the instructor provided appropriate step modifications. As per ACSM, to encourage adherence and enjoyment, participants could sit if needed throughout classes but were asked to continue moving while seated (Chodzko-Zajko et al., 2009). More details are provided elsewhere (Hackney & Earhart, 2010b).

## Measures

The program was evaluated for feasibility, participant satisfaction, and to explore effects on physical function and participation (vision-related QOL). Additional measures of physical and cognitive function are described in Document, Supplemental Digital Content 2, <http://links.lww.com/NRES/A89>. The following were evaluated in regard to feasibility: (a) the ability to gain access to a large, private space for dance classes 4 days a week for 2 hours per day; (b) safety and incidence of adverse events; (c) retention of student volunteers; (d) retention (attendance) and participant satisfaction with the intervention.

Participant satisfaction with tango participation was evaluated using the Exit Questionnaire (Hackney & Earhart, 2009, 2010a) at posttesting. The questionnaire contains nine items asking if the participant enjoyed the classes, would continue, and noted improvements in aspects of physical well-being.

Effects of physical function were measured in terms of dynamic postural control and lower body strength. The dynamic gait index (DGI), including eight items, (e.g., walking while changing speed, stair climbing), was used to evaluate postural control during gait (total score < 20/24 indicates risk for falling). The DGI has shown interrater test-retest reliability ( $r = .96-.98$ ; Shumway-Cook, Brauer, & Woollacott, 2000). The threshold for fall risk on the DGI is 19.5 (Herman, Inbar-Borovsky, Brozgol, Giladi, & Hausdorff, 2009). In this study, the DGI showed internal consistency (Cronbach's alpha = .84) and test-retest reliability (intraclass correlation coefficient [ICC] = 0.85) across two pretests. Associated with falls, lower body strength was measured with the 30-

second chair stand (Rikli & Jones, 2001). Participants rise from a chair to full standing as many times as possible in 30 seconds, without using their hands. The chair stand has test-retest reliability of ICC of 0.84 in older adults (Jones, Rikli, & Beam, 1999) and predicted falls (if  $\leq 14.5$  stands, sensitivity = 0.88, specificity = 0.70). In this study, the chair stand internal consistency was Cronbach's alpha of .89 and test-retest reliability of ICC was 0.90 across two pretests (Figure 1).

The National Eye Institute Visual Function Questionnaire-25 (VFQ-25, range: 0-100; Mangione et al., 2001) has demonstrated good internal consistency (Cronbach's alpha = .73-.94; general vision = 0.81), test-retest reliability (ICC = 0.68-0.91, general vision = 0.86; Mangione et al., 1998), and va-

lidity (Revicki, Rentz, Harnam, Thomas, & Lanzetta, 2010) in older, visually impaired adults. The VFQ-25 measured vision-related QOL, the influence of visual disability on emotional well-being, and social functioning. Higher scores represent better vision-related QOL.

### Testing Protocol

Participants determined an optimal time for evaluations for the first visit, 1 month before training (1 month pre), and were evaluated at the same time of day 3 more times: 1 week before training (1 week pre), within the week after training (1 week post), and 1 month after post-testing (1 month post). Outcome measures were computerized and measured objectively or by self-report. The DGI was videotaped for a qualified rater, blinded to study hypotheses. Research assistants, not blind to treatment or time point, assessed all other outcomes. Each evaluation lasted 2-2.5 hours. The testing order was standardized with rest breaks as needed.

### Statistical Analyses

Using SPSS (Version 19.0), descriptive analyses were used to characterize participants. Internal consistency and test-retest reliability were determined for the DGI and chair stand across the two pretests. Data of only individuals who completed 20 lessons were included in outcome analyses. Repeated measures analyses of variance were performed with time (1 week pre, 1 week post, and 1 month post) as the repeated measure, and Bonferroni corrected  $p$  is less than .05. Outcome measures included DGI, chair stand, and VFQ-25 general vision score. Measures included in the supplemental section were analyzed with the same methods.

### Results

Thirteen individuals with visual impairment (seven women) participated. Nine had macular degeneration, two had glaucoma, and two had both (Table 1).

### Feasibility of Adapted Tango in a Senior Independent Living Community Gaining access to facility.

The community's director of operations arranged for a large dining room to be available. Due to scheduling conflicts, 6 of 44 classes were taught in a smaller room. The intervention appeared not to infringe on regular facility operating procedures.

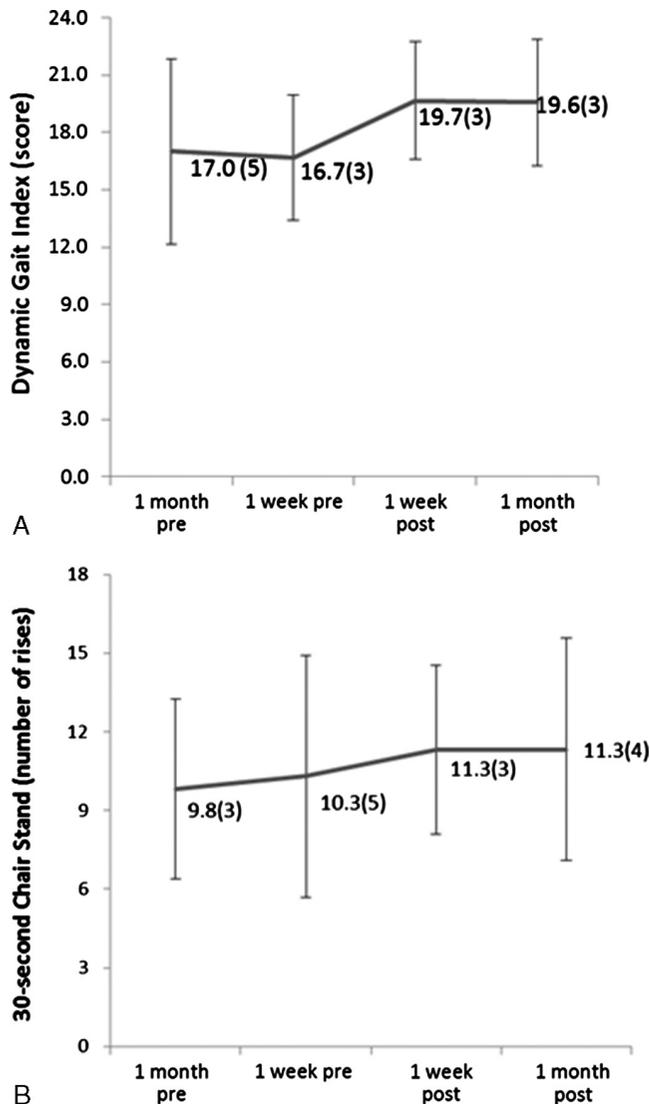


FIGURE 1. Values presented are means and standard deviations of dynamic gait index (A) and 30-second Chair Stand (B). Higher values represent better dynamic postural control (A).

TABLE 1. Participant Characteristics (n = 13, 7 Women)

	<i>M</i>	<i>SD</i>
Age (years)	86.9	5.9
Duration of diagnosis (years)	9.6	6
Worst eye logMAR (Snellen) <sup>a</sup>	1.0	0.7
Best eye logMAR (Snellen)	.63	.6
Number of prescribed medications	3.6	2
Number of comorbidities <sup>b</sup>	3.4	2
Composite physical function index (/24) <sup>c</sup>	18.0	4
Depth perception (arcsec) <sup>d</sup>	45.1	22
Number of falls in the previous year	0.58	0.5
Use of assistive device (Y/N)	7/6	
Fall in previous year (Y/N)	8/5	

<sup>a</sup>Lower logMAR values represent better acuity. Snellen values for worst eye and best eye are 20/658 and 20/90, respectively. Participants were classified by level of visual impairment (mild [Snellen 20/30–20/60]: *n* = 5, moderate [20/60–20/200]: *n* = 4, and severe [20/200–20/1000]: *n* = 4).

<sup>b</sup>Comorbidities included arthritis, high blood pressure, generalized heart problems, osteoporosis, asthma, and joint issues.

<sup>c</sup>Participants' mean score on the CPF indicates moderate risk for loss of function (Rikli & Jones, 2001).

<sup>d</sup>Six individuals could not complete the depth perception test measured by the Howard–Dolman apparatus, because their impairment exceeded measurable limits. The mean values presented here indicate the seven other participants also had impaired depth perception.

**Safety concerns related to conducting the intervention.** No fall-related or other adverse events occurred during dance classes. At 1 week post, one participant reported two falls at home during the intervention's time period.

**Ability to recruit, train, and retain the student volunteers.** Seventeen volunteers were recruited and participated in one or more testing and class sessions. Eleven came regularly to dance classes, averaging about 10 hours per week for 11 weeks (total = 800 hours of volunteer help).

**Retention of participants in the intervention.** One participant dropped after two classes citing preexisting back pain. Twelve individuals completed the intended dosage of twenty 1.5-hour classes (30 hour) in 11 weeks (12 weeks would have been allowed if necessary).

### Participant Satisfaction

Participants *strongly agreed* they enjoyed classes and would like to continue and *agreed* they noticed improvement in balance, mood, coordination, walking, strength, and endurance (Table 2).

### Outcomes

Participants increased scores on the DGI and maintained this increase at 1 month

post (1 week pre: *M* = 16.7, *SD* = 3.3, 1 week post: *M* = 19.7, *SD* = 3.1, 1 month post: *M* = 19.6, *SD* = 3.3;  $F(2, 22) = 31.31, \eta_p^2 = 0.740$ ; 1 week pre vs. 1 week post:  $p < .001$ ; 1 week post vs. 1 month post,  $p = .820$ ). Participants increased marginally on chair stand (1 week pre: *M* = 10.0, *SD* = 4.6, 1 week post: *M* = 11.3, *SD* = 3.2, 1 month post: *M* = 11.3, *SD* = 4.2;  $F(2,22) = 2.98, \eta_p^2 = 0.213$ ; 1 week pre vs. 1 week post:  $p = .075$ ). Participants increased on VFQ 25 general vision score over three evaluations (1 week pre: *M* = 45.8, *SD* = 23; 1 week post: *M* = 51.7, *SD* = 23, 1 month post: *M* = 65.2, *SD* = 24;  $F(2,22) = 4.550, \eta_p^2 = 0.293$ ; 1 week pre vs. 1 month post:  $p = .011$ ; 1 week post vs. 1 month post:  $p = .035$ ). See additional results and figures in Table 3 as well as in Document, Supplemental Digital Content 2, <http://links.lww.com/NRES/A89>.

### Discussion

Adapted tango was feasible in a senior living community and agreeable to most participants in terms of retention and satisfaction. Assessments performed in physical and cognitive function will be used to power adequately future random-

ized, controlled studies related to efficacy of adapted tango in this population.

In spite of visual loss, participants successfully and safely engaged in an adapted tango program, slightly modified from a program originally intended for the fully sighted, with minimal impact on the facility. Participant retention level was high (8% attrition), and self-reports (Table 2) suggest the program was enjoyable, indicating acceptability. As participants grew comfortable with the environment, staff, and dance, vision loss may have affected participation less.

Identifying interventions that improve balance and reduce fall risk for oldest-old adults is crucial (Ray & Wolf, 2008). Increased lower body strength (17.5% increase from 1 week pre to 1 week post on chair stand) and DGI mean improvement from 16.5 (indicating fall risk) to 19.5 (above the fall risk threshold) may have clinical relevance (Herman et al., 2009) and impact ADL performance, pending converging evidence from future studies.

### Limitations

A small sample may violate assumptions of analysis of variance, and lack of a control group may limit the validity of improvements seen in the efficacy measures.

TABLE 2. Exit Questionnaire Item and Open-Ended Responses

Aspects of well-being (n = 12)	Item responses
Enjoyment	1(1,1)
Balance	2(1,3)
Walking	2(1,2)
Mood	2(1,3)
Coordination	2(1,3)
Strength	2(2,3)
Endurance	2(1,4)
Continuing	1(1,4)
More physically active	2(1,4)

*Note.* Participant responses to items regarding aspects of physical well-being on a 5-point Likert scale with medians and first and third interquartiles: 1 = *strong agreement* and 5 = *strong disagreement*, with items stating that the participant noted improvement in various aspects of physical well-being as a result of participation in adapted tango.

TABLE 3. Physical, and Cognitive Performance of Oldest-Old Adults With Vision Loss Before and After Adapted Tango

	Cronbach's alpha	ICC <sup>a</sup>	1 month pre, M (SD)	1 week pre, M (SD)	1 week post, M (SD)	1 month post, M (SD)	F	$\eta_p^2$
Forward gait speed (m/s)	0.93	0.92	0.91 (.2)	1.01 (.2)	0.99 (.2)	0.98 (.3)	2.0 (3,30)	0.33
Forward cadence (steps per minute)	0.95	0.90	109 (11)	114 (11)	112 (10)	110 (14)	2.8 (3,24)	0.26
Brooks spatial task (% correct)	0.96	0.96	59 (14)	64 (15)	65 (17)	70 (10)	1.4 (3,33)	0.22
BPST <sup>b</sup>	0.76	0.52	3.0 (0.5)	3.8 (0.9)	3.8 (0.7)	3.8 (0.8)	4.6 (3,33)	0.28

<sup>a</sup>Intraclass correlation coefficient.

<sup>b</sup>As the body position spatial task span (BPST) was piloted for these individuals, normative data do not exist; however, normative data for individuals aged 70–79 years for forward Corsi blocks upon which the BPST is based are 5.3 (0.8) for span length and 7.4 (1.4) trials correct (Kessels et al., 2008).

Lack of transportation prevented some eligible individuals from participating. In future studies, two to three baseline observations will be conducted to mitigate learning effects of performance-based measures, and more sensitive measures of participation will be used. Potentially, an even number of options for the Exit Questionnaire would encourage participants to be more definitive in their responses.

### Conclusion

Oldest-old adults with vision loss, for whom rehabilitative options are needed, may experience satisfaction with an adapted tango class. ▣

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