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RESEARCH

Effects of dance on the postural balance, cognition and functional autonomy of older adults

Efeitos da dança no equilíbrio postural, na cognição e na autonomia funcional de idosos

Efectos del baile en el equilibrio postural, en la cognición y en la autonomía funcional de los ancianos

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ABSTRACT

Objective: to evaluate the postural balance, cognition and functional autonomy of older adults with dementia, who are long-stay inpatients, subjected to ballroom dancing. **Method:** simple randomized clinical study. Older adult sample: control group (30) and experimental group (30). The groups were subjected to the protocol of functional autonomy for activities of daily living; to the assessment of cognition (mini-mental state examination); and to the analysis of postural balance (stabilometric and postural platforms). The analysis of variance with repeated measures for group and time factors, and Scheffé's post hoc test were used, with significance of $p < 0.05$. **Results:** For the mini-mental state examination, the control group presented a 24.27 mean, and the experimental 22.75. Functional autonomy for activities of daily living – experimental: 54.47 ± 7.24 ($p < 0.0001$) x control: 61.77 ± 8.47 ($p = 0.011$). Postural balance – experimental: $\bar{X} = 3.16 \pm 3.44$ ($p = 0.02$) x control = $X = 6.30 \pm 7.62$ ($p = 0.04$). **Conclusion:** Ballroom dancing can be recommended for older adults to provide improvement in their balance and motor performance of the activities of daily living.

Descritores: Dance; Older Adults; Cognition; Postural Balance; Clinical Study.

RESUMO

Objetivo: avaliar o equilíbrio postural, a cognição e a autonomia funcional de idosos com demência, institucionalizados de longa permanência, submetidos **à** dança de salão. **Método:** estudo clínico randomizado simples. Amostra de idosos: grupo controle (30) e grupo experimental (30). Os grupos foram submetidos ao protocolo de autonomia funcional para atividades da vida diária; à avaliação da cognição (miniexame do estado mental); e à análise do equilíbrio postural (pedana estabilométrica e posturométrica). Fez-se a análise de variância, com medidas repetidas nos fatores grupo e tempo, e o post hoc de Scheffé, com significância $p < 0,05$. **Resultados:** O grupo controle apresentou no miniexame do estado mental média de 24,27, e o experimental 22,75. Autonomia funcional para atividades da vida diária – experimental: 54,47 ± 7,24 ($p < 0,0001$) x controle: 61,77 ± 8,47 ($p = 0,011$). Equilíbrio postural – experimental: $\bar{X} = 3,16 \pm 3,44$ ($p = 0,02$) x controle = $X = 6,30 \pm 7,62$ ($p = 0,04$). **Conclusão:** A dança de salão deve ser indicada para proporcionar melhora no equilíbrio e no desempenho motor nas atividades da vida diária de idosos.

Descritores: Dança; Idoso; Cognição; Equilíbrio Postural; Estudo Clínico.

RESUMEN

Objetivo: evaluar el equilibrio postural, la cognición y la autonomía funcional de los ancianos con demencia, institucionalizados de larga permanencia, sometidos al baile de salón. **Método:** estudio clínico aleatorizado simple. Muestra de ancianos: grupo control (30) y grupo experimental (30). Los grupos fueron sometidos al protocolo de autonomía funcional para actividades de la vida diaria, a la evaluación de la cognición (mini examen del estado mental), y el análisis del equilibrio postural (pedana estabilométrica y posturométrica). Se hizo el análisis de la varianza, con medidas repetidas en los factores grupo y tiempo, y el post hoc de Scheffé, con significancia $p < 0,05$.

Resultados: El grupo control presentó en el mini examen del estado mental promedio de 24,27, y el experimental 22,75. Autonomía funcional para actividades de la vida diaria – experimental: 54,47 ± 7,24 ($p<0,0001$) × control: 61,77 ± 8,47 ($p = 0,011$). Equilibrio postural – experimental: $\bar{X} = 3,16 \pm 3,44$ ($p = 0,02$) × control = $X = 6,30 \pm 7,62$ ($p = 0,04$). **Conclusión:** El baile de salón debe ser indicado para proporcionar una mejora en el equilibrio y el rendimiento motor en las actividades de la vida diaria de los ancianos.
Desciptores: Baile; Salud del Anciano; Cognición; Balance Postural; Estudio Clínico.

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INTRODUCTION

The aging process represents the loss of normal body functions from changes in cells and tissues, increasing the risk of diseases like dementia[1-2]. Dementia is the mental health problem that grows most rapidly, being a neurodegenerative disease characterized by progressive cognitive losses[3-4].

The older adult presents greater impairments of recent memory and, as the clinical picture evolves, impairments of the semantic memory occur, such as the difficulty to remember names and to speak, attention deficits, as well as visual-spatial and executive functions losses. Other deleterious effects that can be highlighted are the loss of postural balance, decrease in maximal oxygen consumption (VO_{2max}), progressive visual loss, weight loss, dementia, among other conditions[4-5].

These changes result in the reduction of the functional reserve of the sensory-motor systems involved in the mechanisms of postural, sensory, visual, somatosensory and vestibular balance, as well as reductions in the vascular tone and muscle strength, range of movements, biomechanical alignment and flexibility, and central processing[6-8].

In this sense, functional autonomy is an important element in the process of active aging by promoting the autonomy of older people and the right to their self-determination. These factors contribute to maintain their dignity, integrity and freedom of choice, being fundamental for the promotion of better health conditions[9].

However, older adults living in long-stay institutions (LSI) often present characteristics like social isolation and mental and physical inactivity. The needs of older adults indicate the need for activities involving social interactions, basic hygiene procedures and proper nutrition[10-12], since these features may lead to losses in functional ability, which predisposes to occurrence of falls and relapse[11-12].

In this sense, the regular practice of a physical activity can bring beneficial effects to the health of older adults by minimizing the use of medicines, allowing a broader movement in the admission environment, and expanding the interactions with other people[13].

Ballroom dancing is a physical activity capable of providing these positive changes in older adults[14-16]. In the study of Borges et al.[15], it was observed that ballroom dancing can contribute to improvements on the balance and functional autonomy of older adults living in long-stay institutions, given that it works by changing the body axis with its different back and forth movements and by shifting the body weight through leading movements.

In the therapeutic field, dancing is considered an alternative therapy that is receiving a lot more attention. The emergence of dance, in this context, was through studies that used it as intervention in the treatment of several diseases, such as Parkinson's[17], dementia[18], epilepsy[19], depression and anxiety. The studies are unanimous about the importance of ballroom dancing as a physical exercise and as an adjuvant therapy, assisting in the mental, emotional and physical well-being of the older adult[20-25].

Thus, this study is justified by the need to provide forms and methods to minimize the deleterious effects of aging, evidencing the positive benefits offered by physical activities, especially ballroom dancing.

OBJECTIVE

To evaluate the postural balance, cognition and functional autonomy of older adults with dementia, who are long-stay inpatients, subjected to ballroom dancing.

METHOD

Ethical aspects

This study met the standards for conducting research in human beings stated in Resolution No. 466, from December 12, 2012, of the National Health Council (Brazil)[26]. This research was referred to the Research Ethics Committee Involving Human Beings of the Universidade Castelo Branco, Rio de Janeiro (UCB/RJ).

Design, place and period of the study

This is a simple randomized clinical study conducted from August to October 2016. Older adults who were inpatients in LSI in Rio de Janeiro were invited to participate in the study.

Population or sample; inclusion and exclusion criteria

The inclusion criteria comprised individuals functionally autonomous in the performance of the activities of daily living (ADL) that were not practicing any regular physical activity for at least three months.

Were excluded from the study subjects who showed any type of condition that prevented them from performing the physical tests and the intervention, such as: heart diseases, arterial hypertension and non-controlled asthmatic bronchitis, osteoarthritis, recent fracture, tendinopathy and use of prostheses, neurological disorders, severe obesity and use of medicines that could cause disturbances of attention.

Study protocol

The diagnosis of dementia was made by a body composed by medical professionals who work at the institutions participating in this research. The sample was composed by 60 older adults randomly divided, through a simple draw, in two groups of equal number, one was the control group (CG, n = 30, age = 67 ± 7.29 years, BMI = 23.57 ± 3.06 kg/m^2) and experimental group (EG, n = 30, age = 66 ± 6.83 years, BMI = 24.51 ± 4.12 kg/

m^2). The groups were subjected to two evaluations, one before the intervention of the ballroom dance program, which was named "pre-test", and another immediately after the 12th week, which was named "post-test", to verify and quantify the effects of ballroom dancing in the study variables. The subjects were submitted to a physical evaluation that comprised the tests described below.

The study was conducted through the analysis of the cognition, functional autonomy, postural balance and the ballroom dancing program. Cognition was assessed through the assessment scale of the mini-mental state examination (MMSE), a screening mechanism of cognitive impairment that can be used in the detection of cognitive loss. This is the most used test around the world for being fast and easy, the average time of application are ten minutes and it does not require any specific material, using only the instrument proposed by Folstein[27].

The MMSE was developed by Marshal Folstein, Susan Folstein and McHugh[28] and translated by Bertolucci et al.[29]. This instrument is composed of seven categories designed to assess specific cognitive functions: orientation to time (5 points), orientation to place (5 points), registration of three words (3 points), attention and calculation (5 points), recalling the three words (3 points), language (8 points) and constructive visual capacity (1 point). The MMSE score ranges from zero to 30 points, and lower values indicate possible cognitive deficit. Values from 27 to 30 denote preserved cognitive functions; from 24 to 26, changes that do not suggest deficit; from 20 to 23, changes that suggest cognitive deficit. Scores from 20 to 26 represent mild cognition impairments; between 11 and 20, moderate cognition impairment; and scores under 10 represent severe cognition impairments[17-19]. However, MMSE scores suffer significant influence from the age and educational level of the individual, suggesting the need to use different cut-off points, because scores lower than 24 in highly educated individuals indicate possible dementia, as well as those lower than 18 in individuals with educational level equivalent to middle school and the lower than 14 for illiterate individuals[28-31].

The functional autonomy related to performance of the ADL was evaluated using the autonomy protocol of the Latin American Group for Maturity (GDLAM)[32], composed of five tests: a) walking 10 m (W10m): the individual walks a 10 m distance in a given time; b) rising from a sitting position (RSP): having his/her arms crossed in front of the body, the individual sits down and stands up from a chair five times when told to by the evaluator; c) rising from a ventral decubitus position (RDVP): the individual is told to rise from the floor as fast as possible, from the ventral decubitus position to the orthostatic position; d) putting on and taking off a t-shirt (PTTS): when told to by the evaluator, the individual must put on and take off a t-shirt in the shortest time possible; e) rising from a chair and moving around the house (RCMH): sitting with the feet off the ground, the individual must perform a triangle-shaped circuit, in which he/she will go around cones positioned three meters from the chair on the left-side and right-side diagonals and then sit in the same chair where the test started, the circuit must be done twice in the shortest time possible. After the tests, the values were processed using a mathematical formula to calculate the overall GDLAM index (GI).

The balance was evaluated using stabilometric and postural platforms. This instrument allows the force distribution system acting on the body weight to be observed and to find the center of gravity, checking the body balance in all positions (Figure 1).

The center of gravity of the lower limbs is located at a point in middle position in relation to two segments. While in vertical posture, center of gravity can shift, changing the distribution of body weight observed in the base of support of the platform. This base is given by a polygon close to a trapezoidal shape, which is formed at the side profile of the feet between the two lines that form, respectively, the front and the posterior region of the foot, 3 cm in front of the ankle (Figure 1).

The stabilometric platform is activated by load cells that instantly register weight changes and make the conversion of the analog signal, sending it to the computer, which reads the data using a software developed by Lizard (Italy, version 3.0). The data are encoded and sent by telemetry signal (Figure 1), through sensors installed on the load cells at the support base of the platform, where the soles of the feet are positioned. The measurement units are read in kilograms (kg). The cells are located on six pressure points, three on each platform, to analyze the forces acting in the plantar region of each foot. The values are given by the difference of values achieved in the distribution of body weight in the right and left sides between each pressure point, and between the mean total of all points (kg) (Figure 1).

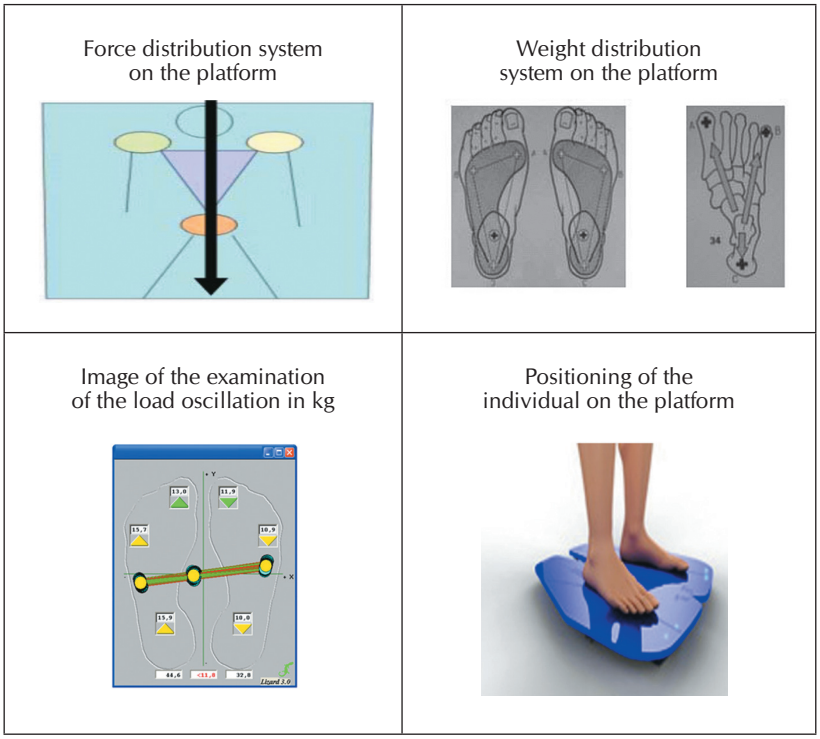

Figure 1 – Weight and force distribution systems on the platform. Load oscillation and positioning of the individual on the platform

The tests in the stabilometric and postural platforms were performed in a room with white walls and natural light, without contrasts or focuses. There was no noise during the exam. The distance from the wall until the platform was marked in three meters, and a walker was placed accounting for a possible imbalance of the participant. The tests lasted ten minutes. The evaluator was positioned behind the platform and after giving a signal, the participant centralized his/her feet according to the pre-existing marks on the platform. During the examination, the participant kept his/her eyes open in the horizontal direction.

The ballroom dance program consisted of 50-minute sessions and happened three times a week, on alternate days, for a period of 12 weeks. The musical rhythms were varied: foxtrot, waltz, rumba, swing, samba and bolero. The basic structure of the class were ten minutes of stretching, performing flexibility exercises and remaining static for ten seconds for every move, then, dancing to low intensity rhythms. The main part was developed with various musical rhythms at higher levels of intensity, of average effort, for 30 minutes. The session ended by relaxing for ten minutes, which was performed with low intensity rhythms[32]. The exercises were developed to provide security and motivation to the participants, based on a specific methodology of ballroom dance classes for older adults, according to the level of intensity of exercise, which was controlled by the subjective scale of perceived exertion[33].

The experimental group had 98% participation. Some participants missed classes due to medical appointments, and there were no withdrawals. The control group kept their daily activities over the entire period of the study. The participants of this group committed to not perform any systematic physical activity during the 12-week experiment, until the post-test was conducted. After this period, these older adults were invited to form another class of ballroom dancing.

Analysis of results and statistics

The data analysis was done using the software IBM SPSS Statistics (version 20 for Windows) and was presented as mean and standard deviation. The normality and homogeneity of data variance from the sample were analyzed by the Shapiro-Wilk and Levene tests, respectively. To verify the intra- and inter-group comparisons, the analysis of variance (Anova) was used, with repeated measures on the factors group (EG and CG) and time (pre- and post-test), followed by Scheffé's post hoc test to identify possible differences. The study considered a $p < 0.05$ value for statistical significance.

RESULTS

For the MMSE scale, the following cut-off scores were adopted, based on educational level: 17 for low educational level, until middle school, and 23 for high educational level. In Table 1, there are 13 older adults (43.34%) from the CG and 15 older adults (50%) from the EG with a score between 18 to 23 – according to the MMSE, equivalent to signs that suggest cognitive deficit – and education ranging from illiteracy to four incomplete years of schooling. We also note that 10 older adults (33.33%) from the CG and 9 (30%) from the EG that obtained from 24 to 26 points, according to the scale, with no changes suggesting cognitive deficit. In addition, 7 participants (23.33%) from the CG and 6 (20%) from the EG presented their cognitive functions preserved, with 27 to 30 points. All older adults were kept in the study due to participating in cognitive workshops and due to memory deficit complaints[28-29,34].

Considering the MMSE scale, the CG participants presented a mean of 24.27 points, and EG, 22.75, obtaining the minimum of 18 and maximum of 30 points, with amplitude of 12 points.

Table 2 shows the results for functional autonomy considering the GDLAM scale. In interferential analysis, we can verify that the EG obtained significant and satisfactory results, for both the intra-group analysis (RDVP, $p < 0.0001$; PTTS, $p = 0.003$; RSP, $p < 0.0001$; W10m, $p < 0.0001$; RCMH, $p < 0.0001$; GI, $p < 0.0001$) and inter-group comparison (RDVP, $p < 0.0001$; PTTS, $p = 0.022$; RSP, $p < 0.0001$; W10m, $p < 0.0001$; RCMH, $p < 0.0001$; GI, $p = 0.011$). The post-test results were reduced to perform the tests.

The series of GDLAM tests resemble the ADL and has been widely used in the evaluation of the functional autonomy of older adults[35-37].

Table 3 shows the data for body balance from the platform evaluations. In the inferential analysis of the comparison between the differences of weight shift, there is a significant reduction of the difference in the EG's post-test when compared to its pre-test ($p = 0.002$) and in relation to the CG's post-test ($p = 0.04$).

Table 1 – Distribution of older adults according to their score in the mini-mental state examination (MMSE) and education level, in the program Nursing in the Health Care for Older Adults and their Caregivers from the Universidade Federal Fluminense (EASIC/UFF/Niterói) and in the Municipal Hospital Miguel Pedro of Geriatrics and Gerontology (HGGMP), Rio de Janeiro, Brazil, 2014

Scores	n CG	n EG	Education level	% CG	% EG
Indication of cognitive deficit (23 points or less)	13	15	Illiterate to 4 incomplete years	43.34	50
Doubtful or no changes indicating deficit (24-26 points)	10	9	4 to 8 incomplete years	33.33	30
Preserved cognitive functions (27-30 points)	7	6	4 to 8 years or more	23.33	20

Nota: GE = grupo experimental; GC = grupo controle.

Table 2 – Functional autonomy analysis

		Experimental group		Control group	
		Mean	Standard deviation	Mean	Standard deviation
RDVP	pre-test	26.57	5.32	26.7	5.05
	post-test	17.96*#	4.35	27.02	5.08
PTTS	pre-test	21.79	4.09	21.8	3.89
	post-test	19.38*#	4.14	21.54	3.57
RSP	pre-test	26.38	4.56	27.02	4.21
	post-test	19.92*#	3.01	26.36	4.45
W10m	pre-test	21.67	6.22	22.54	4.73
	post-test	16.05*#	4.06	22.06	5.16
RCMH	pre-test	66.26	8.98	48.54	16.02
	post-test	47.69*#	16.03	48.48	15.11
GI	pre-test	61.48	8.5	62.39	8.33
	post-test	54.47*#	7.24	61.77	8.47

*Note: *p < 0.05; pre-test EG x post-test EG; #p < 0.05; post-test EG x post-test CG. RDVP: rising from a ventral decubitus position; PTTS: putting on and taking off a t-shirt; RSP: rising from a sitting position; W10m: walking 10 m; RCMH: rising from a chair and moving around the house; GI: general index.*

Table 3 – Body balance analysis

		Experimental group		Control group	
		Mean	Standard deviation	Mean	Standard deviation
Right side	pre-test	28.58	9.58	27.71	9.92
	post-test	28.16	9.35	28.09	9.90
Left side	pre-test	26.54	10.06	25.58	10.10
	post-test	26.02	7.35	26.01	10.23
Difference	pre-test	6.23	6.85	6.10	7.70
	post-test	3.16*#	3.44	6.30	7.62

*Note: *p < 0.05; pre-test EG x post-test EG; #p < 0.05; post-test EG x post-test CG.*

DISCUSSION

The functional autonomy in the ADL of the participants of this study showed significant changes ($p < 0.05$), and this result corroborates the findings of Conradsson et al.[38]. These authors evaluated a group of older adults who were inpatients and living in similar conditions to those from this research, they used the Katz Index to evaluate the ADL and verify the effects of a mild-intensity exercise program. In the same study, the exercise program promoted improvements in levels of the participants' mental state – which was also observed in our research through the use of the mild-intensity ballroom dance program, allowing us to infer that this type of activity also promotes positive changes in the ADL and in the mental health of the observed group.

Over time, complications regarding the functional autonomy and the mental impairment tend to increase, this was observed by Sjörlund et al.[39], who studied the functional autonomy in older adults of both sexes, aged 78 years or older, with dementia, whom received care through non-formal activities, such as dancing. These authors found that the incidence rate to increased loss of functional autonomy was greater in women. This marker was not analyzed in this study but was observed in the older individuals of the researched groups, showing the need to continuously provide motor and cognitive activities to individuals from this age group.

Still considering the impacts of musical stimuli on the brain, studies show that the sound performs significant actions involving cortical and subcortical areas, particularly the limbic and paralimbic areas, which are responsible for the perception and fabrication of emotions[40-42].

In the review performed by Raglio et al.[43], they identified that an approach using music in people with dementia is an effective and low-cost method that uses few drugs, promoting the reduction of behavioral disorders and stimulating the cognitive functions. These findings coincide with the observations about the group that was evaluated in this research.

Regarding the reports of falls and postural balance determined by Berg's Balance Scale (BBS), no significant difference was observed in three months, although studies in the literature report balance changes related to aging, like increased reaction time, more postural oscillations in the orthostatic position and decreased effectiveness of motor strategies of postural balance as the age advances[32].

On the other hand, it is known that the postural control system is considered a multifactorial and redundant mechanism, since even in the absence of information from one of the sensory systems (visual, vestibular or proprioceptive) is still capable of maintaining postural balance. Therefore, a reduction of sensory and musculoskeletal information is expected with aging, however, these changes may be too small to cause greater damage to the functionality of older adults[44].

Based on clinical experiences, Berg et al.[45] stated that a BBS score below 45 indicates impairments to balance and is related to an increased risk of falls. We observe that the older adults evaluated in this research obtained higher scores, similar to other studies that evaluated older adults from a community without reports of falls[46]. In addition, the participants evaluated did not show changes related to postural balance within three months, thus, we can assume that they used strategies to maintain adequate balance in the tasks required by the tests of the scale used.

The study of Hernandez et al.[7] sought to evaluate the performance of body balance and cognition among older adults with different lifestyles. Regarding the level of cognition, the results showed a significant difference between those who socialize and engage in some sort of activity and those who live solitarily, away from the family and that do not practice any physical activities. The first group showed a lower education level than the second, which is reflected in the low scores obtained in the MMSE test. Other studies[30] indicate 17 points as the minimum score for older adults with low education level. This shows, very clearly, that institutionalization leads to the loss of cognitive capacity and that the lack of incentives for

intellectual activities also affect the development of memory and reasoning negatively.

Lower scores obtained by the inpatient group can be explained by the lower education level and institutionalization, which critically contribute to cognitive deterioration[47]. The practice of physical activity improves the cognitive function of older people[7]. Despite this, the older adults of the group 1 have no incentives to regularly practice physical activity controlled by health professionals, despite the existence of laws and practical measures for the older population, such as the *Política Nacional de Saúde da Pessoa Idosa* (National Health Policy for Older Adults) from 2006[48], and the *Estatuto do Idoso* (Statute of Older Adults) from 2003.

In the specific case of the city of Patos de Minas, Minas Gerais, and of the project *Unipam Sênior*, we noted that the implementation of public policies for institutionalized older adults has not received proper attention from the public authorities, which is evidenced by the comparison of the MMSE scores and by the evaluation of body balance through the BBS, of group 1 in relation to group 2. Usually, institutionalized older adults have little offer of physical activity (or almost none), which can aggravate the vicious cycle: aging, sedentary lifestyle and functional capacity deficit. Regarding the older adults who are members of the *Unipam Sênior* project, which offers activities in the most diverse areas, such as dance classes, water aerobics, handcrafts and computing, we can observe that they maintain a good performance and are always encouraged to develop activities[49].

The older adults who showed results with the lowest scores reported cases of dementia in the family. The participants were instructed on the benefits of an early diagnosis, as discussed in this study, and on the importance of participating in activities to stimulate cognition stimulation[28,50].

Study limitations

Withdrawals from older adults were considered as a limitation of this study, they were encouraged to stay in the research. Despite this limitation, the objective was reached and presented in the results.

Contributions to the field of nursing, health, or public policy

Dance is considered as a form of health promotion, in which the care performed by the professional, particularly of nursing, must encourage this practice with the goal of connecting the body and mind. This method has worked as a channel to express feelings and desires, thus, contributing to the confrontation of taboos, myths and social prejudices related to aging.

CONCLUSION

From the results found in this study we can observe that the individuals from the EG, when subjected to the ballroom dance program, showed improvement in their levels of functional autonomy for the ADL and improvement in their mental state when compared to the CG, which did not underwent any intervention.

Therefore, we suggest that ballroom dancing should be recommended to provide improvement in balance and motor performance in the ADL in older individuals. In addition, it is a form of prevention and control of complications from dementia and motor diseases already existing in the older patient.

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