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# Dance for People with Parkinson's Disease

Systematized Literature Review

DEGREE PROGRAMME IN PHYSIOTHERAPY
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ABSTRACT

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This is a systematized literature review about the effects and possible benefits
of regular dance practice as a part of rehabilitation for clients with Parkinson's
Disease (PD). This thesis will be guided by the following research questions:
"What are the effects of dance as a treatment modality for Parkinson's Dis-
ease?" and "What are the benefits of dance for Parkinson's Disease?".

Parkinson's disease (PD) is a chronic and progressive neurodegenerative con-
dition that affects movement and both motor and non-motor functions. It occurs
when nerve cells in the basal ganglia, an area of the brain that controls move-
ment, become impaired. Exercise and physiotherapy combined with medica-
tion, have been shown to control the symptoms caused by the dopaminergic
neurotoxins and the loss of dopamine neurons, yet the causes of PD are un-
known.

This systematized literature review analysed three (3) meta-analysis studies
that contained in total of 24 research papers related to the possible benefits of
dance with PD. Music has been shown to have specific benefits when it comes
to the rehabilitation of people with Parkinson Disease (PD). Therefore, current
knowledge of the benefits of music as a part of neurological rehabilitation for
people with PD have been reviewed for this study.

The findings of this study indicate that dance can be seen as a beneficial
method of rehabilitation for people with Parkinson's disease. Regular dance
practice can improve both motor and non-motor symptoms of people with Par-
kinson's disease. Results show that dance may improve balance, co-ordina-
tion and gait. In addition, dancing is a social activity, whether partnered or non-
partnered dance. The results indicate that dance may improve mood, reduce
depression and offer peer support and a sense of belonging.

The results of this systematized literature review indicate that dance can be an
enjoyable activity with a high attendance rate that may improve acts of daily
living and quality of life for people with Parkinson's disease.

Keywords: Dance, Parkinson's Disease.

# CONTENTS

# 1 INTRODUCTION

The purpose of this thesis is to conduct a systematized literature review about the effects and possible benefits of regular dance practice as a part of rehabilitation for people with Parkinson's Disease (PD).

Parkinson's disease (PD) is a chronic and progressive neurodegenerative condition that affects movement in both motor and non-motor functions. The causes for PD remain unknown. PD can be considered to negatively impact the functions and quality of life of those affected. PD occurs when dopamine producing nerve cells in the basal ganglia, an area of the brain that controls movement, become impaired (Duncan and Earhart, 2014). Exercise and physiotherapy, combined with medication, have been shown to control the symptoms caused by the dopaminergic neurotoxins and the loss of dopamine neurons. Parkinson's disease is the second most common neurogenerative disease after Alzheimer's (Keus et al., 2014). In Finland approximately 14000 people are affected (Liikehäiriösairauksien liitto, 2023).

The most common motor dysfunctions associated with Parkinson's disease (PD) are rigidity, bradykinesia, tremor at rest, postural instability leading to altered gait, poor balance and increased risk of falls. (Delabary et al 2017; Pereira et al 2019). Core areas of physiotherapy according to the European Physiotherapy Guideline for Parkinson's Disease (Keus et al, 2014) include maintenance of physical capacity and functional ability. Therefore, treatment consists of maintaining functional movements that support acts of daily living and maintain functional independence. Additionally, awareness of non-motor symptoms such as apathy, depression and reduced cognitive skills need to be accounted for when planning activities for the clients.

Physical activity, in addition to pharmacologic treatment, is a recommended rehabilitation method for people with PD. Physical activity improves muscle

strength of the lower limbs, improves balance and co-ordination, and consequently reduces the risk of falls (Moratelli et al., 2021; Berti et al. 2020).

Taking the above into consideration, one could suggest that a dance class where music is combined with physical exercise (dual tasking) in a social environment that offers peer support could be of benefit to clients with PD. As a group practice, dance requires an interpersonal coordination in space and time (Mandelbaum, 2014). According to McGill (2016, p.48): "Dance often requires people to multitask and move different parts of the body at the same time whilst also having to anticipate the next action in a sequence of movements". Previous research has shown positive impacts of Dance for PD in relation to improving mobility, maintaining balance and by increasing quality of life of participants, by reducing depression (Shanahan et al., 2015). As dance can affect mood and reduce the symptoms of depression, assessing mood, cognitive abilities and emotional stability can be regarded as important when examining people with a neurological disease (Mandelbaum, 2014).  A wide variety of different dance styles are being used as modalities for Dance for people with PD: tango and ballet being some of the most popular, but also other ball room dance styles, contemporary dance and dance improvisation (Volpe et al., 2013).

In addition to movement, the role of music can be considered as an important part of rehabilitation for both motor and non-motor actions during a dance class. According to Raglio (2015), rhythm plays an important role in rehabilitation, enhancing connections between the motor and auditory systems of the client. Using music and auditory cueing, according to research outlined by Ghai et al. (2018), states that auditive cues might allow auditive neural inputs to bypass the affected basal ganglia network (pallidal-supplementary motor area) via another alternative pathway, allowing a person to perform movements with more ease.  According to Raglio (2015), musical rhythm in PD treatment can improve gait (speed, frequency, and step length), limbs coordination, postural control, and balance. Furthermore, according to Moratelli et al. (2021), previous studies have demonstrated that dance and music may alter gait speed, help to initiate movement, and stimulate dual tasking, making it a suitable method for people with PD.

This systematized literature review has been divided into the following chapters: chapter two (2) clarifies the aims and objectives of this study, chapter three (3) provides a brief summary of the epidemiology and pathophysiology of PD; detailing the most common motor and non-motor symptoms of PD. Chapter four (4) explains the benefits and current research on Dance for Parkinson's, including the effects and benefits of music. Moving forward, chapter five (5) clarifies the research methods and processes, which is followed by chapter six (6) and the systematized literature review. Chapter seven (7) concludes the findings for this study and chapter eight (8) offers a discussion of the research process and the findings of this study. Finally, chapter nine (9) brings the study together and concludes this literature review.

## AIMS AND OBJECTIVES

The aim of this thesis is to outline the current state of research regarding Dance with People with Parkinson's. The objective is to conduct a systematized literature review, which will be guided by the following research questions "What are the effects of dance as a treatment modality for Parkinson's Disease?" and "What are the benefits of dance for Parkinson's Disease?".

The use of dance as treatment and management of PD has steadily gained popularity within the research community, hence, a vast amount of research including systemic reviews and meta-analysis is already available of the benefits of dance and music in relation to treatment of PD. In this systematized literature review attention will be paid to both motor function and non-motor symptoms of PD.

# THEORETICAL BACKGROUND OF PARKINSON'S DISEASE

## Epidemiology of Parkinson's Disease

Parkinson's disease (PD) is a progressive neurodegenerative condition of the central nervous system. People with PD experience deficits in motor function and the illness also includes non-motor symptoms. (Keus et al., 2014). PD is a the second most common neurogenerative disease in Europe after Alzheimer's disease. The occurrence of PD has doubled in the past 25 years, and the number of people living with Parkinson's has yet been estimated to increase due to ageing population worldwide. During 2019 global estimates indicated that there were over 8.5 million individuals with PD (World Health Organization, 2023). In Finland, approximately 16 000 people are affected by PD (Liikehäiriösairauksienliitto, 2023).

Data shows that men are 1.5 times more likely to develop PD than women. Typically, people are diagnosed when they are older than 60 years of age. Approximately 5% of people receive a diagnosis between the age of 40-60 years of age, which is considered early onset PD (Keus et al., 2014).

## Pathophysiology of Parkinson's Disease

Idiopathic Parkinson's disease (PD) is a chronic and progressive neurodegenerative condition of the central nervous system that affects movement and both motor and non-motor functions. It occurs when dopamine producing nerve cells in the basal ganglia, an area of the brain that controls movement, become impaired (Duncan and Earhart (2014). More specifically, the degeneration of dopaminergic neurons in the substantia nigra area is the cause for deficiency of dopaminergic neurons in basal ganglia area (Pereira et al., 2019).

Exercise and physiotherapy combined with medication have been shown to control the symptoms caused by the dopaminergic neurotoxins and the loss of dopamine neurons, yet the causes of PD are unknown. Exercise has been shown to protect and promote the regeneration of damaged nerves. Furthermore, with suitable exercise intensity, dopamine levels have been shown to

increase, lessening the motor and non-motor symptoms of PD (Lee et al 2015). According to Wu et al. (2022): "Exercise increases brain volume, promotes the activation of a wide range of brain regions, and produces neuroprotective effects that allow the brain to repair itself".

Clients with PD experience both motor and non-motor symptoms that affect quality of life in a negative way as the illness progresses. Most common impairments in motor symptoms of PD include rigidity, rest tremor, bradykinesia and postural instability. The illness also includes features such as unilateral onset and persistent asymmetry, which can be measured by using the H&Y scale (Rawson et al., 2019).

The most common symptoms of PD are related to mobility, such as gait, transfer, and turning difficulties, reoccurring falls, slowness and reduction of movement (bradykinesia), as well as rigidity, tremor at rest and postural instability. Postural instability in turning can be found already in early stages of the disease, within the first three years of diagnosis. Rigidity may also cause postural deformities in flexed position, which typically occurs in later stages of the illness. Other motor symptoms include difficulty with swallowing, slurring speech, and speaking more slowly. Drooling may also occur as the disease advances (Keus et al., 2014).

In addition to impaired motor function, impairment in non-motor functions can greatly reduce the quality of life with people for PD. At times, non-motor function impairment can precede the motor control impairment with clients with PD. Typical non-motor function impairments include olfactory disorder, indicating the loss of smell, disturbance with sleep, and constipation. As the disease advances, also depression, anxiety and apathy become more common (Keus et al., 2014).

Treatment Modalities and Physiotherapy for Parkinson's Disease

There is no cure for Parkinson's Disease (PD). Typically treatment includes both pharmacological and non-pharmacological methods to improve the

patient´s quality of life. In addition to medication, physical therapy is highly recommended to be used as a method of rehabilitation. According to previous research, physical activity can improve motor function, and provide improvements in muscle strength and balance (Moratelli, 2021).

In addition, PD can, at times, be treated with deep brain stimulation (DBS), which is a surgical treatment where electrodes are placed on a targeted area of a brain that control movement, with the goal of addressing the movement symptoms such as tremor, bradykinesia and stiffness (www.parkinsons.org, 2023). There is also a non-invasive focused ultrasound (FUS) treatment that aims to destroy damaged cells in a particular part of a brain that cause movement impairment. For example, to aim to reduce the tremor symptoms, the thalamus area of the brain would be treated with FUS (www.michaeljfox.org, 2023).

Pharmacological treatment, most commonly Levodopa, reduces tremor and rigidity of people with PD. Yet the effects of medication on balance and gait are less clear (Duncan and Earhart, 2014). Therefore, non-pharmacological treatments such as physiotherapy and different forms of exercise are recommended to improve balance and gait.

An interest in different practical methods used as part of physiotherapy in the treatment of Parkinson's disease appear quite longstanding. There are at least five core areas of physiotherapy, which affect acts of daily living and are therefore recommended to be taken into account when planning rehabilitation for clients with PD. These five core areas include physical capacity, transfers, manual activities, balance and gait. Physical capacity includes joint mobility, muscle tone, muscle strength and endurance. Transfers include everyday actions such as sit to stand, manual activities include, for example, reaching and gripping that are affected also by resting tremor. Poor balance increases the risk of falling and fear of falling, whereas difficulties with walking include bradykinesia and freezing (Keus at al.,2014).

In addition, it can be suggested that the emerging of evidence-based practice (EBP) and research during the early 1990s has shaped the way that physiotherapy research is conducted and reviewed. According to Veras and Kairy,

(2016) EBP can be seen as a field of practice and research in which physiotherapists may use a variety of research methods to collect information and to produce scientific evidence on physiotherapy interventions, as well as to assess the quality of the scientific evidence already available.

One could, for example, consider the Cochrane reviews, which are produced by a not-for-profit organisation promoting systematic reviews within the healthcare sector. The Cochrane organisation has, for example, published research papers which compare different physiotherapy techniques. Cochrane reviews in the field of PD research have been published in 2001 and 2014. The reviews compared the effectiveness of several different approaches of physiotherapy in order to find out if any specific type of physiotherapy intervention provides greater benefit than another as a treatment for PD. The techniques included in the Cochrane reviews consisted of the following methods: general physiotherapy, exercise, treadmill training, cueing, dance and martial arts (Tomlinson et al., 2014; Deane, 2001). However, Tomlison et al. (2014) concluded that the techniques employed within each of these categories were overly diverse, and they considered it not possible or appropriate to combine the results by statistical meta-analysis, as it would be very difficult or impossible to interpret the results. Also, such vast amount of heterogeneous data would also be difficult to summarise by using qualitative data. Therefore, Tomlinson et al. (2014) concluded that, based on the evidence gathered, there is no robust evidence to support that one approach of physiotherapy would be more effective than any other when treating clients with PD. Therefore, in this systematized literature review the aim is to focus on one type of exercise, dance, and the possible benefits of dance practice with people with PD, in order to better understand how dance could be utilised as a part of physiotherapy practice.

# DANCE FOR PARKINSON'S DISEASE

Benefits of Dance for Parkinson's Disease

The use of dance as a rehabilitation method has a relatively long history. Formally dance and movement therapy (DMT) can be considered to have been established during the 1940's by American Marian Chace, who emphasised the importance between practice and research from the beginning of her movement exploration, stressing the importance of clinical work to develop her methods (Cruz, 2016).

Dance can be seen as a complex motor activity, as it requires people to multitask, and to move different parts of the body at the same time whilst anticipating and preparing for the next action in a sequence of movements required for the dance (McGill, 2016; Hasan et al., 2021).

Dance as a rehabilitation method for neurological diseases such as Parkinson's Disease (PD) has steadily become more popular within the last twenty years. Dance for PD aims to improve and maintain functional mobility and balance, reduce the risk of falls, to improve quality of life, and to reduce non-motor symptoms such as depression and anxiety (Volpe et al., 2013; Moratelli et al., 2021; Pereira et al., 2019; Shanahan et al., 2015). As stated by Fontanesi and De Souza (2020), research about Dance for PD can be divided into studies which examine changes and improvements in motor performance such as gait, balance, coordination, reduction of freezing, and those that look at non- motor performance improvements associated with dance, such as cognitive, emotional and social benefits. Usually, the former is conducted within the field of physiotherapy and latter in the field of dance. Luckily, there are also few research articles that focus on both motor and non-motor function of people with PD and dance.

Dance offers an enjoyable and interactive way of moving with music. In addition, dance has been shown to improve gait speed and dynamic balance, as well as to stimulate dual tasking. This indicates that dance can be considered

as a helpful rehabilitation method to support motor and non-motor functions of people with PD (Moratelli et al., 2021; Duncan and Earhart, 2014).

Multiple types of dance styles are being used as a form of rehabilitation for clients with PD. Argentinian tango and classical ballet being some of the most popular styles, but other ball room dance styles, such as waltz/foxtrot, folk and social dancing such as Irish traditional dancing, contemporary dance, community dance and dance improvisation are also being used as foundations for therapeutic dance classes, as a part of rehabilitation, for people with PD  (Emmanouilidis et al., 2021).

Tango seems to be one of the most popular types of dance intervention for people with PD. Previous research indicates that people with PD who have taken tango classes have shown reduction of motor impairment symptoms in both short- and long-term studies. In addition, tango has been shown to improve balance, functional mobility, endurance, social activity and quality of life. Tango is being considered as useful for clients with PD due to the fact that it incorporates dynamic balance and continuous movement initiation and termination, due to the steps required in tango in multiple directions as well as variations in speed and rhythm.  In addition, it is a partner dance, indicating a social activity and assurance and safety offered from the partner (Shanahan et al., 2015).

In addition, specific dance programmes for people with PD have been developed. Most notably, Dance for Parkinson's Disease, or Dance for PD® (DfPD), was developed by the Brooklyn Parkinson Group and the Mark Morris Dance Group back in 2001. Dance for PD now has registered practitioners in 25 countries worldwide (danceforparkinsons.org). The programme was based on the assumption that utilising dance rehabilitation would both beneficial and enjoyable for the clients with PD (McRae et al., 2017). According to Kalyani et al. (2023) DfPD provides a complex multifaceted intervention that draws on different dance styles and classes are typically led by professional artists. The DfPD classes often provide more comprehensive, carefully planned and executed dance classes than those based on a single dance style. During DfPD classes, professionals integrate movement from modern, ballet, tap, folk and social dancing. An important aspect of DfPD classes is that they emphasise

both individual as well as group format dancing (Westheimer et al. 2015) rather than partnered dancing (Hackney & Earhart, 2009a, 2010, in McRae et al. 2017).

It seems that typically quantitative research for People with PD has mainly focused on testing short-term (10-12 weeks) functional outcomes for motor symptoms (McRae et al. 2017). In order to provide a comprehensive overview of the research conducted around the topic of dance for PD, a few preliminary longitudinal studies that account for both motor and non-motor functions and symptoms, which focus on the benefits of dance for PD will be briefly mentioned here. Particularly, those of McRae et al (2017), Duncan and Earhart (2014) and Bearss and DeSouza (2017) are worthy of mention. Due to the progressive nature of Parkinson's disease, longitudinal studies of the benefits of dance for people with PD could be seen to be able to provide valuable information about the possibility of maintaining the gained results over a period of time.

In their study, McRae et al. (2017) measured the impact of DfPD on physical and psychosocial functioning as well as on daily activities outside of the studio environment. In other words, they were interested in self-efficacy and possible improvements on quality of life (QoL). Their longitudinal study was able to establish that those who had attended DfPD classes for one year or longer felt greater benefits outside the studio environment. The study focused on non-motor symptoms, and participants interestingly reported that the classes had a more important social aspect than that of improved functional mobility. Overall, the study considers the option that the benefits of DfPD classes might be cumulative and that regular attendance over time could have both motor and non-motor benefits for clients with PD.

A two -year prospective pilot study conducted by Duncan and Earhart (2014) measured the effects of community based Argentinian tango dance classes on disease severity, balance and functional mobility. The possible motor and non-motor improvements were measured at 12 month and 24 month intervals by using MDS-UPDRS I, II and III. Interestingly, their study found that most benefits were gained by 12 months and maintained for 24 months.

In turn, Bearss and De Souza (2021) were interested in understanding how attending DfPD dance classes affected the UPDRS score over a three-year period, making their study a ground-breaking longitudinal investigation. The aim of the study was to create a long term neurorehabilitation strategy to combat symptoms of PD. Their study found that there were no impairments in either motor or non-motor scores of the UPDSRS.

In addition to the above, a recent large systemic review by Emmanouilidis et al. (2021), that includes both motor and non-motor symptoms, consists of 38 studies of which,17 are RCT´s and 21 non-randomized studies. This systemic literature review does not contain a meta-analysis due to the heterogeneity of intervention and outcome measures and was therefore not included in the systematized literature review of this study. However, this research paper is being mentioned due to its comprehensive nature despite also containing non-randomized studies. In addition, previous research has shown that within a meta-analysis, which contains both randomized and non-randomized studies, non-randomized studies tend to show larger treatment effects (Haidich 2010). The results from this study show moderate to large benefits of dance for people with mild to moderate PD. RCT's showed significant short-term improvements for balance measured by Berg Balance scale (BBS), reduction of UPDRS score, improvement of TUG and endurance improvement measured with 6-minute walking test, reduced gait freezing measured by (freezing of gait scale) and reduced depression measured by Beck Depression intervention. Therapeutic dance can, in short term, significantly improve balance, mobility, gait, disability, and quality of life in clients with PD. Emmanoulidis et al. (2021) concluded that generally dance classes had high levels of adherence and they were a great way to improve exercise capacity and simultaneously to socialise. Despite this study being a comprehensive systemic analysis, there seem to be several, yet unfortunately typical, irregularities within the included trials. Emmanoulidis et al. (2021) also noted that typically, intervention duration and frequency were reported, however, intensity of dance therapy was not. Also, Shanahan et al. (2015) reported in their study that the methodological quality of studies related to the benefits of dance with PD differ on terms of frequency,

intensity, duration and type of dance. Also, often trials do not control for the effects of medication such as levodopa.

Overall, it seems that dance for PD has generated continuous interest amongst the research community, and as a result there exists several well-established meta-narrative analyses, that look at the possible benefits of dance as a rehabilitation method for people with PD. Some of these analyses will also be used as material for the systematized literature review of this research project.

Music and Parkinson's Disease

In addition to movement, the role of music can be considered as an important part of rehabilitation for both motor and non-motor actions during a dance class. Overall, studies that evaluate the effects of music as a part of rehabilitation for people with PD have typically focused on motor performance, but some also include the effects of music on quality of life, cognition and social life (Sihvonen et al., 2017). Furthermore, music is an important part of the dance class, which has been shown to have specific benefits when it comes to the rehabilitation of people with Parkinson Disease (PD). Music can be considered as versatile stimulus for the brain. Music has been shown to activate the dopaminergic mesolimbic system, which regulates memory, attention, regulation of movement, mood and motivation (Sihvonen et al., 2017, Wu et al., 2022). Studies on the benefits of music with clients with PD have shown that musical rhythm is able to improve gait (speed, step length, frequency), co-ordination of limbs, posture and balance (Raglio, 2015).

Music-based rehabilitation interventions such as listening to music (receptive), and/or singing or playing an instrument (active) can be used as a part of rehabilitation for clients with neurological diseases such as stroke, dementia, epilepsy, multiple sclerosis and Parkinson's Disease (PD). According to Sihvonen et al., (2017) the rhythm in music is able to activate neural circuits involved in motor actions, and music acts as an external cue for movement and in turn replaces the impaired internal timing function in people with PD.

Studies have shown that listening to music improves neural connectivity and playing an instrument, in turn, promotes neural plasticity. Therefore, music intervention can be considered to be useful as a part of motor rehabilitation with people with PD.

Interest to use music as a therapeutic tool in neurological rehabilitation has been growing in popularity since the 1990's. According to Raglio (2015) neurological music therapy (NMT) aims at enhancing sensory, cognitive and motor functions of clients with PD. The concept of neurological music therapy, which is based on rhythmic entrainment, was developed by Michael Taut and his colleagues in the early 1990's. Their studies showed that the rhythmic entrainment mechanism can be successfully used in rehabilitation for people with Parkinson's disease, stroke, traumatic brain injury and cerebral palsy. In their studies they showed that auditory rhythmic patterns encourage rhythmic entrainment patterns of movement when included as a part of rehabilitation with patients with movement disorders. In addition, to helping with the timing and initiation of movements, rhythmic patterns may also influence gait, more specifically, by improving stride length and force parameters (Thaut et al., 2015). As stated by Sihvonen et al. (2017) rhythmic entrainment is based on connectivity between auditory and motor functioning of the brain. Rhythmic entrainment can act as an external timer helping to execute movements, therefore people with PD might find it easier to move with rhythmic support. Interestingly, however, Sihvonen et al. (2017) state music as a stimulus might be more effective than auditory cueing without music, such as verbal cues or metronome beat for example. Furthermore, Ghai et al. (2018) also highlight the importance of social and psychological factors of tempo changes whilst listening or dancing to music, because listening and dancing to music releases dopamine and serotonin, which are neurotransmitters that are deteriorating in a person with Parkinson's disease. Consequently, the release of endorphins might improve their mood during and after the class and possibly to increase their motivation to return to dance classes and to perform home exercises.
An interesting study by Moratelli et al. (2021) about different types of dance rhythms investigated the effects of binary (two-beat rhythm) and quaternary (four-beat rhythm) on motor symptoms for people with PD by using RCT. The

study found that dance rhythms utilising binary rhythm can improve balance, reduce freezing during gait, and to increase mobility as per results from UP-DRS III and quaternary rhythm improved balance and mobility score UPDRS III.

# THESIS METHODS AND PROCESS

Systematized Literature Review

There are several types of literature reviews typically used in academic literature, out of which, the following tend to be commonly used: narrative, or systemic/systematized and meta-analysis (qualitative and quantitative). This bachelor's thesis is a systematized literature review, which differs from a systematic review in few ways. Systemic literature review is typically conducted by two or more researchers, whereas systematized literature review is conducted by one person, and it is narrower in scope, making it suitable for a bachelor's level thesis.

The core principles of a systematized literature review include the use of already published research studies as material to be used in the literature review. Preferably, systematized literature reviews are conducted by using the results from randomized control trials (RCT) and network meta- analysis, which are both required to use quantitative research methods that are transparent and replicable. During systematized literature review, inclusion and exclusion criteria are used to determine suitable research material to be analysed. The inclusion and exclusion criteria used in this literature review can be found below (table 1). For this literature review online databases PubMed and Pedro were used to search suitable research papers. Filters that were used in PubMed to search suitable research material were: Meta-analysis, RCT, aged 19+ and English.

This systematized literature review was conducted between May 2023 and December 2023 after the approval of a research plan in April 2023. The data searches were conducted between August 2023 and September 2023 and writing of the systematized review took place between September 2023 and December 2023. The outcome of the thesis was presented in a thesis seminar during December 2023.

Meta-Analysis

Meta-analysis is a type of quantitative statistical research that systematically examines data from previous research studies, typically of RCT's, to explore possible patterns and consistency of treatment effects in evidence-based medicine, or to determine is there an effect and whether it is positive or negative and to form a summary of the effect. Outcomes from a meta-analysis may include a more precise estimate of the effect of a specific treatment for a particular disease, or alternative outcomes, than individual study contributing to the pooled analysis. Meta-analysis may also be able to provide answers and outcomes for questions not posed by the individual studies, settle differences arising from different, and at times, conflicting studies and at sometimes to generate new hypotheses. Meta-analysis requires a sensitive and comprehensive literature review of the existing material as well as a clear hypothesis that it aims to answer, for which the examination of heterogeneity is vital (Haidich, 2010).

Understanding Statistical Significance in Quantitative Research

In order to understand how to interpret the results of quantitative analysis, the reader needs to be acquainted with the concept of probability, better known as the $p$-value. The $p$-values found in the quantitative analysis indicates whether the results of the analysis occurred by random chance and whether they show statistical significance or not. The $p$-value is typically expressed between 0 and 1. The smaller the $p$-value, the less likely the results occurred by random chance. Typically, in statistical analysis, the confidence interval of 95% is used,

indicating that in order for research results to have significance the expected $p$-values would be $p < 0.05$ or smaller, such as 0.01, or even 0.001.

## Research Question

The aim of this thesis is to provide an overview of the present research regarding benefits of dance with people with Parkinson's by conducting a systematized literature review.

The thesis will be guided by the following research questions "The effects of dance as a treatment modality for Parkinson's Disease?" and "What are the benefits of dance for Parkinson's Disease?".

## Search Strategy

In order to formulate search strategies, the PICO framework has been used. The concept of PICO was introduced in 1995 by Richardson et al. in order to provide a frame for formulating research questions as well as to be used to support literature search strategy by identifying key concepts. (Eriksen and Frandsen, 2018; Critical Appraisal Skills Programme, 2023).

PICO is a mnemonic formula, originally created to be used with health-related questions, consisting of the following parts: patient, intervention, comparison, outcome (PICO), and is often used as a search strategy tool for academic literature reviews. The PICO formula used in this literature review consists of the following:

**P**opulation:  population (19+) years of age, male and female with idiopathic Parkinson's disease.

**I**ntervention: Understanding the benefits of Dance with Parkinson's classes that last between 3-12 months.

**C**ontrol: Control PD group with alternative physical activity or no physical activity.

**O**utcome: Benefits of Dance with people with Parkinson's Disease

Inclusion and Exclusion Criteria

The studies selected for this literature review were based on specific inclusion and exclusion criteria (see table 1). The inclusion and exclusion criteria are used to aid the selection of suitable research material that supports the aims and objectives of the literature review.

Table 1. Inclusion and exclusion criteria

| Inclusion criteria | Exclusion criteria |
|---|---|
| Population (19 >) years of age, male and female with Parkinson's disease. | Population (< 19) years of age, male and female with Parkinson's disease. |
| Dance classes as form of rehabilitation lasting between 3 months-12 months. | Dance classes as form of rehabilitation lasting less than 3 months. |
| A randomized control trial systematic review and meta- narrative analysis was used | A randomized control trial, systematic review and meta- narrative analysis was not used |
| Session length min. 60min | Session length less than 60min |
| Language used English | Language used other than English |
| UPDRS used as measurement | UPDRS not used as measurement |
| Published 2013 onwards | Published before 2013 |

Study Selection

For this literature review, two online databases were used to search for suitable research articles. In addition, manual search was conducted. The online databases selected were PubMed and PEDro. In PubMed search terms were "dance with and for Parkinson's" Boolean operators (AND & OR) were used in the search. Boolean operators are effective for separating, combining, and

excluding certain terms. Filters applied in PubMed were: Meta-analysis, RCT, records for last 10 years and English.

In PEDro the search "dance with Parkinson's" was used. The filter applied was that publication took place after 2013. PEDro does not use Boolean operators or mesh terms. The search results for publications from 2013 onwards included 28 systematic reviews and 19 clinical trials totalling 47 search results. Results of study selection criteria can be found on table 2.

Table 2 Study selection criteria

| Search Engine | Seach words used | Search results | Results with filters |
|---|---|---|---|
| PubMed | (Dance for Parkinson) AND (Dance with Parkinson) | 294 | 53 |
| PEDro | Dance for Parkinson's | 53 | 47 |

A total of 126 records were identified through database search and manual search. After removal of duplicates and initial screening, 18 full-text articles were assessed. Of these, 13 studies were excluded, and 3 studies were included, risk of bias was assessed, and a quantitative analysis was conducted. During the initial examination of abstracts, some were set aside for further examination in order to choose the best available ones for this analysis. Based on the abstracts, the most suitable research papers were selected to be read as whole. Based on the whole articles read, the final selection for this systematized literature review included 3 meta-analyses to be analysed. A detailed description of the selection criteria can be found on below, which is based on the Prisma flow diagram (Figure 1).
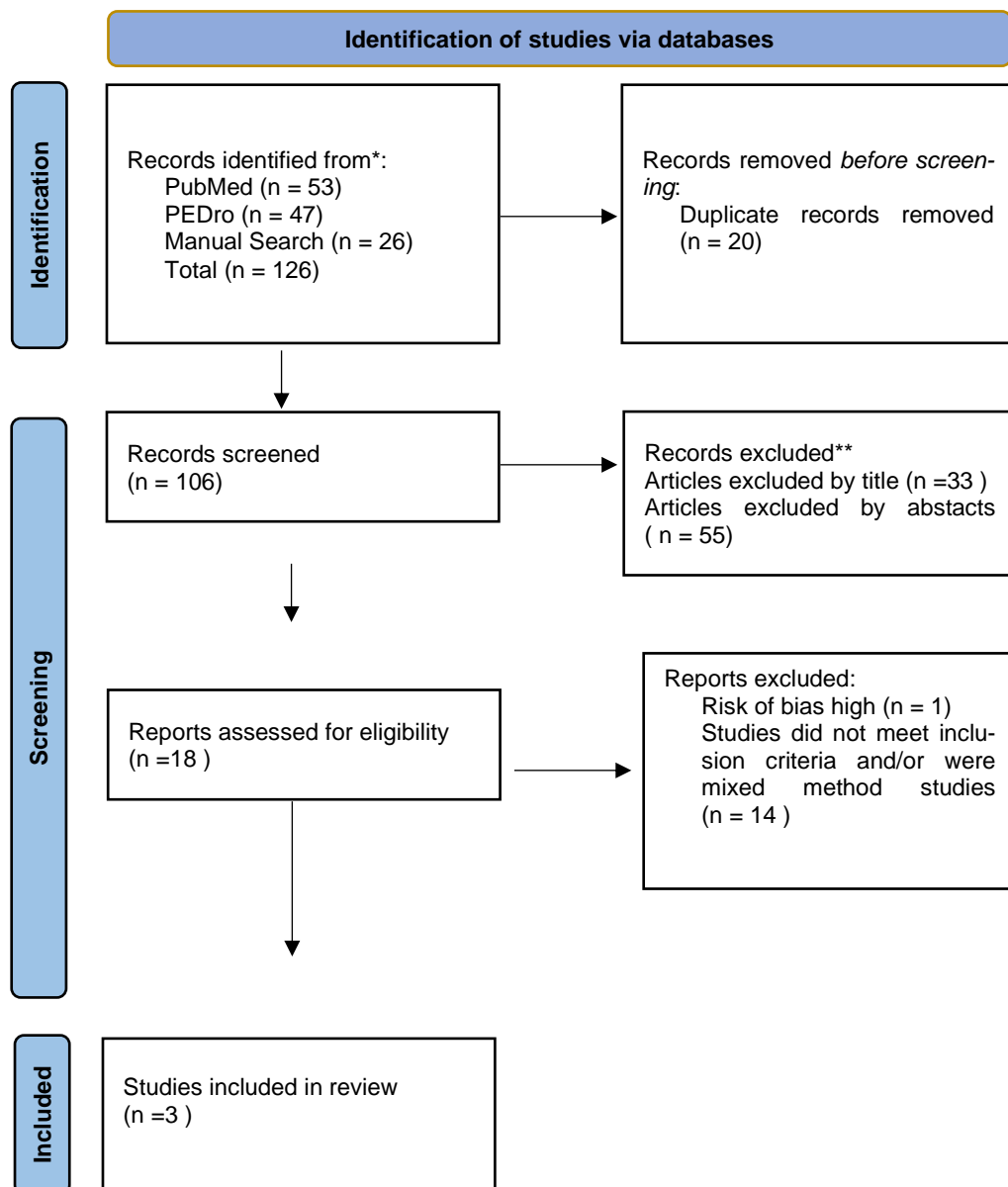
**Identification of studies via databases**

**Identification**

Records identified from*:
    PubMed (n = 53)
    PEDro (n = 47)
    Manual Search (n = 26)
    Total (n = 126)

Records removed *before screening*:
    Duplicate records removed (n = 20)

**Screening**

Records screened
(n = 106)

Records excluded**
Articles excluded by title (n =33 )
Articles excluded by abstacts ( n = 55)

Reports assessed for eligibility
(n =18 )

Reports excluded:
    Risk of bias high (n = 1)
    Studies did not meet inclusion criteria and/or were mixed method studies (n = 14 )

**Included**

Studies included in review
(n =3 )

Figure 1. Study selection based on Prisma flow diagram.

Table 3. Summaries of the studies selected for the systematized literature review

| Author | Study Design | Sample Size | Intervention | Method | Measure | Outcome |
|---|---|---|---|---|---|---|
| **Sharp & Hewitt (2014)** | Meta-analysis | N=199 | Dance classes between 3-12 months. Meta-analysis included tango, foxtrot, Irish set dancing. | 5 RCT | MDS- UP-RDRS III, Berg Balance, Quality of life (PDQ-39) | Short-tern Improvements in UPDRS III motor scores, berg balance, gait speed and quality of life. This indicates improvements in motor function, functional mobility and quality of life. |
| **Delabary et al. (2017)** | Meta-analysis | N=159 | Dance classes between 10 weeks and to 12 months. Meta-analysis only included tango. | 5 RCT | MDS- UPDRS III, TUG, six minute walking test (6MWT), Freezing of gait questionnaire (FOG_Q), GAITrite, quality of life (PDQ 39) | Improvements in UPDRS motor scores, and decreased TUG time, indicating improvements in motor function and functional mobility. |
| **Hasan et al (2022)** | Meta-analysis | N=372 | Dance classes between 3-12 months. Meta-analysis included tango, Irish set dancing, Sardinian folk dance, walt/foxtrot, ballet, jazz, K-pop dance (online) | 14 RCT | MDS- UPDRS III, Berg Balance, TUG, Mini-BES. | Improvements in UPDRS motor score, berg balance, TUG and Mini-BES indicating improvements in motor function, functional mobility. |

Quality Assurance of Selected Studies

When choosing research papers for this study, attention was paid to the methodological quality of the studies included in the above-mentioned meta-analyses. Where possible, the Physiotherapy Evidence Database (PEDro) scale was used to evaluate the methodological quality of studies chosen for this systematized literature review. The PEDro scale is used as a tool in an easy format to assess the reliability of the results of the research in question. The PEDro scale only includes clinical trials and consists of 11 questions, of which 10 are used to calculate the final score of the research publication. The higher the score, the more robust the research process has been. The PEDro scores for each individual study included in two of three selected systematic reviews and they were reviewed for this study. The available PEDro scores are listed in chapter six (6).

In addition, the selected systematic reviews used The Cochrane Handbook for Systematic Reviews of Interventions to assess risk of bias within the RCT's included in the systematic reviews.

Another factor when selecting the studies for this literature review, was that they would need to have at least one common test method, that of Movement Disorder Society-Sponsored Revision of the Unified Parkinson's Disease Rating Scale (MDS-UPDRS), which is a widely used clinical rating scale for PD MDS-UPDRS consists of four parts I-IV. Part I measures non-motor experiences of daily living, part II measures motor experiences of daily living, part III consists of motor examination, and part IV deals with possible motor complications. (Goetz, et al. 2008). In the RCT's selected for this study, they all used at least part III, which consists of motor examination that comes with specific instructions.

Also, evidence of use of the Hoehn and Yarn (H&Y) scale as a part of inclusion and exclusion criteria was looked for. The H&Y helps to provide an indication of the disease progression by measuring functional disability. H&Y have scores from 1-5. The larger the score, the more severe the functional motor disabilities are. Therefore, if most dance classes are offered for people with mild to moderate PD, it would be expected that the H&Y score would be

between 1-3. It is important to note that the H&Y score does not include non-motor functions of PD.

# SYSTEMATIZED LITERATURE REVIEW

A total of three (3) studies, detailed above in table 3, were selected for this study. They are all systemic reviews that include a meta-analysis. In total, the three systemic reviews with meta-analysis included 24 studies in total, consisting of 730 participants, before any exclusion criteria for the meta-analysis or prior accounting for duplicate research papers being used were added within these three meta-analyses. The meta-analyses included some duplicate research papers, indicating that the meta-analyses partially evaluated the same RCT studies. The articles inspect the effects of dance practice on mobility, balance, gait, and often quality of life of people who are living with idiopathic PD. After a careful screening, the studies were selected to provide a comprehensive overview of the current state of research and possible benefits of dance for people with PD. The included research papers have been published between 2014-2021 and the intervention mainly varied between 3 months and 12 months.

Sharp and Hewitt (2014) included five RCT trials in their study that compared dance intervention with no intervention or with alternative exercise intervention. Their meta-analysis consisted of 199 participants. They used Cochrane's risk of bias assessment tool to determine the methodological quality of all the individual trials included in the systemic review. The PEDro scores of the included studies varied between 5-7 and H&Y score was used in 4/5 research papers indicating mild to moderate symptoms. The testing period varied between 3 months, 6 months and 12 months.

For the purposes of this meta-analysis, Sharp and Hewitt (2014) combined two papers that examined dance versus no intervention (Hackney and Earhart 2009 a,b). The First study (a) compared tango and foxtrot and the second

study (b) compared tango, foxtrot and tai chi. For this meta-analysis, the results from tango and foxtrot groups from both study a and b were combined. Sharp and Hewitt (2014) made this decision, as the aim of their review and meta-analysis was to understand the effects of dance rather than compare different dance styles. In addition, the results for tai chi were excluded as tai chi is considered as a form of exercise and not as a type of dance.

Their findings indicated that, in order to be beneficial, interventions need to take place regularly and to be enjoyable and that dance can be shown to have short term clinically meaningful benefits for clients with PD. More specifically, improvements were found in UPDRS motor score, Berg balance and gait speed when comparing with intervention, and when compared with other exercise interventions, results were seen to improve Berg balance and quality of life (QoL).

The standardised mean differences were calculated. The results showed that UPDRS motor score $p=0,0004$, Berg balance score $p=0,0006$ and gait speed $p=0,02$ when compared with no intervention. When results were compared with other type of exercising, significant improvements were found in Berg balance $p=0,002$ and QoL $p=0,01$. Berg balance score $p=0,0006$ and gait speed $p=0,02$ when compared with no intervention. When results were compared with other type of exercising significant improvements were found in Berg balance $p=0,002$ and QoL $p=0,01$.

The concept of neuroplasticity was also discussed within their research as an important aspect to treat PD. Fox et al. (2008) within Sharp and Hewitt (2014) describe how exercise and activity may enhance neuroplasticity in relation to PD. They name five aspects how exercise may be beneficial to promote neuroplasticity: intensive activity increases synaptic plasticity; complex activities promote greater structural adaptation; rewarding activities increase dopamine levels and promote learning/relearning; dopaminergic neurons respond easily to exercise and inactivity; and finally, if exercise is introduced early in the disease progress, the progression of disease might be slowed.

Furthermore, it was valuable to notice how Sharp and Hewitt (2014) described how different dance forms have different qualities that are assumed to target specific symptoms of PD. Tango, which is well researched and used within the field of dance for PD, requires constant movement initiation and pausing as

well as spontaneous change of direction and speed that might be specifically helpful to support movement initiation, turning and bradykinesia. This is important, as tango seems to be one of the most common forms of dance used with people with PD.

Hasan et al. (2021) included 14 RCT studies. Nine of the selected studies compared dance with no intervention (control group), four studies measure dance versus other type of exercise and one study compared dancing versus no intervention versus other types of exercise. Tango seemed to be the most popular type of dance intervention. Their meta-analysis consisted of 372 participants. They used Cochrane's risk of bias assessment tool to determine the methodological quality of all the individual trials included in the systemic review.  They found the Cochrane risk of bias score to be moderate. PEDro scores were not available for all of the studies. Eight (8) of the included studies had included Pedro score, which varied between 5-7 and H&Y score was used in all 14 research papers and varied between mild to moderate (1-2). The testing period varied between 3 months, 6 months and 12 months.

The selected RCT studies measured the benefits of regular dance classes after three (3), six (6) and twelve (12) months of practice. When compared with control group (no intervention) and with exercise intervention, dance classes were shown to significantly improve the UPDRS III score, indicating improvements in motor activities. In addition, compared to other exercise dance improved also the results of TUG, BBS and Mini-BES tests indicating improvements in balance, functional mobility and cognition (mood). Interestingly, their study showed insignificance in relation to QoL and depression.

They also highlight how tango has been shown to be highly effective to improve TUG results. Hasan et al. (2021) state that tango is a type of multidimensional activity that challenges participants both physically and cognitively. It contains multi- directional movement with varying rhythm and speed that might have a positive effect on balance, gait, functional mobility, cognition, depression, apathy and QoL, and could slow down the progression of the disease.

According to Hasan et al. (2021), previous studies suggest that the area of basal ganglia appears as active during dancing, indicating that this might be one reason why dancing might be beneficial to clients with PD. Furthermore,

Hasan et al. are the only ones to briefly mention music therapy in their article, by stating that music therapy alone improves mood, quality of life, motor function and consequently acts of daily living. However, they do not address the combined effects of dance and music.

The standardised mean differences of the meta-analysis of Hasan et al. (2021) indicate that that UPDRS motor score improvement when compared with control group after three months was $p=0{,}0001$, after six months $p= < 0{,}0001$ and after twelve months $p=0{,}005$. In other words, their results indicate that sustained, longitudinal and regular dance practice may provide the best results in regard to motor function improvements as measured by UPDRS scale III. Interestingly, when compared with other types of exercise dance showed significant superiority only at three (3) months in TUG, BBS, Frontal Assessment Battery. They study found that in terms of UPDRS III, gait/walking velocity, 6MWT and FOG at three months, there was no significant difference statistically.

Delabary et al. (2017) included five RCTs in their meta-analysis, which aimed to analyse the effects of motor symptoms of PD, functional mobility and QoL. Four (4) out of five (5) focused on Argentinian Tango or Adapted Tango for people with PD. Three of the included studies compared dance intervention with alternative exercise intervention and two had control groups with no exercise intervention.

Delabary et al. (2017) found improvements in UPDRS III motor score, and functional mobility (TUG) when compared with other exercise interventions and, when compared with no exercise interventions, results were seen to improve motor score results measured with UPDRS III.

The standardised mean differences were calculated. The results showed that UPDRS motor score decreased by $p=0{,}02$, and functional mobility, measured by TUG, improved by $p=0{,}02$ when compared with other exercise intervention. They found no significant improvements in QoL $p$ - $0{,}53$ or with freezing of gait (FOG_Q) $p= 0.50$ When results were compared with no intervention, significant improvements were found in those who took dance classes, as demonstrated by UPDRS motor score $p=0{,}003$. No statistically significant

improvements were found between in 6MWT p=0,10 or with freezing of gait (FOG_Q) p=0,08. Berg balance score $p$=0,0006 and gait speed $p$=0,02.

Overall, Delabary et al. (2017) found that dance improved functional mobility and decreased the motor symptoms of PD, indicating a better management of acts of daily living and independence. They also stressed the importance of regular practice.

However, a closer inspection of the original articles included showed that Delabary et al. (2017) only selected a part of a study by Duncan and Earhart (2009) for their analysis. They only included tango versus no intervention and excluded waltz/foxtrot intervention that is included in the original study. They also excluded Volpe et al (2013) from the meta-analysis due to difference in intervention time (longer time + home programme in addition to weekly classes) and type of dance, Irish folk dance, that differed from the other studies. In other words, it appears that Delabary et al. (2017) excluded other forms of dance than that of tango from their meta-analysis. It appears that they used more strict criteria than it would seem from the onset of the research during the meta-analysis.

Delabary et al (2017) and Sharp and Hewitt (2014) used partially the same studies in their meta-analysis. To be more specific, both contained 5 RCT studies, of which, 3/5 were the same. Furthermore 2/5 were included in the meta-analysis but used differently. Also, Hasan et al. (2021) also included the same studies found in Delabary et al. (2017) and Sharp and Hewitt (2014). The reason for this is mainly because of the inclusion and exclusion criteria, specifically the requirements for the duration of research experiment, the quality assurance measurement requirements such as Pedro score and risk of bias, and research method requirements of the usage of UPDRSM to have a common measurement tool.

Typically, and also at this instance, this is not considered as problematic and appears quite common due to the fact that meta- analysis is considered as highest in the hierarchy of evidence- based research requiring statistical analysis done with rigour, and as independent replication of the research studies are generally welcomed to revalue the hypothesis to strengthen the reliability of the findings. Most commonly, the objective findings of a replication study

would be expected to be the same, yet differences may rise with interpreting the results, initiating discussion and reflection amongst academics and readers alike, which at best would provide a novel angle or an interpretation and at worst unnecessary duplications and wasted efforts or attempts to update past research (Siontis et al. 2013).

## CONCLUSION

The results of this systematized literature review suggest that dance can be an effective and beneficial form of rehabilitation, at least short-term, to improve motor symptoms with clients with PD, as well as quality of life, which in turn can support the maintenance of ADL activities, reduce the risk of falls, and improve gait and co-ordination. Dance can be considered as an activity that supports both motor function and non-motor symptoms of people with PD. The drop- out rates were small in the selected studies, emphasising that dance can be considered as an enjoyable social activity that people are committed to participate in, in addition to being a suitable physical activity for people with PD to manage and improve motor symptoms. Dance practice can be considered to offer a socially engaging and fun activity as an alternative to physiotherapy and gait training.

## DISCUSSION

This systematized literature review has aimed to provide an overview of the benefits of dance for people with PD. Three systematised literature reviews that all included a meta-analysis were used as material for this study. Due to the fact that this systematized literature review was based on meta-analysis meant that it was necessary to reduce some of the original inclusion and exclusion criteria, such as use and monitoring of medication, as this was not

evident in all the 24 research papers. Also, originally the inclusion age was ≤45 years, but it became quite apparent that several of the research papers within the meta-analyses had an age limit of ≤19 years, prompting a change in inclusion criteria for this study. Meta-analyses were selected over individual RCT's to provide a more comprehensive systematized literature review. Meta-analyses were chosen due to the fact that they represent a type of quantitative statistical research that examines data from previous research studies, typically of RCT's, to explore possible patterns and treatment effects in evidence-based practice (Haidich, 2010). Outcomes from a meta-analysis are expected to portray a wider and larger study with a more precise estimate of the effect of a specific treatment for a particular disease, or alternative outcomes, than an individual RCT study. However, as it became apparent in the systematized literature review of the selected meta-analyses, same studies were interpreted slightly differently, emphasising different aspects. These differences most likely occurred in order to meet the criteria and aims set by those responsible for each of the separate meta-analyses. Therefore, great consideration and eye for detail was required when interpreting their results for this study. For example, the study by Delabary et al (2017) by solely focusing on tango in their meta-analysis, possibly reduced the heterogeneity of the original data, but simultaneously strengthened the knowledge of the benefits of tango. By making their choices transparent, like Sharp and Hewitt (2014) allowed one to understand the rationale behind their choices.

Despite of the best efforts to provide a comprehensive study by including meta-analyses, this study does not come without its limitations. The sample sizes of the selected studies were limited. The dance classes detailed in the research differed in terms of frequency, intensity, duration and by type of dance being used for patients with PD. In addition, none of the studies included in this systematized literature review shared a class structure and/or detailed plan, and possible progression and adaptations required and/or created over time. Taking all this into account and based on the evidence provided, it is not possible to determine whether one type of dance is more beneficial than others. Argentinian tango or adapted tango seemed to be the most popular forms of dance, especially with patients with mild to moderate symptoms. Tango is a partnered

dance, indicating that in addition to providing support during the movements, partnering provides an opportunity to do an enjoyable activity with carers and family members without focusing on the illness. By having extra healthy bodies as a part of the dance class also reduces the risk of PD participants falling. Tango, as stated by Hewitt and Sharp (2014), requires constant movement initiation, momentary pausing with spontaneous change of direction and speed that might be specifically helpful to support movement initiation, turning and bradykinesia. Hasan et al. (2021) add that tango contains multi-directional movement with varying rhythm and speed that might have a positive effect on balance, gait, functional mobility, cognition, depression, apathy and QoL and dance may consequently slow down the progression of the disease.

The biggest shortfall of the studies used in this systematized literature review would appear to be the fact that the duration of the testing period remains relatively short, and it varied between the studies, some lasting less than three months. Most commonly the trials lasted for approximately (3) three months, some (6) six, and at best (12) twelve months. Further longitudinal RCTs would be needed to better understand the benefits of dance for people with PD, and whether the positive effects on functional mobility, that are well established in UPDMRS III scores, would remain long-term. Preliminary longitudinal studies conducted by Duncan and Earhart (2014) and Bearss and De Souza (2021) mentioned in chapter 4.1 showed that benefits gained during dance practice can be maintained over a longer period of time. Further exploration would be needed to better understand how effective dance can be as a form of rehabilitation as the disease progresses and symptoms become more severe and whether specific dance styles such as the DfPD programme by Mark Morris Dance Company would be more suitable during the more advanced stages of the illness.

All the studies included in this systematic review showed positive changes in motor function, which was tested by using MDS-UPDRS Part III. Based on the findings of this study, one could suggest that in quantitative research it seems to be more common to focus on motor function than non-motor symptoms and in turn qualitative research such as McRae et al. (2017) mentioned in chapter

4.1, tends to focus more on self-efficacy and quality of life alongside the weekly dance class. Some of the research papers used in this systematized research paper include the use of PDG-39, which also aims to measure quality of life. As stated earlier, all the studies had participants with mild to moderate symptoms. Therefore, an additional benefit of a longitudinal study, in addition to better understanding the benefits of treating motor dysfunction, would be to explore whether greater benefits of dance as a method of rehabilitation would be gained by focusing more on non-motor dysfunction and of the possible benefits of taking part in an enjoyable social activity, rather than just any type of exercise, as the severity of symptoms increase. PD is a degenerative neurological disease and, therefore, it would be useful to gather information about patients` motor and non- motor function and the benefits of dance practice as the disease progresses and the needs change.

An important aspect of this systematized literature review was to better understand what kind of effects music has been shown to have on people with PD, and how well is this knowledge embedded in the research about dance for PD. The benefits of music for people with PD seems clearly established in the research addressing neurological rehabilitation. Therefore, it was surprising to discover that most of the research that focused on benefits of dance for PD rarely explored the impact of music during dance classes. More specifically, as stated in chapter 4.2, music can be considered as a versatile stimulus for the brain which activates the dopaminergic mesolimbic system that regulates memory, attention, regulation of movement, mood and motivation (Sihvonen et al 2017; Wu et al 2022). Studies on the benefits of music with clients with PD have shown that musical rhythm is able to improve gait (speed, step length, frequency), co-ordination of limbs, posture, and balance (Raglio, 2015). Furthermore, according to Sihvonen et al (2017), the rhythm in music is able to activate neural circuits involved in motor actions and music acts as an external cue for movement, in turn replacing the impaired internal timing function in people with PD. Taking all this into account, and when considering the benefits of dance with PD as an multi-sensory activity that includes all the senses that may influence motor, mood, cognitive and neural challenges faced by people with PD (Bearss and DeSouza 2021), it is rather surprising that there does not

seem to be that much of cross disciplinary research collaboration between the fields of dance therapy, music therapy and neurological rehabilitation. In the future, it would be beneficial to bring together the knowledge and expertise from these fields to benefit the current and future practices of dance for PD. There seems to be a clear overlap between the benefits of music and those of dance for people with PD. It would be important to further explore what kind of music is most suitable, what type of rhythm (for example binary or quaternary) and what tempo could be considered to be the most effective for best thera-peutic effects and benefits.

To conclude, suggestions for future studies would include: closer collaboration between the fields of dance and music therapy within neurological rehabilita-tion;, more consistent longitudinal studies that include regular dance practice that account for different stages of a progressive neurological illness such as PD;, and to further explore how dance can be beneficial to addressing non-motor symptoms such as depression, anxiety and social isolation as well as motor dysfunction in more advanced stages of the illness. Also, it would be important to understand how different types of dance affect patients with PD more closely. In order to provide larger samples and more suitable research data, it would be important to agree on the use of standardised tests such as UPDRMS I-IV, Berg Balance test and that of PDQ-39 for example, so data would be more compatible in the analysis process, and therefore there would be better opportunities to gain greater understanding for practical implementa-tion to better support patients with PD in the future.

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