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Effect of a Community-Based Argentine Tango Dance Program on Functional Balance and Confidence in Older Adults

Patricia McKinley, Allison Jacobson, Alain Leroux, Victoria Bednarczyk, Michel Rossignol, and Joyce Fung

Tango-dancing and walking programs are compared in nondemented seniors at risk for falls. Fallers ($N = 30$) age 62–91 were randomly assigned to a 10-wk (40 hr, 2 hr 2×/wk) tango class or walk group. The Activities-specific Balance Confidence (ABC) scale, sit-to-stand scores, and normal and fast walk were measured pre-, post-, and 1 month postintervention. Two-way repeated-measures ANOVAs indicated a significant main effect ($p < .01$) for time on all measures. Group and interaction effects for ABC led to improvement only in tango because of high baseline mean for the walk group. Clinical improvements measured using Established Populations for Epidemiologic Studies of the Elderly scoring were greater for the tango group. From these preliminary results it is suggested that although both interventions are effective activities for increasing strength and walk speed, tango might result in greater improvements than walking in balance skills and in walking speed in the 10-wk intervention. The study needs to be repeated with a greater sample size to determine the effectiveness of walking on fear of falling.

Keywords: older people, tango dancing, balance confidence, balance performance

Seniors rank fear of falling highest among other common fears such as financial problems, criminal violence, or forgetting an appointment (Walker & Howland, 1991). Fear of falling also curtails external activities and efforts to socialize (Brouwer, Musselman, & Culham, 2004; Gill, Williams, & Tinetti, 1995; Howland et al., 1998; McAuley et al., 2000; Powell & Meyers, 1995), thus leading to decreased satisfaction with life and physical capabilities and increased disability and isolation (McAuley et al., 2000). The role of exercise as a means for reducing falls and increasing balance confidence has been the focus of much research in the recent past. In addition, although home-based exercises might be effective in reducing falls (Delbaere et al., 2006; Robertson, Devlin, Gardner, & Campbell,

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2001), they lack a social component, thereby not addressing issues of loneliness and isolation.

Many types of community exercise interventions have been examined, including Tai Chi (Wolf et al., 2006), general group exercise (Barnett, Smith, Lord, Williams, & Baumand, 2003), balance-specific training (Brouwer, Walker, Rydahl, & Culham, 2003; Hess & Woollacott, 2005), resistance or agility training (Liu-Ambrose, Khan, Eng, Lord, & McKay, 2004), and walking (McAuley, 1993), to name a few. Results with respect to the effectiveness of these interventions have been uneven (Gillespie, Gillespie, Cumming, Lamb, & Rowe, 2001; Kuramoto, 2006; Wu, 2000). Some researchers have suggested that this lack of demonstrated effectiveness might be because of recruitment of participants who are at too low a risk for falling for the programs implemented (Glasgow, Vogt, & Boles, 1999; Province et al., 1995; Robertson et al., 2001), whereas others have suggested that the programs are not of sufficient duration. A third possibility is that the outcome measures selected for evaluation were not specific to the type of exercise program implemented. For example, although most researchers in the field have a clear understanding of the specificity of exercise for strengthening and endurance, the notion of specificity of exercise for balance-related features has not been explored in great detail (Woollacott & Shumway-Cook, 2002).

A variety of physical activities might be more effective than selecting one exercise (such as walking or Tai Chi) in developing better balance skills and balance confidence. Community-based programs that are appealing to seniors and are sustainable at reasonable costs are also important to assess. This latter feature is important, because a recent study (Hughes et al., 2005) demonstrated that commercial gyms or YMCAs, senior centers, park or recreation centers, and senior housing facilities manage to attract 6% of the total older adult population within the catchment district. This is not the sort of engagement that will result in health prevention for increasing numbers of seniors. For example, in Canada it is estimated that by 2030 there will be more elderly persons than individuals under the age of 15 (Statistics Canada, 2006). Therefore, programs that cater to the needs of seniors, are sustainable, and engage them are important to identify. Indeed, one of the biggest predictors for long-term engagement in leisure-based activity programs is physical activity (McAuley et al., 2007). In addition, two major predictors for cessation of these activities are being female and slow walking (Shimada, Lord, Yoshida, Kim, & Suzuki, 2007). Moreover, it appears that barriers such as fear of falling are better than motivators for predicting adherence to these activities (Forkan et al., 2006). Keeping these issues in mind, we searched for a physical activity that could be implemented in the community setting, would appeal to seniors, and would be challenging enough so that anyone participating in the activity would perceive improvements in his or her balance.

Recently, there has been a focus on the use of dance programs as a means to improve mobility, balance, and fitness. For example, a dance-based 12-week (1 hr, 3×/wk) aerobic-exercise program (Shigematsu et al., 2002) was demonstrated to improve balance and gait speed in the healthy elderly, and a 3-month (1 hr, 3×/wk) dance program reduced fall incidence in middle-aged adults 58–68 years of age (Federici, Bellagamba, & Rocchi, 2005). Dance exercise classes often rely on learning a fixed sequence of steps, however, and do not always increase in intensity or complexity. This limit to the amount of variety and challenge in these

classes could increase dropout rate because of boredom. The Argentine tango was selected for this population because it is a challenging dance to learn, is an activity that has appeal for seniors, is readily available in most communities, and is often danced with same-sex partners, thus accommodating the larger number of women than men in the senior population. More pertinent, this activity captures identified balance features that are important for fall prevention.

Specifically, although the Argentine tango consists mainly of walking backward and forward, it encourages multidirectional and longer step lengths, quick turns or pivots, and standing on one foot while raising the other to perform adornments and incorporates flexibility, strengthening, and exercises for increasing stability and balance. These aspects are important because they encompass many features that have been identified as characterizing increased risk of falling in the elderly: decreased sense of limits of stability (Horak, Henry, & Shumway-Cook, 1997; Horak, Shupert, & Mirka, 1989; Nashner, 1994), taking too small steps when trying to recover balance (Hsaio & Robinovitch, 2001), diminished range of motion into hip extension (Kerrigan, Lee, Collins, Riley, & Lipsitz, 2001), lack of safety during reach (Robinovitch & Cronin, 1999), weight transfer, unilateral maintenance of static balance and while turning or swiveling (Corriveau, Hebert, Prince, & Raiche, 2001; Maki, Edmondstone, & McIlroy, 2000), inability to adapt quickly to unexpected conditions (Brown, Shumway-Cook, & Woollacott, 1999; Horak et al., 1989; Nashner), stepping quickly in the proper direction (Luchies et al., 2002) or laterally (McIlroy & Maki, 1996), fear of falling or lack of self-efficacy for performance of specific tasks (McAuley, 1992, 1993; McAuley, Mihalko, & Bane, 1997), and restoring balance (Powell & Meyers, 1995; Tinetti, Richman, & Powell, 1990; Tinetti, Speechley, & Ginter, 1988).

In this feasibility study we addressed a primary question: Can a 10-week series of tango lessons result in increased strength, balance confidence, and other balance skills after a 40-hr (2×/week for 10 weeks) session of dance classes that are comparable to those from a walking program of equivalent intensity? Part of this study has been published in abstract form (McKinley, Bednarczyk, Jacobson, Leroux, & Fung, 2005).

Methods

Inclusion Criteria

To be included in the study, individuals had to be over the age of 60, have experienced at least one unexplained fall during the previous year, and have an expressed fear of falling. They had to be healthy to the degree that participating in exercise testing and a dance or walking exercise program would not exacerbate any existing symptoms such as chest pain because of angina or dizziness because of vestibular problems. In addition, they had to score the following on the Inter-RAI: living independently; be independent on the ADL self-performance, including bathing, other personal hygiene, and walking; have a physical activity level of at least 1–2 hr within the past 3 days; and express ideas without difficulty, have clear comprehension, hear adequately, and have adequate vision. They also had to have

an understanding of written and spoken English or French and a willingness to be randomly assigned to treatment condition.

Exclusion Criteria

Individuals were excluded if they had signs or symptoms consistent with (a) major unstable cardiopulmonary diseases; (b) cognitive impairment defined as having a of score less than 24 on the Folstein Mini Mental Status test (Crum, Anthony, Bassett, & Folstein, 1993); (c) contraindications to physical exercise such as major orthopedic conditions (severe lumbar spine, hip, knee, or ankle arthritis that limits exercise capability); (d) mobility restricted to a wheelchair or walker; or (e) reports of terminal cancer or evidence of any other progressive or unstable neurological or medical condition and sensory impairment resulting from neuropathy.

Ethics

This study was approved by the ethics committee of the Centre de Recherche Interdisciplinaire en Réadaptation du Montreal Métropolitain (CRIR).

Experimental Design

Screening and Recruitment. Schemas for screening, recruitment, and participation are shown in Figure 1. Potential participants were recruited through local newspaper ads, medical clinics, and senior centers. Individuals (n = 40) expressing interest were interviewed by telephone by a licensed physical therapist using the inter-RAI (Carpenter, 2006). These forms were subsequently evaluated by the coordinator for inclusion and exclusion criteria. At the end of the preliminary screening period, eligible candidates were invited to attend an information session, where the details of the study were spelled out for them and they could meet the researchers and instructors and read through the consent forms. At this time, it was explained again that they would be randomly placed into either a tango class or a walk group but that those placed into the walk group would be offered an identical tango course after the study was terminated, and, similarly, those in the tango course would be offered a walking program.

Thirty of the 34 candidates agreed to participate in the study. At this point they were given an appointment to come to the participating rehabilitation center for a final screening for cognitive function, using the Folstein Mini Mental Status test. Those who scored more than 24 were then invited to participate in the study and were randomly allocated to the Argentine tango program or the walk program by selecting envelopes that contained group codes. Male participants were stratified to provide an equal number of men in each group. Each group met for 2 hr two times per week for a total of 4 hr/week, and a maximum exercise time of 3 hr, as there were rest periods totaling 30 min allotted to each exercise session. The participants were given a battery of tests at the following intervals:

- Preintervention, 1 week before the onset of classes
- Postintervention, 1 week after the last class
- Follow-up, 1 month after the program finished

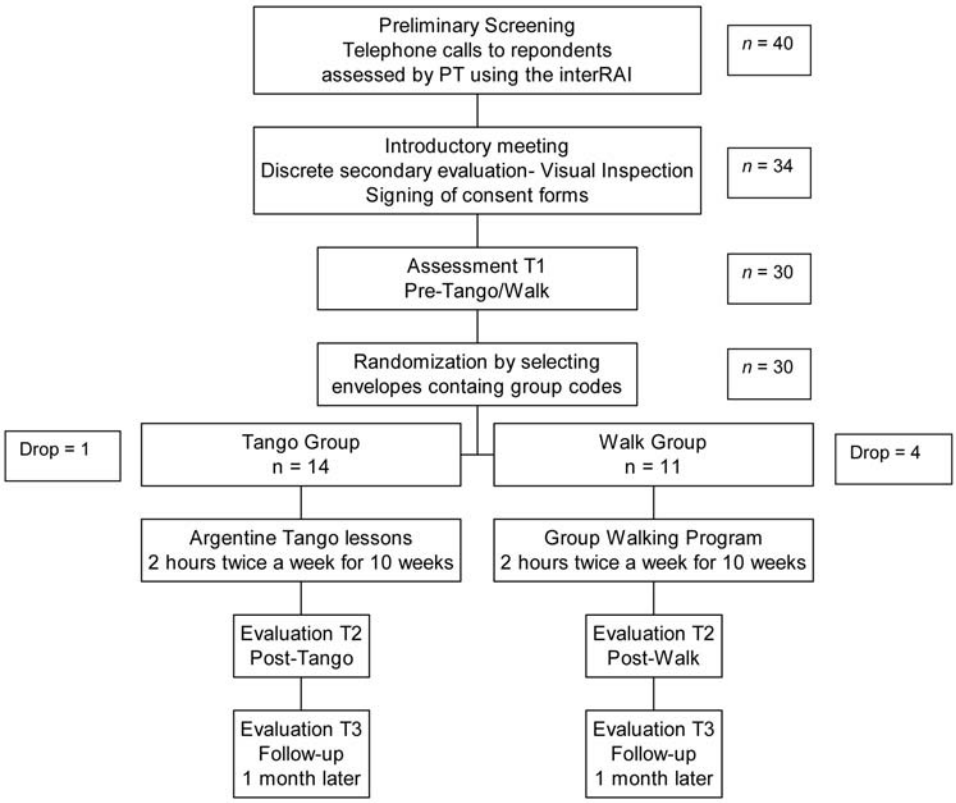

Figure 1 — Schematic design for recruitment for and implementation of the study.

During the 1-month follow-up period, participants were asked to take part only in the activities that they were doing before the program began but to refrain from tango or intensive walk programs. Testing was done within the first three afternoons of each time period. A psychologist administered the Folstein Mini-Mental Status test for cognitive function, and a physical therapist administered the physical-performance tests at the Constance Lethbridge Rehabilitation Centre. Both testers were blind to treatment status. An exit interview with each participant was held at the end of the study to obtain personal opinions regarding the exercise programs.

Outcome Measures. Outcome measures that have known validity and prediction for falls were used to capture specific features of the tango program that we wished to assess: (a) strength, using the sit-to-stand measure of the Established Populations for the Epidemiological Study of the Elderly (EPESE), shown to be related to fall risk (Guralnik et al., 2000; Studenski et al., 2003) and sensitive to change in older women (Ostir, Volpato, Fried, Chaves, & Guralnick, 2002); (b) balance confidence, using the Activities-specific Balance Confidence scale (ABC),

a 16-item scale requiring participants to rate on a continuum ranging from 0 (*no confidence*) to 100 (*completely confident*) their level of balance confidence when performing specific activities of daily living that has been shown to be associated with exercise levels (Myers, Fletcher, Meyers, & Sherk, 1998; Myers et al., 1996; Powell & Meyers, 1995) and has predictive cut-off risks for falls (Lajoie, Teasdale, Bard, & Fleury, 1996); and (c) normal and fast walk speed from the EPESE.

Exercise Program. The tango dance program consisted of 20 min of warm-up and individual exercises that focused on the components of the basic tango: walk (forward and backward), the pivot, and other basic patterns, with an emphasis on postural alignment and weight shift (practice in front of a mirror). This was followed by another 20 min of directed couples practice, in which specific patterns were emphasized and practiced; there was then a 30-min break period followed by another 20 min of directed couples practice and 30 min of free practice. Partners were changed regularly during the class, and the women were encouraged to learn both roles so that they could lead or follow. The class was lead by an expert instructor with two assistants, all of whom danced with all the participants so that each participant was guided by an expert at least four times during each session. The tango program took place at the Cummings Jewish Senior Centre in a room with a wooden floor and full-length mirrors on one wall. The walk program consisted of scheduled outings to parks or malls in the Montreal area (depending on the weather) with a qualified exercise scientist and an assistant. Participants were encouraged to walk at a pace that was comfortable but slightly difficult (12–13 on the 6–20 Borg RPE scale; Borg, 1982). They could rest at any time for a total of 30 min during the walk period. The walking started with a warm-up of 5 min and ended with a cool-down of 5 min.

Data Analysis

Separate mixed-model two-way ANOVAs for repeated measures (SAS) were used: Treatment (walk vs. tango) × Assessment Time (pre- vs. postintervention vs. follow-up). Post hoc tests (Tukey–Kramer) were performed when indicated for significant main effects or interactions. Percent change scores were calculated relative to baseline measures for descriptive between-group comparisons (two-tailed). Percent change was calculated by subtracting the mean baseline value from the mean postintervention value, dividing by the mean baseline value, and multiplying by 100. The level of association between changes in balance confidence and the other outcome measures was determined for the tango and walk groups separately, using Spearman rank correlation coefficients, because we were also interested in whether the participants would link improvement in balance confidence with changes in physical-performance parameters.

Results

Thirty participants completed baseline testing, but 5 were lost before program completion; 4 were dissatisfied with the group allocation (walk group) and withdrew, and 1 withdrew because of a knee injury (unrelated to the activity under

study, which was the tango). Twenty-five participants completed the programs (14 in the tango group and 11 in the walk group) with excellent attendance (>90% for both programs). Ten participants attended all 20 sessions, 12 missed one session, and 3 missed two sessions. Postintervention data were collected from all individuals who participated in the entire study. The two groups that completed both testing intervals were equivalent in terms of age, gender, medical conditions, and scores on the Folstein Mini-Mental Status test (Table 1).

Outcome-Measure Statistics

The two-way ANOVAs indicated a significant effect for time for all primary outcome measures: sit-to-stand (STS), $F(2, 46) = 15.25$, $p < .0001$; normal walking speed, $F(2, 46) = 5.63$, $p = .0065$; fast walking speed, $F(2, 46) = 9.74$, $p = .0003$; ABC, $F(2, 46) = 5.04$, $p = .0105$. The ABC also showed a significant main effect for group, $F(1, 23) = 4.49$, $p = .045$, and an interaction effect, $F(2, 46) = 3.55$, $p = .0368$. Tukey–Kramer adjusted post hoc tests revealed significant differences between pre- and post- and pre- and follow-up for STS ($p = .0012$ and $< .0001$, respectively), normal walk ($p = .02$ and .01, respectively), and fast walk ($p = .009$ and $< .0003$, respectively). For the ABC, post hoc contrasts indicated significant differences for tango pre- and post- ($p = .009$) and pre- and follow-up ($p = .003$) and for tango pre- and walk pre- ($p = .03$). No significant differences for the ABC were seen between tango and walk for the post- and follow-up time periods, nor were there any significant differences between time periods in the walk group for this measure. For reference, baseline, postintervention, and follow-up means and standard deviations for each group are presented in Table 2.

Assessment of Percentage-Change Scores

STS and normal walk change scores were greater for the tango group than for the walk group. Change scores between the two groups for the ABC were not compared because of the significant difference at baseline between these measures.

Table 1 Baseline Participant Demographics ($N = 25$) by Group Allocation

Variable	Tango group ($n = 14$)	Walking group ($n = 11$)	p
Age, *M* (*SD*)	78.07 (7.6)	74.6 (8.4)	.45
Sex, male/female	3/11	3/8	
Walked with cane	2	2	
Asthma	2	1	
Osteoporosis	3	2	
Hypertension	3	3	
Stable cardiovascular condition	1	1	
Non-insulin-dependent diabetes	3	3	
Mini-Mental score, *M* (*SD*)	28.5 (1.58)	28.6 (1.43)	.8

Spearman's Rank Correlation Coefficients

Correlations between change scores for all outcome measures as compared with balance confidence for each group are shown in Table 3. None of the measures demonstrated significant correlation with the ABC. The Spearman's rank correlation coefficient matrix for changes in outcome measures is shown in Table 4.

Table 2 Outcome Measures, *M* (*SD*)

Outcome measure	Baseline	Postintervention	Follow-up
Tango (n = 14)			
ABC (%)	71.3 (13.7)	81.9 (12.63)	82.94 (11.24)
STS (s)	17.12 (7.05)	12.36 (4.46)	10.67 (4.41)
normal walk (cm/s)	86.4 (22)	99 (27.8)	98 (28.7)
fast walk (cm/s)	111.4 (28.5)	124.4 (34.3)	131.04 (35.83)
Walk (n = 11)			
ABC (%)	86.2 (9.75)	87.15 (9.61)	87.15 (8.18)
STS (s)	14.3 (2.47)	12.31 (3.39)	11.32 (5.76)
normal walk (m/s)	84.4 (0.15)	93.3 (19.8)	96.27 (17.8)
fast walk (m/s)	117.4 (16.98)	129.4 (23.02)	132.2 (23.4)

Note. ABC = Activities-specific Balance Confidence Scale; STS = Sit-to-stand.

Table 3 Percent Change Scores (Posttreatment Relative to Baseline Values)

	Percent Change		
Variable	Tango	Walk	All participants
Activities-specific Balance Confidence Scale	17	2	10.6
Sit-to-stand	−24*	−13	−19
Normal walk	16*	12	14
Fast walk	13	10	12

*$p \leq .05$.

Table 4 Spearman Rank Correlation Coefficient Matrix for Changes (Δ) in Outcome Measures

Δ Activities-specific Balance Confidence Scale	Δ normal walk speed	Δ fast walk speed	Δ sit-to-stand[a]
Tango	.069	.042	–.27
Walk	.010	.282	–.05

[a]Negative correlations indicate improvement in both outcomes in this column; for other columns, positive correlations indicate improvement in both outcomes.

Clinical Significance

Because high- and low-risk limits for falls have been established for STS and normal walk in the Established Populations for Epidemiologic Studies of the Elderly (Guralnik et al., 2000; Studenski et al., 2003), we assessed changes in both cohorts over time. Figure 2 illustrates the numbers of individuals who fell within the four quartiles of the Established Populations for Epidemiologic Studies of the Elderly measures (Guralnik et al.) for performance and fall risk for STS and normal walk at the three time periods. For STS, 6 tango participants were in the high-risk category (time > 16.7 s) before the tango dance class, and all but 1 of these participants moved into lower risk categories. For many others who were at the border between low and moderate risk, the posttango values moved them farther away from the moderate risk and well into the area of no risk, so the safety margin for risk of falls was increased for this group using this criterion regardless of how poor or good their baseline scores were. A similar change occurred in the walk group, although the changes were smaller because only 1 of the 11 fell into the high risk for falls category at baseline. Normal walking speed moved close to or into the zone that has been correlated with no fear of falling (>126.7 cm/s) for several of the participants in the tango but not the walk group. Persistence into follow-up of these two measures was also clinically relevant. For normal walk, a fifth column was added to indicate the number of individuals who scored in the 1.26 m/s or above range, indicating very low fear of falls. The number of individuals reaching the fourth quartile (best performance and low fall risk) persisted into follow-up.

The significant change in the ABC for the tango cohort was also critical in greatly reducing fall risk profile. At baseline, half the participants scored at or below 67% on the ABC, which placed them at greater than a 50% risk for falling within the next year (Lajoie et al., 1996). Two of the lowest scoring individuals increased their balance confidence dramatically. In addition, those who scored on or close to the borderline of 50% risk for falls moved farther into the low-risk zone. Thus, for 13 of 14 participants, regardless of status at baseline, balance confidence was increased. In contrast, the walking group was already at 85% for balance confidence before the study onset, significantly different from the tango group. We cannot say whether this parameter did or did not improve with the walking program, because according to Myers et al. (1998), individuals who score in the mid-80s or better on the ABC are unlikely to show further improvement in balance confidence. It was curious, however, that several of the participants scored themselves lower in balance confidence after the walking course.

Discussion

Feasibility and Acceptance of the Program for this Population

Of the 15 participants in the tango cohort, only 1 person dropped out; the stated reason was acute knee pain. Other participants used canes for walking (2), had a hip replacement (1), had minor sensory deficits in the feet (2), had stable cardiovascular disease, or were senior seniors over the age of 85 (3). Thus, the major

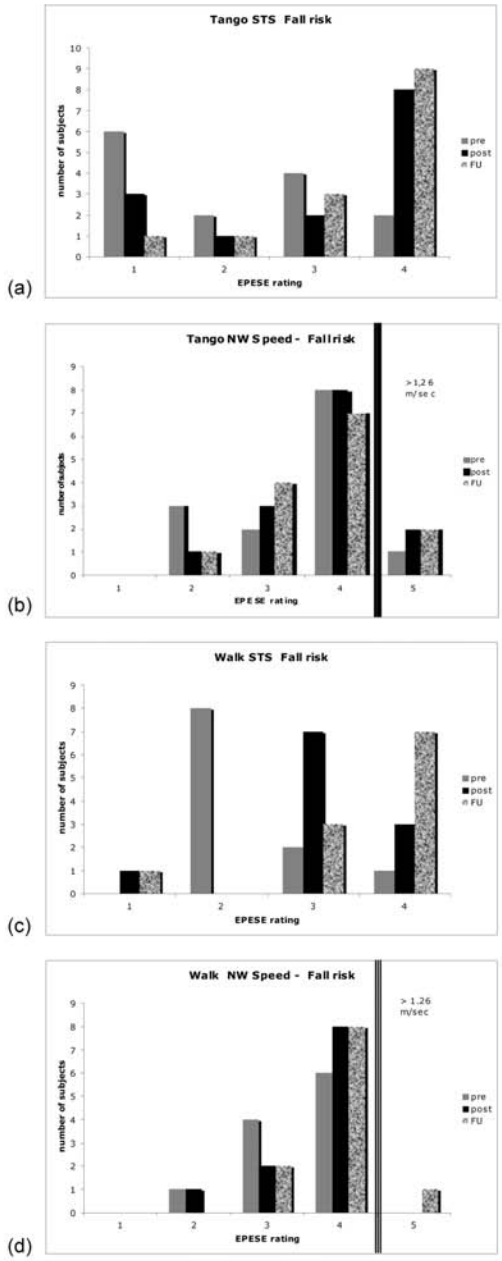

Figure 2 — Histograms of the number of individuals in each quartile of the Established Populations for Epidemiologic Studies of the Elderly (EPESE) for (a) and (c) sit-to-stand (STS) and (b) and (d) normal walk speed (NW). For STS, intervals are (1) >16.7 s , (2) 13.7–16.6 s, (3) 11.2–13.6 s, and (4) <11.2 s. For NW, intervals are (1) ≤0.46 m/s, (2) 0.47–0.63 m/s, (3) 0.64–0.81 m/s, and (4) ≥0.82 m/s. A fifth column (to the right of the vertical double bar) has been added to indicate individuals who were capable of walking at or above 1.26 m/s because this value has been observed to be related to significant decrease in fear of falling and is equal to the pace necessary to complete 1/4 mile in 5 min.

barrier to participation in this activity might be knee arthritis or acute knee injury. This is not surprising, because knee injury is a major indicator for risk of frailty (Sturnieks et al., 2004). In addition, no matter how disturbed their balance was before program onset, these seniors were able to learn, remember, and execute complex dance patterns by the end of the 10-week period. Thus, the activity is feasible for this population. It should be noted, however, that the instructor needs to be very supportive and patient with this cohort; otherwise some individuals might get discouraged. Our instructor had the attitude that "if you have legs you can dance." Nevertheless, some of the individuals were better at picking up the steps than others. Indeed, the participant who had fallen the most frequently and walked slowly with a cane was one of the best dancers. This ended up in being a great leveler—at the end of the 10-week course, all participants were equally able to dance at a set pace. Indeed, walking with a cane was not a barrier to performing the tango—none of the participants who walked with a cane had any trouble dancing without their canes. In addition, it should be noted that subsequent to this study, another group of researchers has used our protocol to develop a tango dance intervention for patients with Parkinson's disorder (Hackney, Kantorovich, Levin, & Earhart, 2007) that was met with improved balance and function. Thus, this type of dance program can be considered as an option for a variety of vulnerable populations.

Persistence in attendance for the walking group was aided by going to various parks throughout the greater Montreal area. Even so, there was a 25% dropout rate. This was primarily because these individuals only wanted to tango, and they were not willing to participate in the 10-week walk program to receive their tango lessons. Therefore, although all the individuals accepted the randomization into either the tango or walk group, dropouts from the walk group need to be planned for when recruiting for a larger study.

Amelioration of Balance and Balance Confidence

Based on the statistical analysis, both interventions were effective in significantly improving and maintaining gains for STS and normal and fast walk. The significant gains in the walk group might be expected, because the walking program targeted increasing intensity and duration of exercise, and similar results have been reported previously (Melzer, Benjuya, & Kaplanski, 2003). The gains in these measures with the tango are novel and indicate that the Argentine tango can be used to increase and maintain gains in strength and walk speed. Because this was a feasibility study, and the participant number in each group was quite small, there might be differences between walk and tango with a larger sample size. As indicated by the change scores and illustrated in Figure 3, where the mean and standard deviations for the two groups are plotted across the three time periods, we can see that for all measures, the tango participants improved more over the 10-week period. It could be argued, however, that these individuals made the greatest gains because their baseline values were poorer. Differences between the two groups were most likely not a result of gender, because there was an equal number of men in each group. A larger study might be able to examine this issue, however, because the number of our male participants was small. Differences observed with respect to the ABC are inconclusive, because the walk group was

already above 85% at baseline, indicating a low risk for falls (Lajoie et al., 1996). In contrast, the tango group expressed significantly lower balance confidence (71%) at baseline.

Although our poorest performers at baseline almost uniformly made the greatest gains in all the measurements, most members of the tango cohort made gains in all measurements that also had clinical relevance. Thus, tango dancing is a physical activity that appears to be a viable alternative for improving balance and balance confidence in seniors at risk for falls, regardless of initial physical status. This aspect is important, because it suggests not only that challenging activities can be tolerated by the most physically challenged but also that they are useful in ameliorating performance regardless of initial fitness level. In addition, it avoids the sensitivity issue that might be inherent in other balance programs (Glasgow et al., 1999; Province et al., 1995) in which benefits to those with higher function cannot be observed. Because challenge has recently been identified as a primary motivator to exercise, especially in older men (Newson & Kemps, 2007), the tango might be of considerable interest to older men if publicized in a way that emphasizes this aspect. Because the physical parameters important for both balance maintenance and balance confidence improved, this cohort is less at risk for having a mismatch between ability and confidence, which could present a fall-risk problem as Lord, Ward, Williams, and Strudwick (1995) have pointed out. Notably, most of the improvements persisted into the follow-up period. Because 1 month is sufficient to observe decline (Teixeira-Salmela et al., 2005), the benefits of the tango program appear to be robust, thus affording participants in such a program the opportunity to go on vacation and return to their activities with little loss in function.

The continued improvement in normal walk speed during follow-up observed for the walk program might suggest a delayed effect when walking. Alternatively, because we could not control the amount of walking that this cohort did during follow-up, it could be that they continued to walk during this period, and the gains in normal walk speed need more than a 10-week period to be observed when using walking as an activity. This aspect is important and worth further investigation, because there is controversy over what specific gains are present in walking programs, and the vagaries observed might result from issues related to duration, intensity, and frequency of the programs. From meta-analysis studies, the recommendation of 30 min/day of moderate walking has been suggested to improve quality of life and fitness (Pate et al., 1995), but as recently indicated, perception of the elderly of their capacity to walk at a pace that is critical for health maintenance (0.25 miles in 5 min) is greatly overestimated by half the population (Newman et al., 2006). Thus, the parameters of duration, intensity, frequency, and perception of effort have to be more closely examined in this population. In addition, many programs use mall walking or treadmill walking, activities that might not have the same benefits as walking outside in new and stimulating environments.

As evaluated using percent change scores, the tango group showed greater improvements in STS and normal walk than the walk group. This might be because of the increased challenge of tango dancing as compared with walking, so that changes occur more rapidly; the specificity of the program; or the lower (though nonsignificant) scores at baseline. Follow-up scores were not considered in this measure, and as previously mentioned, benefits for walking might be either

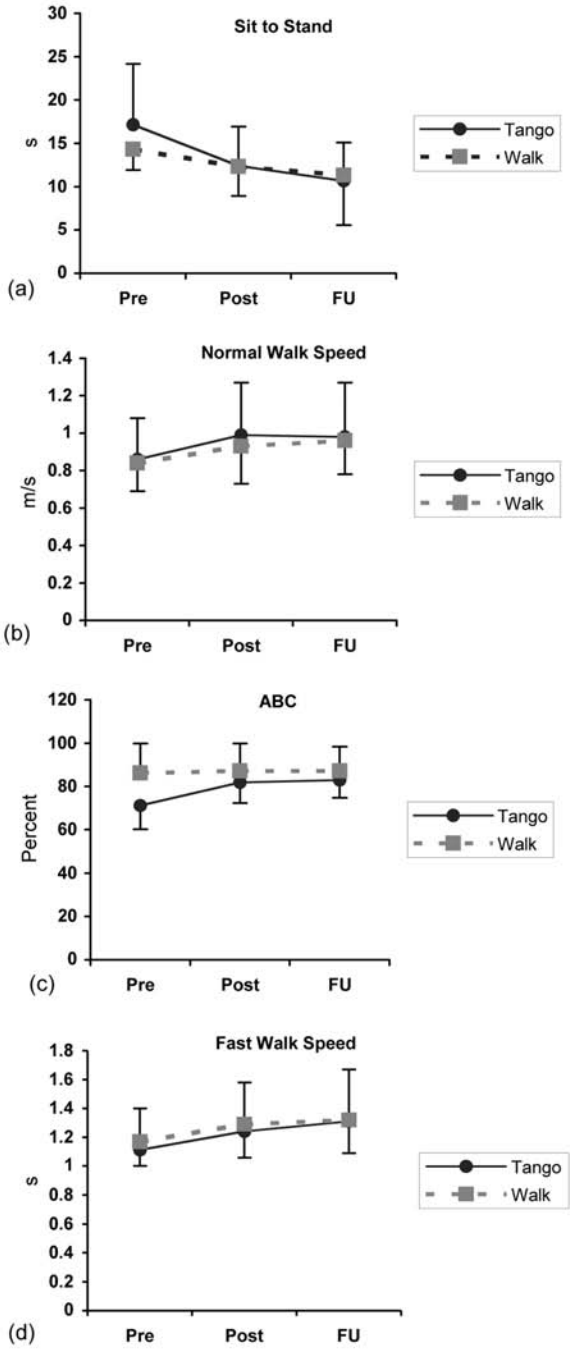

Figure 3 — Means and standard deviations for walk (squares) and tango (circles) groups pre- and postintervention and at follow-up (FU). Standard-deviation bars up for tango and down for walk. (a) Sit-to-stand, (b) normal walk, (c) the Activities-specific Balance Confidence scale (ABC), and (d) fast walk. An increase in value denotes improvements for all but the sit-to-stand, for which improvement is denoted by a decrease in value.

delayed or take a longer period of time to emerge. Future studies should address these issues.

The weak correlation between change in strength (as manifested by the comparison of change scores for STS with those for the ABC) is in agreement with the findings of Lord et al. (1995) and supports their hypothesis that strength change is not always associated with perception of balance confidence. This aspect might also reflect the findings of Schlicht, Camaione, and Owen (2001), who found that although strength training alone improved walking speed in the elderly, it did not improve balance. Given the results of this study, however, strengthening that occurs in concert with engaging in specific physical activities might contribute to improved balance in subtle ways. The lack of correlation between walking speed and balance confidence similarly supports the idea that walking speed is not associated with balance confidence. Given the recent findings on the strong correlation between walking speed and fall risk (Studenski et al., 2003), it might be important for health professionals to educate their older clients about the importance of being able to walk at a moderate pace. Both walking in a group or with a partner at a specific rating of perceived exertion and practicing tango to music encourage individuals to walk at a quicker pace. The music component for the tango and the flow around the dance floor act as additional stimuli to encourage both longer and quicker strides. Thus, it is our opinion that challenging activities that stimulate increased walking speed should be encouraged in this cohort. The distinction between activities that foster balance control and those that increase walking speed should also be part of an education program for seniors. Currently, Tai Chi is a highly accepted program in this cohort, who might select this activity in place of a walking program. It is our opinion that any leisure activity that includes walking at a faster than normal pace is also an essential component in a senior's activity plan.

Clinical Significance

Improvements in ABC, STS, and normal walk speed are clinically important because they shifted many of our participants from the high-fall-risk group to either no risk or a moderate risk of falls. As reflected in Figure 3, these improvements were greater for the tango group than for the walk group. Nonetheless, both interventions resulted in lowering fall risk. In addition, these changes persisted into the follow-up interval.

The increase in strength as exhibited by the sit-to-stand measure was also an important clinical finding, because although strengthening of the lower limb has been previously associated with walking (Forrest, Zmuda, & Cauley, 2006), it was not a feature of physical improvement expected with tango dancing. In exit interviews, participants mentioned that they had improved arm and trunk strength, as well. Thus the effect of tango dancing on core and upper and lower limb strengthening is another aspect that should be considered when examining this activity in future studies. Finally, the number of actual falls was not measured explicitly, except by self-report from the participants during exit interviews. No one reported having fallen during the time period, but future studies should investigate this aspect more rigorously, particularly over an extended follow-up period. Because fear of falling has been found to be a stronger predictor of nonparticipation in social activities than an actual history of falls (Howland et al., 1998), however, we

chose to focus more on fear of falling. Clinically, normal walk speed improved for both groups. This is important, because falling, frailty, and cardiovascular fitness have all been linked to normal walk speed. Chamberlin, Fulwider, Sanders, and Medeiros (2005) have noted that the walk speed of 1.26 m/s is important for reducing fear of falls, and Newman et al. (2006) have linked the inability to walk at that speed for 1/4 mile (within 5 min) to heart disease and frailty. Although we cannot say whether our individuals can maintain a pace of 1.26 m/min for 5 min, we do know that both groups increased their walking speeds significantly. Coupled with the cardiovascular-training benefits of both tango (Peidro et al., 2002) and walking (Pate et al., 1995), it is possible that they could also maintain this speed. This feature should be examined in future studies.

The significant change in the ABC for the tango cohort was also critical in greatly reducing their fall-risk profile. Although the ABC has not been demonstrated to have floor or ceiling effects among individuals in transition to frailty (Kressig et al., 2001), the walking group scored an average of 85% for balance confidence before the study onset. According to Myers et al. (1998), however, individuals who score in the mid-80s or better on the ABC are unlikely to show further improvement in balance confidence. Thus we will not conjecture whether walking did or did not improve balance confidence. A study with a larger sample should be able to address this question.

In conclusion, this feasibility study showed that using Argentine tango dancing as a physical activity is feasible in a population of elderly individuals and serves to improve both physical fitness and balance for individuals at risk for falls. In addition, it is an activity that is sustainable in this population; many of the seniors have continued to take tango lessons (Cummings Centre, personal communication). These preliminary results suggest that Argentine tango as compared with walking might have resulted in greater improvements in balance skills and in walking speed within the 10-week intervention. These results are sustainable for 1 month postintervention. Walking benefits included strengthening and walk speed. We cannot determine whether improvements in balance confidence would occur with walking, because this group scored above cutoff for improvement at baseline. Further studies need to be done because our sample size was small and statistical difference between the groups at baseline prevented contrasts to be made between the two groups for balance confidence.

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