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Music and Parkinson's disease: the state of the art of music therapy in Parkinson's disease — a systematic review

Muzyka i choroba Parkinsona: stan wiedzy na temat muzykoterapii w chorobie Parkinsona – przegląd systematyczny

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Abstract

Introduction: Parkinson's disease is a neurodegenerative disorder leading to the loss of independence and deterioration in patients' quality of life. In recent years, researchers have developed various forms of rehabilitation as a support strategy alongside drug treatment. It has been suggested that music therapy can have a positive impact on both cognitive and motor function in Parkinson's disease patients and, more importantly, improve quality of life. **Aim of the study:** The purpose of this systematic review was to assess the latest research and summarise the possibilities and effectiveness of music therapy. **Materials and methods:** Four databases were systematically searched and analysed from 1 January 2021 to 14 February 2023, according to the established criteria and definition. **Results:** Thirteen studies were included in the analysis. The methodology of the studies varied. Most of them were short-term and involved a small number of participants. Studies examining the impact of singing, dancing and playing instruments, were included in the analysis. Of the studies, 69.2% reported positive effects on motor function, 84.6% on cognitive function, and 53.8% on improved mental well-being. **Conclusions:** Although the research methodology needs further refinement, the benefits of music therapy on motor, cognitive, and mental functioning are evident in short-term studies. The potential beneficial effects in long-term follow-up require further research.

Keywords: music therapy, Parkinson's disease, dancing, singing, non-pharmacological treatment

Streszczenie

Wstęp: Choroba Parkinsona jest chorobą neurodegeneracyjną prowadzącą do stopniowej utraty samodzielności oraz pogorszenia jakości życia pacjentów. W ostatnich latach rozwijane są różnorodne formy rehabilitacji jako strategie wspomagające leczenie farmakologiczne. Dowody literaturowe sugerują, że muzykoterapia może wywierać korzystny wpływ na funkcje poznawcze i ruchowe pacjentów z chorobą Parkinsona, a co ważniejsze, przyczyniać się do poprawy jakości ich życia. **Cel pracy:** Celem przeprowadzonego przeglądu systematycznego była ocena aktualnego stanu wiedzy oraz podsumowanie możliwości i efektywności muzykoterapii jako formy terapii wspomagającej leczenie farmakologiczne pacjentów z chorobą Parkinsona. **Materiał i metody:** Systematyczne przeszukiwanie objęło badania pochodzące z czterech baz danych i zostało przeprowadzone w okresie od 1 stycznia 2021 do 14 lutego 2023 roku, zgodnie z uprzednio zdefiniowanymi kryteriami włączenia oraz definicjami. **Wyniki:** Do analizy końcowej zakwalifikowano trzynaście badań, które charakteryzowały się różnorodną metodologią. Większość z nich miała charakter krótkoterminowy i obejmowała niewielkie grupy badane. W uwzględnionych pracach oceniano efektywność śpiewu, tańca i gry na instrumentach muzycznych jako form rehabilitacji wspierającej leczenie farmakologiczne. W 69,2% badań odnotowano pozytywny wpływ interwencji na funkcje motoryczne, w 84,6% – na funkcje poznawcze, a w 53,8% – na dobrostan psychiczny uczestników.

Wnioski: Mimo ograniczeń metodologicznych wyniki dostępnych badań krótkoterminowych wskazują na potencjalnie korzystny wpływ muzykoterapii na funkcje motoryczne, poznawcze i psychiczne u osób z chorobą Parkinsona. Efekty długofalowe takiego rodzaju terapii wymagają jednak dalszych badań.

Słowa kluczowe: muzykoterapia, choroba Parkinsona, taniec, śpiew, leczenie niefarmakologiczne

INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disorder caused by the loss of dopamine-producing neurons in the midbrain, specifically in the substantia nigra. It causes motor symptoms such as rigidity, bradykinesia, tremor, and postural instability. In addition, PD is associated with numerous non-motor symptoms, including autonomic dysfunction, sleep disturbances, cognitive issues, and neuropsychiatric disorders (dos Santos Delabary et al., 2018). Those symptoms are mainly related to the dysfunction of non-dopaminergic neurotransmitter systems, all of which negatively affect the quality of life (QoL) (Berganzo et al., 2016; Skorvanek et al., 2015) and result in the loss of independence for patients with PD (Santos García et al., 2021).

There has been a steady global increase in the number of PD cases in recent years. Moreover, years of healthy life lost due to disability (YLDs) (per 100,000 population), attributed to PD, have been observed in many countries (Ou et al., 2021). In response to this challenge, some promising therapeutic strategies are being developed and tested. However, to date, there is no effective drug that can halt the progression of the disease (Foltynie and Langston, 2018). This is why it is so important to develop new non-pharmacological methods to improve patients' daily functioning. One supporting strategy that may contribute to a favourable effect in this regard is music therapy.

Music therapy is defined by the American Music Therapy Association (AMTA) as the clinical and evidence-based use of music interventions to accomplish individualised goals within a therapeutic relationship, conducted by a credentialed professional who has completed an approved music therapy programme and provides the indicated treatment including creating, singing, moving to, and/or listening to music (American Music Therapy Association, 2005). In recent years, researchers have developed various forms of music rehabilitation, such as group therapeutic singing (GTS) (Stegemöller et al., 2017a, 2017b) or the Dance for PD programme (DfPD®), which has gained global popularity and has been used in numerous studies (Michels et al., 2018, Zhang et al., 2019). Most importantly, these studies strongly suggest improvements in cognitive functioning, mobility, and, most importantly, the QoL of patients with PD (Carapellotti et al., 2020; Machado Sotomayor et al., 2021; Michels et al., 2018; Stegemöller et al., 2017a, 2017b; Zhang et al., 2019).

To evaluate the benefits of non-pharmacological approaches, Machado Sotomayor et al. analysed studies related to music therapy in PD. They hypothesised and confirmed the positive effects of music therapy programmes in different spheres of human functioning in patients with PD (Machado Sotomayor et al., 2021). The use of music in therapy continues to inspire the search for new evidence regarding its effectiveness. There are many definitions of music therapy. This review is based on studies using the AMTA's strict definition of music therapy, and aims to summarise the recent research and evaluate the effects of singing, dancing, or playing instruments on motor function (MF), cognitive function (CF), QoL, and the well-being of patients with PD.

METHODS

Four databases (Web of Science, Scopus, Medline, and EMBASE) were searched systematically using the following search string: "Parkinson's AND (therapy OR therapeutic OR rehabilitation OR intervention OR training) AND (music OR singing OR sing OR rhythm OR rhythmic OR dancing OR dance OR voice OR auditory OR

Inclusion criteria	Exclusion criteria
Studies in English, published from 1 January 2021 to 14 February 2022	Case studies, case series, reviews, editorials, conference abstracts, books, opinion articles, etc.
Clinical trials, randomised controlled trials, observational studies, pilot studies	Studies not focused on music therapy
Research on music therapy defined as group therapy associated with dancing, singing, or playing instruments by patients with Parkinson's disease	Studies assessing physical therapy, walking, or exercises to music in the background
Studies assessing the impact on motor function or cognitive function, or quality of life of patients with Parkinson's disease	Studies comparing physical therapy to music therapy
Interventions in which both the study group and control groups consisted only of patients with Parkinson's disease, or in which only the Parkinson's disease subgroup was clearly separated	Studies with unreliable diagnosis of Parkinson's disease
	Studies in which patients with Parkinson's disease were compared with patients with non-Parkinson's disease/general population
	Duplicate items

Tab. 1. Inclusion and exclusion criteria for article selection in the systematic review
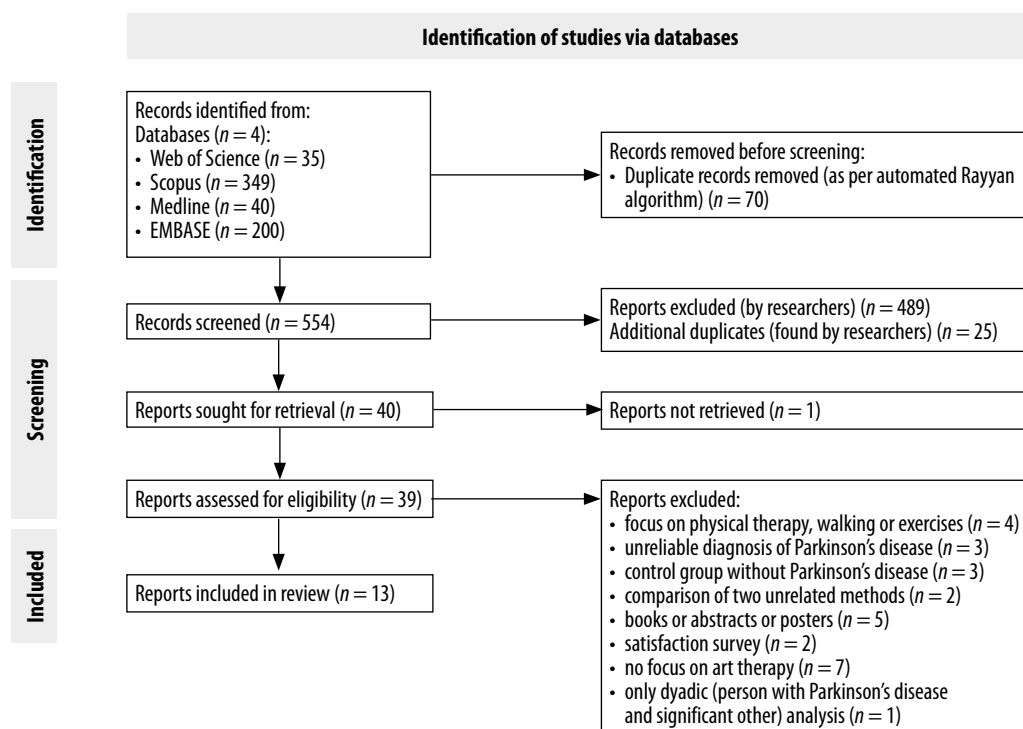
Identification of studies via databases

Fig. 1. Process of article selection based on PRISMA guidelines and template

sounds)". The search was conducted according to PRISMA guidelines (Page et al., 2021). The results were narrowed down to publications in English from 1 January 2021 to 14 February 2023. The qualification of studies was performed systematically by two independent researchers (JWG and NS) according to the established criteria (Tab. 1) and the definition of music therapy formulated by the AMTA. Any concerns about the publications were discussed by the authors. The reliability of the results from the eligible studies was assessed using the JBI Critical Appraisal Checklist for Quasi-Experimental Studies questionnaire (Suppl. 1) by two independent researchers (JWG and NS), and discrepancies were resolved through discussion. The full diagram of the selection process is shown in Fig. 1. Of the original 624 articles identified, 13 (2.08%) were included in the final analysis.

RESULTS

The general characteristics of the included studies include the following data: study authors, type of intervention, number of PD patients at the study baseline and number of patients analysed, age of PD patients (as mean, median, or range of values), duration of PD, and information on medications taken by patients (defined as a list of drug types, a full list of medications, or calculated levodopa equivalent daily dose – LEDD value). Of the 13 eligible articles, nine were intervention studies, three were pilot studies, and one was a preliminary longitudinal intervention.

The analysed studies differed in the type of therapeutic intervention: nine studies used a dance therapy intervention, one study used instrumental play, and three articles described interventions using GTS. Most of analysed articles compared the study group before and after music therapy (as a single experimental group with test-retest measurements) or included PD experimental groups that received music therapy and PD control groups without music rehabilitation (with drug treatment only). In most of the included studies, the PD group was larger at the beginning than at the end of the study. Statistical analysis was performed in 12 articles. In one case, statistical analysis was not conducted due to the small group size at the end of the intervention. Patient age was described as mean, median, or range. Only one study did not include information on the age of PD patients. PD duration was defined similarly. In four of the 13 studies, there was no information on the duration of PD. In addition, in eight studies, there was no information on the drug treatment used by PD patients. All studies were conducted while patients were taking antiparkinsonian medications.

Detailed data related to the characteristics of the eligible studies are shown in Tab. 2.

In the studies reviewed, motor function was mainly assessed using the Movement Disorder Society – Unified Parkinson's Disease Rating Scale, Part III (MDS-UPDRS). Other methods used included the 6-Minute Walk Test (6MWT), Timed Up and Go under dual-task conditions (DT-TUG), Timed Up and Go (TUG), Fingertip-to-Floor (Ftf), the

Number	Study title, authors and year of publication	Type of study	Type of intervention	Number of patients with PD at baseline	Number of patients with PD considered in the analysis	Age of patients [years]	PD duration [years]	Information about pharmacological treatment – types of drugs, LEDD or medication list (Yes/No)
1	Beauty that moves: dance for Parkinson's effects on affect, self-efficacy, gait symmetry, and dual task performance. Fontanesi et al., 2021	Intervention	75-min DfPD® classes conducted once	7	7	Mean age: 71.4 ± 6.7	Mean duration: 5.8 ± 3.5	Yes
2	Dance training and performance in patients with Parkinson disease: effects on motor functions and patients' well-being. Bouquiauxa et al., 2022	Intervention	60-min of dance training classes during 4-month period (16 classes)	Experimental group: 10 Control group: 6	Experimental group: 8 Control group: 6	Experimental group (median): 65 (56.75–75.25) Control group (median): 68 (62.5–70.5)	Experimental group (median duration): 9.5 (6.75–11.75) Control group (median duration): 4 (3.25–7)	No
3	Effects of a structured dance program in Parkinson's disease. A Greek pilot study. Elpidoforou et al., 2022	Pilot study	16 DfPD® 60-min classes, performed twice weekly over a period of 8 weeks (16 classes)	16	13	Mean age: 56 ± 12	Mean duration: 6 ± 4.6	No
4	Evaluating the effects of dance on motor outcomes, non-motor outcomes, and quality of life in people living with Parkinson's: a feasibility study. Carapellotti et al., 2022	Pilot study	60-min DfPD® classes over the course of 12 weeks (20 classes), an average of 2 classes per week	10	7	Range of age: 53–72	Range of duration: 1–9	Yes
5	A high dose tango intervention for people with Parkinson's disease. Rabinovich et al., 2021	Intervention	90-min classes held over a duration of 2 weeks	8	8	DNA	DNA	Yes
6	Parkinson's disease motor symptom progression slowed with multisensory dance learning over 3-years: a preliminary longitudinal investigation. Bearss and DeSouza, 2021	Preliminary longitudinal intervention	85-min DfPD® classes once a week over a 3-year period	Experimental group: 16 Control group: 16	Experimental group: 16 Control group: 16	Mean age: 68.7 ± 8.4	Mean age of onset: 63.9 ± 11.5	No
7	More than movement: exploring motor simulation, creativity, and function in co-developed dance for Parkinson's. Bek et al., 2021	Pilot study	60–75-min dance classes once a week over the course of 6 weeks	10	No statistical analysis	Range of age: 50–71	DNA	No
8	Physical activity based on dance movements as complementary therapy for Parkinson's disease: effects on movement, executive functions, depressive symptoms, and quality of life. Duarte et al., 2023	Intervention	50-min dance classes based on "Baila Parkinson" method twice a week for 6 months	18	13	Mean age: 65.9 ± 6.5	Mean duration: 6.4 ± 3.4	No

DfPD® – Dance for Parkinson's Disease; **DNA** – data not available; **GTS** – group of therapeutic singing; **LEDD** – levodopa equivalent daily dose; **PD** – Parkinson's disease.

Tab. 2. General characteristics of studies assessing the influence of music therapy on patients with PD

Number	Study title, authors and year of publication	Type of study	Type of intervention	Number of patients with PD at baseline	Number of patients with PD considered in the analysis	Age of patients [years]	PD duration [years]	Information about pharmacological treatment – types of drugs, LEDD or medication list (Yes/No)
9	Effects of dance on gait and dual-task gait in Parkinson's disease. Haputhanthirige et al., 2023	Intervention	60-min classes of DfPD® twice a week for 12 weeks	Experimental group: 17 Control group: 16	Experimental group: 17 Control group: 16	Experimental group (mean): 65.8 ± 11.7 Control group (mean): 67.0 ± 7.7	Experimental group (mean duration): 3.76 ± 2.88 Control group (mean duration): 5.94 ± 3.61	Yes
10	Piano training enhances Stroop performance and musical self-efficacy in older adults with Parkinson's disease. Bugos et al., 2019	Intervention	180-min intensive piano training each morning over a 10-day period	Experimental group: 34 Control group: 11	Experimental group: 34 Control group: 11	Experimental group (mean): 65.79 ± 8.38 Control group (mean): 67.55 ± 7.29	DNA	No
11	The effects of group therapeutic singing on cortisol and motor symptoms in persons with Parkinson's disease. Stegemöller et al., 2021	Intervention	60-min of group of therapeutic singing (GTS)	Experimental group: 17 Control group: 8	Experimental group: 17 Control group: 8	Experimental group (mean): 74.29 ± 1.70 Control group (mean): 70.00 ± 1.48	Experimental group (mean duration): 7.50 ± 1.15 Control group (mean duration): 6.25 ± 1.54	No
12	Group therapeutic singing improves clinical motor scores in persons with Parkinson's disease. Stegemoller et al., 2024	Intervention	60-min of GTS for an average of 2.4 ± 1.4 years	18	18	Mean age: 74.9 ± 7.2	Mean duration: 7.5 ± 4.7	Yes
13.	The effects of therapeutic group singing on voice, cough and quality of life in Parkinson's disease. Brooks et al., 2021	Intervention	60-min weekly of GTS for 12 weeks	22	Experimental group: 10 Control group: 9	Experimental group (median) age: 68 Control group (median) age: 69	DNA	No
DfPD® – Dance for Parkinson's Disease; DNA – data not available; GTS – group of therapeutic singing; LEDD – levodopa equivalent daily dose; PD – Parkinson's disease.								

Tab. 2. General characteristics of studies assessing the influence of music therapy on patients with PD (cont.)

Berg Balance Scale (BBS), the Sensory Organisation Test (SOT), the Dexterity Questionnaire 24 (DexQ24), and the Performance-Oriented Mobility Assessment (POMA). Two of the 12 studies did not analyse motor function.

More than half of the studies found positive effects of music therapy on various aspects of motor symptoms. Detailed data are presented in Tab. 3.

The quality of life and well-being of patients with PD were assessed by the following methods: the Beck Depression Inventory (BDI), the Beck Depression Inventory-II (BDI-II), the Unified Parkinson's Disease Rating Scale (UPDRS) (Parts I and II), the Body Self-Efficacy (BSE), the Positive and Negative Affect Schedule (PANAS-X), the Visual Analogue Scale of Happiness (VAS Happiness), the Parkinson's Disease Questionnaire (PDQ-8), the Parkinson's Disease Fatigue Scale (PFS-16), the Patient Health Questionnaire (PHQ-9), the Parkinson's Disease Questionnaire (PDQ-39), the General Self-Efficacy Scale (GSE), the Musical Performance Self-Efficacy Scale (MPSE),

the Communicative Effectiveness Survey-Revised (CES-R), the Voice Handicap Index (VHI), and the Montgomery–Åsberg Depression Rating Scale (MADRS). All 13 studies included quantitative measures – questionnaires. Four studies provided information about conducting interviews with participants. Five of the 13 eligible articles did not include information on mental health in PD patients – either because mental health assessments were not included, or because statistical analysis could not be performed due to the size of the group. In the remaining studies, improvements in this area of health were observed. All data are shown in Tab. 4.

Ten of the 13 studies assessed CF using neuropsychological scales; one used a standardised neuropsychological testing protocol (for fluency and subtraction). Two studies did not include measures of CF. The following methods were used to assess CF: the Montreal Cognitive Assessment (MoCA), the Trail Making Test (TMT), the Digit Span Forward (DF), the Digit Span Backwards (DB), the Digit

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Number	Study title, authors and year of publication	Methods assessing the motor function	Results
1	Beauty that moves: dance for Parkinson's effects on affect, self-efficacy, gait symmetry, and dual task performance. Fontanesi and DeSouza, 2021	6MWT	Increase in an average symmetry index (%) ($Z = 2.032$, $p = 0.042$) for DfPD® compared to control group
		DT-TUG	Overall decrease in dual task cost ($Z = -2.023$, $p = 0.043$) for DfPD® compared to control group
2	Dance training and performance in patients with Parkinson disease: effects on motor functions and patients' well-being. Bouquiauxa et al., 2022	Tinetti test 10-meter test 6MWT FtF test	Walking speed improvement in the 10-meter test ($Z = -2.629$; $p = 0.009$) for the dancing intervention group compared to the no-dancing control group
3	Effects of a structured dance program in Parkinson's disease. A Greek pilot study. Elpidoforou et al., 2022	BBS	Balance improvement in BBS (absolute change: 2.53 ± 2.29, % change: 5 ± 4, $p = 0.003$) before and after intervention
4	Evaluating the effects of dance on motor outcomes, non-motor outcomes, and quality of life in people living with Parkinson's: a feasibility study. Carapellotti et al., 2022	MDS-UPDRS III Scale TUG DT-TUG SOT	Decrease in TUG test in comparison of the baseline and post-intervention state (change score: 1.7, $p = 0.016$)
5	A high dose tango intervention for people with Parkinson's disease. Rabinovich et al., 2021	MDS-UPDRS III Scalew	Reduction in motor symptoms from the pre-score ($M = 21.1$, $SD = 10.5$) to the post-score ($M = 17.2$, $SD = 10.8$) in MDS-UPDRS III scale ($p = 0.016$)
6	Parkinson's disease motor symptom progression slowed with multisensory dance learning over 3-years: a preliminary longitudinal investigation. Bearss and DeSouza, 2021	MDS-UPDRS III Scale	Reduced progression of motor impairments assessed using MDS-UPDRS III scale in PD-dancers compared to PD patients who do not train in dance ($p < 0.05$)
7	More than movement: exploring motor simulation, creativity, and function in co-developed dance for Parkinson's. Bek et al., 2022	Self-report questionnaire DextQ-24	Potential improvements in functional dexterity. No statistical analysis
8	Physical activity based on dance movements as complementary therapy for Parkinson's disease: effects on movement, executive functions, depressive symptoms, and quality of life. dos Santos Duarte et al., 2023	POMA	Improvement of balance and gait between pre- and post-intervention ($p = 0.0207$)
9	Effects of dance on gait and dual-task gait in Parkinson's disease. Haputhanthirige et al., 2023	Spatiotemporal gait during regular walking and DT-TUG assessed on an even and uneven surface	Statistically significant improvement of gait parameters with and without DT on even surface and improvement of uneven surface walking with a serial subtraction task
10	Piano training enhances Stroop performance and musical self-efficacy in older adults with Parkinson's disease. Bugos et al., 2021	DNA	DNA
11	The effects of group therapeutic singing on cortisol and motor symptoms in persons with Parkinson's disease. Stegemöller et al., 2021	MDS-UPDRS III Scale	No statistically significant difference between pre- and post-intervention assessment of motor functionality
12	Group therapeutic singing improves clinical motor scores in persons with Parkinson's disease. Stegemoller et al., 2022	MDS-UPDRS III Scale	Total motor scores assessed in MDS-UPDRS III scale showed a trend toward statistical significance ($p = 0.09$), but patients displayed an improvement in gait and postural assessment ($p = 0.03$). Tremor assessment was close to statistical significance ($p = 0.05$)
13	The effects of therapeutic group singing on voice, cough and quality of life in Parkinson's disease. Brooks et al., 2021	DNA	DNA

6MWT – 6 min walking test; **BBS** – The Berg Balance Scale; **DexQ24** – Dexterity Questionnaire 24; **DfPD®** – Dance for Parkinson's Disease; **DNA** – data not available; **DT-TUG** – dual task performance with Time Up and Go Test; **FtF** – fingertip-to-floor; **MDS-UPDRS III Scale** – Movement Disorder Society – Unified Parkinson's Disease Rating Scale; **PD** – Parkinson's disease; **POMA** – Performance Oriented Mobility Assessment; **SOT** – Sensory Organisation Test; **TUG** – Timed Up and Go.

Tab. 3. Analysis of the influence of music therapy on motor function in PD

Symbol Substitution Test (DSST), the Mini–Mental State Examination (MMSE), the Kinaesthetic and Visual Imagery Questionnaire (KVIQ), the Beat Alignment Test (BAT), the Advanced Measures of Music Audiation (AMMA), the Wechsler Abbreviated Scale of Intelligence (WASI), the Music Reading Assessment (MRA), the Paced Auditory Serial Addition Task (PASAT), the Delis–Kaplan Executive Function System (DKEFS), the Western Aphasia Battery (WAB), and the Frontal Assessment Battery (FAB). Among these, MoCA and MMSE were used most often.

The results regarding the effect of dance therapy on CF in the studies analysed were as follows: not statistically significant (three studies), not available (four studies), or no statistical analysis performed (two studies). Four studies reported improvements in CF. Detailed data are shown in Tab. 5.

Number	Study title, authors and year of publication	Source of information about mental state	Methods assessing quality of life and mental well-being	Results
1	Beauty that moves: dance for Parkinson's effects on affect, self-efficacy, gait symmetry, and dual task performance. Fontanesi and DeSouza, 2021	Q	UPDRS, PANAS-X, BSE, BDI-II	Significant correlation between the levels of Subscale of PANAS-X (General Positive Affect, GPA) reported after intervention and the average Skin Conductance Levels (SCL) recorded during the dance session (Spearman's rho = 0.900, $p = 0.037$). Significant increase in BSE ($Z = -2.371$, $p = 0.018$), beauty subscale ($Z = -2.121$, $p = -0.034$)
2	Dance training and performance in patients with Parkinson disease: effects on motor functions and patients' well-being. Bouquiauxa et al., 2022	Q	VAS Happiness	Significant improvement in VAS Happiness ($Z = -2.433$; $p = 0.015*$)
3	Effects of a structured dance program in Parkinson's disease. A Greek pilot study. Elpidoforou et al., 2022	Q	PDQ-8, BDI-II, PFS-16	All measures improved significantly. PDQ-8 ($p = 0.020$). BDI-II ($p = 0.046$). PFS-16 ($p = 0.021$)
4	Evaluating the effects of dance on motor outcomes, non-motor outcomes, and quality of life in people living with Parkinson's: a feasibility study. Carapellotti et al., 2022	Q, I	PDQ-39, PHQ-9	Significant improvement in PDQ-39 subscale (Bodily Discomfort) ($p = 0.036$) and PHQ-9 ($p = 0.034$). Participants underlined the subjective positive impact of the program on their mood in the interview questions
5	A high dose tango intervention for people with Parkinson's disease. Rabinovich et al., 2021	Q, I	15-item Likert Based Questionnaire (not standardised)	Subjectively, participants felt more motivated and dance helped them with coping with illness
6	Parkinson's disease motor symptom progression slowed with multisensory dance learning over 3-years: a preliminary longitudinal investigation. Bearss and DeSouza, 2021	Q	UPDRS	No direct information about mental state of participants
7	More than movement: exploring motor simulation, creativity, and function in co-developed dance for Parkinson's. Bek et al., 2022	Q, I	PDQ-39, Qualitative data from focus group	No statistical analysis
8	Physical activity based on dance movements as complementary therapy for Parkinson's disease: effects on movement, executive functions, depressive symptoms, and quality of life. dos Santos Duarte et al., 2023	Q	MADRS, PDQ-39	Significant improvement in MADRS pre and post intervention (t (12) = 2.264, $p = 0.0214$) and in PDQ-39 (t (12) = 4.239, $p < 0.001$)
9	Effects of dance on gait and dual-task gait in Parkinson's disease. Haputhanthirige et al., 2023	DNA	DNA	DNA
10	Piano training enhances Stroop performance and musical self-efficacy in older adults with Parkinson's disease. Bugos et al., 2021	Q	PDQ-39, GSE, MPSE	Significant difference pre and post intervention in MPSE ($p = 0.001$)
11	The effects of group therapeutic singing on cortisol and motor symptoms in persons with Parkinson's disease. Stegemöller et al., 2021	Q	PDQ-39, UPDRS	No statistical analysis of variable – focus on stress and cortisol in the context of singing
12	Group therapeutic singing improves clinical motor scores in persons with Parkinson's disease. Stegemöller et al., 2022	Q	BDI	DNA
13	The effects of therapeutic group singing on voice, cough and quality of life in Parkinson's disease. Brooks et al., 2021	Q	BDI, CES-R, VHI	No significant differences

BDI – Beck Depression Inventory; **BDI-II** – Beck Depression Inventory-II; **BSE** – Body Self-Efficacy; **CES-R** – Communicative Effectiveness Survey-Revised; **DNA** – data not available; **GSE** – General Self-Efficacy Scale; **I** – interview; **MADRS** – Montgomery–Åsberg Depression Rating Scale **MPSE** – Musical Performance Self-Efficacy Scale; **PANAS-X** – Positive and Negative Affect Schedule; **PDQ-8** – Parkinson's Disease Questionnaire; **PDQ-39** – Parkinson's Disease Questionnaire; **PFS-16** – Parkinson's Disease Fatigue Scale; **PHQ-9** – Patient Health Questionnaire; **Q** – questionnaire; **UPDRS** – Unified Parkinson's Disease Rating Scale; **VAS Happiness** – Visual Analogue Scale of Happiness; **VHI** – Voice Handicap Index.

Tab. 4. Analysis of the influence of music therapy on quality of life and mental well-being in PD

DISCUSSION

This review addresses the effects of music therapy on motor status, cognitive performance, and quality of life of patients with PD, based on an analysis of scientific articles published from January 2021 to February 2023. The topic was previously analysed based on publications covering the years 2015–2020 in a review that included articles from two databases and defined music therapy according to the broad definition of the World Federation of Music Therapy

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Number	Study title, authors and year of publication	Source of information about cognitive state	Methods assessing cognitive function	Results
1	Beauty that moves: dance for Parkinson's effects on affect, self-efficacy, gait symmetry, and dual task performance. Fontanesi and DeSouza, 2021	S	MoCA	DNA
2	Dance training and performance in patients with Parkinson disease: effects on motor functions and patients' well-being. Bouquiauxa et al., 2022	S	MoCA	No statistically significant findings
3	Effects of a structured dance program in Parkinson's disease. A Greek pilot study. Elpidoforou et al., 2022	S	MoCA	Significant improvement ($p = 0.010$)
4	Evaluating the effects of dance on motor outcomes, non-motor outcomes, and quality of life in people living with Parkinson's: a feasibility study. Carapellotti et al., 2022	S	MoCA, TMT A&B, DS Forward, DS Backward, DSST	No statistically significant findings
5	A high dose tango intervention for people with Parkinson's disease. Rabinovich et al. 2021	DNA	DNA	DNA
6	Parkinson's disease motor symptom progression slowed with multisensory dance learning over 3-years: a preliminary longitudinal investigation. Bearss and DeSouza, 2021	DNA	DNA	DNA
7	More than movement: exploring motor simulation, creativity, and function in co-developed dance for Parkinson's. Bek et al., 2022	S	KVIQ, experimental task assessing embodiment	No statistical analysis
8	Physical activity based on dance movements as complementary therapy for Parkinson's disease: effects on movement, executive functions, depressive symptoms, and quality of life. dos Santos Duarte et al., 2023	S	FAB	Significant change in general FAB score (t (12) = 2.840, $p < 0.01$) and in subdomains – "conceptualization" (t (12) = 2.941, $p < 0.01$) and "inhibitory control" (t (12) = 2.920, $p < 0.01$)
9	Effects of dance on gait and dual-task gait in Parkinson's disease. Haputhanthirige et al., 2023	T	DTverb, DTsub (tasks performed whilst walking)	No statistically significant findings
10	Piano training enhances Stroop performance and musical self-efficacy in older adults with Parkinson's disease. Bugos et al., 2021	S	AMMA, WASI, MRA, Stroop, TMT, PASAT, D-KEFS	Significant change in MRA (pre- and post-intervention) ($p = 0.009$), significantly fewer errors in Stroop ($p = 0.03$)
11	The effects of group therapeutic singing on cortisol and motor symptoms in persons with Parkinson's disease. Stegemöller et al. 2021	S	MMSE	No statistical analysis of variable – focus on stress and cortisol in the context of singing
12	Group therapeutic singing improves clinical motor scores in persons with Parkinson's disease. Stegemoller et al., 2022	S	MMSE	DNA
13	The effects of therapeutic group singing on voice, cough and quality of life in Parkinson's disease. Brooks et al., 2021	S	MMSE, WAB	Significant change in speech rate – words per minute ($p = 0.009$)

AMMA – Advanced Measures of Music Audiation; **BAT** – Beat Alignment Test; **DKEFS** – Delis–Kaplan Executive Function System; **DNA** – data not available; **DS Backwards** – Digit Span Backwards; **DS Forward** – Digit Span Forward; **DSST** – Digit Symbol Substitution Test; **KVIQ** – Kinesthetic and Visual Imagery Questionnaire; **MMSE** – Mini–Mental State Examination; **MoCA** – Montreal Cognitive Assessment; **MRA** – Music Reading Assessment; **PASAT** – Paced Auditory Serial Addition Task; **S** – scale; **TMT** – Trail Making Test; **WAB** – Western Aphasia Battery; **WASI** – Wechsler Abbreviated Scale of Intelligence.

Tab. 5. Analysis of the influence of music therapy on cognitive functions in PD

(Machado Sotomayor et al., 2021). The current review expands on this by incorporating two additional databases – EMBASE and Medline – and using more specific keywords. In addition, the definition of music therapy from the AMTA (American Music Therapy Association, 2005) was used. The wide spectrum of definitions of music therapy influenced the selection of papers with different research methodologies for the review.

Nine of the 13 eligible studies (69.2%) reported a positive effect of music therapy on various aspects of motor function. Nine of these studies used dance as a therapeutic modality (Bearss and DeSouza, 2021; Bek et al., 2022; Bouquiaux et al., 2022; Carapellotti et al., 2022; Duarte

et al., 2023; Elpidoforou et al., 2022; Fontanesi and DeSouza, 2021; Haputhanthirige et al., 2023; Rabinovich et al., 2021). Observed improvements included gait and balance parameters (Bouquiaux et al., 2022; Carapellotti et al., 2022; Duarte et al., 2023; Elpidoforou et al., 2022; Fontanesi and DeSouza, 2021; Haputhanthirige et al., 2023), with changes assessed using the MDS-UPDRS III Scale (Bearss and DeSouza, 2021; Rabinovich et al., 2021). One study, a longitudinal analysis, found reduced progression of motor impairment in dancers with PD after three years of follow-up (Bearss and DeSouza, 2021). In another study, no statistical analysis was performed (Bek et al., 2022). In addition, there was one study with instrument play (Bugos et al., 2021) and

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three studies with GTS (Brooks et al., 2021; Stegemöller et al., 2021, 2022). In the former, motor function assessment was not available (Bugos et al., 2021). The results of the GTS studies were inconsistent: one showed significant improvement in gait and postural assessment (Stegemöller et al., 2022), while the other two showed no significant results or lacked motor function assessment (Brooks et al., 2021; Stegemöller et al., 2021). Consequently, the effects of singing on motor function remains unclear.

Seven of the 13 studies (53.8%) reported improvements in the psychological well-being of PD patients (Bugos et al., 2021; Bouquiaux et al., 2022; Carapellotti et al., 2022; Duarte et al., 2023; Elpidoforou et al., 2022; Fontanesi and DeSouza, 2021; Rabinovich et al., 2021). Six of these studies conducted statistical analyses and used psychological questionnaires to measure the general psychological condition before and after music therapy. One study reported subjective improvement based on qualitative methods and a self-designed questionnaire. Other studies either did not measure or did not analyse mental health data. The most commonly used questionnaires were PDQ-39 (Bek et al., 2022; Bugos et al., 2021; Carapellotti et al., 2022; Duarte et al., 2023; Stegemöller et al., 2021) and BDI-II (Brooks et al., 2021; Fontanesi and DeSouza, 2021; Stegemöller et al., 2022).

Eleven of the 13 studies (84.6%) included assessment of CF in patients with PD. Four of these studies (36.36%) reported significant improvement in CF (Brooks et al., 2021; Bugos et al., 2021; Duarte et al., 2023; Elpidoforou et al., 2022). Most studies used screening scales (MMSE and MoCA) to assess cognitive status as part of their inclusion criteria. However, assessing CF in response to music therapy was not the primary goal of these studies, so some did not analyse the effect of the intervention on CF.

The studies analysed have a number of limitations. Only one was longitudinal, providing very limited insight into the sustaining role of this type of intervention in PD. Studies on music therapy tend to involve a limited number of participants, which makes it difficult to adequately determine the positive effects of incorporating music therapy into the interventions offered to PD patients. In the analysed articles, the number of participants ranged from seven to 34. In the current review, only five of the 13 (38.46%) studies mentioned drug treatment (Carapellotti et al., 2022; Fontanesi and DeSouza, 2021; Haputhanthirige et al., 2023; Rabinovich et al., 2021; Stegemöller et al., 2022). Providing this information is crucial, as the type of pharmacotherapy and the absence or presence of changes in the timing of interactions can influence the effects of music therapy. Another important limitation of the analysis is that not all articles reported the duration and severity of PD. In this review, 9 of the 13 studies (69.23%) included such information (Bearss et al., 2021; Bouquiaux et al., 2022; Carapellotti et al., 2022; Duarte et al., 2023; Haputhanthirige et al., 2023; Elpidoforou et al., 2022; Fontanesi and DeSouza, 2021; Stegemöller et al., 2021, 2022). These variables also can influence the effects of music therapy.

A key limitation of the study is the use of diverse methodologies across the included research. This contributed to a less statistically advanced comparison of the included articles within this paper and also may limit the generalisability of the findings to a larger population. However, despite methodological issues, the original studies included in the review reported similar conclusions.

The systematic review itself also has some limitations, e.g. the sample size of the included research is relatively small. However, the articles were chosen to best respond to the research question and to acknowledge music therapy in the broadest sense. The described inclusion key implemented within the available sources may also limit the full generalisability of the findings e.g. in the context of different cultures.

CONCLUSIONS

Analysis of short-term studies allows for several conclusions. First, the methodologies used vary, making comparisons difficult. There is a need to standardise methods for assessing improvement across different levels of functioning.

Most studies were conducted in small groups, so the assessment of the effectiveness of music therapy is limited.

Also, many studies do not provide information on drug therapy, which is the primary treatment for Parkinson's disease. This aspect should be included to fully assess the potential of music therapy as a form of rehabilitation.

While most interventions focused on dance, the evaluation of the effects of GTS and instrument playing remains limited, especially in terms of the effects of these forms of rehabilitation on the cognitive sphere.

Although many methodological aspects need improvement, the effectiveness of music therapy as a form of rehabilitation appears to be significant. However, long-term studies, involving larger participant groups and conducted using standardised and improved methodology, are needed to strengthen the evidence base.

Ethical considerations

This study, being a literature review, is exempt from Institutional Review Board approval.

Data sharing policy

The data presented in the study can be accessed via contact with the corresponding author.

Reporting guidelines

Funding

Author contribution

Original concept of study; Collection, recording and/or compilation of data; Analysis and interpretation of data: JWG, NS. Writing of manuscript: JWG, NS, AKM, AG. Critical review of manuscript; Final approval of manuscript: AKM, AG.

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