

Influence of Rhythmic Auditory Stimulation using music associated with physical therapy on depressive symptoms in Parkinson's

Influência da estratégia de Estimulação Auditiva Rítmica com música associada à fisioterapia sobre os sintomas depressivos no Parkinson

Influencia de la estrategia de Estimulación Auditiva Rítmica con música asociada a fisioterapia en los síntomas depresivos en el Parkinson

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ABSTRACT | Depressive symptoms are commonly found in Parkinson's disease and are considered an important factor for an individual's poor quality of life and disability. Therapeutic interventions based on rhythm and music, such as rhythmic auditory stimulation, have been used to treat the mobility and seem to positively influence on mood. This study aims to evaluate the effect of rhythmic auditory stimulation using music associated with physical therapy on mood in individuals with Parkinson's, with an emphasis on depressive symptoms. This is a quasi-experimental study with a final sample of 18 patients aged 40–80 years, with a clinical diagnosis of idiopathic Parkinson's disease, in the mild to moderate stages of the disease. Patients were randomized into two groups: Rhythmic Auditory Stimulation and Control Groups. Depressive symptoms were assessed using the Portuguese version of the Beck Depression Inventory. Both groups reduced their The Beck Depression Inventory scores. However, only in the Rhythmic Auditory Stimulation Group the reduction was significant, with a mean difference in the inventory score three times greater than the Control Group.

Keywords | Parkinson Disease; Depression; Music; Acoustic Stimulation.

RESUMO | A sintomatologia depressiva (SD) é comum na doença de Parkinson (DP) e considerada fator importante para má qualidade de vida e incapacidade do indivíduo. Intervenções terapêuticas baseadas em ritmo e música, a exemplo da Estimulação Auditiva Rítmica (EAR), têm sido utilizadas no tratamento da mobilidade e parecem influenciar positivamente o estado de humor do paciente. O objetivo deste estudo é avaliar o efeito da EAR com música associada à fisioterapia no estado de humor de pessoas com DP, com ênfase na SD. Trata-se de estudo quase experimental, com amostra de 18 pacientes com idades entre 40 e 80 anos e diagnóstico clínico de DP idiopática nos estágios leve a moderado. Os pacientes foram randomizados em dois grupos: grupo EAR e grupo-controle (GC). A SD foi avaliada por meio da versão em português do Inventário de Depressão de Beck (BDI). Os escores do BDI apresentaram redução em ambos

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os grupos. Entretanto, apenas no grupo EAR essa redução foi significativa, com diferença média no escore três vezes maior do que no GC.

Descritores | Doença de Parkinson; Depressão; Música; Estimulação Acústica.

RESUMEN | La sintomatología depresiva (SD) es frecuente en la enfermedad de Parkinson (EP) y se considera un importante factor para predecir la mala calidad de vida y la discapacidad del individuo. Las intervenciones terapéuticas basadas en el ritmo y la música, como la Estimulación Auditiva Rítmica (EAR), se han utilizado en el tratamiento de la movilidad y pueden influir positivamente en el estado de ánimo del paciente. El objetivo de este estudio es

evaluar el efecto de la EAR con música asociada a la fisioterapia en el estado de ánimo de personas con EP, con énfasis en la SD. Se trata de un estudio cuasiexperimental, realizado con una muestra de 18 pacientes de entre 40 y 80 años de edad, con diagnóstico clínico de EP idiopática en estadios leve a moderado. Los pacientes se dividieron al azar en dos grupos: Grupo EAR y grupo control (GC). La SD se evaluó mediante la versión en portugués del Inventario de Depresión de Beck (BDI). Las puntuaciones del BDI tuvieron una disminución en ambos grupos. Sin embargo, esta reducción fue significativa solo en el grupo EAR, con una diferencia media en la puntuación tres veces mayor que en el GC.

Palabras clave | Enfermedad de Parkinson; Depresión; Música; Estimulación Acústica.

INTRODUCTION

Parkinson's disease (PD) is a neurodegenerative disease characterized by the progressive loss of dopaminergic neurons of the midbrain substantia nigra pars compacta. The neuropathological process triggers characteristic motor symptoms in the form of resting tremor, bradykinesia, rigidity, and postural instability.

Moreover, identifying non-motor symptoms is important — especially mood disorders — as they may occur throughout the course of the disease and may decrease quality of life and anticipate hospitalization¹⁻⁴. Among mood disorders, depressive symptoms (DS) is frequently presented in PD and, although its diagnosis is difficult due to overlapping symptoms, it should be considered an important factor for the individual's poor quality of life and disability^{5,6}.

Therapeutic approaches that go beyond using drugs to control DS are already being studied, including music, which, as a rehabilitation instrument, can influence the sensation of pleasure and, consequently, affect the mood and rehabilitation process of the person with PD⁷. Furthermore, therapeutic interventions based on rhythm and music, such as Rhythmic Auditory Stimulation (RAS)⁸, have been used to treat the mobility of patients with PD and seem to positively affect not only motor symptoms (such as spatiotemporal gait parameters), but also non-motor symptoms, such as psychological disorders⁹.

RAS is based on motor training from a metronome or music¹⁰, with music offering greater efficiency than the

isolated use of a metronome^{11,12}. The emotional relationship and motivation provided by music is believed to enhance the effects on gait¹¹. It can also influence the regulation and functioning of motor areas and stimulate pleasurable reactions, assisting in the rehabilitation⁷. The correlation between movement and music to improve the mental health of individuals may be associated with the release of neurotransmitters, facilitated by music¹³.

Thus, this study aims to evaluate the effect of music-based RAS on depressive symptoms of people with Parkinson's disease. The hypothesis is that music-based RAS associated with physical therapy is beneficial and its use may help reduce DS in PD patients.

METHODOLOGY

This is a quasi-experimental study conducted from October 2019 to March 2020 with a convenience sample composed of PD patients registered at the Neurology/Pro-Parkinson Outpatient Clinic of the Hospital das Clínicas (HC) of the Federal University of Pernambuco (UFPE).

For participants selection, the following inclusion criteria were adopted: individuals aged from 40 to 80 years; and diagnosis of idiopathic PD¹⁴ in the mild to moderate stages of the disease (1 to 3), according to the Hoehn and Yahr scale¹⁵. The following individuals were excluded: those who used antidepressants; with hearing loss; unable to walk independently; diagnosed with

another neurological disorder; with moderate or severe functional restriction in one or both lower limbs; with a history of surgery for PD; and with cognitive impairment identified by the Mini-Mental State Exam, according to schooling level¹⁶.

The patients included were randomized into two groups: physical therapy associated with music-based RAS (RAS group) and only physical therapy, the control group (CG).

A smartphone application with RAS called ParkinSONS, developed by the Pro-Parkinson Research Group was used. The application shows a menu of options for training gait with RAS composed of six Brazilian musical tracks (70–120bpm), besides presenting popular regional songs appropriate to the age group of the population using it.

The selection of the musical track for training each patient's steps and gait was performed based on the cadence found in the evaluation by the 10 Meter Walk Test. This test requires the participant to walk a 10-meter straight path, using the initial 2m for acceleration, the next 6m to walk at self-selected speed, and the final 2m for deceleration¹⁷. Within 6m, a physical therapist clocked the time, another counted the number of steps, and a third filmed the footage to prove the count. Cadence was estimated as follows: number of steps/time×60. The result was based on the average of three test shots. For the balance and strength exercises, a 70bpm musical track was selected^{18,19}.

The physiotherapeutical intervention protocol was developed based on the guide of the Royal Dutch Society for Physiotherapy^{20,21}, which is composed of brief and concise recommendations on the evaluation and specific treatment strategies for PD based on evidence. In total, 10 sessions were applied, which were performed twice per week, lasting 50 minutes each. The protocol included nine exercises: transfer training; reaching and grabbing; muscle strengthening (with emphasis on torso and lower limbs); dissociation of scapular and pelvic girdles; balance and proprioception; gait training; and step training.

DS was evaluated using the Beck Depression Inventory (BDI)²². The Brazilian version of the BDI is a validated and reliable instrument to assess the severity of depression in this population²³, consisting of 21 categories of symptoms and attitudes. The statements were evaluated according to the severity range, from neutral to maximum. Values from 0 to 3 are used to measure the degree of severity.

The instrument quotation allows for categorizing DS intensity into symptoms: minimal (0–13), mild (14–19), moderate (20–28), and severe (29–63). BDI was applied before and after the end of the physiotherapeutic intervention.

The equivalent dose of Levodopa per day (EDL/day) was properly monitored and calculated in the evaluation and reevaluation using the Levodopa Equivalent Dose Calculator, from Parkinson's measurement.

The Shapiro–Wilk test was used to verify data normality. The homogeneity of the sample between the groups before the intervention was performed by the Mann-Whitney and chi-square tests (or Fisher's exact test, when applicable). For the intergroup analyses, the Mann-Whitney test was used; for the intragroup analyses, the Wilcoxon test. The statistical package was BioEstat 5.0, considering $p < 0.05$.

RESULTS

In total, 20 patients were recruited, of whom only one did not meet the eligibility criteria. Among the 19 included, 10 were allocated in the RAS group (six men and four women) and nine in the CG (six men and three women). In the CG, one female patient did not complete the intervention, being considered 18 patients for the final analysis (Table 1).

Table 1. General baseline characteristics of the study sample (n=18)

Characteristic	RAS, n=10	CG (N=8)	p-value
Age, mean (±SD)	64 (10)	67 (6)	0.509
†Stage of the disease (n)			
HY1	0	1	0.512
HY2	6	4	
HY3	4	3	
‡ MMSE, mean (±SD)	29 (1)	27 (3)	0.155
‡EDL/day, mean (± SD)	1.104 (509)	823 (585)	0.130

RAS: Rhythmic Auditory Stimulation group; CG: control group; SD: standard deviation; HY: Hoehn and Yahr stage scale; MMSE: mini-mental state examination; EDL/day: equivalent dose of Levodopa per day; † No normal distribution (Mann-Whitney test); ‡ Chi-square or Fisher's exact test.

Most patients presented symptoms characteristic of minimal depression in both groups, 88.8% of the total sample in the evaluation and 94.4% of the total sample at reevaluation. The EDL/day values showed no significant difference after the intervention (1,131±186 vs 833±195; $p=0.289$).

The BDI scores showed a reduction in both groups, however, the reduction was only significant in the RAS group, and no significant difference was observed in the intergroup analysis (Table 2).

Table 2. Beck Depression Inventory Scores in both groups

Group	Evaluation	Reevaluation	Mean difference	Intragroup analysis p-value
RAS (n=10)	9.4 (7.9)	5.0 (4.4)	4.4	0.012*
CG (n=8)	8.8 (4.9)	7.5 (5.5)	1.3	0.446
Intergroup analysis p-value	0.834	0.328		

RAS: Rhythmic Auditory Stimulation group; CG: control group; values expressed by mean (standard deviation); intergroup analysis - Mann-Whitney test; intragroup analysis - Wilcoxon test.

Most BDI domains showed a variation of scores from 0 to 1 in both groups, except for the domains “tiredness” and “interest in sex,” which presented variation from 0 to 3 in both groups in the evaluation, with improvement in the reevaluation to 0-1 only in the RAS group (Table 3).

Table 3. Minimum-maximum variation of Beck Depression Inventory scores by domain between groups

BDI Domain	RAS (n=10)		CG (n=8)	
	Evaluation	Reevaluation	Evaluation	Reevaluation
Mood	0-1	0-1	0-1	0-2
Pessimism	0-0	0-1	0-1	0-1
Sense of failure	0-1	0-0	0-1	0-0
Lack of satisfaction	0-1	0-1	0-1	0-1
Guilty feeling	0-1	0-0	0-0	0-1
Sense of punishment	0-3	0-0	0-1	0-1
Self-hate	0-2	0-1	0-0	0-0
Self-accusations	0-2	0-1	0-0	0-1
Suicidal desire	0-0	0-0	0-0	0-0
Crying Spells	0-1	0-0	0-3	0-1
Irritability	0-3	0-1	0-1	0-1
Social withdrawal	0-2	0-0	0-1	0-0
Indecisiveness	0-2	0-1	0-3	0-2
Body Image	0-3	0-2	0-2	0-2
Work Inhibition of energy	0-2	0-2	0-3	0-2

(continues)

Table 3. Continuation

BDI Domain	RAS (n=10)		CG (n=8)	
	Evaluation	Reevaluation	Evaluation	Reevaluation
Sleep disturbance	0-2	0-3	0-3	0-3
Fatigability	0-3	0-1	0-3	0-2
Loss of Appetite	0-1	0-1	0-1	0-1
Weight loss	0-2	0-2	0-1	0-1
Somatic preoccupation	0-1	0-1	0-1	0-2
Loss of libido	0-3	0-1	0-3	0-3
Total	2-29	0-13	3-19	1-17

BDI: Beck Depression Inventory; RAS: Rhythmic Auditory Stimulation group; CG: control group.

DISCUSSION

Although no significant differences were observed in the BDI scores between the groups, the paired analysis showed a significant reduction of scores in the RAS group. The difference in the mean BDI score after intervention in the RAS group was three times higher than in the CG. These findings may be promising, as they suggest a positive influence of music in rehabilitation.

Scientific evidence shows that music as a therapeutic proposal can achieve beneficial emotional responses to treatment²⁴. It is possible to observe a positive response in non-motor symptoms of Parkinson's disease, such as in mood disorders, from the hearing of music. This influence of music may be associated with a greater stimulation of the limbic and reward systems²⁵. Music-based interventions for people with PD can influence the improvement of cognition, motor function, emotional aspects, and well-being of these individuals¹², proving to be a powerful tool in the rehabilitation of neurological patients²⁶.

Another relevant finding are the results of the BDI domains identified as “fatigability” and “loss of libido,” which improved in the reevaluation of the RAS group. Regarding fatigability, our finding corroborates the study by Särkämö et al.²⁷, in which music increased gray matter volume in the anterior cingulate cortex, a factor that could be associated with reduced depression and fatigue symptoms.

In addition, music can attenuate the signs of fatigue, as it enhances physical activity performance²⁸. Musical

stimulus provides an incentive to voluntary movements of the human body²⁴, such as dancing. Many studies have shown that music in therapeutic interventions guarantees benefits for people with motor disorders in both physical and psychological aspects^{9,29}, besides being a playful way to encourage the patient's motor rehabilitation.

Regarding "loss of libido," this is a subject little discussed and evaluated in PD, although studies show a high prevalence of sexual dysfunctions among patients³⁰. Among the seven therapeutic capacities of music²⁴, two may have contributed to the patients' improvement in this aspect: music is physical, that is, it can provide results beyond physical exercise, resulting from mood and excitement; besides being engaging in both psychological and neurological aspects²⁴. This outcome could also have been influenced by the reduction of fatigue and the improvement in the performance of physical activities. However, a better investigation of this hypothesis is necessary in later studies.

Most patients in the study presented minimal DS, without antidepressants, a result of the criterion adopted in the study design and the objective of evaluating the isolated effect of music therapy. More severe cases of DS may present some limitations, considering the probable use of drugs to alleviate the symptom, which could configure a bias in the analysis of the effect of music on treatment. However, we emphasize that music therapy associated to the usual treatments used for depression seems to intensify therapeutic effects³¹.

This study may be complementary to future studies on the relationship between rehabilitation and use of music and its positive effects on the treatment of DS in people with PD. However, because it is a preliminary study, we recommend caution when interpreting the results. Low-cost technology (in this case, a smartphone) seems to enable a playful rehabilitation by RAS with music in PD, being able to be used in hospital, outpatient, and home environments. That said, more studies are needed to analyze the effect of these technologies on patients' moods.

CONCLUSION

The findings suggest that music-based RAS associated with physical therapy is beneficial and may help reduce depressive symptoms in patients with Parkinson's disease.

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