

## Scottish Country Dance: Benefits to Functional Ability in Older Women

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The effects of long-term participation in Scottish country dance on body composition, functional ability, and balance in healthy older females were examined. Participants were grouped into dancers and physically active nondancers (ages 60–70 and 70–80 for both groups). Physical activity, body composition (body-mass index, skinfold thickness, waist-to-hip ratio), functional ability (6-min walk distance, 6-m walk time, 8-ft up-and-go time, lower body flexibility, shoulder flexibility), and static balance were measured. Younger dancers and physically active nondancers had similar 6-min walk distance, 6-m walk time, and 8-ft up-and-go time results; however, while older dancers performed similarly to younger dancers, older physically active nondancers performed poorer than their younger counterparts ( $p < .05$ ). Body composition and static balance were the same for all groups. Regular physical activity can maintain body composition and postural stability with advancing age; however, Scottish country dance can delay the effects of aging on locomotion-related functional abilities.

**Keywords:** functional fitness, timed up-and-go, chair sit-and-reach, group exercise

Regular physical activity is associated with numerous health benefits for individuals of all ages. Engaging in the recommended frequency, intensity, and duration of exercise proposed by the American College of Sports Medicine and the American Heart Association decreases all causes of mortality by reducing the risk of developing chronic disease (Garber et al., 2011). While the biological aging process cannot be prevented, regular physical activity can mitigate the potentially disabling effects of aging (American College of Sports Medicine et al., 2009). For older adults, the aim of exercise interventions is not only to reduce the risk of chronic disease, but also to maintain functional ability, allowing for independent aging.

The ability to perform everyday living tasks such as rising from a seated to a standing position, walking at a speed fast enough to successfully cross the road, stepping onto or avoiding a raised object, and simply maintaining an upright postural position are key indicators of functional ability and, consequently, independent living. Neuromuscular degeneration is a key contributor to a reduced ability to perform these everyday tasks with increasing age. Fortunately, the aging neuromuscular system allows for regeneration following a period of resistance training or neuromotor training (for detailed reviews, see Chou, Hwang, & Wu, 2012; Granacher, Zahner, & Gollhofer, 2008; Peterson, Rhea, Sen, & Gordon, 2010). However,

surveys show that with aging, there is a greater preference for lower intensity, predominantly cardiorespiratory physical activities such as walking, with <15% of 65- to 75-year-old adults participating in strength training reducing to <9% for adults over 75 years old (Schoenborn & Adams, 2010).

Scottish country dance is an activity that is hugely popular in older individuals—not only in Scotland, but also in North America, Australia, and New Zealand. The cultural resonance and social benefits that come with group dance make this an appealing activity for the older age group (Cooper & Thomas, 2002; Lima & Vieira, 2007; Wikstrom, 2004). Scottish country dance, like other traditional dance forms such as square dancing and folk dancing, articulates choreographed multidirectional movements incorporating many elements of neuromuscular control. It consists of a number of set dances in pairs and groups, with varying degrees of intensity. Participants perform various vertical and lateral movements, turning and spinning around in different directions to the rhythms of both slow and faster tempos.

In recent years, evidence is emerging on the physical benefits of various forms of dance to an older population (for detailed review, see Keogh, Kilding, Pidgeon, Ashley, & Gillis, 2009). Intervention studies have found that after 8–12 weeks participation in dance, there are increases in aerobic power, muscle endurance, muscle strength, and flexibility (Eyigor, Karapolat, Durmaz, Ibisoglu, & Cakir, 2009; Hopkins, Murrah, Hoeger, & Rhodes, 1990; Machado, Schettino, & Pereira, 2010; McKinley et al., 2008). Specific to functional ability, improved walking, change of direction, timed up-and-go, and stair climb speed have been reported, along with favorable improvements in

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both static and dynamic balance (Federici, Bellagamba, & Rocchi, 2005; Hackney, Kantorovich, & Earhart, 2007; Hopkins, Murrah, Hoeger, & Rhodes, 1990; Jeon, Choe, & Chae, 2000; Keogh, Kilding, Pidgeon, Ashley, & Gillis, 2012; McKinley et al., 2008; Shigematsu et al., 2002; Sofianidis, Hatzitaki, Douka, & Grouios, 2009; Song, June, Kim, & Jeon, 2004; Young, Weeks, & Beck, 2007). Similarly, cross-sectional studies found that older dancers had greater aerobic power, muscle strength, muscle endurance, muscle power, balance, and walking speed with additional findings of increased bone-mineral content compared with older nondancers (Uusi-Rasi et al., 1999; Verghese, 2006; Zhang, Ishikawa-Takata, Yamazaki, Morita, & Ohta, 2008).

This study assessed the functional ability of habituated Scottish country dancers, in comparison with individuals who participated in a variety of physical activities, to investigate whether Scottish country dance may improve the performance of various functional ability tasks.

## Methods

### Participants

Sixty healthy older females participated in the study after giving written informed consent. The sample consisted of Scottish country dancers ( $n = 26$ , age  $67.6 \pm 6$  years, body mass  $66.0 \pm 9.3$  kg, stature  $160.2 \pm 6.6$  cm) and physically active nondancers ( $n = 34$ , age  $71.3 \pm 6$  years, body mass  $64.7 \pm 10.6$  kg, stature  $157.1 \pm 6.5$  cm), which were split into two subgroups: a younger one (60–70 years) and an older one (70–80 years). Participants had no known neuromuscular disorders and had to be considered as medically stable, according to the criteria described by Greig et al. (1994). All participants were engaging in some form of physical activity at least three times a week. The dancers had a minimum of 10 years participatory involvement in Scottish country dancing. Physically active nondancers participated in a variety of activities, most commonly brisk walking, golf, bowls, and gardening. Ethical approval was obtained from the ethics committee of the University of Strathclyde, and all procedures followed were in accordance with the 1975 Declaration of Helsinki.

### Physical Activity Assessment

Current levels of physical activity were measured using the Rapid Assessment of Physical Activity (RAPA) scale, which is an easy-to-use, valid measure of physical activity in older adults (Topolski et al., 2006). This scale consists of nine tick-box responses relating to level and intensity of usual physical activity, as well as additional strength and flexibility activities. RAPA 1 measures cardiorespiratory-based physical activity (scoring 1–7 points, with a maximum score of 7), RAPA 2a and 2b measure strength- and flexibility-based physical activity, respectively (yes/no answer).

### Body-Composition Assessment

Body-mass index (BMI) was calculated from height and body mass. Skinfold measurements were taken in triplicate using Harpenden skinfold calipers (Burgess Hill, UK) at four sites: biceps, triceps, subscapular, and suprailiac. The average value from each site was used, and the sum of the four sites (Sum4SF) is reported.

Waist and hip circumferences were measured in duplicate with an anthropometric tape while the subjects were wearing light clothing. Waist circumference was measured at the minimum circumference between the iliac crest and the rib cage. Hip circumference was measured at the maximum protuberance of the buttocks. Waist-to-hip ratio (waist:hip) was also calculated.

### Functional Ability Assessment

A range of functional ability tests, as described by Rikli and Jones (2012) and Thomas, De Vito, and Macaluso (2007), were used to assess a number of parameters important in everyday living tasks.

**6-Min Walk Test.** To estimate cardiorespiratory fitness, participants were instructed to walk at their normal walking pace for 6 min around a predetermined course in an indoor sports hall. Total distance covered was recorded. This test has been shown highly reliable for this population, with an interclass correlation of .91 (Rikli & Jones, 2012).

**6-m Walk Time.** To assess maximal walking speed, participants started from a static standing position and walked as fast as they could to the end of a 9-m course (Thomas, De Vito, & Macaluso, 2007). Visible markers were placed at the start, 6 m, and 9 m. Time taken from start to 6 m was recorded using a stopwatch (Seiko S052-4000, Seiko Watch Corp., Tokyo, Japan). The test was done in triplicate, with the best score used for further analysis. Although reliability data are not available for this particular test, gait speed tests are highly reliable (Steffen, Hacker & Mollinger, 2002) with a similar distance gait speed test (7.62 m) yielding a correlation coefficient of  $>.90$  (Bohannon, 1997).

**8-ft Up-and-Go Time.** To assess the integration of neuromuscular parameters (power, speed, agility, and dynamic balance; Rikli & Jones, 2012), time taken to raise from a seated position, walk 2.44 m (8 ft), turn, and return to the seated position was recorded. This test was done in triplicate with the best score used for further analysis. The reliability of this test in a similar population was high (intraclass correlation coefficient = .9; Rikli & Jones, 2012).

**Chair Sit-and-Reach.** To assess back and hamstring flexibility, while sitting on a chair with the legs stretched out in front, the volunteers were asked to reach down toward their toes. The distance between the extended fingers and the tip of the toes was measured. This was measured in triplicate for each side, and the average for

each side was used for further analysis. Similar to the previous tests, this test was shown to have high reliability, as indicated by a high intraclass correlation coefficient of .96 (Rikli & Jones, 2012).

**Back Scratch.** To assess shoulder range of motion, the participant had one hand reaching down over the shoulder and the other one up the middle of the back. The distance between the extended fingers of the two hands was measured, with the two fingers touching being 0 cm; overlapping was denoted by positive scores, while the fingers being apart denoted by negative scores. This was measured in triplicate and the average for each side was used for further analysis. Data are reported as left or right back scratch, depending on which hand was reaching down over the shoulder. The interclass correlation coefficient of this test was .92 for similar population, indicating high reliability.

### Static Balance Assessment

Static balance is a determinant of falling likelihood in older individuals (Granacher et al., 2008). Balance performance was assessed during quiet standing with the feet together and arms by the side (Romberg's test). Participants stood barefoot, centrally aligned on a force platform (AMTI OR6-6; Advanced Mechanical Technology, Inc., Watertown, MA) and maintained the position for 30 s. Participants had to focus on a visual target placed 2 m in front of them at eye level and maintain their balance with as little movement as possible. Center-of-pressure sway data were recorded at 100 Hz, and 95% ellipse area was calculated using BioAnalysis software (Advanced Mechanical Technology, Inc., Watertown, MA) as an indicator of balance, with a larger sway area indicating more difficulty in maintaining balance and increased likelihood of falling (Dewhurst, Riches, & De Vito, 2007).

### Statistical Analysis

Strength and flexibility exercise participation were analyzed using chi-square. Normality of data for the remaining variables was examined using the Shapiro-Wilk test. As normality was not confirmed for all examined variables, nonparametric tests were used for the analysis. The Kruskal-Wallis test was used to examine for differences between the groups for level and intensity of usual physical activity, body composition, functional ability, and static balance test variables. Where differences were found, the Mann-Whitney *U* test was used, with Bonferroni correction for multiple comparisons. For significantly different comparisons, effect sizes (ES) were also calculated as an indication of the magnitude of the significance (Cumming, 2011). Significance was set at .05. For all statistical analyses, SPSS v. 15.0 (SPSS, Chicago, IL) was used. Data are given as  $M \pm SD$  unless otherwise stated.

## Results

Descriptive statistics of all groups can be found in Table 1.

### Physical Activity Assessment

All groups participated in the same amount of physical activity, with the median score for the cardiorespiratory-based physical activity for all four groups being 6: "I do 30 minutes or more a day of moderate physical activities, 5 or more days a week." Seventeen percent participated in strength-based exercise, while 54% participated in flexibility-based exercise.

### Body-Composition Assessment

All anthropometric and body composition measurements were the same for all group comparisons. Descriptive statistics can be found in Table 1.

**Table 1** Anthropometric and Body-Composition Measurements for All Groups,  $M \pm SD$

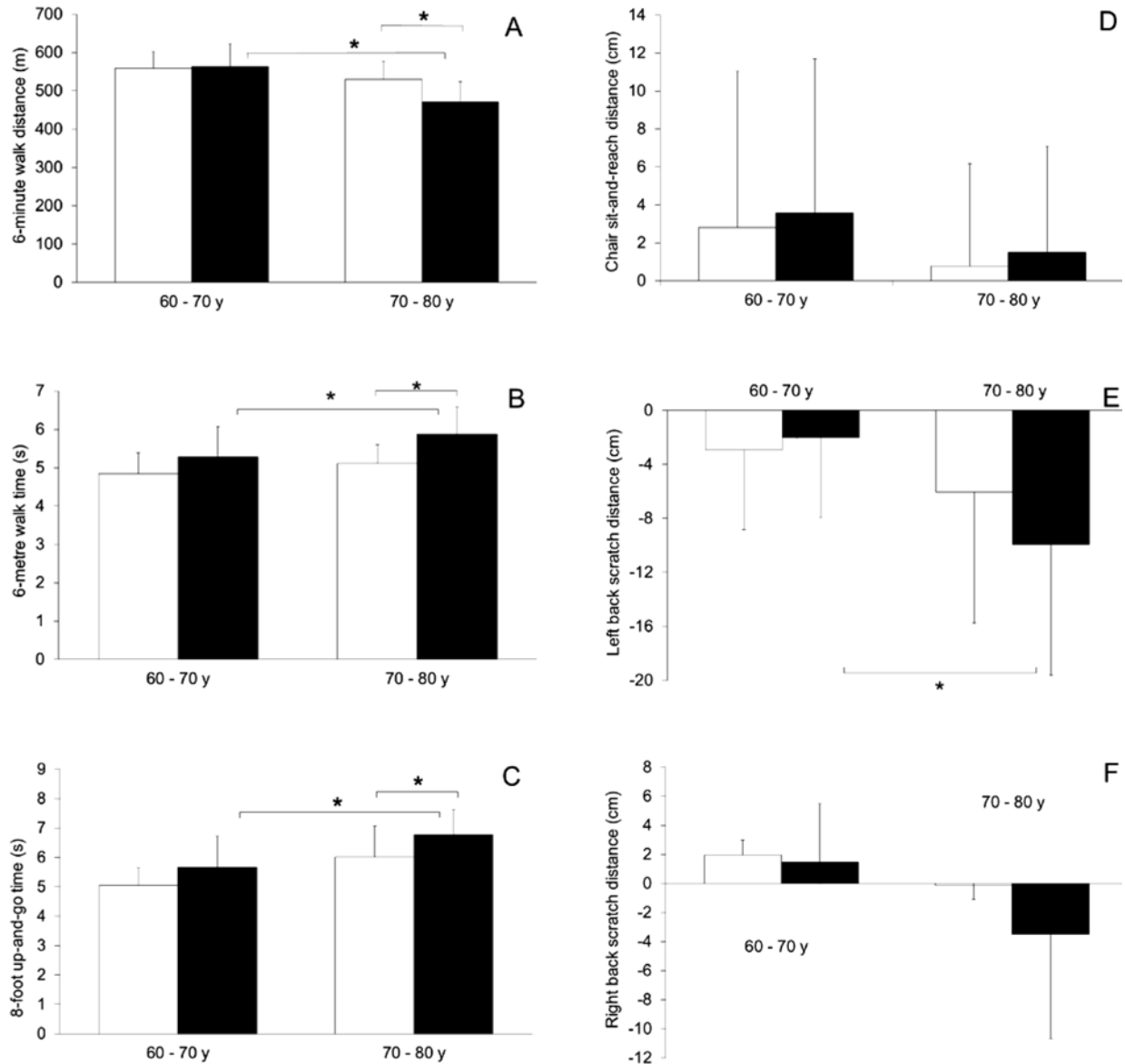
Category	Scottish Country Dancers		Nondancers	
	60–70 years ( <i>n</i> = 15)	70–80 years ( <i>n</i> = 11)	60–70 years ( <i>n</i> = 13)	70–80 years ( <i>n</i> = 21)
Age (years)	63.5 ± 3.0	73.7 ± 2.7	65.2 ± 3.4	75.1 ± 2.5
Height (cm)	1.61 ± 0.06	1.58 ± 0.08	1.55 ± 0.07	1.58 ± 0.06
Body mass (kg)	68.6 ± 9.5	62.4 ± 8.6	62.7 ± 11.8	65.9 ± 9.8
Body-mass index (kg/m <sup>2</sup> )	26.5 ± 3.6	24.9 ± 2.8	25.9 ± 4.5	26.5 ± 4.6
Sum of four skinfolds (mm)	71.4 ± 18.9	67.5 ± 22.9	61.9 ± 19.1	72.1 ± 19.2
Waist circumference (cm)	84.0 ± 7.4	79.7 ± 8.2	80.5 ± 11.3	85.6 ± 9.4
Hip circumference (cm)	104.4 ± 6.1	101.0 ± 5.9	100.6 ± 9.5	104.4 ± 9.0
Waist:hip ratio	0.80 ± 0.04	0.79 ± 0.05	0.80 ± 0.06	0.82 ± 0.05

### Functional Ability Assessment

Younger dancers' and nondancers' performance in the 6-min walk distance, 6-m walk time, and 8-ft up-and-go time was not significantly different. There was no significant difference between younger and older dancers in the performance of the same tests, suggesting no age effect. However, the older nondancers had a significantly poorer performance compared with the younger nondancers group ( $p < .05$ , 6-min walk ES = 1.14, 6-m walk time ES = 1.15, 8-ft up-and-go time ES = 0.77). In addition, the

older nondancers' performances were also significantly poorer than the older dancers ( $p < .05$ , 6-min walk ES = 1.62, 6-m walk time ES = 0.77, 8-ft up-and-go time ES = 1.15; Figure 1[A], [B], and [C]).

Sit-and-reach distances of the left and right sides were not significantly different, hence they were averaged, and the averaged value was used for further analysis. No significant difference in the chair sit-and-reach scores was present for any group comparison (Figure 1[D]).



**Figure 1** — Functional ability parameters: (A) 6-min walk distance, (B) 6-metre walk time, (C) 8-ft up-and-go time, (D) chair sit-and-reach distance, (E) left back-scratch distance, and (F) right back scratch distance for groups age 60–70 and 70–80 years. For (E) and (F), positive scores indicate hand overlap, while negative scores indicate the hands are apart. Scottish country dancers are shown with the white bars, and physically active control are shown with the black bars. \*Significant difference between groups ( $p < .05$ ). Data are presented as  $M \pm SD$ .

Left and right side back scratch scores were significantly different; hence comparisons between groups were made for each side separately. For the left-hand back scratch, the distance was not significantly different between the younger dancers and nondancers. Similarly, no significant difference was found between the younger and older dancers or between the older dancers and nondancers. However, there was a significant increase in the distance from the younger to the older nondancers ( $p < .05$ ,  $ES = 0.40$ ; Figure 1[E]). Similar patterns were not seen in the right-hand back scratch with the distance measured not significantly different for any group comparison (Figure 1[F]).

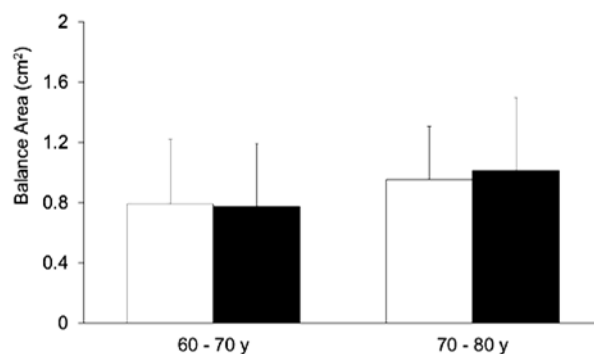
### Static Balance Assessment

For the dancers and physically active nondancers and both younger and older groups, the 95% ellipse area (balance area) was not significantly different (Figure 2)

## Discussion

The main finding of the current study was that dancers aged 60–70 years old had a similar functional ability (6-min walk distance, 6-m walk time, and 8-ft up-and-go time) as physically active nondancers of similar age. However, while older dancers (70–80 years) did not differ in performance to younger dancers, older nondancers showed a poorer performance when compared with their younger counterparts. Therefore, Scottish country dancing can serve as a beneficial physical activity in adequately stressing functional abilities of the older individuals. The current results concur with recent findings by Keogh et al. (2012) and Machado et al. (2010), who reported improvements in functional abilities and explosive strength of older individuals who participated in dancing.

All groups participated in the same amount of physical activity per week. The median response to the



**Figure 2** — Static balance area (95% ellipse area) for the groups age 60–70 and 70–80 years old. Scottish country dancers are shown with the white bars, and physically active control are shown with the black bars. Data are presented as  $M \pm SD$ .

cardiorespiratory physical activity score was 6 on the RAPA scale of 1–7, worded as “I do 30 minutes or more a day of moderate physical activities, 5 or more days a week.” This meets the recommendation of the American College of Sports Medicine et al. (2009) for cardiorespiratory exercise in healthy older adults, quantified as being moderate-intensity exercise for >150 min/week or vigorous-intensity exercise >75 min/week. Strength-based physical activity had a much lower participation, as only 17% of the women reported doing activities to increase muscle strength once a week or more, whereas 54% responded positively to participating in activities to improve flexibility once a week or more. The strength results compare favorably with findings by Schoenborn & Adams (2010), who reported a similarly low percentage of participation in strength training (<15%) for older adults age 65–75 years. As there was no difference between the groups in the physical activity levels, it may be assumed that the differences in the functional ability tasks are due to the inclusion of Scottish country dance to the weekly physical activity of the young and older dancers.

Body-composition measures (BMI, Sum4SF, waist and hip circumference, waist:hip) were not different in dancers and physically active nondancers or between the younger and older age groups. When the BMI and waist circumference were categorized according to the National Institutes of Health (1998) guidelines, all groups fell into the lower end of the overweight category (BMI 25.0–29.9), with all groups having a waist circumference below the high disease-risk cutoff of  $\approx 88$  cm. Waist:hip ratio gives an index of subcutaneous and intra-abdominal adipose tissue. All groups fell below the abdominal obesity cutoff of  $\approx 0.85$  presented by the World Health Organization (2011). The findings agree with literature suggesting that meeting the physical activity guidelines has favorable effect on body composition, which in turn reduces the risk of developing chronic disease (for review, see American College of Sports Medicine et al., 2009).

The 6-min walk distance is a well-established measure of cardiorespiratory fitness, replicating efforts commonly performed by healthy individuals during daily activities (Mangan & Judge, 1994). All groups were meeting the physical activity guidelines for cardiorespiratory fitness which is reflected with favorable comparisons to results reported from other community dwelling older populations (Bautmans, Lambert, & Mets, 2004; Lusardi, Pellecchia, & Schulman, 2003; Steffen et al., 2002). Of particular interest is that the 6-min walk distance, and therefore cardiorespiratory fitness, did not decrease in the older age group in the dancers, but it did in the physically active nondancers, suggesting that Scottish country dance may provide enough of a stimulus to delay the inevitable effects of aging on the cardiorespiratory system in individuals in their eighth decade of life. Indeed, the ES is very high for all comparisons, indicating a substantial difference rather than just a statistical one (Cumming, 2012). In addition, the younger dancing and nondancing groups, as well as the older dancing groups, were above

the norms (by 5%, 4%, and 9%, respectively) provided by Rikli & Jones (1999), while the older control group was below (by 3%) those norms for this test.

Neuromuscular function is reflected in the 6-m walking time test and the 8-ft up-and-go. The 6-m walking time test has been found to improve with increased strength (Schlicht, Camaione, & Owen, 2001) while the 8-ft up-and-go test provides the neuromuscular system with a variety of challenges, including generation of leg force to lift the individual off the chair without using their arms, assume a balanced upright position, walk at speed, change direction, and walk at speed again while turning to resume a seated position (Rikli & Jones, 2012). The performance of these tasks is compromised with age, as the individuals may be working close to their maximum capacity. For example, simply rising from the chair has been estimated to require almost 100% of a healthy older individual's leg torque (Alexander, Schultz, Ashton-Miller, Gross, & Giordani, 1997). Our results for the 6-m walk test indicate slower speeds as compared with the speeds reported by Thomas et al. (2007). On the contrary, results for 8-ft up-and-go compare very favorably with norms reported by Rikli and Jones (1999), with all four groups scoring faster 8-ft up-and-go times than the norm. While for the physically active nondancers, both the 6-m walking speed and 8-ft up-and-go test performances was poorer in the older age group compared with the younger group (with large to high ES [Cumming, 2011], indicating practically significantly lower scores, too), this was not the case for the dancers. The younger and older dancers had similar performance for both assessments, suggesting that in addition to being of benefit to cardiorespiratory health, Scottish country dance may reduce the age-induced degeneration of the neuromuscular system. It is of interest to note that older dancers performed significantly better than the older physically active nondancers in the locomotion-related functional tests.

It is suggested that this reflects specific adaptations to the activity in question. Scottish country dance routines continually stresses the neuromuscular system with their skipping, turning, and hopping elements, and while no direct comparison can be made to resistance training, it appears that Scottish country dance may be an effective way to train the neuromuscular system without the need of additional specific strength-based training.

Back and hamstring flexibility was measured from the chair sit-and-reach test, which was not different between the groups, suggesting that Scottish country dancing has no additional benefits to lower back or hamstring flexibility. This flexibility appears to have been maintained from the younger to the older groups, possibly due to over half of the participants engaging in flexibility-based exercises at least once a week. Interestingly, although the scores for both younger groups are higher than the norm (Rikli & Jones, 1999), the dancers' scores are below the norm for the older group, while just over the norm for the physically active control.

Upper body flexibility was estimated from the back scratch. The left-hand back scratch test showed a

decrease in performance in the older physically active nondancers when compared with the younger physically active nondancers. This was not seen between younger and older dancers. Interestingly, the right back scratch did not show this with all groups having similar performances. As by far most participants were right handed, it is assumed that flexibility was better maintained in the dominant side, as the preferred side for many everyday functions (e.g., combing hair, putting on clothes, etc.; Rikli & Jones, 2012).

It is well established that aging affects balance in older individuals (for review see Maki & McIlroy, 1996). However, in studies where physically active older participants were compared with non-physically active counterparts, physical activity was shown to have a positive effect on balance (Howe, Rochester, Neil, Skelton, & Ballinger, 2011; Perrin, Gauchard, Perrot, & Jeandel, 1999). Indeed, better balance was found with increased length of engagement in physical activity (Perrin, Gauchard, Perrot, & Jeandel, 1999). Balance in older individuals is an important factor for their well-being, as improved balance reduces the risk of falling (Choy, Brauer, & Nitz, 2003; Dewhurst et al., 2007; Howe, Rochester, Neil, Skelton, & Ballinger, 2011). The present findings concur with the literature, as balance was not different between the younger and older age groups for both Scottish country dancers and physically active nondancers, suggesting that physical activity levels were sufficient in both groups to ensure maintenance of postural control. A recent Cochrane review (Howe, Rochester, Neil, Skelton, & Ballinger, 2011) called for more research on activities that can improve balance in older populations. The present study posits that it may be possible to maintain balance in older adults not only through general physical activity, but also through more specific activities.

In summary, these findings advocate the participation in Scottish country dance in combating the inevitable degenerative effects of aging in the performance of functional ability tasks when compared with age-matched individuals participating in other forms of cardiorespiratory physical activity. Our results agree with recommendations made by Keogh et al. (2009) regarding the benefits of dance in older women. Both dance and regular physical activity appear to maintain favorable body composition and prevent a decrease in balance with older age.

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