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Physical Benefits of Dancing for Healthy Older Adults: A Review

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Dancing is a mode of physical activity that may allow older adults to improve their physical function, health, and well-being. However, no reviews on the physical benefits of dancing for healthy older adults have been published in the scientific literature. Using relevant databases and keywords, 15 training and 3 cross-sectional studies that met the inclusion criteria were reviewed. Grade B–level evidence indicated that older adults can significantly improve their aerobic power, lower body muscle endurance, strength and flexibility, balance, agility, and gait through dancing. Grade C evidence suggested that dancing might improve older adults' lower body bone-mineral content and muscle power, as well as reduce the prevalence of falls and cardiovascular health risks. Further research is, however, needed to determine the efficacy of different forms of dance, the relative effectiveness of these forms of dance compared with other exercise modes, and how best to engage older adults in dance participation.

Keywords: dance, exercise, falls, functional ability

The aging process causes many changes in body composition and physiological function. Older adults typically have significantly greater body fat percentage, reduced muscle mass (Fiatarone-Singh, 2002; Young, Stokes, & Crowe, 1985), and less muscle strength and endurance (Harridge, Magnusson, & Saltin, 1997; Hurley, Ree, & Newham, 1998; Imrhan & Loo, 1989), balance (Doyle, Dugan, Humphries, & Newton, 2004; Hsiao-Wecksler & Robinovitch, 2007), and aerobic power (Harridge et al.; Wiebe, Gledhill, Jamnik, & Ferguson, 1999) than young adults. Although these reductions in body composition and physiological function might be multifactorial in origin (Barry & Carson, 2004; Enoka et al., 2003), they typically result in diminished levels of functional ability. This can be readily seen in older adults taking longer to complete tasks such as the timed up-and-go, sit-to-stand, stair climb, or timed walk (Hurley et al.; Steffen, Hacker, & Mollinger, 2002; Wagner & Kauffman, 2001). Of great concern is that a loss of these functional abilities can result in a rapid downward spiral for the older adult (see Figure 1). This may involve an increased incidence of falls (Dite & Temple, 2002; Shumway-Cook,

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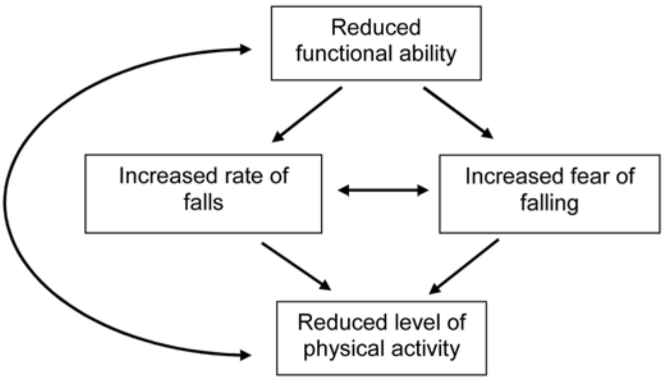

Figure 1 — Relationship between functional ability, falls rate, fear of falling, and level of physical activity in older adults.

Brauer, & Woollacott, 2000), an increase in the fear of falling (Brouwer, Musselman, & Culham, 2004; Liu-Ambrose, Khan, Eng, Lord, & McKay, 2004), a reduction in gait (walking) velocity (Whitney, Marchetti, Morris, & Sparto, 2007), and a reduced level of daily incidental physical activity (Brouwer et al.; Carter, Williams, & Macera, 1993). This reduction in physical activity then further increases the risk of falling and of developing chronic diseases such as diabetes, stroke, cardiac infarction, and cancer (American College of Sports Medicine, 1998; Enoka, 1997; Fiatarone-Singh). Because falls-related injuries and many chronic diseases are expensive to treat, at both an economical and social level (Campbell et al., 2005; Gillespie et al., 2003), preventive methods to attenuate falls-related injury and chronic disease in older adults should be investigated.

Exercise Benefits for Older Adults

Numerous studies have found that exercise, be it resistance training (Deley et al., 2007; Keogh, Morrison, & Barrett, 2007; Liu-Ambrose, Khan, Eng, Janssen et al., 2004; Schlicht, Camaione, & Owen, 2001), aerobic exercise (Deley et al.; Seals, Hagberg, Hurley, Ehsani, & Holloszy, 1984), balance training (Liu-Ambrose, Khan, Eng, Janssen et al.; Nnodim et al., 2006), Tai Chi (Hill, Choi, Smith, & Condron, 2005; Nnodim et al.), or even Tae Kwon Do (Cromwell, Meyers, Meyers, & Newton, 2007) might offer many significant physical benefits for older adults. These benefits might include improvements in body composition, muscle strength and endurance, aerobic power, balance, functional ability in activities of daily living, and reduced incidence of falls. Unfortunately, each of these exercise modes will not necessarily result in all of these adaptations, and not all older adults are likely to commence, let alone adhere to, programs involving these forms of exercise.

A review by Fiatarone-Singh (2002) indicates that although resistance training can significantly increase older adults' muscle mass, muscle strength, power, and endurance, its effects on aerobic endurance and balance are less well demonstrated. Conversely, although aerobic exercise may significantly increase older adults' aerobic power and reduce their body fat percentage and risk of cardiovascular disease, it has less effect on balance, muscle strength, power, and endurance (Fiatarone-Singh). It is also known that exercise preferences of older individuals vary considerably (Mills, Stewart, Sepsis, & King, 1997; Wilcox, King, Brassington, & Ahn, 1999). This means that older adults who enjoy walking (and therefore regularly walk) might not necessarily be keen to participate in resistance- or balance-training programs. Thus, investigations into the benefits of various forms of exercise for older adults are warranted.

Possible Benefits of Dance for Older Adults

Judge (2003) has proposed that dancing would be a beneficial form of physical activity for older adults, with its primary physical benefits being improved balance and a reduced risk of falls. This assertion appears to be based on the fact that many forms of dance (a) are similar to Tai Chi and Tae Kwon Do in that they are generally performed in an upright posture and require substantial periods of unilateral stance and the transfer of the line of gravity (vertical line through the body's center of mass) outside the base of support (Cromwell et al., 2007; Hill et al., 2005; Judge; Nnodim et al., 2006), (b) can involve moderate to moderately high ground-reaction forces and joint torques (Lin, Su, & Wu, 2005; Michaud, Rodriguez-Zayas, Armstrong, & Hartnig, 1993; Simpson & Kanter, 1997), and (c) can result in relatively high heart rates (68–90% of age-predicted maximum heart rate), levels of oxygen consumption (42–90% of VO_{2max}), or ratings of perceived exertion (up to 14 out of 20) in young (Guidetti, Emerenziani, Gallotta, & Baldari, 2007; Ozkan & Kin-Isler, 2007; Peidro et al., 2002; Wigaeus & Kilbom, 1980) and older (Grant et al., 2002; Peidro et al.) adults.

Because dance can take many forms, be performed in a variety of settings, and does not necessarily require much expense or equipment, it might appeal to a wide range of individuals of all ages. Dancing may be less threatening to many older adults than other exercise modes, given that many older individuals will have had positive experiences of dance when they were younger (Dunlap & Barry, 1999; Lima & Vieira, 2007). Dance might also be an important promoter of successful and healthy aging (Connor, 2000; Lima & Vieira; Wikstrom, 2004). According to Connor, Lima and Vieira, and Wikstrom, dance might allow older adults to maintain a connection to everyday life because it encourages fun and enjoyment and promotes social interaction, a sense of community, appreciation of aesthetics and continued health, physical activity, and mobility. Because of these factors, dancing would appear to be a form of physical activity that may be more likely to be adopted as part of many older adults' exercise programs than other exercise modes. Although dance has been shown to have considerable physical benefits for middle-aged and older adults with arthritis, osteoporosis, and neurological conditions (Berrol, Ooi, & Katz, 1997; Hackney, Kantorovich, & Earhart, 2007; Kudlacek, Pietschmann, Bernecker, Resch, & Willvonseder, 1997; Marks, 2005; Moffet, Noreau, Parent, & Drolet, 2000), no reviews on the physical benefits of dance for healthy older adults have yet been published.

Methods

Literature-Search Methods

A search of Medline (PubMed), CINAHL, SportDiscus, ProQuest 5000 International, and Google Scholar was conducted using the keywords *dance, dancing, older adults, elder,* and all of their derivatives. Additional search strategies included using the "Related Articles" option in PubMed and perusing the reference lists of articles found in the initial searches. To be included in this review, the studies had to have been published in peer-reviewed journals and involve groups of apparently healthy older adults (>60 years old), who as a group were not all diagnosed with medical conditions such as Parkinson's disease, arthritis, or osteoporosis. These studies had to either compare a group of older dancers with an age-matched group of nondancers or involve an exercise intervention that was primarily dance based and lasted at least 8 weeks. Studies that used any form of dance, such as more traditional folkloric dance, as well as those that used more fitness-associated aerobic and line dancing, were included. In addition, no restriction was applied on the language or year in which the article was published.

Data Analysis

In accordance with Toussant and Kohia's (2005) review on the benefits of physical therapy for older hip-fracture patients, we wished to critique the design of each of the studies reviewed to describe the certainty of our recommendations. To achieve these aims we used the critical evaluation methods of Megens and Harris (1998) and Sackett (1989). Using these scales, each study reviewed was categorized using a 5-point scale. Level I studies were large randomized controlled trials, defined as those with more than 100 participants, in which the level of false positives and false negatives would likely be low. Level II studies were smaller randomized controlled trials (<100 participants) that had greater chances for false positives or false negatives to occur. Level III studies were nonrandomized, concurrent, cohort comparisons. Level IV studies were nonrandomized studies that compared older adults who received the intervention (i.e., were regular dancers) with those who were nondancers. Level V studies were case series or studies in which no control group was used. The recommendations given were as follows: Grade A recommendations required the support of at least one Level I study, Grade B recommendations required the support of at least one Level II study, and Grade C recommendations required the support of at least one Level III, IV, or V study (Megens & Harris; Sackett).

The scientific rigor of each study was also evaluated using six criteria (Megens & Harris, 1998; Sackett, 1989): having inclusion and exclusion criteria clearly described, having the dance program adequately described, use of reliable outcome measures, use of valid outcome measures, having assessors blinded to treatment allocation, and having participants in the study accounted for. Studies labeled with *Y* for "yes" in Table 1 fulfilled the specific criteria; those with an *N* for "no" indicate that the criteria were not reached. In order for a study to be given a *Y* for the reliability and validity criteria, they had to report their own adequately high experimental reliability or validity data, refer to other studies that had shown high

Table 1 Evaluative Criteria for the Training Studies Reviewed

Study	Inclusion and exclusion criteria	Treatment can be replicated	Reliability of outcome measures	Validity of outcome measures	Blind assessment of outcome measures	Account for attrition
Engels, Drouin, Zhu, & Kazmierski (1998)	Y	Y	Y	Y	N	N
Eyigor, Karapolat, Durmaz, Ibisoglu, & Cakir (2009)[b]	Y	Y	Y	Y	Y	N
Federici, Ballagamba, & Rocchi (2005)[b]	Y	Y	Y	Y	N	Y[a]
Hackney et al. (2007)[b]	Y	Y	Y	Y	Y	Y[a]
Holmerová et al. (personal communication)[b]	Y	Y	Y	Y	Y	Y[a]
Hopkins, Murrah, Hoeger, & Rhodes (1990)[b]	Y	Y	Y	Y	N	N
Jeon et al. (2005)	Y	Y	?	?	N	N
Jeon, Ounpuu, & Davis (2000)	Y	Y	N	N	N	N
Kim, June, & Song (2003)	Y	Y	Y	Y	N	N
Kudlacek et al. (1997)	Y	?	Y	Y	N	Y[a]
McKinley et al. (2008)[b]	Y	Y	Y	Y	Y	N
Shigematsu et al. (2002)[b]	Y	Y	?	?	Y	N
Sofianidis, Hatzitaki, Douka, & Grouios (2009)[b]	Y	Y	Y	Y	N	N
Song, June, Kim, & Jeon (2004)	Y	N	Y	Y	Y	N
Young, Weeks, & Beck (2007)[b]	Y	Y	Y	Y	N	N

Note. Y = yes; N = no; ? = unclear or only partially.

[a]These studies accounted for all participants in their pre–post analyses, although this might have just been because they had no dropouts. [b]Studies were randomized controlled trials.

levels of reliability and validity, or use tests that are widely considered criterion or gold standard.

Results

A relatively small number of peer-reviewed (3 cross-sectional and 15 training) studies were found that examined the physical benefits of dance for healthy older adults. Nine of the 15 training studies were categorized as being Level II (Eyigor et al., 2009; Federici et al., 2005; Hackney et al., 2007; Holmerová et al., personal communication; Hopkins et al., 1990; McKinley et al., 2008; Shigematsu et al., 2002; Sofianidis et al., 2009; Young, Weeks, & Beck, 2007), with the other six training studies being Level III–V (Engels et al., 1998; Jeon et al., 2005; Jeon et al., 2000; Kim et al., 2003; Kudlacek et al., 1997; Song et al., 2004). All three cross-sectional studies were categorized as being Level IV (Uusi-Rasi et al., 1999; Verghese, 2006; Zhang, Ishikawa-Takata, Yamazaki, Morita, & Ohta, 2008). Across these 18 studies, a variety of dance forms and outcome measures were used. Of the 15 training studies, the most common forms of dance were traditional Korean (Jeon et al., 2005; Jeon et al., 2000; Kim et al.; Song et al.) and aerobic (Engels et al.; Hopkins et al.; Shigematsu et al.) dance. Aerobic power, muscle endurance and strength, and static and dynamic balance were the most commonly assessed outcome measures. Some studies also investigated changes in body composition, gait performance, prevalence of falls, and cardiovascular risk factors.

Cross-Sectional Studies

As summarized in Table 2, three cross-sectional studies compared the physical function of older dancers with that of older nondancers (Uusi-Rasi et al., 1999; Verghese, 2006; Zhang et al., 2008). These studies found that compared with older nondancers, the older dancers had significantly greater bone-mineral content, aerobic power, muscle strength, muscle endurance, muscle power, balance, and gait speed. Verghese also observed that older dancers' gait was characterized by a significantly longer stride length and swing time, as well as shorter stance and double-support times, than the nondancers. The gait differences reported by Verghese appear indicative of the older dancers' having a more powerful and stable gait pattern than their nondancing peers (Judge, Ounpuu, & Davis, 1996; Maki, 1997). Zhang et al. also found that older dancers had a significantly lower body-mass index and prevalence of diabetes and hypertension than older nondancers.

Training Studies

Fifteen longitudinal studies investigated the chronic physical benefits of dancing for older adults, and the results of these studies are summarized in Tables 3 and 4. In Table 3, the results of nine studies that assessed changes in body composition and/or physical fitness are presented. Six of these nine studies reported significant increases in the muscle endurance of older adults (Engels et al., 1998; Eyigor et al., 2009; Holmerová et al., personal communication; Hopkins et al., 1990; McKinley et al., 2008; Young et al., 2007). Three studies reported significant increases in the older adults' aerobic power (Engels et al.; Eyigor et al.; Hopkins

Table 2 Cross-Sectional Studies That Compared the Body Composition, Physical Fitness, and Functional Ability of Older Dancers And Nondancers

Study	Participants	Body composition	Aerobic power	Muscle endurance	Muscle strength	Muscle power	Static balance	Dynamic balance/agility	Gait speed
Uusi-Rasi et al. (1999)	117 M gymnasts and folk dancers[a] 62 ± 5 y, 116 M controls 62 ± 5 y	4% greater tibia-shaft BMC and 8% distal-tibia BMC in dancers*	13% greater VO_{2max} in dancers*		10% greater knee-extension strength in dancers*	13% greater jump height in dancers*		8% faster figure-8 running in dancers*	
Verghese (2006)	24 M and F social dancers 80 y, 84 M and F controls 81 y			13% quicker 5 STS in dancers	10% greater grip strength in dancers		41% greater 1-leg-stance time in dancers*		13% greater normal gait speed in dancers*
Zhang et al. (2008)	112 M and F social dancers, 112 M and F controls, 50–87 y entire group						13% greater postural-stability index in dancers*		11% greater maximum gait speed in dancers[b]

Note. M = male; y = years old; F = female; BMC = bone-mineral content; STS = sit-to-stand. Although the 5 STS time is considered a muscle-endurance measure in this table, it could also be considered a measure of muscle strength.

[a]This group consisted of 98 Finnish rhythmic gymnasts and 19 Finnish folk dancers. [b]The between-groups difference approached significance ($p = .053$).

*Significantly better ($p < .05$) performance in dancers than controls (nondancers).

Table 3 Changes in Older Adults' Body Composition and Physical Fitness as a Consequence of Contemporary/Traditional and Aerobic Dance

					Changes in Body Composition and Physical Fitness				
Study	Participants	Dance style	Duration	Frequency	Body composition	Aerobic power	Flexibility	Muscle endurance	Muscle strength
Contemporary/Traditional Dance									
Eyigor et al. (2009)	E 19 M 74 ± 8 y, C 18 M 71 ± 6 y	Turkish folkloristic	8 weeks	3/week 60 min/session + 2/week walking for 30 min/session		+17% 6-min walk*, +3% 6-min walk		−19% 5 STS time*, −2% 5 STS time	
Holmerová et al. (personal communication)	E 27 M and F 81 ± 10 y, C 25 M and F 83 ± 8 y	Mixed ballroom	3 months	1/week 60 min/session			+77% sit-and-reach*, −12% sit-and-reach*	+38% 30-s STS*, −14% 30-s STS*	
Jeon et al. (2000)	E 15 M, C 14 M, 65–75 y entire group	Korean traditional	12 weeks	3/week 50 min/session					+34% leg ext*, −10% leg ext
Kudlacek et al. (1997)	13 nonosteoporotic M 65 ± 2 y	Folkloristic, Viennese waltz, and aerobic	12 months	3.3 ± 0.8 hr/week	0% lumbar BMD				
McKinley et al. (2008)	E 14 M and F 78 ± 8 y, walking 11 M and F 75 ± 8 y	Argentine tango	10 weeks	2/week 90 min/session				−24% 5 STS time*, −13% 5 STS time	

(continued)

Table 3 *(continued)*

Aerobic/Line Dance									
Engels et al. (1998)	E + hand weights 12 M and F, E no hand weights 11 M and F, C 11 M and F; 67 ± 6 y entire group	Aerobic	10 weeks, 10 weeks	3/week 60 min/session, 3/week 60 min/session	−2% Σ skinfolds, 0% Σ skinfolds, −2% Σ skinfolds	+10% VO_{2max}*, +9% VO_{2max}*, −2% VO_{2max}	0% hip flexion, +3% hip flexion, −2% hip flexion	−21% 5 STS time*, −21% 5 STS time*, +4% 5 STS time	+10% elbow ext, +10% elbow ext, 0% elbow ext
Hopkins et al. (1990)	E 30 M 65 ± 4 y, C 23 M 66 ± 4 y	Aerobic	12 weeks	3/week 50 min/session	−5% Σ skinfolds, −1% Σ skinfolds	+13% half-mile walk*, −4% half-mile walk	+9% sit-and-reach*, 0% sit-and-reach	+62% 30-s STS*, 0% 30-s STS	
Shigematsu et al. (2002)	E 20 M 79 ± 4 y, C 18 M 80 ± 5 y	Aerobic	12 weeks	3/week 60 min/session		−9% 3-min-walk distance, +4% 3-min-walk distance		−7% isometric squat time, −7% isometric squat time	−3% handgrip, +2% handgrip
Young et al. (2007)	E 10 M 65 ± 8 y, E + squats 10 M 63 ± 4 y, E + squats + foot stomps 12 M 65 ± 8 y	Line	12 months	1/week, squats 5/week, squats + foot stomps, 5/week	0% lumbar BMD, 0% lumbar BMD, −1% lumbar BMD			+150% squat reps with 12 kg*, +225% squat reps with 12 kg*, +600% squat reps with 12 kg*	

Note. E = experimental; M = male; y = years old; C = control; BMD = bone-mineral density, STS = sit-to-stand; ext = extension. Although the 5 STS time is considered a muscle-endurance measure in this table, it could also be considered a measure of muscle strength.

*Indicates significantly better ($p < .05$) performance in experimental than control group.

Table 4 Changes in Older Adults' Falls Prevalence and Functional Ability as a Consequence of Contemporary/Traditional and Aerobic Dance

					Falls and Functional Ability Changes			
Study	Participants	Dance style	Duration	Frequency	Falls prevalence	Static balance	Dynamic balance/agility	Gait speed
Contemporary/Traditional Dance								
Eyigor et al. (2009)	E 9 M 74 ± 8 y, C 18 M 71 ± 6 y	Turkish folkloristic	8 weeks	3/week 60 min/session + 2/week walking for 30 min/session		+2% Berg Balance*, 0% Berg Balance		−11% stair-climb time*, −2% stair-climb time
Federici et al. (2005)	E 20 M and F 63 ± 4 y, C 20 M and F 64 ± 4 y	Caribbean	3 months	2/week 30–60 min/session		+18% Romberg*, 0% Romberg	−13% SUG time*, 0% SUG time	
Hackney et al. (2007)[a]	E 9, Str & Flex 10; M and F age unknown	Argentine tango	12 weeks	2/week 60 min/session		+12% 1-foot stance*, +44% 1-foot stance*		+14% gait velocity, +7% gait velocity
Holmerová et al. (personal communication)	E 27 M and F 81 ± 10 y, C 25 M and F 83 ± 8 y	Mixed ballroom	3 months	1/week 60 min/session			−8% TUG time, +16% TUG time	
Jeon et al. (2005)	E 130, C 123; M and F 60–79 y entire group	Korean traditional	12 weeks	3/week		+27–34% 1-foot stance*, −11–0% 1-foot stance		
Jeon et al. (2000)	E 15, C 14; M 65–75 y entire group	Korean traditional	12 weeks	3/week		+5% balance eyes closed*, −21% balance eyes closed	+31% walk with turn*, −23% walk with turn	

(continued)

Table 4 *(continued)*

Study	Participants	Dance style	Duration	Frequency	Falls and Functional Ability Changes			
					Falls prevalence	Static balance	Dynamic balance/agility	Gait speed
Contemporary/Traditional Dance								
Jeon et al. (2000)	E 15, C 14; M 65–75 y entire group	Korean traditional	12 weeks	3/week		+5% balance eyes closed*, −21% balance eyes closed	+31% walk with turn*, −23% walk with turn	
McKinley et al. (2008)	E 14 M and F 78 ± 8 y, walking 11 M and F 75 ± 8 y	Argentine tango	10 weeks	2/week 90 min/session			+17% ABC*, +2% ABC	+16% gait velocity*, +12% gait velocity
Sofianidis et al. (2009)	E 14 M and F 69 ± 4 y, C 12 M and F 73 ± 5 y	Traditional Greek	10 weeks	2/week 40–60 min/session		−41% ML sway 1-foot stance*, −14% ML sway 1-foot stance	+21% trunk rotation in ML weight-shift task*, 0% trunk rotation in ML weight-shift task	
Song et al. (2004)	E 46 M and F 76 ± 8 y, C 27 M and F 74 ± 8 y	Korean traditional	6 months	3/week 50 min/session	10% had a fall*, 21% had a fall		+5% SIP mobility*, +37% SIP mobility	−39% SIP ambulation*, +30% SIP ambulation

(continued)

Table 4 *(continued)*

					Falls and Functional Ability Changes			
Study	Participants	Dance style	Duration	Frequency	Falls prevalence	Static balance	Dynamic balance/agility	Gait speed
				Contemporary/Traditional Dance				
McKinley et al. (2008)	E 14 M and F 78 ± 8 y, walking 11 M and F 75 ± 8 y	Argentine tango	10 weeks	2/week 90 min/session			+17% ABC*, +2% ABC	+16% gait velocity*, +12% gait velocity
Sofianidis et al. (2009)	E 14 M and F 69 ± 4 y, C 12 M and F 73 ± 5 y	Traditional Greek	10 weeks	2/week 40–60 min/session		−41% ML sway 1-foot stance*, −14% ML sway 1-foot stance	+21% trunk rotation in ML weight-shift task*, 0% trunk rotation in ML weight-shift task	
Song et al. (2004)	E 46 M and F 76 ± 8 y, C 27 M and F 74 ± 8 y	Korean traditional	6 months	3/week 50 min/session	10% had a fall*, 21% had a fall		+5% SIP mobility*, +37% SIP mobility	−39% SIP ambulation*, +30% SIP ambulation

(continued)

Table 4 *(continued)*

Aerobic/Line Dance							
Engels et al. (1998)	E + hand weights 12 M and F, E no hand weights 11 M and F, C 11 M and F; 67 ± 6 y entire group	Aerobic, aerobic	10 weeks, 10 weeks	3/week 60 min/ session, 3/week 60 min/session		+13% forward reach, +7% forward reach, +2% forward reach	
Hopkins et al. (1990)	E 30 M 65 ± 4 y, C 23 M 66 ± 4 y	Aerobic	12 weeks	3/week 50 min/ session		+12% 1-foot stance*, 0% 1-foot stance	−13% chair agility time*, +3% chair agility time
Shigematsu et al. (2002)	E 20 M 79 ± 4 y, C 18 M 80 ± 5 y	Aerobic	12 weeks	3/week 60 min/ session		+10% forward reach*, −3% forward reach	−19% cone walk time*, +3% cone walk time
Young et al. (2007)	E 10 M 65 ± 8 y, E + squats 10 M 63 ± 4 y, E + squats + foot stomps 12 M 65 ± 8 y	Line	12 months	1/week, squats 5/week, squats + foot stomps 5/week		+186% 1-foot stance*, +86% 1-foot stance*, +115% 1-foot stance*	10% TUG time*, −20% TUG time*, −20% TUG time*

Note. E = experimental; M = male; C = control; y = years old; F = female; SUG = sit-up-and-go; Str & Flex = strength and flexibility training; TUG = timed up-and-go; ABC = activities-specific balance confidence; ML = mediolateral; SIP = Sickness Impact Profile. A higher SIP score indicates a greater limitation in function.

[a]No mean age was listed for either of the groups in this study, although the minimum age was 55 years. Furthermore, the "control" group was an exercise group that performed a variety of resistance and flexibility exercises for the same frequency and duration as the dance group.

*Significantly better ($p < .05$) performance in experimental than control group.

et al.), and two found significant increases in flexibility (Holmerová et al., personal communication; Hopkins et al.). It is interesting that all of the studies that investigated dance-related changes in the body composition of older adults found no significant change in adiposity (Engels et al.; Hopkins et al.) or bone-mineral content of the lower limb (Kudlacek et al., 1997; Young et al., 2007).

Although increasing muscle endurance and aerobic power are important outcomes for older adults, improving balance and functional ability and reducing falls might be of even more benefit. A summary of the 13 studies that investigated changes in falls prevalence, balance, and functional ability are presented in Table 4. Most of these studies reported that dancing significantly improved older adults' static and dynamic balance. The gait performance of the older adults was also markedly increased. Specifically, significant improvements in gait speed when moving in a straight line, around obstacles, and up stairs (Eyigor et al., 2009; Federici et al., 2005; Hackney et al., 2007; Hopkins et al., 1990; Jeon et al., 2000; McKinley et al., 2008; Shigematsu et al., 2002; Song et al., 2004; Young et al., 2007) also indicated an overall improvement in the older adults' agility. Furthermore, and perhaps most important, dancing could also significantly reduce the prevalence of falls in older adults (Jeon et al., 2005).

Kim et al. (2003) also found that a 12-week dance program resulted in significant reductions in total cardiovascular health risk, as well as cholesterol and triglyceride levels, of the older adults.

Grade Recommendations

Based on the results summarized in Tables 2–4, we propose a number of recommendations.

Because none of the studies were randomized controlled trials involving more than 100 participants, no recommendations could be given Level A status (Sackett, 1989).

Grade B recommendations were as follows: A dance-based exercise program can improve older adults'

- Aerobic power (Eyigor et al., 2009; Hopkins et al., 1990)
- Muscle endurance of the lower extremities (Eyigor et al., 2009; Holmerová et al., personal communication; Hopkins et al.; McKinley et al., 2008; Young et al., 2007)
- Muscle strength of the lower extremities (Eyigor et al.; McKinley et al.)
- Flexibility of the lower extremities (Holmerová et al., personal communication; Hopkins et al.)
- Static balance (Eyigor et al.; Federici et al., 2005; Hackney et al., 2007; Hopkins et al.; Shigematsu et al., 2002; Sofianidis et al., 2009; Young et al., 2007)
- Dynamic balance and agility (Federici et al.; Hopkins et al.; McKinley et al.; Shigematsu et al.; Sofianidis et al.; Young et al., 2007)
- Gait speed (Eyigor et al.; Hackney et al.; McKinley et al.)

Grade C recommendations were as follows: A dance-based exercise program for older adults may

- Increase bone-mineral content in the lower body (Uusi-Rasi et al., 1999)

- Increase muscle power of the lower extremities (Uusi-Rasi et al.)
- Reduce the rate of falls (Jeon et al., 2005)
- Reduce cardiovascular health risk (Kim et al., 2003; Zhang et al., 2008)

Discussion

Using the rules of evidence described by Sackett (1989), there is relatively strong (i.e., Grade B) evidence that dancing can significantly improve the aerobic power, muscle endurance, strength, and flexibility of the lower body; static and dynamic balance/agility; and gait speed of older adults. Although the Grade B evidence was based on only nine studies, the scientific rigor of these studies was generally high (Eyigor et al., 2009; Federici et al., 2005; Hackney et al., 2007; Holmerová et al., personal communication; Hopkins et al., 1990; McKinley et al., 2008; Shigematsu et al., 2002; Sofianidis et al., 2009; Young et al., 2007). With the exception of Shigematsu et al., who might have used some “questionable” tests to assess changes in the muscle endurance and strength of the older adults, the eight other studies all had clear inclusion/exclusion criteria and clearly described dance programs and used reliable and valid outcome measures.

Because of the relative strength of this literature, further development and promotion of older-adult-specific dance classes, similar to that done with Tai Chi and resistance training (Faber, Bosscher, Chin, & van Wieringen, 2006; Hill et al., 2005; Liu-Ambrose, Khan, Eng, Janssen et al., 2004), might be recommended. If the accessibility of such dance classes for older adults were to increase, we believe that many older adults would dance, because there is considerable intragroup variability in the preferred forms of physical activity for older adults (Mills et al., 1997; Wilcox et al., 1999), it might be less threatening to many older adults than other exercise modes (Dunlap & Barry, 1999), and it can be an important promoter of successful aging (Wikstrom, 2004).

The reader should, however, be aware of the limitations of this review and hence regard some of these recommendations with a degree of caution. The major limitations included the relatively small number of studies and the variety of dance forms used in the studies, predominance of female participants in the studies, and somewhat conflicting evidence for the effect of dance on muscle strength. These issues will now be discussed in further detail.

The review consisted of only 15 training and 3 cross-sectional studies. Within this relatively small sample of literature, there was considerable diversity with respect to the forms of dance used. The three cross-sectional studies used mixed samples of older dancers, with ballroom, line, and Finnish folk dance being some of the dance forms that the participants practiced most often. Of the 15 training studies, 11 involved traditional forms of dance such as Korean, ballroom, Argentine tango, Turkish folkloristic, Greek, and Caribbean and 4 used aerobic or line dance. To dance purists, the inclusion of aerobic or even line dancing in this review might seem inappropriate. Although we agree with this contention at an aesthetic and creative level, we included these forms of dance for two reasons: these were the relatively small number of eligible studies and because aerobic, line, and more traditional dance styles appear to offer somewhat similar biomechanical and physiological challenges to the older adult, with this appearing sufficiently high to cause improvements in many aspects of physical function (Grant et al., 2002; Guidetti et al., 2007; Ozkan & Kin-Isler, 2007; Wigaeus & Kilbom, 1980). Inspection of the data found in Tables 2–4 indicated that older adults were able to obtain significant physical benefits from traditional, as well as aerobic and line, dance styles. This supports our contention that all forms of dance will have some physical benefits for many older adults. However, any intradance variation in technical requirements and movement patterns would still alter the biomechanical and/or physiological demands of the dance style in some way, resulting in somewhat specific adaptations to each dance form (Harris, Cronin, & Keogh, 2007; Schoene, 2007).

Of the 18 studies included in this review, 7 of the 15 training (Eyigor et al., 2009; Hopkins et al., 1990; Jeon et al., 2000; Kim et al., 2003; Kudlacek et al., 1997; Shigematsu et al., 2002; Young et al., 2007) and 1 of the 3 cross-sectional (Uusi-Rasi et al., 1999) studies involved only female participants. Although the other eight training (Engels et al., 1998; Federici et al., 2005; Hackney et al., 2007; Holmerová et al., personal communication; Jeon et al., 2005; McKinley et al., 2008; Sofianidis et al., 2009; Song et al., 2004) and two cross-sectional (Verghese, 2006; Zhang et al., 2008) studies used mixed samples, these studies were still typically dominated by female participants. Therefore, it is still somewhat unclear whether older men can derive the same physical benefits from dancing as do older women.

In a number of the studies, the validity and reliability of several of the tests and outcome measures may not have been sufficiently high. For example, significant improvements in balance were often observed in static standing tasks (Federici et al., 2005; Hackney et al., 2007; Hopkins et al., 1990; Jeon et al., 2005; Sofianidis et al., 2009; Young et al., 2007). Because most falls occur during dynamic activities such as walking, turning, and reaching (Judge, 2003; Lockhart, Woldstad, & Smith, 2003; Overstall, 2004) and there is often a low correlation between static and dynamic balance (Hrysomallis, McLaughlin, & Goodman, 2006), it is unclear whether changes in static balance would translate to an improvement in overall physical function or a reduction in the falls rate in older adults. Another possible issue is the use of the Berg Balance Scale (BBS) by Eyigor et al. (2009) to assess changes in the dynamic balance of their participants. Although the BBS is a validated measure of dynamic balance and functional ability in older adults (Berg, Wood-Dauphinee, Williams, & Maki, 1992), it is unclear whether the statistically significant change in the BBS reported by Eyigor et al. for the dance group (preintervention 54.1 vs. postintervention 55.3) is of any clinical significance. The BBS involves 14 activities of daily living scored on a scale of 0–4, where 0 means being unable to perform the task, and 4, being able to complete the task based on the criterion (Berg et al.; Steffen et al., 2002). Because the maximum score on the BBS is 56, this test can suffer ceiling effects in studies like that of Eyigor et al., in which the older adults were well functioning before starting the dance program. It could therefore be recommended that although the BBS might be useful to describe the pretraining status of older adults in such studies, its use as an outcome measure might be most appropriate for frailer older adults who have lower pretraining scores.

There are similar concerns regarding the validity and reliability of some tests of muscle function—for example, elbow-extension and handgrip strength and half-squat isometric muscle endurance—used in some of the reviewed studies (Engels et al., 1998; Shigematsu et al., 2002). The use of these potentially “questionable” tests may have contributed to the somewhat conflicting results for the effect of dancing on older adults’ muscle strength, whereby significant increases (Engels et al.; Eyigor et al., 2009; Jeon et al., 2000) and no significant change (Engels et al.; Shigematsu et al., 2002) were both reported.

The somewhat conflicting results for the effect of dance on older adults’ muscle strength might also reflect between-study differences in the specificity of training and testing. The principle of specificity states that the greater the similarity in factors such as posture, range of motion, velocity, and mode of contraction between the training and testing tasks, the greater the training-related benefits (Harris et al., 2007). When comparing these studies, it was apparent that when lower body strength was assessed, significant increases in strength were demonstrated (Engels et al., 1998; Eyigor et al., 2009; Jeon et al., 2000; McKinley et al., 2008), whereas no significant change in strength was found when upper body strength was tested (Engels et al.; Shigematsu et al., 2002). Research indicates that one of the primary stimuli for improving strength is the production of high levels of force by specific muscle groups (Crewther, Cronin, & Keogh, 2005). Because dance typically involves the production of substantially greater lower than upper body forces and torques (Lin et al., 2005; Michaud et al., 1993; Simpson & Kanter, 1997), the dance-related significant increases in lower but not upper body strength are not surprising.

Conclusion

The results of this literature review demonstrate the potential for dancing to improve the physical function of older adults. Although the size of this literature sample is still relatively small, there appears sufficient Grade B evidence to suggest that dancing can improve the aerobic power, lower body muscle endurance, strength and flexibility, static and dynamic balance/agility, and gait speed of older, especially female, adults. The further development and promotion of older-adult-specific dance classes would therefore be useful because it would provide older adults with another physical activity option that might significantly improve their physical capabilities.

Future research in this area is most warranted and should concentrate on a number of areas. Some research should investigate how best to structure dance programs for older adults to maximize gains in physical function while ensuring participant safety and enjoyment. This may involve investigating the optimal frequency and duration of dancing, as well as comparing the relative effectiveness and safety of a variety of dance styles with other activities such as Tai Chi and resistance training. Because any group of older adults will have members with varying physical abilities and limitations, these studies should use dance programs that allow differentiation of ability and ensure appropriate progression for all participants. Furthermore, research into the factors that influence the uptake of and adherence to a dance-based exercise program in this population should also be conducted.

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