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Revisiones

Effects of dance on balance in Parkinson's disease: A Systematic Review with Meta-Analysis

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ABSTRACT

The objective of this study was to investigate whether dance classes are effective in improving balance in people with Parkinson's Disease (PD), when compared to other groups with or without interventions, in Randomized Clinical Trials (RCTs), through a Systematic Review with meta-analysis. A search was conducted in MEDLINE, LILACS, Cochrane, PEDro, PsycINFO and Google Scholar in April 2020. RCTs that analysed dance effects in comparison to other physical training types or to no intervention on balance of people with PD, were selected. Two independent reviewers selected the studies, extracted the data and conducted the risk of bias evaluation. Three studies were included, totalling 126 participants. Tango showed an improvement in the dynamic balance compared to non-intervention. Irish dance showed no improvement in balance. This study indicates that dance, more specifically tango, improves the dynamic balance of people with PD.

Keywords: Dancing; Parkinsonian disorders; Postural Balance.

Efectos de la danza sobre el equilibrio de personas con la enfermedad de Parkinson: una revisión sistemática con metaanálisis

RESUMEN

El objetivo de este estudio fue investigar si clases de danza son efectivas para mejorar el equilibrio en personas con enfermedad de Parkinson (EP), en comparación con otros grupos con o sin intervenciones, en Ensayos Clínicos Aleatorizados (ECAs), mediante una revisión sistemática con metaanálisis. Una búsqueda fue realizada en MEDLINE, LILACS, Cochrane, PEDro, PsycINFO y Google Scholar en abril de 2020. Fueron seleccionados ECAs que analizaban los efectos de la danza en el equilibrio de personas con EP comparados a otros tipos de entrenamiento físico o sin intervención. Dos revisores independientes seleccionaron los estudios, extrajeron los datos y realizaron la evaluación del riesgo de sesgo. Se incluyeron tres estudios, totalizando 126 participantes. El Tango demostró mejora en el equilibrio en comparación con no intervención, mientras que, la danza irlandesa no demostró mejora. Este estudio indica que la danza, más específicamente tango, mejora el equilibrio dinámico de las personas con EP.

Palabras clave: Baile; Enfermedad de Parkinson; Equilíbrio Postural.

Efeitos da dança no equilíbrio de pessoas com doença de Parkinson: uma revisão sistemática com meta-análise

RESUMO

O objetivo deste estudo foi investigar se aulas de dança são eficazes na melhoria do equilíbrio em pessoas com Doença de Parkinson (DP), quando comparadas a outros grupos com ou sem intervenções, em Ensaios Clínicos Randomizados (ECRs), através de uma Revisão Sistemática com metanálise. Uma busca foi realizada no MEDLINE, LILACS, Cochrane, PEDro, PsycINFO e Google Scholar em abril de 2020. Foram selecionados ECRs que analisaram os efeitos da dança no equilíbrio de pessoas com DP comparados com outros tipos de treinamento físico ou sem intervenção. Dois revisores independentes selecionaram os estudos, extraíram os dados e conduziram a avaliação do risco de viés.

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Três estudos foram incluídos, totalizando 126 participantes. O tango mostrou uma melhora no equilíbrio dinâmico em comparação com a não intervenção. A dança irlandesa não apresentou melhora no equilíbrio. Este estudo indica que a dança, mais especificamente o tango, melhora o equilíbrio dinâmico de pessoas com DP.

Palavras-chave: Dança; Doença de Parkinson; Equilíbrio Postural.

Introduction

Parkinson's disease (PD) is a progressive neurodegenerative disorder of the extrapyramidal system, of unknown origin [1,2]. Cells of the substantia nigra are affected, and the production of dopaminergic neurons located in the basal ganglia is reduced. It is the second most prevalent neurodegenerative disease of the entire central nervous system, second only to Alzheimer's disease [3] and its average age of onset is 55 years [4].

Drug therapies together with other interventions are known to alleviate PD symptoms. According to the literature, practicing physical exercise is considered an effective complementary therapy in PD treatment [5-7]. According to Friedman et al. [8], numerous therapeutic activities have been proven to be beneficial for PD, such as occupational therapy, relaxation, dance, music therapy, walking, game recreation, psychotherapy, and tai chi.

Dance classes have been shown to enhance motor parameters, such as balance, in different populations [9-14]. Dancing requires constant weight transfers at different rhythms, together with changes in direction [15]. Therefore, dance classes might be a very effective strategy to treat Parkinson's symptoms, since the movements involved promote balance improvement [16,17].

The study aimed to investigate whether dance classes are effective at improving balance in people with PD, when compared to other groups with or without intervention, in Randomized Clinical Trials (RCTs), through a Systematic Review with meta-analysis.

Methods

This study is a systematic review with meta-analysis, following the recommendations proposed by the Cochrane Collaboration [18] and by the Preferred Reporting Items for Systematic Review and Meta-Analyses: The Prisma Statement [19]. The present is registered in the International Prospective Register of Systematic Reviews (PROSPERO) with number CRD42019146477.

Eligibility Criteria

This systematic review included RCTs that analysed balance in people with PD, of both genders, over 50 years of age, in which intervention groups were exposed to any type of dance class and were compared with control groups exposed to other activities or no intervention. We included RCTs that presented any kind of dance intervention and there was no restriction on intensity, duration of session or weekly frequency. Only studies published in English, Spanish and Portuguese were included. Duplicate articles and substudies were only included once. Abstracts or extended abstracts published from conferences, theses, dissertations, or studies not yet published in journals were not included.

Study Search and Selection Strategy

In April 2020, we conducted an unrestricted period search using the MeSH and entry terms of the words "Dancing", "Parkinson's Disease" and "Postural Balance", and a specific filter for randomized clinical trials, in the following databases MEDLINE, LILACS, Cochrane, PEDro, PsycINFO and Google Scholar.

Two independent (R.G.D. and M.S.D) reviewers selected the studies, in two phases. First, based on reading of the titles and abstracts, looking for the eligibility criteria. After which, the selected articles were read in full by the same independent reviewers who followed standard criteria to determine their inclusion or exclusion. Any disagreement between the two reviewers was decided by a third reviewer (A.N.H.). The reviewers were not blinded to authors, institutions or manuscript journals. When necessary, the corresponding author was contacted to obtain unpublished data.

Evaluation of study characteristics and methodological quality (risk of bias)

Two independent, blinded reviewers (R.G.D. and M.S.D.) conducted standardized data extraction considering the following characteristics of the studies: title; authors and date; objectives; design; type of intervention; class attendance and duration; sample size; gender; age; follow-up duration; between-group comparisons; and means, medians, and standard deviation of balance values as the evaluated outcome.

The included studies were assessed for risk of bias (methodological quality) by the same two independent reviewers, through the items proposed by Cochrane [20]; randomization method, allocation concealment, patient and therapist blinding, outcome evaluation blinding, incomplete outcomes, selective reporting of outcomes and other possibilities bias sources. The items were defined as high risk of bias, low risk of bias or unclear risk of bias.

Data synthesis and analysis

Due to similarities in the methodological characteristics of the studies found, a meta-analysis was conducted for the balance outcome. Pooled effect estimates were computed based on changes in the: mean scores between baseline and end of the intervention; standard deviations (SDs); and the number of participants. Statistical heterogeneity of treatment effects between studies was assessed using the Cochrane Q-test and I^2 Inconsistency test. Forest plots were generated to present the effect size through the standardized mean difference, calculated with a 95% confidence interval. The random effects model was applied. All analyses were performed using Comprehensive Meta-Analysis version 3.3.070 and values of $\alpha \leq 0.05$ were considered statistically significant.

Results

Study Identification

Of the 67 articles found in the MEDLINE, LILACS, SciELO, Cochrane and PsycINFO databases, after removing the duplicates, 25 were left. After reading titles and abstracts, 13 were excluded because the sample did not include people with PD, or because they were not RCTs. Afterwards, the 12 remaining RCTs were read in full, and 9 were excluded because they did not meet the eligibility criteria. Three RCTs

Table 1. Summary of the characteristics of the studies

Study	Intervention	Participants	Stage of Disease (H&Y)	Characteristics of sessions	Outcome Measures
Duncan and Earhart (2012)	Tango versus no intervention	Total = 52 Tango group (n = 26; age 69.3 ± 1.90) Control group (n= 26; age 69.0 ± 1.5)	Tango group (2.6 ± 0.1) Control group (2.5 ± 0.1)	2 lessons per week 1h 24 weeks	Balance (Mini-BESTest)
Rios Romenets et al. (2015)	Tango versus no intervention	Total = 33 Tango group (n= 18; age 63.2 ± 9.9) Control group (n = 15; age 64.3 ± 8.1)	Tango group (1.7 ± 0.6) Control group (2.0 ± 0.5)	2 lessons per week 1h 12 weeks	Balance (Mini-BESTest)
Shanahan et al. (2017)	Irish Dance versus no intervention	Total = 41 Tango group (n= 20; age 69.3 ± 1.9) Control group (n= 21; age 69.0 ± 1.5)	Tango group (2.6 ± 0.1) Control group (2.5 ± 0.1)	1 lesson per week + home lessons 1.5h class / 20 min home 10 weeks	Balance (Mini-BESTest)

met the eligibility criteria and were included in this review. Figure 1 shows the flowchart of studies included in this review.
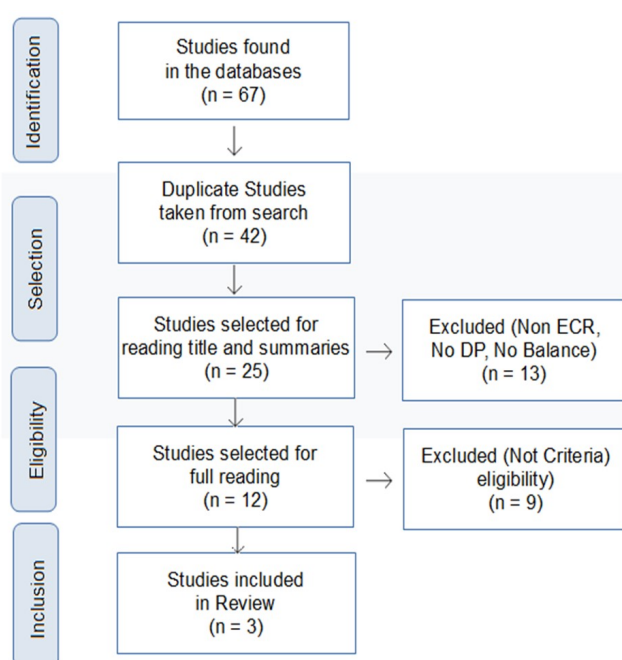

Figure 1. Flowchart diagram of articles selection process

Characteristics of included studies

The three studies included in the review compared a dance class intervention group with a control group. Two studies [16,17] used tango classes as an intervention, and one study used Irish dance classes [21]. A total of 126 people with PD participated in the studies, 64 in the intervention groups and 62 in the control groups. Table 1 presents the characteristics of the included studies.

The study of Duncan and Earhart [16] aimed to determine the effects of a 12-month tango program on disease severity and physical function in people with PD. The participants were randomized to the intervention (n = 26), or to the control group without intervention (n = 26). Participants were evaluated before the intervention, and after 3, 6 and 12 months. Balance was assessed using the Mini-BESTest. There were significant group-by-time interactions for Mini-BESTest results, and balance scores in the Tango group at 3, 6, and 12 months were significantly better than control scores.

The study by Rios Romenets et al. [17] also evaluated an intervention with Argentine tango classes for people with PD twice a week for 12 weeks. The participants were randomized in two groups:

tango classes group (n=18), and control group (n=15). Balance was assessed using the Mini-BESTest. The results showed that balance improved in the tango group compared to controls.

The study by Shanahan et al. [21] analysed the effects of Irish dance intervention in people with PD. The intervention involved one and a half hours of dance classes a week for 10 weeks. The intervention group should, in addition to classes, conduct a home dance program for 20 minutes three times a week. The control group continued with their usual care and daily activities. Ninety participants were randomized (45 in each group). Balance was assessed using the Mini-BESTest. There were no significant changes in balance after the intervention.

The results of the first two studies were included in the meta-analysis. However, the balance data from the study by Shanahan et al. [21] were presented using medians and not means. Although the authors were contacted by e-mail in order to obtain the data (in means), no answers were obtained, making their inclusion in the meta-analysis unfeasible.

Methodological Quality (Risk of Bias)

Regarding the methodological quality, the three RCTs included in this review had low risk of bias - between 4 and 5 points. All three were randomized, presented adequate randomization sequence generation, and reported allocation concealment. Only one study blinded both participants and therapists, due to the technical difficulty of doing so in intervention studies. All the studies blinded the evaluators, showed follow-up and intention to treat. Thus, the studies were considered of high methodological quality, which strengthens the analysis of the present research.

Balance outcome analysed for tango-based intervention versus no intervention

A meta-analysis was performed for dynamic balance outcome, using the two studies that presented similar methodologies and they proposed the same dance gender intervention [16,17]. It was decided to divide the study by Duncan and Earhart [16] in two parts, due to the way the evaluations were performed (at 3, 6 and 12 months) and also to verify if the dance intervention provided improvements with a longer intervention time. Thus, the results from the 3 and 12 months of intervention were analysed separately.

Figure 2 shows the balance measurements in the two RCTs analysed using the Mini-BESTest in a total of 85 participants.
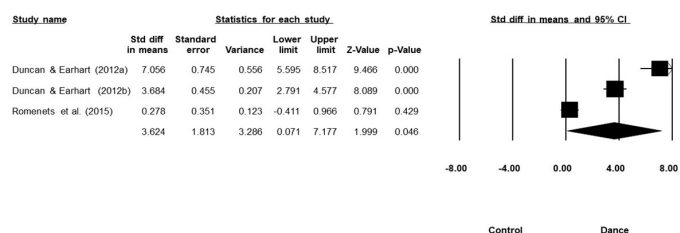
Figure 2. Standardized mean differences of balance promoted by dance versus control (no intervention)

To measure balance, the three studies Duncan and Earhart a [16], Duncan and Earhart b [16] and Rios Romenets et al. [17] . Figure 2 shows that dance is associated with improvement of 2.53 points in balance compared to control groups (no intervention) (ES = 3.624, 95%CI 0.071 to 7.177, p = 0.046, I^2 = 98%). The analysis of publication bias showed no significant bias (p = 0.249).

Discussion

This systematic review investigated whether dance classes are effective at improving balance in people with PD, when compared to other groups with or without intervention, in Randomized Clinical Trials (RCTs), through a Systematic Review with meta-analysis. A significant increase in the balance of people with PD who participated in the tango-based intervention group was detected when compared with the control group without intervention.

Thus, tango-based intervention was shown to be effective in improving balance, even with a short intervention time (3 months). The study by Duncan and Earhart [16] further demonstrates that the benefits of tango intervention increase over time, suggesting that this dance genre offers constant stimuli that may assist in improving dynamic balance.

Balance is the ability to maintain the body on its support base, whether stationary or moving [22] . Balance can be subdivided into two categories: static and dynamic [23] . In the standing position, on both feet, the body swings on its support base. Static balance, therefore, involves controlling the swaying body when the individual is standing still [24] . Dynamic balance, in turn, involves body movements and the ability to perform them without major oscillations. The studies included in this review specifically investigated dynamic balance in people with PD, as they tend to have difficulty maintaining stability.

Postural instability and impaired balance, common symptoms in people with PD, lead to a higher risk of falls [25-27] and negatively impact quality of life [28] , thus decreasing functional independence. Therefore, improved dynamic balance in people with PD increases functional capacity and facilitates activities of daily life [29] .

In the study by Hackney and Earhart [30] , dance practice was found to provide better movement control and improved balance. Their findings demonstrate the severity of Parkinson's symptoms was reduced as shown by the significant improvement in step length, movement speed, and fewer freezing gait episodes. The results of the present review corroborate those reported in this study.

Tango classes, as used in both of the included studies [16,17] , involve wide dance steps, which require the student to occupy considerable space in the room. Moving around a large area allows the support base to generate successful postural adjustments and avoid imbalance [31,32] .

Tango stimulates multidirectional movements, elongated steps and spinning turns, which allow the dancer to remain with one foot on the floor while the other performs specific steps using in tango classes, as "ganchos" and "boleos", usually, calling as "decorations". These movements could increase postural stability and dynamic balance [33] . Other stimuli offered by tango classes include: the couple "embrace"; the forward-leaning stance, with the couple forming a triangle in relation to the floor; the constant shifting of body weight;

and an imposing attitude while walking, which is one of the parts of tango technique [34] .

However, Shanahan et al. [21] , who used the Irish dance intervention, found no significant improvements in dynamic balance. Irish dance has different characteristics from tango, it is individual (not in pairs), the upper body remains static, and the steps are short and fast, with small jumps and constant weight shifts.

It is speculated that compared to Irish dance, in tango the performer spends more time supported on one foot (unipodal balance), because the "decorations" only involves one leg, while the other serves as a support, and the steps are longer, extending the leg as much as possible. Thus, tango would be more effective in improving balance, since it reduces body stability and increases body sway, requiring the control system to make more corrective movements to maintain balance [35] .

The results of this study are clinically relevant. However, they must be viewed in light of the following potential limitations. The analysis of balance revealed a high degree of heterogeneity, the source of which we were unable to identify using sensitivity analysis or meta-regression, due to low number of eligible studies. In addition, like all reviews, meta-analyses are limited by the data available or obtainable.

On the other hand, some strengths should be highlighted. The two included RCTs have high methodological quality, as they completely fulfil the criteria in the risk of bias assessment. The relatively large number of participants included (85 participants) enhances the power of the analyses, and, to a certain extent, compensates for the scarcity of studies that provide reliable evidence of the benefits of tango-based intervention in the balance of people with PD. This approach allowed us to better estimate the effectiveness of therapeutic interventions and provide suggestions for further quantitative studies based on literature reviews.

Conclusion

The present systematic review with meta-analysis indicates that dance, specifically tango, improves the dynamic balance of people with PD. These gains are important for these populations, due to the impact that motor symptoms cause in their activities of daily life and quality of life.

This study provides new insights and evidence to show a tango-based intervention, as a complementary therapy, is effective in improving dynamic balance in people with PD. The improvement in dynamic balance, which occurs as a result of tango classes, can ameliorate motor symptoms, preventing falls, and improving quality of life and activities of daily life.

It is suggested that more RCTs need to be conducted to investigate balance in people with PD, using interventions based on dance genres other than Tango.

Award id

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