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EFFECTS OF DANCE IN PATIENTS WITH PARKINSON: SYSTEMATIC REVIEW

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Abstract. The aim of this review was to find out the effects of different dance programmes on the improvement of symptoms and quality of life in patients with Parkinson's disease (PD), as well as to determine the possible differences depending on the type of dance modality used. A systematic review of different dance programmes was carried out in three databases (Google Scholar, Pubmed and Dialnet). We included 14 trials with a total of 469 participants and evaluated different dance modalities, which showed favourable results on motor function, cognitive function and quality of life in people with PD. The modality of tango, followed by samba, seems to be the most suitable for this type of disease, producing greater improvements in balance, speed of movement and gait pattern, due to its variety of movements and characteristic marked rhythm. However, the two most challenging dances were the waltz and the cha-cha-cha, due to the crossing of the feet, changes of direction and less grip. Although there is a need for continued research and longer programs, the analysis of results suggests that dancing can be an effective treatment for PD patients, as there is a decrease in symptoms and therefore an improvement in quality of life.

Keywords: Physical activity, dance, Parkinson disease, quality of life, and health.

EFECTOS DEL BAILE EN PACIENTES CON PÁRKISON: REVISIÓN SISTEMÁTICA

Resumen. El objetivo de esta revisión fue conocer los efectos de distintos programas de baile en la mejora de los síntomas de pacientes con enfermedad de párkinson (EP), así como determinar las posibles diferencias en función de la modalidad de baile a utilizar. Se llevó a cabo una revisión sistemática de diferentes programas de baile en tres bases de datos (Google académico, Pubmed y Dialnet). Se incluyeron 14 ensayos con un total de 469 participantes y se evaluaron distintas modalidades de baile, los cuales mostraron resultados favorables en la función motora, cognitiva y calidad de vida de las personas con EP. La modalidad del tango, seguida de la samba parece ser la más idónea para este tipo de enfermedad, produciendo mayores mejoras en el equilibrio, velocidad de movimiento y patrón de marcha, debido a su variedad de movimientos y característico ritmo marcado. Sin embargo, los dos bailes más desafiantes fueron el vals y el cha-cha-cha, debido al cruce de los pies, cambios de dirección y menor sujeción. A pesar de existir la necesidad de una continua investigación y programas de mayor duración, el análisis de resultados sugiere que el baile puede ser un tratamiento efectivo en pacientes con EP, ya que se aprecia una disminución de los síntomas y por lo tanto una mejora de la calidad de vida.

Palabras clave: Actividad física, danza, enfermedad de Párkinson, calidad de vida y salud.

Introduction

Parkinson's disease (PD) is a progressive neurodegenerative disorder that affects dopamine-producing cells in the substantia nigra, within the basal ganglia (Lötzke et al., 2015; Poewe et al., 2017; Pereira et al., 2019). Other cell groups in the central and peripheral autonomic nervous system are also affected. It is the second most common neurodegenerative disorder in the elderly and it is projected that by 2030 more than 9.3 million people will be diagnosed (Poewe et al., 2017). Given its epidemiological importance, the disease can be considered a public health problem (Tillmann et al., 2017). Its main clinical diagnosis is based on bradykinesia, referred to as slowness and difficulty in moving (Lötzke et al., 2015; Poewe et al., 2017).

This disease is associated with deficits in motor, cognitive, and emotional domains, impairing the quality of life of people who suffer from it (Ventura et al., 2016). Among the main motor symptoms are postural instability, tremors, lack of balance, as well as difficulties in the gait pattern, symptoms highly related to falls in this type of population, which generate devastating consequences, such as hip fractures, immobility, reduced quality of life and high medical expenses (Duncan & Earhart, 2014; Lötzke et al., 2015). Freezing of gait is the motor deficit that promotes the highest risk of falls in PD patients, potentially causing death or even psychological trauma resulting in fear of further falls (Pereira et al., 2019). Regarding non-motor symptoms, according to Bognar et al., (2017), fatigue, cognitive changes, as well as mood disorders are noteworthy. People with PD also cope with psychosocial aspects of chronic diseases, such as social isolation, decreased self-efficacy, and depression, affecting these symptoms to health-related quality of life (Sharp & Hewitt, 2014; Bognar et al., 2017).

It should be noted that as the disease progresses, the person's ability to perform activities of daily living (ADLs) may be impaired, leading to dependence on others (Foster et al., 2013). As mentioned above, the risk of falls is present in the lives of these people, so postural instability is a major risk factor for disability, worsening their health and leading to an increased risk of long-term hospitalization (De Natale et al., 2017).

More than half of the general population does not achieve the recommended daily levels of physical activity, and activity levels in people with Parkinson's disease are lower than in healthy older adults (McNeely et al., 2015b). Currently, sedentary lifestyles are a leading cause of death, as well as a high-risk factor for many chronic diseases, making this a major problem (McNeely et al., 2015b). (Kruk, 2014). This has become a global public health problem in the 21st century (Kruk, 2014; Gaetano, 2016). It is therefore necessary to raise public awareness of the negative effects of physical inactivity on health and the development of diseases (Gaetano, 2016). Participation in physical-sports activities is positively correlated with functional status and life satisfaction. (Foster et al., 2013). It also protects against physical and cognitive deterioration as people get older, this aspect being more relevant in people with Parkinson's disease. (Foster et al., 2013).

Often people with PD reduce their level of physical activity due to impaired mobility, fear of falling, or low outcome expectations (Lötzke et al., 2015). However, physical activity has been an effective adjunct to PD treatments, but sometimes the practice of some activities or exercises may not be sufficiently engaging or socially appealing (Duncan & Earhart, 2014). Consequently, approaches to therapies for people with Parkinson's disease aim to counteract the physical impairments and impairments of the disease, but often do not take into account what kind of exercises or activities are interesting for the target group and how to increase long-term participation (Lötzke et al., 2015).

Therefore, according to Duncan & Earhart, (2014), it is necessary to look for innovative activities that arouse the interest of the target group. To this end, dance can be seen as a nonpharmacological alternative (Bearss et al., 2017), as older adults believe that dance is more enjoyable than traditional exercise, and in turn promotes adherence and motivation (Duncan & Earhart., 2014).

Since ancient times, dance has had a therapeutic connotation, which today is still present in some cultures (Valverde Guijarro & Flórez García, 2012), keeping this discipline related to wellness and different healing rituals, tracing these aspects to the history of mankind. (Kalyani et al., 2019). Nowadays, dance is considered a form of expression and movement that contains elements of rhythm and corporal action. (Sanchez et al., 2011). It is characterized by its way of exercising the body and mind simultaneously, activating the organism to optimal effort thresholds and stimulating the memory by remembering certain sequences. (Sanchez et al., 2011). Nowadays, dance is also understood as a form of expression and/or communication in many societies around the world. (Kalyani et al., 2019).. However, there is great ignorance about the contributions of dance in the health and quality of life of people, not only physically but also psychologically (Sanchez et al., 2011).

Dance is a physical activity that can challenge gait and balance impairment in people with PD. Many dance styles include walking as a primary step, which encourages task-specific practice. Dynamic balance challenges are often incorporated into dance, as the subject has to adapt to a constantly changing environment while moving (Duncan & Earhart, 2014). Dance can improve motor and cognitive performance, as well as facilitate long-term physical activity compliance because it incorporates exercise and socialization which helps motivate individuals with PD to engage in physical activity. (De Natale et al., 2017; (Prewitt et al., 2017).

As an enjoyable activity, dance combines a number of factors that benefit PD patients through: auditory cues, aerobic and strength exercises, stretching, and a supportive social community (Sowalsky et al., 2017). This is a multidimensional activity that offers auditory, visual, and sensory stimulation, as well as a musical experience, increased social interaction, and enhanced motor development (Sharp & Hewitt, 2014). Tillmann et al., (2017), state that activities that have a cultural aspect to the population in question, and are enjoyable, allow participants to engage in the long term. According to McNeely et al., (2015b), the contributions of this discipline to patients suffering from Parkinson's disease can generate numerous benefits when it comes to counteracting their symptoms, and thus improving their quality of life.

It is necessary to emphasize that music plays a primordial role in dance, being one of the most universal forms of expression of humanity (Welch et al., 2020). It is present in the daily lives of people of all ages and from all cultures around the world (Welch et al., 2020). When the body is in movement, and we follow a music, a relationship between both is created, because our body seeks to accompany that rhythm and the music facilitates the realization of controlled and rhythmic movement. (Sanchez et al., 2011). Movement therapy based on dance and music for patients with PD combines cognitive movement strategies, balance, and physical activity, while focusing on the enjoyment of movement to the rhythm of the music. (Lötzke et al., 2015; Fragnani & Bezerra, 2018).

Each discipline and/or style of dance presents different characteristics and qualities; however, the contributions of each of them in patients with PD are currently unknown, as well as the lack of consensus on the durations of dance classes and whether any particular modality generates greater benefits with respect to others (Bearss et al., 2017).

Therefore, the objective of this review is to determine the benefits of a dance program in patients with Parkinson's disease, as well as to determine if there are differences depending on the dance modality used.

Method

A systematic review was carried out, conducting the search during the months of February and March 2020. The following databases were used to explore the articles: Google Scholar, Pubmed, and Dialnet. The Spanish keywords used for the search were: "danza", "párkinson", "baile terapéutico", "tango en párkinson" and "enfermedad de párkinson", as well as the English terms: "dance", "Parkinson", "therapeutic dance", "tango in Parkinson" and "Parkinson disease".

As for the inclusion/exclusion criteria, we selected those articles no more than 10 years old and those that related Parkinson's disease to different dance programs and their benefits.

A total of 61 articles were identified in the initial search. After a first analysis, 4 articles that were repeated were eliminated, leaving 57 articles for further screening. After title/abstract analysis, 13 records were eliminated, leaving 41 articles selected for full-text analysis. Fourteen studies were included, which met the inclusion/exclusion criteria. In this last analysis, 3 articles were discarded because they did not meet the inclusion criteria.

Results

In total, 469 participants (233 women and 236 men) were analyzed in the studies present in this review. Table 1 describes the objectives of each intervention, participants, scales used, methodology, and main results. Of these, seven articles investigated the effects of dance on PD using only one dance modality; tango (Duncan & Earhart, 2012; McKay et al.,2016; Holmes & Hackney, 2017; Rawson et al., 2019; Poier et al., 2019), dance therapy (Michels, et al., 2018) and Thai dance (Khongprasert et al., 2012). The rest of the studies used more than one style of dance; Latin, ballroom, ballet, jazz, contemporary, or Zumba (Hackney & Earhart, 2010; Heiberger et al., 2011; Hashimoto et al., 2015; Delextrat et al., 2016; Kunkel et al., 2017; Hulbert et al., 2017; Kunkel et al., 2018). Two studies compared during their intervention a dance program with another type of physical activity; tango, stretching, and treadmill (Rawson et al., 2019) tango and Tai Chi (Poier et al., 2019). All interventions had objectives focused on finding benefits at the level of motor control, cognitive functions, and quality of life.

Table 1
Selected studies on dance programs in Parkinson's disease patients

Article	Target	Participants	Scales used	Methodology	Results
(Hackney & Earhart, 2010)	To determine the effects on balance and mobility of people with Parkinson's disease when dancing with and without a partner.	39 participants, with a minimum age of 40 years old Women (n=11) Men (n=28) Divided into two groups: dancing with a partner and dancing without a partner. Partner dancing (N= 19) Dance without partner (N= 20)	Berg Balance Scale (BBS) Timed Up and Go	Participants received 1 hour of dance class, 2 times per week for a period of 10 weeks. Pre- and post-intervention testing	Better results were demonstrated in both groups on the Berg Balance Scale (BBS), as well as improvements in mobility. However, the unpaired dance group obtained higher results in lower limb mobility.
(Heiberger et al., 2011).	The effects of dance on motor control in individuals with PD and on quality of life.	11 participants Ages between (58-85 years) Women (n=6) Men (n=5)	Accelerated Timing Test (TUG) Test Semitandem (SeTan) Quality of Life Scale (QOLS)	Participants received ballet, jazz, and contemporary dance classes 1.5 hours a week for 8 months. Analyses were performed before and after the intervention.	There were improvements in stiffness scores, followed by improvements in hand movements, finger movements, and facial expression. No significant changes were found in TUG or SeTan. The questionnaires showed positive effects of dancing in the lives of the participants.

(Khongprasert et al., 2012).	To determine the impact of a Thai dance program on mobility and quality of life in patients with Parkinson's disease.	21 participants Men (n=10) Women (n=11)	Timed Up and Go Test (TUG) 8-item Parkinson's Disease Questionnaire (PDQ8)	Participants received a Thai dance program 3 times per week (1 hour each session), for 12 weeks. Functional mobility and quality of life were assessed before and after the intervention.	Significant improvements of 4" in the TUG test. It was found that participants significantly improved PDQ8, claiming to improve their quality of life.
(Duncan & Earhart, 2012)	To determine the effects of a tango program for individuals with PD.	62 participants Men (n=35) Women (n=27) Experimental group (EG) N=32 Control group (CG) N=30	Motor symptoms of the disease (MDS-UPDRS-3) MiniBESTest balance test; Freezing of Gait Questionnaire (FOG_Q); 6-minute walk test (6MWT) Walking speed, dual task, and backward walking; and nine-hole pin test (9HPT).	Experimental group: They received 2 tango classes per week of 1 hour each session for 12 months. Tests performed at 3, 6 and 12 months. Control group: They had no prescribed exercise and were instructed to continue with their daily lives.	(MDS-UPDRS-3) improved only in GE. Motor symptoms were significantly better at 3, 6 and 12 months compared to baseline and better at 6 and 12 months compared to 3 months. Balance improved in the EG and slightly worsened in the CG over the course of the study. There were no differences in (FOG_Q) for any group. (6MWT) It remained stable in the EG and decreased in the CG. The EG had a higher walking speed than the CG at 6 and 12 months. (9HPT) improved in the EG and slightly worsened in the CG.
(Hashimoto et al., 2015)	To examine the effectiveness of	46 participants Women (n=34)	Time and Gait Test (TUG)	Dance group:	The dance group showed improvements in TUG time and

	dance on motor and cognitive functions in PD.	Men (n=12) Dance group N=15 Group exercises EP N= 17 Control group N=14	Berg Balance Scale (BBS) (MRT) for assessing cognitive function Self-assessment Depression Scale (SDS)	1 session of 60'per week for 12 weeks of different dance styles. Group exercises EP: 1 session of 60' per week for 12 weeks. Focused on improving balance and range of motion. Control group: They continued with their daily routines. All groups were evaluated before and after the intervention.	number of steps and BBS after the intervention, while the EP exercise group showed improvements in TUG time and number of steps, but not in BBS. TUG time also improved in the control group, but the number of steps did not. No improvements in MRT were found. Improvements in SDS were also obtained for the dance group.
(Delextrat et al., 2016)	Assessing the feasibility of Zumba in people with PD.	11 participants Women N= 6 Men N=5	2 min walk test (2MWT) Rated Perceived exertion (RPE)	1 Zumba session (60') per week during 6 weeks RPE after each session During each session, physical activity levels were measured using: triaxial accelerometers, average heart rate (HR mean)	The RPE recorded after all sessions ranged from 9 to 12, between the first and the last session performed. The average HR during the six sessions was (56.5 ± 9.2%) of max HR (56.5 ± 9.2%).
(McKay et al., 2016)	To investigate the efficacy of a high-volume tailored tango intervention.	22 participants Women (n=15) Men (n=7)	6-minute walk test (6MWT38)	15 sessions of 1.5 hours each during 3 weeks Pretest 1 week before the intervention and Posttest 1 week after the intervention.	There were some improvements in the walking test, but not in the freezing gait.

			Freezing of Gait Questionnaire (FOG42)		
(Kunkel et al., 2017)	To determine the effectiveness of a ballroom dancing program in patients with PD.	51 participants Average age 75 years Men (n=25) Women (n=26) Experimental group N= 36 Control group N=15	The Berg Balance Scale (BBS) 6-minute walk test (6MWT38)	Experimental group: Participants received 2 sessions per week of 1 hour each for 10 weeks. Control group: Continued with their daily life. Tests were performed before and after the intervention.	In the test (6MWT38) there was an increase in the distance walked by those in the dance group by an average of 20m, while the control group decreased their distance by an average of 1m. No significant improvements in the balance of any group were found.
(Hulbert et al., 2017)	To determine the effects of ballroom and Latin dancing on the coordination of PD patients.	27 participants Men (n= 13) Women (n=14) Experimental group N= 15 Control group N=12	Three-dimensional motion analysis Coda (Charnwood Dynamics Ltd)	Experimental group: They received 20 1-hour dance classes for 10 weeks. Control group: They continued with their usual routines. Analysis of body coordination by means of 12 turns before and after the intervention.	Those who danced were better able to coordinate their axial and perpendicular segments, representing a closer coupling of axial and perpendicular segments.
(Holmes & Hackney, 2017)	To explore the perceived impact of a tango program on PD quality of life.	27 participants Men (n=15) Women (n=12)	Perceived quality of life survey and changes since the conclusion of the intervention.	2 tango classes per week, 1 hour and a half for 12 weeks. Data collection was performed during the intervention and at the end of 6 months.	Some participants reported perceived improvements in motor skills, physical endurance, and self-confidence after receiving the dance classes. However, some participants indicated no perceived improvements.

(Michels et al. , 2018)	To explore the safety and feasibility of dance therapy in PD.	13 participants Men (n=6) Women (n=7) Dance therapy N=9 Control group N=4	Unified Parkinson's Disease Rating Scale (MDS-UPDRS) Satisfaction Questionnaire	Dance therapy group: 60' sessions per week for 10 weeks Control group: Continuity of daily life Evaluations were completed 1-2 weeks prior to the first session and upon completion.	The greatest improvement in motor measures occurred in MDS-UPDRS in the dance group. In the dance group, 7 out of 9 felt they had benefited from the classes.
(Kunkel et al., 2018)	Exploring the views of people with Parkinson's on receiving partner dance classes.	14 participants Men N=7 Age range (65-79) Women N=7 Age range (49-81)	Semi-structured interviews to explore participants' experiences and points of view	Received a dance program 2 times a week for 10 weeks Interviews conducted after the end of the intervention	When dance couples were able to develop a good relationship, they gained a greater enjoyment and sense of accomplishment from dance classes compared to couples who did not enjoy dancing together or had conflicting approaches.
(Rawson et al., 2019)	To assess the impact of tango, treadmill walking and stretching on gait, balance, motor function, and quality of life.	96 participants Average age of 67 Men (n=56) Women (n=40) Tango N=39 Tape N=31 Stretching N=26	Mini-BESTestest) for measuring dynamic equilibrium Spacetime march using a 5 m GAITRite gateway (CIR Systems Inc.) 6-minute walk (SMWT)	The sessions for the 3 groups were 1 hour, twice a week for 10 weeks. Assessments performed before and after the intervention.	Only the treadmill improved forward gait, while backward gait improved with treadmill and stretching. All 3 groups presented improvements in backward walking. Tango was the group that achieved the greatest improvement in endurance

(Poier et al., 2019)	To investigate the influence of Argentine Tango on the quality of life of people with PD in comparison with Tai Chi.	29 participants Tango N=14 Men (n=9) Women (n=5) Tai Chi N=15 Men (n=3) Women (n=12)	Quality of life of patients, measured with the Parkinson's Disease Questionnaire (PDQ-39).	Both groups received one 60' session per week for 10 weeks. The analysis was performed before, at 5 weeks and at the end of the program.	They found a significant improvement in the PDQ-39 "Mobility" dimensions in the tango group.

Discussion and conclusions

Dancing simultaneously affects motor function, cognitive function, and mental symptoms (Hashimoto et al., 2015; Holmes & Hackney, 2017). Notably, dance is associated with improvements in balance, freezing of gait, walking performance, and well-being (Aguiar et al., 2016), so dance therapy appears to be a complementary tool in treatment with PD (Hashimoto et al., 2015).

During dance programs, there is a risk of falls; however, partner dancing is potentially a safe intervention as subjects can serve as a support and has been shown not to create dependence or loss of balance, in addition having a dance partner fosters social support and self-perceived improvement (Hackney & Earhart, 2010; De Dreu et al., 2015; Poier et al.,2019). It is important during dance classes, the rhythm of the music, since when strong and marked rhythms are used, it provides a time frame, allowing precise synchronization of movements similar to external auditory signals (De Dreu et al., 2015; Hashimoto et al., 2015; Aguiar et al.,2016).

Within the different dance modalities, the tango modality has proven to be one of the most beneficial for this type of disease, increasing the speed of movement and balance. (McKay et al., 2016). The tango includes great variety of movements; walking backwards, speed changes, frequent stops, and starts (McNeely et al., 2015a). Tango movements, following a well-defined and precise rhythm, are associated with increased activation of neural areas that are not normally activated in PD patients and with stimulation of cortical activation by increasing motor skills (Hashimoto et al., 2015; De Dreu et al.,2015; Tillmann et al.,2017; Michels et al., 2018). Another of the most effective modalities, is the samba, due to the fact that its lateral steps, forward and backward, performed rhythmically, can stimulate cortical activation, as in tango, increasing attention and concentration (Tillmann et al.,2017). Highlighting that the two most challenging dances were the waltz (due to the crossing of the feet and changes of direction) and the cha-cha-cha (due to its speed and less holding) (Kunkel et al., 2017). Understanding the similarities and differences in the impacts of different dance styles on motor function may be important to inform the development of PD-based dance programs (McNeely et al., 2015a).

The European guideline for Parkinson's disease recommends dancing as a meaningful approach to improve functional mobility and balance (De Dreu et al., 2015). However, at present, there is no clear consensus on program durations, but several studies agree that a duration of 60-90 minutes per session twice a week for a period of 10-12 weeks is adequate for this type of subject. (Hackney & Earhart, 2010; Khongprasert et al., 2012; Hashimoto et al., 2015; McNeely et al., 2015b; Kunkel et al., 2017; Holmes & Hackney, 2017).

This review has analyzed the effects of dancing in patients with PD. The information provided is of great interest since improvements in health and quality of life can be observed, especially when the tango modality is used. However, there is a need for continued research and analysis of this type of alternative therapy, as well as a prior assessment of the patient's condition and disease, in order to offer a treatment according to their needs using the optimal durations and modalities for their condition.

As for the limitations encountered during the development of the work, it is worth highlighting the lack of studies that directly compare different dance modalities in their intervention, as well as studies with longer durations, which could determine whether the benefits can last over time.

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