

1 **Ballroom dancing for community-dwelling older adults: A 12-month**  
2 **study of the effect on well-being, balance and falls risk.**

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1 **Ballroom dancing for community-dwelling older adults: A 12-month**  
2 **study of the effect on well-being, balance and falls risk.**

3 Abstract

4 Physical activities that involve muscle strengthening, balance and co-ordination  
5 skills such as ballroom dancing are encouraged for older adults to assist with the  
6 maintenance of functional autonomy and prevention of falls. Twenty-three  
7 community-dwelling older adults engaged in regular ballroom dancing completed  
8 a 12-month study assessing well-being, falls risk and balance using a set of  
9 clinical outcome measures. Those attending ballroom dancing classes were more  
10 likely to be active older adults, with lower levels of BMI and obesity compared to  
11 the general population. Participants scored lower in the falls risk tests than  
12 normative values. Some of the results suggest a possible substantive finding for  
13 clinical practice and indicate ballroom dancing is an activity with good attrition  
14 and adherence rates among community-dwelling older adults that can improve  
15 well-being, balance and reduce falls risk as part of an active lifestyle.

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18 **Keywords:** active aging, dancing, falls, physical activity, well-being

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# 1 **Introduction**

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3 The World Health Organization (WHO, 2016) predicts that between 2000 and 2050 the  
4 world's population of adults over the age of 60 years will double from 11% to 22%. In  
5 the United Kingdom (UK), the percentage of over 65-year-olds has risen from 15% in  
6 1984 to 18% in 2014, and the number of adults in the 'oldest old' age bracket, above 80  
7 years, has risen from 19% of the over-65 population in 1984 to 22% in 2014 (Office for  
8 National Statistics, 2015). There is an acknowledged age-related risk of many chronic  
9 health conditions, such as coronary heart disease, type 2 diabetes and cancer  
10 (Department of Health, Physical Activity, Health Improvement and Protection,  
11 DHPAHIP, 2011) and progressive functional decline due to aging may have a  
12 significant impact on many individuals' quality of life. Amongst those aged 75 years  
13 and over, it is thought that around 25% live in ill-health and are, therefore, particularly  
14 at risk of poor mental health and well-being or social exclusion issues (Allen, 2008).

15

16 Evidence suggests that promoting a healthy aging process is dependent upon  
17 multiple factors including appropriate policies at national level to combat the known  
18 risks associated with aging, such as those highlighted above. For example, in the UK,  
19 "social prescribing" aims to use networks commissioned by Clinical Commissioning  
20 Groups (CCGs) and local councils to link health service users with community groups  
21 to provide non-medical interventions that aim to reduce social isolation, loneliness and  
22 improve physical and mental health (Department of Health, 2019), an example being  
23 referral to community-based physical activity classes. In relation to falls, the National  
24 Health Service's (NHS) National Service Framework (NSF) for Older People  
25 highlighted 'falls prevention' as a priority. Introduced in 2001, the NSF suggested that

1 integrated falls services involving local authorities and health and social care provision  
2 are needed, as this has been shown to reduce the number of falls and their negative  
3 impact by up to 30% (Department of Health, 2003, p.8). However, NHS falls pathways  
4 tend to be fairly short-lived meaning upon discharge, individuals need to then self-  
5 manage conditions and transition to community-based physical activity programmes to  
6 maintain the benefits of physical activity and avoid return to one's physical state pre-  
7 rehabilitation (Hawley, 2009). Falls are a leading cause of both injury and death in the  
8 over 65-year-old age group (Lueckenotte & Conley, 2009; Mitty & Flores, 2007; Perell  
9 et al., 2001) and over 75-year-old age group (DH, 2003) and can lead to increased need  
10 for long-term care amongst older adults (Campbell & Robertson, 2003). The National  
11 Institute for Health and Care Excellence (NICE, 2013) estimate the cost of falls to the  
12 NHS to be £2.3 billion per year, and it is predicted that the incidence of falls will rise  
13 2% each year with increasing numbers of people aged 60 and over (McMillan, 2012).

14  
15 The American Geriatrics Society/ British Geriatrics Society (AGS/BGS) have  
16 also echoed the importance of falls prevention programmes, and suggest, given the  
17 consequences of hospitalisation, functional decline and reliance on nursing home care,  
18 that falls prevention is “an important public health objective” (AGS/BGS, 2011, p.148).  
19 The AGS/BGS also emphasise the effectiveness of multifactorial fall intervention  
20 programmes for community-dwelling older adults when they include an exercise  
21 component that varies in intensity and includes resistance, balance, gait and co-  
22 ordination training of more than 12 weeks' duration (AGS/BGS, 2011, p.151).  
23 Therefore, transition from NHS-led pathways and uptake of community based physical  
24 activities for older adults must be encouraged by health-care professionals.

1 ***Physical activity for older adults***

2 Maintaining physical activity for older people is important in encouraging social  
3 interaction, preventing chronic diseases, decreasing cognitive decline and maintaining  
4 physical independence (Wurm, Tomasik & Tesch-Romer, 2010). Whilst research  
5 promotes the importance of physical activity to support successful aging (Flynn &  
6 Stewart, 2013) and guidelines for exercise ‘dose’ exist for older adults from associations  
7 such as the American College of Sports Medicine (ACSM, 2009), the specific *types* of  
8 exercise or activity that are recommended for community-dwelling older-adults are less  
9 clear. There is some suggestion that walking, jogging, cycling and gardening are  
10 suitable activities but there is criticism that this remains ‘vague’ (Paterson &  
11 Warburton, 2010) and that the methodologies reviewed contained insufficient details on  
12 the minimum volume of physical activity recommended to enable any strong  
13 conclusions to be formed. Stevens et al. (2014) acknowledge that all of the physical  
14 activity interventions in the studies they reviewed were left to participants to organise;  
15 and as the studies were heterogeneous in design and at times poorly reported, the types  
16 and quantity of activity were difficult to compare for the most beneficial interventions.

17  
18 Aerobic and strengthening exercises were found to be of benefit for older adults  
19 in the studies considered by Paterson and Warburton (2010), and included alongside  
20 these guidelines were the inclusion of balance and resistance exercise. The Department  
21 of Health, Physical Activity, Health Improvement and Protection (DHPAHIP, 2011)  
22 guidelines also recommend that older adults perform a physical activity to improve  
23 muscle strength, balance and co-ordination (particularly if at risk of falls) on at least two  
24 days a week. As ballroom dancing includes steps and routines that would improve  
25 muscle strength, balance and co-ordination, it is proposed as a specific physical activity

1 that has the potential to assist with physical improvements and a reduction in falls risk,  
2 with the additional benefit of enhancing the social and mental health components that  
3 are also important for successful aging.

4

##### 5 ***Social ballroom dancing and health in older adults***

6 Evidence in the literature on ballroom dancing as an intervention for health  
7 improvements tends to include ballroom dancing classes for periods of time ranging  
8 from 2 weeks (Hackney & Earhart, 2009a) to ongoing involvement in dancing classes  
9 and competitions (Kattenstroth, Kalisch, Kolankowska & Dinse, 2011). A short-  
10 duration feasibility study undertaken by Hackney and Earhart (2009a) revealed  
11 significant findings for positive changes in balance, concentration and reaction times.  
12 The majority of studies reviewed included intervention programmes of around 2 to 3  
13 months' duration. During such an intervention period, positive results were found for  
14 significant improvements in function and gait measurements, motor, cognitive and  
15 perceptual performance, cardiac efficiency, balance and physical performance,  
16 functional autonomy, a reduction in depression and improvements in self-esteem and  
17 observations of increased physical participation (Belardinelli, Lacalaprice, Ventrella,  
18 Volpe & Faccenda, 2008; Gomes da Silva Borges et al., 2012; Haboush, Floyd, Caron,  
19 LaSota & Alvarez, 2006; Hackney & Earhart, 2009b; Hackney, Kantaorovich, Levin &  
20 Earhart, 2007; McKinley et al., 2008). However, these studies largely used clinical  
21 populations and the lack of detail in some studies of baseline measurements, the  
22 plethora of different ballroom dances studied and the heterogeneous quantitative  
23 outcome measures and qualitative research methodologies used within each of these  
24 studies makes comparison and interpretation of findings across the studies problematic.

25

1 ***Falls risk assessment***

2 There has been much debate about the relevance of formal ‘falls’ risk assessments for  
3 community-dwelling individuals or inpatients in hospital settings (Donoghue, Graham,  
4 Gibbs, Mitten-Lewis & Blay, 2003; Muir, Berg, Chesworth, Klar & Speechley, 2010;  
5 Scott, Votova, Scanlan & Close, 2007). An accurate method of assessment is important  
6 to predict those at risk of falls and for an appropriate prevention programme to be  
7 implemented, but Scott et al. (2007) suggest that there is no single test that can be  
8 recommended for implementation in all settings as assessments, whilst shown to be  
9 valid and reliable in some settings, have yet to be tested in more than one setting.  
10 Therefore, questions remain regarding the inter-rater reliability, validity and specificity  
11 of the numerous tests that have been suggested. Indeed, some authors have found there  
12 to be no difference between the accuracy of some validated tests, which are time-  
13 consuming to complete, and nurses’ own clinical judgements (Eagle et al., 1999 cited  
14 by Donoghue et al., 2003) or even the self-reporting of balance problems (Muir et al.,  
15 2010). The numerous outcome measures with their different indications for use mean  
16 that careful consideration is needed prior to their implementation. Ambulatory capacity,  
17 age, balance, lower limb strength and range of joint motion have been cited as risk  
18 factors for falls and the chosen tests in this study assessed some of these intrinsic factors  
19 (Donoghue et al., 2003; Hansma, Emmelot-Vonk & Verhaar, 2010; Lueckenotte &  
20 Conley, 2009; Mitty & Flores, 2007; Perell et al., 2001; Scott et al., 2007; Wolfe,  
21 Lourenco & Mukland, 2010). The outcome measurement tests used, as outlined below,  
22 are all commonplace in clinical practice.

23

24 In summary, social ballroom dancing is an activity that can provide older adults  
25 with improvements in functional independence, balance, cognitive performance and

1 sociality, even over relatively short durations of time. Kattenstroth et al. (2011, p.7)  
2 suggest that dance can enrich the environment for individuals due to its, “unique  
3 combination of physical activity, rhythmic motor coordination, emotion, affection,  
4 balance, memory, social interaction and acoustic stimulation”. Given its popularity,  
5 there remains a paucity of literature supporting the use of ballroom dancing as an  
6 engaging activity beneficial to physical and social health and mental wellbeing in  
7 community-dwelling, non-symptomatic older adults.

8

9         The aim of this study was to investigate the effect of social ballroom dancing on  
10 well-being, balance and falls risk outcome measures in community dwelling older  
11 adults.

12

## 13 **Methods**

14

### 15 *Participants*

16 A purposive sample of 26 older adults were recruited from a population of community-  
17 dwelling ‘older people’ who participated in social ballroom dance at least once a week,  
18 via approaches made to local dance tutors leading community-based ballroom dance  
19 classes. Inclusion criteria were: aged 58 years and over (to allow for the inclusion of  
20 partners of those aged 60 years and above; on which many outcomes measures were  
21 based); living in their own home (not residing in assisted living or nursing home  
22 accommodation); and participating in ballroom dancing at least one hour per week.  
23 Exclusion criteria included those with diagnosis of a dementia-related pathology. The  
24 aims of the study and the commitment required from individuals to participate were



1 explained on a detailed information sheet and there was an opportunity for potential  
2 participants to have any questions answered.

3

#### 4 ***Data collection***

5 Participants completed the physical tests at baseline, 3 months, 6 months, 9 months and  
6 12 months after baseline. If a participant felt unable to continue any of the tests on that  
7 day for health reasons, the tests were not carried out, or if started, ceased immediately.  
8 Following each session, participants were contacted via e-mail or telephone to arrange a  
9 convenient time for the next visit.

10

11         The age, height and weight of all participants were collected at baseline.  
12 Information relating to known medical problems, any diagnosis of dementia or  
13 dementia-related illness, current medication use, any history of falls, frequency of  
14 ballroom dancing and participation in any other form of exercise was collected at  
15 baseline and updated at subsequent visits.

16

#### 17 ***Well-being, falls risk and balance outcome measures***

18 Clinical wellbeing was measured using the Clinical Outcomes in Routine Examination  
19 (CORE-GP); a 14-item measure including questions covering issues such as general  
20 well-being, depression, anxiety, self-esteem and risk and life/social functioning which  
21 has been validated for use within a non-clinical general population (CORE-IMS, 2014).  
22 Higher scores indicate greater levels of distress. The scale boundaries for the CORE-GP  
23 test are 0-20 are considered to be a “healthy” range, with 21-33 depicting a “low level  
24 of client distress” and a national “clinical cut-off” has been established as a score of 10

1 (CORE-IMS, 2014). Falls risk was measured using the Falls Efficacy Scale-  
2 International (FES-I); a 16-item commonly used measure with questions focussing on  
3 social activities and the impact of a fear or concern of falling upon one's social life  
4 (Yardley et al., 2005). Balance was measured using the Timed Up and Go test (TUGT),  
5 designed to assess elements of functional ability, motor performance, balance, gait and  
6 transfers (Fawcett, 2007) for older adults in a variety of settings; and via an Overall  
7 Stability Index (OSI) of dynamic balance obtained from the Biodex Balance System SD  
8 (BBS), (Biodex Medical Systems Inc., Shirley, New York). For each participant, this  
9 latter measure was compared to age-dependent normative data, with scores higher than  
10 normative values being suggestive of deficiencies in strength, proprioception, vestibular  
11 or vision and therefore, individuals being at risk of falls (Biodex Medical Systems Inc,  
12 n.d. b). All physical tests were performed at a university exercise laboratory on 5  
13 occasions over the course of a 12-month period.

14  
15 The CORE-GP, FES-I, TUGT and Biodex Overall Stability Index instruments  
16 used in the study are all validated instruments with demonstrably high reliability  
17 (CORE-IMS, 2014; Dawson, Dzurino, Karleskint & Tucker, 2018; Fawcett, 2007;  
18 Yardley et al., 2005). The TUGT has been validated as a suitable functional outcome  
19 measure to predict falls in community-dwelling older adults and is commonly used in  
20 clinical practice (AGILE, n.d.).

## 21 ***Rejected tests***

22 Additional testing procedures considered included the Functional Reach Test; the  
23 Performance Orientated Assessment of Mobility (POAM) (Mitty & Flores, 2007; Perell  
24 et al., 2001; Raïche, Herbert, Prince & Corriveau, 2000; Wolfe et al., 2010) and the

1 Four Square Step Test (FSST) (Dawson et al., 2018) to measure dynamic standing  
2 balance in an adult population. These tests were found to show poor discriminative  
3 capability between participants and were rejected from further consideration.

#### 4 *Statistical analysis*

5 The sample was summarised descriptively. Mean and standard deviation (SD) values  
6 were derived for numerical measures at baseline and after 12 months' dancing activity.  
7 The significance of any differences from baseline in key outcome measures was  
8 assessed using paired samples t-testing. The significance of any differences in  
9 functional outcome study data from age-standardised normative data was assessed using  
10 single sample t-testing.

11

#### 12 *Ethical issues*

13 Ethical approval was sought and gained from the University's School Research Ethics  
14 Panel to ensure compliance with regulations for the use of human subjects and data  
15 storage. Written informed consent was obtained from all participants and all data were  
16 anonymised. Any risks of harm during physical testing procedures were mitigated; for  
17 example, due to the positioning of crash mats around the testing equipment where  
18 participants might have been at risk of falling off the testing equipment.

19

1 **Results**

2 *Demographic data*

3 Twenty-six participants agreed to participate in the study. Three participants withdrew  
4 after the data collection at baseline; with analysis conducted on the remaining 23  
5 participants (88%) who completed all 5 data collection sessions at baseline and at 3, 6, 9  
6 and 12 months. Of these participants, 18 were either married or life partners dancing  
7 together, and 5 were single. Participant characteristics are summarised in Table 1.

8

9 *Table 1: Participant Demographic Information*

10 [Insert table 1 here]

11

12 *Outcome Measures*

13 Outcome measures recorded at baseline and 12-months are summarised in Table 2.

14

15 *Table 2: Outcome measures at baseline and 12 months*

16 [Insert table 2 here]

17

18 The range of scores for the CORE-GP was 0-24 points, indicating at worst low level  
19 client distress. Low level distress was indicated on only 3 of 115 measurement  
20 occasions (2.61%) and ‘healthy’ values were recorded on 112 of 115 occasions (97.4%).  
21 Mean scores for the TUGT were almost within the normative values in all age groups.

22

1 ***Significance testing***

2 A paired samples t-test conducted on CORE-GP scores of completing dancers at  
3 baseline and 12 months revealed no evidence of a significant effect at the 5%  
4 significance level ( $p=0.07$ ; 95% confidence interval for the difference (-0.17, 3.36)).  
5 However, the change of 1.6 points (25% reduction from baseline) suggested an  
6 improvement of substantive importance.

7

8 Normative values for the falls risk OSI for individuals aged 54 to 71 years of age  
9 were 2.3 (SD=1.4) and for those aged 72 to 89 were 3.0 (SD=1.0) (Biodex Medical  
10 Systems Inc., n.d. b). At baseline, the mean score for the 54 to 71-year-old age group  
11 was 1.23 (SD=0.53) and the mean score for the 72 to 89-year-old age group was 1.88  
12 (SD=1.07). At 12-months, corresponding OSI scores were 1.17 (SD=0.489) for the 54  
13 to 71-year-old age group and 1.96 (SD=1.17) for the 72 to 89-year-old age group.  
14 Between testing at baseline and 12 months, there was no consistent increase or decrease  
15 at an individual level in the falls risk OSI scores. The mean difference between the  
16 observed and normative values was 0.99 (95% CI (0.74, 1.24) in the 54 to 71-year-old  
17 age group and 0.14 (95% CI (0.165 to 2.12) in the 72 to 89-year-old age group. Single-  
18 sample t-tests revealed these differences to be statistically significant at the 5%  
19 significance level ( $p<0.001$  for the 54 to 71-year-old age group;  $p=0.030$  for the 72 to 89  
20 year-old age group). However, under the application of a Bonferroni correction for  
21 multiple comparisons, this latter result would not be considered significant.

22

23

## 1 **Discussion**

2

3 The quantitative element of this study was performed in the context of a feasibility  
4 study and thus not powered to detect significant effects. Therefore, significant  
5 differences were not particularly expected due to the small sample size. Nonetheless,  
6 some significant effects were observed; alongside effects that did not reach significance  
7 at standard significance levels but appeared to be of some substantive importance. Tests  
8 were performed to potentially identify ‘promising’ effects even in small sample sizes  
9 and have demonstrated that the data are amenable to the form of testing if repeated in  
10 future, larger scale studies.

11

### 12 *Effect of dancing and concomitant activities*

13 It appears that ballroom dancing attracts people who are ‘active’ in their lifestyle, and is  
14 an activity which, once taken up, is generally maintained: 17 of the 23 participants  
15 continued dancing consistently for the 12-month period; and those who did not maintain  
16 the activity constantly over the 12-month period reported factors unrelated to dancing,  
17 such as worsening illness or injury to be the cause of stopping and this also meant their  
18 partners stopped dancing. These adherence rates are slightly higher than those found in  
19 the systematic review of community based group exercise programmes by Farrance,  
20 Tsofliou and Clark (2016) who found adherence rates at 6 to 12-months of 69.1% in  
21 adults with a mean age of 73.8 years. While the majority of participants (20; 87%)  
22 reported being involved in other forms of exercise at the start of the trial, participation  
23 in these other exercises was generally not as regularly attended as the weekly ballroom  
24 dancing, for which consistent attendance of a constant weekly frequency was recorded.

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The low attrition rate recorded in this study is consistent with the findings of other studies (Belardinelli et al., 2008; Hackney & Earhart, 2009a; Pinniger, Brown, Thorsteinsson & McKinley, 2012). As ballroom dancing is a partnered activity, the act of being in a ‘couple’, as well as being in the group as a whole, might help to enhance the social aspect of dance. Therefore, the sociality of ballroom dancing may assist with improving one’s emotional and social health status, a reduction in social isolation as well as providing physical assistance for more frail older adults.

This sample suggests that those attending dancing classes were more likely to be more active older adults, as their levels of participation in physical activity were greater than those previously reported by Flynn and Stewart (2013) who suggested only 13% of 65 to 74 year-olds and 6% of over 75 year-olds participate in vigorous physical activity, with ballroom dancing previously being classified as such (Blanksby & Reidy, 1988; Lima & Vieira, 2007). The study sample comprised individuals with lower levels of BMI and a lower proportion of obese participants compared with the general population in which adult obesity levels are around 26.9% in England (Public Health England, 2015). Aydoğ, Bal, Tolga, Aydoğ and Çakei (2006) note that in individuals with Rheumatoid Arthritis, age and BMI were the most important factors affecting postural dynamic balance. Furthermore, Greve, Alonso, Bordini and Camanho (2007) have previously found a link between increased BMI and reduced postural balance in adults with a BMI greater than 30 kg/m<sup>2</sup>. Calculations for this were not performed within this sample population as there was only 1 participant with a BMI over 30 kg/m<sup>2</sup>.

1           There is no evidence that the study sample is systematically different from the  
2 age strata of the population from which it was drawn. Twenty-one participants (91%)  
3 were taking regular medication; similar to reported figures for the incidence of  
4 medication use by older adults in the UK, whereby 75% of 65 to 74 year-olds and 84%  
5 of those aged 75 plus were taking regular medication (Chen, Dewey & Avery, 2001). At  
6 baseline 5 of the 23 participants had reported having a previous fall with a further 8 falls  
7 reported in 6 participants over the course of the study (26% of participants falling over  
8 the 12-month period). Yoshida (2007) noted similar findings in community-dwelling  
9 older adults over the age of 64, with 28-35% falling each year and in those of 70, 32-  
10 42% fall each year.

11

## 12 ***Well-being measures***

13 For the CORE-GP test, 97.4% of participant scores were within a healthy mental well-  
14 being range. Three of the possible 115 scores were between 21 and 33, indicating a low  
15 level client distress. The mean scores for all participants at each testing period were  
16 always less than 10, indicating a healthy range of well-being throughout the study. The  
17 lack of statistical significance between CORE-GP scores at baseline and at 12-months is  
18 likely to be because the sample were generally already in a healthy range of well-being  
19 at baseline and no participants were diagnosed with a mental health condition. Also, as  
20 mentioned above, as a feasibility study the population was not powered to detect  
21 significant changes and significant differences were not really expected.

22

23           Some of the higher scores recorded in the FES-I questionnaire appeared to be  
24 seasonal, in that participants were more concerned about walking outside during the



1 heavy snow and ice periods that occurred during the course of the study and this did  
2 coincide with higher scores for certain individuals. However, possibly of note is the  
3 reduction of the mean FES-I scores from baseline to the end of the follow-up period of  
4 1.40 points, representing a reduction of about 7% from baseline values.

5

6         Whilst there were no significant findings or changes over the 12-month study  
7 period in the FES-I outcome measure, Oliver et al. (2008, p.626) note that one should be  
8 cautious at the use of falls risk prediction tools and clinicians should not be “seduced by  
9 the attractiveness of an ‘off the shelf’ solution to the problem of falls” and they suggest  
10 that the most successful falls risk programmes involve post-fall assessment and  
11 treatment plans rather than the use of falls-risk indicators.

12

13         There is a paucity of evidence for normative data for the BBS equipment. That  
14 which does exist has often been performed in small numbers or with younger  
15 participants; for example, Akbari, Karimi, Farahini and Faghihzadeh (2006) who  
16 studied 30 symptomatic male athletes, aged 20 to 35 with ankle sprains; Testerman and  
17 Griend (1999, cited by Aydoğ et al., 2006) who studied 10 individuals under 30 years of  
18 age with ankle sprains, Aydoğ et al. (2006) who evaluated dynamic postural balance  
19 using the BBS with participants with rheumatoid arthritis and Dawson et al. (2018) who  
20 studied 105 healthy subjects with a mean age of 24.5 years. Whilst the Biodex manual  
21 provides normative mean and ranges for data for the falls risk test, at present there are  
22 no standard guidelines for other tests, other than suggesting that in terms of a person’s  
23 overall stability, proprioception and dynamic balance, it is better to have a lower overall  
24 stability index (OSI) (Biodex Medical Systems Inc., n.d. b). This is perhaps because the

1 BBS provides a number of levels of difficulty for each test and hence normative data are  
2 likely to be varied at each level and for each age-group.

3  
4 The BBS user's manual suggests reliability levels of platform stability settings  
5 such as those provided by Lephart, Pincivero and Henry (n.d., cited by Biodex Medical  
6 Systems Inc., n.d. a). These guidelines suggest on a bilateral stance platform level  
7 setting of 8 and that two test trials are performed for participants to familiarise  
8 themselves with the BBS and that after this, all data can be assumed reliable (Lephart at  
9 al., n.d., cited by Biodex Medical Systems Inc., n.d. a). However, their study was only  
10 performed using 10 university-aged students and on one platform setting. Whilst there  
11 might have been a learning effect involved in the present study, the tests were  
12 performed using the default 3 attempts settings for each set of the balance tests  
13 performed and the authors suggest any more than 3 attempts at each test would have led  
14 to results being affected by elements of fatigue, given the age of participants and their  
15 subjective feedback that it was not an easy test to perform. In addition, the platform  
16 stability settings were considered after the pilot study and after discussions with the  
17 clinical technician staff it was decided to use a mid-range, 'moderate' setting of 6. A  
18 higher setting might have been easier for participants and produced different results,  
19 however, OSI scores in this participant sample were better than those suggested in the  
20 normative data on the more difficult settings used within this study.

21  
22 Finn et al. (1999, cited by Biodex Medical Systems Inc., n.d. a: 3-8) studied 200  
23 participants (106 males and 94 females) aged between 18 and 89 years old. In 54 to 71  
24 year-olds, the mean OSI was 2.57 (SD 0.78) and in 72 to 89 year-olds it was 2.70 (SD  
25 0.80). In a further study (Finn, 2010, cited by Biodex Medical Systems Inc., n.d. b) the

1 normative OSI was 2.3 (SD 1.4) in 50, 54 to 71 year-olds and 3.0 (SD 1.0) in a sample  
2 of 17, 72 year-olds or above (with no defined upper age limit). In the current study, the  
3 platform was set at 6-2 for the majority of participants; therefore, this trial's settings  
4 required a greater balance skill level. Despite this, and the small sample size of the  
5 study, the mean OSI score for study participants were significantly lower in both age  
6 groups, suggesting a beneficial effect of dancing on balance.

### 7 *Future research and implications for professional practice*

8         With regard to the future feasibility of a larger randomised controlled trial into  
9 the physical health benefits of ballroom dancing for community dwelling older adults,  
10 this study demonstrated promising findings in terms of attrition and adherence to both  
11 ballroom dancing and the 12-month study length itself. Larger participant numbers  
12 would need to be sought from additional dancing classes to increase the sample size but  
13 preliminary findings from this study indicate the potential for a significantly better  
14 balance and hence a lower falls risk in older adults who participate in ballroom dancing.  
15 Further work is needed to establish normative values measured by the Biodex Balance  
16 System equipment to provide more workable comparisons with a general population.

17  
18         Overall participants were found to be performing tests to higher levels of  
19 function; thus a ceiling effect was evident with scores. The CORE-GP test demonstrated  
20 healthy well-being scores and a decline of 1.4 points over the 12-month follow-up  
21 period in the FES-I test. Although no statistical significance was revealed, the findings  
22 over 12 months suggest a reduction in scores that might be a substantive finding in  
23 clinical practice.

24

1           Whilst these tests were unable to discriminate between the participants in this  
2 sample, since they are previously validated and commonly used measures in clinical  
3 practice, it is suggested they are of some worth in terms of ethical practice value; that is  
4 they might be used as a baseline ‘family of outcome tests’ to illustrate homogeneity  
5 within a sample and be used to demonstrate the participants’ risk levels for inclusion in  
6 a study. The issue of sensitivity does create a wider issue of the use of outcome  
7 measures in clinical practice in terms of cost-effectiveness. As noted previously above,  
8 Oliver et al. (2008, p.626) note clinicians should be cautious at the use of falls risk  
9 prediction tools. Perera, Mody, Woodman and Studenski (2006) also question what  
10 constitutes clinically meaningful change in the field of clinical geriatrics. They argue if  
11 this was known, it would be useful to plan, evaluate and compare treatment  
12 interventions that use outcome measures and that this information could be used to form  
13 power calculations for sample sizes in research trials. This point might have had an  
14 impact upon this study; if clinically meaningful change parameters were known, power  
15 calculations might have been made to formulate an ideal sample size for this study. It is  
16 of note that the normative data scores for the TUGT are single figures and not a range of  
17 ‘normative’ figures, thus meaning it is harder to interpret the findings for individuals  
18 who lie even 0.1 seconds either side of the normative scores.

19

20           In addition, clinicians should be mindful that it is not possible to totally separate  
21 the effects of some of the confounding variables of the study. For example, in dancing  
22 pairs, the amount of dancing is dependent on each individual being willing and able to  
23 participate; if one person were to fall ill and not attend dancing, their partner would also  
24 be unlikely to attend for that duration.

## 1 **Conclusions**

2           This research study aimed to explore the influence of ballroom dancing on  
3 health and well-being for older, community-dwelling adults over a 12-month period.  
4 Specifically it aimed to assess well-being and functional activity in terms of balance and  
5 falls risk.

6  
7           The results of this study appear to indicate positive findings in comparison to  
8 normative data. However, the sensitivity of these outcome measures for an older adult  
9 population is difficult to establish in this specific group of active older adults. Although  
10 these tests are validated for an older adult, community-dwelling population (AGILE,  
11 n.d.), findings suggest that a ceiling effect may have been reached in the study sample,  
12 with participants generally scoring at or just under the best scores for these tests. This  
13 may limit the predictive value of these tests in the study population.

14  
15           The economic burden of the ageing population worldwide has led to a sense of  
16 ‘moral obligation’ for older adults to maintain or improve their health and remain  
17 physically active. A central role of the present day healthcare professional working with  
18 older adults is to promote health and encourage individuals to realise their potential and  
19 remain functionally independent for as long as possible by means of tailoring physical  
20 activity programmes to an individual’s personal interests. The findings of this study  
21 suggest that ballroom dancing is an activity that is pursued by healthy older adults; they  
22 are naturally active individuals, with healthy levels of well-being, low anxiety of falling  
23 and are of a low falls risk than normative data for the parent population.

24

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3 Word count: 6767 including references and tables. 5189 excluding references and

4 tables.

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1 Table 1. Participant demographic information.

2

Variable	Mean (SD)
Age (years)	66.5 (5.96)
Weekly participation in dancing (hours)	
Baseline	1.18 (0.37)
3 months	1.41 (0.48)
12 months	1.59 (0.48)
Variable	Frequency (valid %)
Gender	
Male	10 (43%)
Female	13 (57%)
BMI at baseline	
Normal weight (20-25 kg/m <sup>2</sup> )	9 (39.1%)
Overweight (25-30 kg/m <sup>2</sup> )	13 (56.5%)
Obese (over 30 kg/m <sup>2</sup> )	1 (4.3%)
Reported falls within previous 12 months	
No falls	18 (78.3%)
One or more falls	5 (21.7%)
Pre-existing medicated conditions	
No pre-existing conditions	2 (8.7%)
One or more pre-existing conditions	21 (91.3%)
Concurrent activities	
No	3 (13.0%)
Yes	20 (87.0%)

3

4

1 Table 2. Outcome measures at baseline and 12 months.

2

Measure	Mean (SD) scores at baseline (n=23)	Mean (SD) scores at 12-months (n=23)
CORE-GP	7.5 (5.1)	5.0 (3.7)
Falls Efficacy Scale (FES-I)	20.2 (3.63)	18.8 (3.42)
Timed Get-up and Go test		
Age group 58-59	8.71 (1.61)	6.53 (1.44)
Age group 60-69	8.81 (1.65)	7.63 (1.01)
Age group 70-79	11.3 (1.42)	7.88 (1.08)
Age group 80-89	11.76 (no SD; 1 case only)	9.83 (no SD; 1 case only)
Falls Risk Test Overall		
Stability Index		
Age group 54-71 years	1.23 (0.533)	1.17 (0.489)
Age group 72-89 years	1.88 (1.07)	1.96 (1.17)

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