Archives of Gerontology and Geriatrics 55 (2012) 492–496

Contents lists available at SciVerse ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

The effect of ballroom dance on balance and functional autonomy among the isolated elderly

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ARTICLE INFO

Article history:
Received 29 April 2011
Received in revised form 31 August 2011
Accepted 1 September 2011
Available online 5 April 2012

Keywords:
Ballroom dance
Physical balance of elderly
Functional autonomy

ABSTRACT

The aim of the present study was to analyze the influence of a ballroom dancing program on the functional autonomy and physical balance of institutionalized elderly individuals. The study enrolled 75 sedentary elderly subjects from long-term institutions who were randomly divided into a ballroom dance program group (EG; $n = 39$) and a control group (CG; $n = 36$). The protocol of the Latin American Group for Maturity (GDLAM) was used to evaluate functional autonomy. Physical balance was analyzed using a stabilometer and posture meter platforms. The level of significance in statistical tests was set at $p < 0.05$. Regarding the physical balance evaluation, only the members of the EG achieved a significant reduction in weight ($\Delta = -0.98$ kg) following the experiment, both in the intragroup ($p = 0.002$) and in the intergroup analysis ($p = 0.012$). In the evaluation of functional autonomy, only the EG showed a significant reduction in the execution time of all the tests and in the GDLAM index: GI ($\Delta = -6.99$), both in the intragroup ($p < 0.001$) and in the intergroup analysis ($p = 0.011$). Thus, it can be inferred that sedentary elderly individuals who are residents of long-term institutions can improve their functional autonomy and balance with a ballroom dance program.

1. Introduction

Various physiological and anatomical changes may be observed in the aging process. Aging is characterized by the progressive loss of functional capabilities, such as the impairment of various organs and systems (Marim et al., 2003). An example of this effect is observed in the muscular system (Cappola et al., 2001; Hakkinen et al., 2001), which is important due to its role in maintaining levels of functional autonomy (Cader et al., 2007) and of physical activity (Berlezi et al., 2006) among the elderly.

Due to the poor financial and psychological circumstances of their families, many elderly individuals are referred to institutions that specialize in the care of people over 60 years of age (Brazil, 2003). Most of the entities that provide elder care are religious and philanthropic institutions and are maintained through donations. Their social role is to provide housing to elderly individuals with housing issues, no family and no living income (Guimarães et al., 2005). Davim et al. (2004) have presented some of the negative aspects of these institutions, such as isolation and physical and mental inactivity. These institutions have been considered inappropriate and inadequate for the resident's needs because they do not provide social assistance, basic hygiene assistance and adequate food resources.

Changes in the somatosensory, visual, and vestibular systems due to aging have been shown to cause difficulties in information feedback to the ascending and descending neural pathways, which reduces the information that reaches the posture control centers (Santos, 2002). Thus, the effector muscles lose the ability to appropriately respond to disturbances in postural stability, which generates changes in balance (Chanler and Studensk, 2002; Perracini and Ramos, 2002). In a study performed with individuals in a static position, Barela (2000) showed that the center of mass moved several times in the anteroposterior and mediolateral directions in the course of 25 s; these findings demonstrate the

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doi:10.1016/j.archger.2011.09.004

variation in the muscular forces that act in the maintenance of balance.

Ballroom dance consists of a series of frequent body movements, performed to a rhythm. Dance is meaningful in all human cultures (Thomas, 2005). It is a widespread activity among the elderly, but there is little information on its physical and mental effects over the long-term. Participating in dance is associated with an improvement in force balance, a decrease in the risk of falling and the prevention of cognitive decline. Researchers have studied the importance of participating in dance as a physical activity for the elderly.

Gobbi et al. (2007), in a study on dance and weight training, among elderly persons, indicate that both activity are widely accepted by the elderly and those who exercised had an improvement in mood. Severo and Dias (2000) indicate that dance has the power to change the lives of the elderly, making it possible for them to improve their quality of life.

Given the above, the objective of the current study was to analyze the effects of a ballroom dance program on the functional autonomy and the posture balance of institutionalized elderly individuals.

2. Subjects and methods

2.1. Population, sample, and data collection

The sample was selected randomly and refined according to the inclusion and exclusion criteria. The inclusion criteria were functional autonomy in the performance of daily physical activities and not practicing physical activity within the last three months (Lemmer et al., 2000; Kraemer et al., 2001). Individuals were excluded if they had any type of health condition that could prevent tests of functional autonomy, such as cardiopathy, hypertension, uncontrolled asthmatic bronchitis and any musculoskeletal conditions that might prevent testing (osteoarthritis, recent fractures, tendonitis and dental prosthesis), neurological problems, morbid obesity or the use of medications that can cause attention impairment.

The study was performed in three long-term institutions for the elderly: Hotelar (Ingá), Doce Lar (São Gonçalo), and Aconchego (Niterói), all of which are located in the state of Rio de Janeiro. The total number of elderly residents was 121. After applying the inclusion and exclusion criteria, the initial study population consisted of 80 subjects (age: 77.68 $\pm$ 11.23 years). However, there was attrition throughout the study due to voluntary withdrawal ($n = 3$) and accidents (falls) that resulted in injuries that prevented the subjects' participation in the study ($n = 2$). Therefore, the final sample consisted of 39 subjects in the experimental group (EG) and 36 in the control group (CG). Table 1 shows the anthropometric characteristics of the sample and illustrates the homogeneity of these characteristics between the groups.

This study was approved by the Ethics Committee for Research on Human-Beings of the Castelo Branco University (protocol no.: 0042/2009). The aims, risks, and benefits of the research were explained and we ensured the confidentiality of personal information. Following the criteria of the Declaration of Helsinki (2008), only general data were disclosed to the academic community. All of the subjects agreed to participate in the research by signing the free and informed consent form, which covered the ethical requirements for performing research on human beings.

Table 1
Anthropometric characteristics of the sample.

	Groups	Mean ± S.E.M.	Median	S.D.	SW $p <$	Inter $p =$
Age	EG	67.95 ± 1.33	67.00	8.33	0.001	0.713
	CG	67.22 ± 1.28	65.50	7.70	0.033	
Height	EG	1.63 ± 0.02	1.60	0.14	0.759	0.844
	CG	1.63 ± 0.02	1.60	0.15	0.001	
Weight	EG	65.51 ± 1.73	66.00	10.83	0.005	0.791
	CG	64.89 ± 1.81	64.50	10.85	0.245	
BMI	EG	24.63 ± 0.52	24.61	3.28	0.565	0.379
	CG	25.84 ± 0.87	25.18	5.22	0.032	

Notes: BMI, body mass index; SW, Shapiro–Wilk-test.

After clarifying the research and answering any questions, the interested individuals were invited to participate in the data collection (on functional autonomy and balance) at a predetermined location and time.

The Latin American Group for Maturity (GDLAM) protocol was used to evaluate functional autonomy (Dantas and Vale, 2004). It is composed of five tests: walking 10 m (W10m) (Sipilä et al., 1996); standing up from a seated position (SSP) (Guralnik et al., 1994); standing up from a prone position (SPP) (Alexandre et al., 1997); standing up from a chair and moving about the room (SCMA) (Andreotti and Okuma, 1999); and putting on and taking off a shirt (PTS) (Vale et al., 2006). These tests are used in a mathematical formula to calculate the GDLAM index (GI) (Vale, 2005). The equipment used consisted of a 48-cm chair (measured from the seat to the floor), a stopwatch (Casio, Malaysia), two cones, a mat (Hoom, Brazil) and a Sunny brand metal tape measure. Balance was evaluated by a stabilometer and a posture meter platform (Fig. 1).

The human body constantly oscillates in order to stay as close as possible to the ideal center of gravity. This process can be seen as adjusting a load that continuously moves over the six support points of the foot. The width of the area covered by the projection of the center of gravity, the direction of the oscillation, its speed and the distance from the ideal center of gravity all have a specific meaning that is related to muscle tone, the somatosensory system and the efficiency of receptors. The principal of the stabilometer is based on load cells that instantly record changes in weight, which are converted into analog signals and sent to a computer. The computer organizes the data and makes them readable. The current is low, and the signal is amplified and operated by a microprocessor.

The Ballroom Dance Program lasted for 50 min and took place three times a week. There were various rhythms, such as the foxtrot, the waltz, the rumba, swing, samba and bolero. The basic structure of the class was the same for all of the participants; however, each dancer displayed a different level of development (progression), depending on his or her physical ability, energy level, level of motivation and cognitive ability. All of the classes were preceded by a warm-up and stretching period and ended with a cool-down. The intensity level of the exercise was controlled by the Subjective Scale of Perceived Exertion (the Borg Scale).

The control group maintained their normal daily activities during the entire study period. This group committed to not performing any systematized physical activity during the eight months of the experiment.

2.2. Statistical analysis

Descriptive statistics, including the absolute delta, mean, and standard deviation, were used. The normality of the sample was evaluated by the Shapiro–Wilk test, and the homogeneity of the variance was evaluated by Levene's test. For intragroup comparisons, Student's t-test was used for functional autonomy, and the Wilcoxon-test was used for balance. To test differences between the groups in functional autonomy, a two-way ANOVA model was used, with the post-hoc Sheffe's test for multiple comparisons. The Kruskal–Wallis test (non-parametric) was used in test balance, with multiple comparisons examined using the Mann–Whitney test with a Bonferroni correction ($p < 0.012$). To verify associations between balance and the functional autonomy variables, Spearman's

Fig. 1. The stabilometer platform.

correlation coefficient (r) (non-parametric) was used. The level of statistical significance was defined as $p < 0.05$, and Excel and SPSS 14.0 software packages were used to evaluate the results.

3. Results

In the analysis of normality, the Shapiro–Wilk test revealed a non-normal distribution for the PTS tests (in both the EG and CG) and for the difference between the EG and CG in the balance test.

Fig. 2 shows the descriptive and inferential analysis of the EG group for functional autonomy. The graph shows that the EG obtained a significant ($p < 0.05$) and satisfactory improvement in all of the tests performed after the experiment (SPP, $p < 0.001$; PTS, $p = 0.003$; SSP, $p < 0.001$; W10m, $p < 0.001$; SCMA, $p < 0.001$), whereas the GI (62.55 ± 9.57 vs. 55.56 ± 8.21; $p < 0.001$) showed a decrease in the execution time of the tests.

Fig. 3 shows the descriptive and inferential analysis of the CG for functional autonomy. The graph suggests that the CG did not obtain significant improvements in the tests or in the GI (63.40 ± 9.34 vs. 62.34 ± 9.58; $p > 0.05$).

Fig. 4 shows the intergroup comparisons for functional autonomy using the absolute delta (Δ = post-test − pre-test). In this graph, we can see that the EG obtained a $p < 0.001$; PTS, $\Delta = -3.310$, $p = 0.022$; SSP: $\Delta = -6.330$, $p < 0.001$; W10m: $\Delta = -5.86$, $p < 0.001$; SCMA: $\Delta = -18.62$, $p < 0.001$ and in the GI $\Delta = -6.99$, $p = 0.011$, when compared to the CG. In the pre-test phase, there was no significant difference between the groups.

Fig. 5 outlines the intragroup and intergroup comparisons for balance. This graph shows that the EG obtained a significant ($p < 0.05$) and satisfactory ($\Delta = -98$ kg) improvement, both in the intragroup analysis ($p = 0.002$) and in the intergroup comparison ($p = 0.016$). In the pre-test phase, there was no significant difference between the groups.

Table 2 presents the correlations among the study's variables. According to the Sigmound (2004), the significant correlations in Table 2 can be classed as average (PTS with the stabilometer) and low-average (SCMA stabilometer and GI with the stabilometer).

4. Discussion

Besides facing possible death, which is common among this group of individuals, this research experienced interference from some uncontrollable factors that modified the responses to the ballroom dance program. These factors were possible changes in the medications used by the elderly, modifications in the psychological state (which interfered with motivation), changes

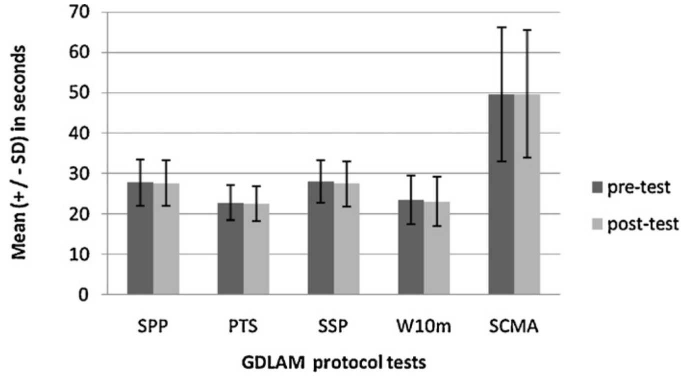

Fig. 3. Intragroup comparisons of functional autonomy for the control group.

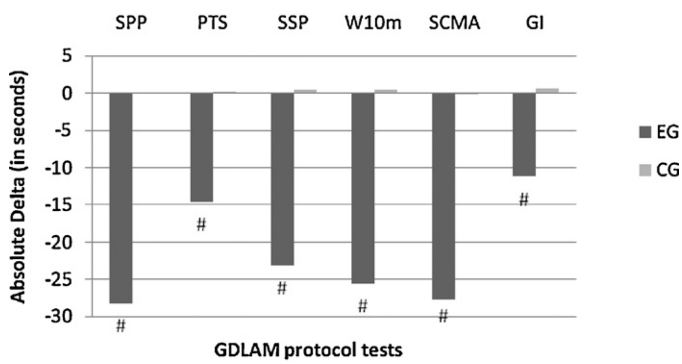

Fig. 4. Intergroup comparisons of functional autonomy.

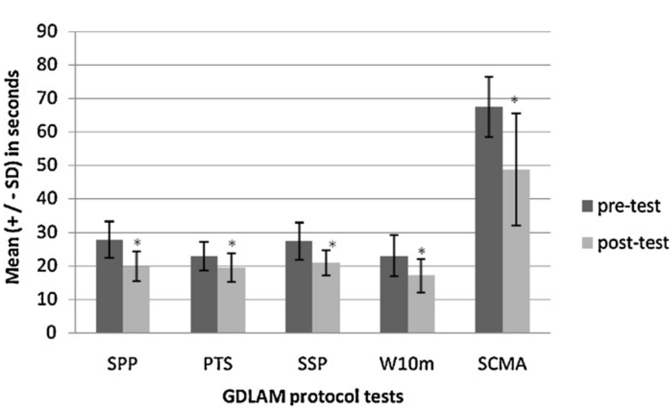

Fig. 2. Intragroup comparisons of functional autonomy for the experimental group.

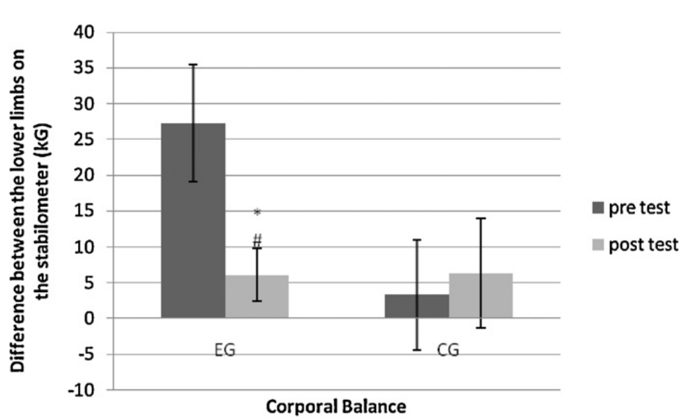

Fig. 5. Intragroup and intergroup comparisons of balance.

Table 2
Correlation (r) between the variables used in the study with the stabilometer data.

Parameters	r	$p <$
SPP	0.256	0.023
PTS	0.447	0.001
SSP	−0.088	0.444
W10m	0.181	0.112
SCMA	0.175	0.124
GI	0.257	0.023

Notes: Stabilometer, the difference in weight distribution between the lower limbs, which represents balance.

in daily habits (sleeping and daily activities) and changes in environmental conditions, such as the temperature.

The DATASUS data recorded 24,645 deaths due to falls, which are the third leading cause of death overall and the first leading cause among interned patients. A fractured femur is the injury with the highest incidence (Alves Júnior and Paula, 2008). Thus, falls resulting from poor balance may influence functional capability. This information supports the current study because the analysis of balance using the stabilometer revealed values that predisposed individuals to falling in the pre-test phase.

During the aging process, there is a decrease in the velocity of nerve conduction, which decreases the speed at which somatosensory centers receive the information necessary to effectively control one's posture (Alfieri et al., 2004). Thus, deficiencies in balance may be the result of an inadequate interaction among the three systems of sensory afferents and of musculoskeletal and muscular coordination changes (Alfieri et al., 2004). This information supports the results found in the current study, which revealed an increase in body imbalance when evaluating balance with a stabilometer.

The current study had the goal of both demonstrating significant balance problems and of proposing physical activity for this population. This goal corroborates the study by Barnet et al. (2003), which showed a significant increase in tests of balance, force, muscular resistance and agility when performing activity of daily living (ADL) and a decreased risk of falls after participating in a program of controlled physical exercise. These results corroborate those shown in Fig. 4.

The research of Zambaldi et al. (2007), which was performed among the elderly in a non-systematized and brief manner, used balance exercises. In their evaluation of the Borg balance score (BBS), they found an increase in the balance score (from a minimum of 34 and a maximum of 50 to a minimum of 42 and a maximum of 54), even though the program was not systematic and had no isolated strength work. Although the protocol used in the study involved the use of a stabilometer, these data indicate that while sedentary habits are associated with a reduction in balance, the practice of physical activity improves balance.

Elderly individuals who reside in retirement homes have their independence and autonomy in performing of functional activities impeded. The reduction of physical capacities, such as muscular strength, aerobic capacity and flexibility, are somatized by sedentary habits and directly influence the daily activities of these individuals by changing their gait and balance (Aveiro et al., 2004). These findings support the current study because, in addition to a reduction in balance, the functional autonomy level of the sedentary elderly individuals in the current study was below the ideal standard proposed by Vale (2005) for the GDLAM protocol.

There are various benefits to the practice of physical exercise as a means to promote healthy aging that have been mentioned in the literature. In a study performed among osteoporotic elderly women (osteoporosis is also common among long-term retirement homes), a significant improvement was found ($p < 0.05$) in balance, muscle strength and gait among after controlled physical activity (Aveiro et al., 2004).

In a meta-analysis of interventions performed among the elderly involving strength training, flexibility and resistance exercises, only those interventions that provided balance training showed a reduction in the fall index (Province et al., 1995). This result is consistent with the current study, which found a need for increased balance in the study population, suggesting a reduction in the difference in the distribution of the body's load among the lower limbs. The data presented by Alves Júnior and Paula (2008) support these findings.

The most important factor that affects dependence and the risk of mortality in elderly individuals is their ability to perform ADLs (Ramos et al., 2001). Considering that functional autonomy is associated with ADLs, the GI, which was used in this study and in previous studies (Andreotti and Okuma, 1999; Vale et al., 2003; Cromwell and Newton, 2004; Varejão et al., 2004), is ideal for measuring this factor among the elderly.

Using the GDLAM protocol, Cader et al. (2006) analyzed the functional autonomy profile of institutionalized elderly individuals and obtained the following results: W10m (13.39 s), SSP (13.07 s), PTS (15.70 s), SCMA (6.15 s), SCMA (76.60 s), and GI (47.32 s). According to Vale (2005), these results denote a weak level of functional autonomy. These results corroborate the data of the current study; in Fig. 2, the GDLAM tests show values that can be considered weak, although there was an improvement following the experiment.

Pereira et al. (2003) performed a study involving two philanthropic institutions. In both these institutions, the tests of functional autonomy showed weak results: W10m (13.71 s and 29.57 s); SPP (6.36 s and 10.00 s); and SSP (18.86 s and 20.21 s). These results indicate the same tendency that was observed in the present study because the residents of the institution in which the research was performed, as a philanthropic entity that does not receive any type of assistance or incentives from the federal or state government, also had weak values for functional autonomy. This weakness probably occurs because studying institutionalized elderly individuals is more complex than it seems; the individuals and the institution that houses them generally do not handle the complexity and the difficulties of senescence and senility by themselves, which results in a decrease in functional autonomy (Duarte and Pavarini, 1998; Pereira et al., 2005).

Aragão et al. (2002), DeVito et al., 2003, Hauer et al. (2002), King et al. (2000), Schlicht et al. (2001) and Vale et al. (2003) showed a significant increase in tests of functional autonomy after a program of physical activity among non-institutionalized elderly individuals. The current study of institutionalized elderly individuals found longer times for these tests, suggesting that elderly people who reside in their own home may be more active than those who live in an institution. This result shows the importance of training programs, such as the ballroom dance program, in elderly populations.

5. Conclusion

This study offered an important and unprecedented opportunity to use a stabilometer to assess the effects of a ballroom dance program on physical balance. Functional autonomy was also evaluated using the GDLAM protocol. This ballroom dance program led to an increase in the level of functional autonomy and in physical balance among institutionalized elderly individuals.

Conflict of interest statement

None.

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